The Sixth Session of the Asia-Pacific Regional Space Agency Forum

APRSAF-6

Report

May 24-27, 1999
Tsukuba Space Center, JAPAN

JOINT ORGANIZERS:
Science and Technology Agency (STA)
Institute of Space and Astronautical Science (ISAS)
National Space Development Agency of Japan (NASDA)
(1) Participants for a group photo at APRSAF-6

(2) APRSAF-6 in Session
Technical Tour

(3) Explanation for Participants at National Research Inst. for Earth Science and Disaster Prevention (NIED)

(4) Participants visiting at NASDA's Exhibition Hall/

Tsukuba Space Center (TKSC)
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I. The Concept of APRSAF-6

The Sixth Session of the Asia-Pacific Regional Space Agency Forum

1. Background

On the occasion of the International Space Year (ISY) of 1992, the Asia-Pacific Regional Space Agency Forum (APRSAF) was established for the purpose of exchange views, information on space activities, and future cooperation among its region. And the forum has been held for five times since 1993. From First Session to Forth Session, they were held in Tokyo hosted by the Science and Technology Agency (STA), the Institute of Space and Astronautical Science (ISAS), and the National Space Development Agency of Japan (NASDA). And Fifth Session was held in Ulanbaatar, Mongolia hosted by STA, ISAS, NASDA and National Remote Sensing Center (NRSC), Mongolia.

2. Objective

APRSAF shall provide opportunities to:

2.1 Gather the representatives from space agencies and/or international organizations in the Asia-Pacific region.

2.2 Seek measures to contribute to socio-economic development to the Asia-Pacific region and the preservation of the global environment, through space technology and its applications.

2.3 Exchange views, opinions and information on national space programs and space resources.

2.4 Discuss possibilities of future cooperation among space technology developers and space technology users to bring mutual benefits of the countries in the Asia-Pacific region, identify areas of common interest, and assign priorities thereto.

2.5 Review progress in the implementation of cooperative plans and programs for further cooperation within the Asia-Pacific region.

2.6 Consider and recognize importance to cooperate with space agencies and/or organizations outside the Asia-Pacific region that support APRSAF objectives.
3. **Outline of the Sixth Session**

The Sixth Session was held as a pre-event of UNISPACE-III under the theme of “Application of Space Technology”. The Session dealt with not only the existing areas of cooperation such as Earth Observation, but also a new area such as Space Environment Utilization etc.

In this sense, the forum was an enlarged session with the additional participation of space agencies in Europe (CNES, DLR, and ESA) and private companies.

4. **Organization and Procedures**

- APRSAF will be annually held.
- APRSAF will respect the harmony of activities of space agencies and/or international organizations outside the Asia-Pacific region.
- Conclusion resulting from APRSAF are non-binding and will be acted upon at the discretion of each participating country.
- Results of annual APRSAF will regularly be published. For this propose every participant are expected to prepare presentation in good quality.
II. Agenda

Tuesday, May 25, 1999

Time       Events

09:30-10:30  Registration
            (in front of the Conference Room on the 2nd floor at the Space Experiment Bldg.)

10:30-13:20 Opening Plenary Session
            General Chairperson: Prof. Yasunori Matogawa, ISAS

10:30-10:40 Chairperson's Remarks  Prof. Yasunori Matogawa, ISAS

10:40-10:50 Opening Remarks  Mr. Kaname Ikeda, Director-General
                            Research & Development Bureau,
                            STA

10:50-11:00 Welcome Address  Mr. Isao Uchida, President, NASDA

11:00-11:20 Keynote Address-1
            "Contribution of Space Technology in Asia-Pacific Region"
            By  Mr. Virgilio Solis Santos, Economic Affairs Officer,
                 Space Technology Applications Section, UN/ESCAP

11:20-12:20 Keynote Address-2  "National Space Policy"
            By  Mr. Nik N. Nasruddin Mahmood, Director,
                 MACRES (Malaysia)
            Mr. Luo Ge, Director General, Department of Foreign
            Affairs, CNSA (China)
            Dr. Suvit Vibulsresth, Deputy Permanent Secretary,
            MOSTE (Thailand)

12:20-13:20 Special Lecture
            "International Cooperation in Asia-Pacific Region"
            By Ms. Takemi Chiku, Office for Outer Space Affairs, UN
            Mr. Gilbert R. Kirkham, NASA Representative(USA)
            Mr. Jean-Pascal Le Franc, Assistant Director,
            Int'l Relations, CNES(France)
            Mr. Michel Giroux, Director, External Relations,
            CSA(Canada)

13:20-14:30 Lunch  (at Cafeteria)
14:30-15:30  **Session-1: “Space Education and Public Relations”**

*Session Chairperson: Mr. H.S.P. de Alwis, Deputy Director
Arthur C. Clarke Institute for Modern Technologies*

*Introduction of Member’s Activities*

14:30-14:45  “Education, Training and Research of Space Applications at Asian Institute of Technology”
Prof. Shunji Murai, Tokyo University

14:45-15:00  “Space Education for a Changing World”
To read ISU paper by Mr. Michio Ozawa, ISU Japan Liaison Officer

15:00-15:15  “Space Education in Japan”
Prof. Yasunori Matogawa, ISAS(Japan)

15:15-15:30  Q & A

15:30-15:45  **Break**

15:45-17:00  **Session-2: “Space Environment Utilization”**

*Session Chairperson: Prof. Yasunori Matogawa, ISAS*

*Introduction of Member’s Activities*

15:45-16:15  “The Outline of the International Space Station (ISS) Project and Japan’s Contribution”
Mr. Yasushi Horikawa, JEM Project Manager,
Office of Space Utilization Systems, NASA(Japan)

16:15-16:45  “Current ISS Utilization Project” NASA(Japan)
Mr. Susumu Yoshitomi, Senior Engineer,
Office of Space Utilization Systems, NASA(Japan)

16:45-17:00  Q & A

**To Take Group Photo before Leaving for Reception**

18:00-20:00  **Reception**

*at “Tsukuba Dai-ichi Hotel “SUBARU” Room
1st Floor at the Annex Building*
Wednesday, May 26, 1999

**Time**                **Events**

09:00-09:30  Registration
(in front of the Conference Room on the 2nd floor at the Space Experiment Bldg.)

09:30-17:45  **Session-3: “Earth Observation”**
Session Chairperson:  Prof. Shunji Murai, Tokyo University
Panel Moderator:  Mr. Takashi Moriyama, Senior Researcher
Office of Earth Observation Systems, NASA

09:30-11:30  **Disaster Monitoring and Its Mitigation by using Earth Observation Data (Examples, Case Study and Panel Discussion)**

09:30-09:45  “Application of Satellite Data for Forest Preservation”
Dr. Swoyambhu Man Amatya, Deputy Director General
Ministry of Forests & Soil Conservation
Dept. of Forest Research & Survey (Nepal)

09:45-10:00  “Fire Monitoring in Mongolia using Satellite Data”
Mr. S. Khudulmur, Director, National Remote Sensing Center,
Ministry of Nature and the Environment (Mongolia)

10:00-10:15  “Monitoring of Land and Forest Fires with High Resolution Optical Sensors”
Dr. Lim Hock, Director, CRISP, National University of Singapore (Singapore)

10:15-10:30  “Application of Satellite Data for Disaster Monitoring and its Mitigation”
Mr. Makoto Ono, Senior Research Scientist,
Data Analysis and Application Division, RESTEC (Japan)

10:30-11:15  **Panel Discussion**
Panelists: the above speakers and those from following companies
Mr. Makoto Higashi, Director, Data, RESTEC
Mr. Hiroyoshi Ishibashi, Chairman and CEO,
Weather News Inc.
Dr. Atsushi Rikimaru, President, Air-Graph Co.

11:15-11:30  Break

11:30-15:45  **Earth Observation Data Application (Examples, Case Study and Panel Discussion)**

11:30-11:45  “Remote-Sensing Activities for Resource Monitoring and Management in Indonesia”
Prof. Dr. Harijono Djojodihardjo, Chairman, LAPAN (Indonesia)
11:45-12:00 “Activities in Space Technology Application in Vietnam”
   Dr. Hoang Viet Giao, Scientific Secretary, Vietnam National Council for Space Technology Applications (Vietnam)

12:00-12:15 “Application of Remote-Sensing Data for Land Management”
   Prof. Huandong Guo, Director, IRSA, CAS(China)

12:15-12:30 “Emerging Challenges in South Asia in Geoinformatics”
   Mr. Pramod S.S. Pradhan, Division Head, MENRIS, ICIMOD(Nepal)

12:30-12:45 “Philippine Tropical Forest Resources Information Analysis Technology”
   Prof. Teresita Pamela M. Liao, Seniore Enviromental Management Specialist, Environmental Management Bureau (Philippine)

12:45-13:00 Q&A

13:00-14:30 Lunch (at Cafeteria)

*Earth Observation Data Application  (continued)*

14:30-14:45 “The New CSP Radar Application Program”
   Mr. Florian Guertin, Program Manager, Director, Natural Resources Canada, Data Acquisition Division, CSA (Canada)

14:45-15:00 “Earth Observation Data Application”
   Mr. Atsushi Ono, Special Staff to the Manager, Office of Earth Observation Systems, NASA(Japan)

15:00-15:45 Panel Discussion

Panelist:
   the above speakers and those from following Japanese companies
   Mr. Makoto Higashi, Director, Data Distribution Dept. RESTEC
   Mr. Hiroyoshi Ishibashi, Chairman and CEO, Weather News Inc.
   Mr. Atsushi Rikimaru, President, Air-Graph Co.

15:45-16:00 Break
16:00-17:45  *Future Mission on Earth Observation (Project Introduction)*

16:00-16:15  "Earth Observation in the 21 Century including HYPERSAT Project"
   Dr. Brian J.J. Embleton, Executive Director,
   Cooperative Research Center for Satellite Systems,
   CSIRO(Australia)

16:15-16:30  "Development of Space Infrastructure for the Conservation of Land and Earth Environment."
   Mr. Nik Nasruddin Mahmood, Director,
   MACRES(Malaysia)

16:30-16:45  "Data Utilization of KOMPSAT-1"
   Dr. Gi-Hyuk Choi, Senior Researcher, KARI(Korea)

16:45-17:00  "RADARSAT II Project"
   Mr. Pierre Hebert, Project Manager, Radarsat II
   CSA(Canada)

17:00-17:15  "About CHAMP Mission"
   Dr. Hans-Joachim Kroh, International Cooperation,
   DLR(Germany)

17:15-17:30  "About ADEOS-II, ALOS, GCOM"
   Mr. Naoya Tomii, Engineer Senior Scientist, EOPD,
   Office of Earth Observation Systems, NASA(Japan)

17:30-17:45  Q&A
Thursday, May 27, 1999

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<td><strong>Session-4: “Satellite Utilization Projects in the Field of</strong></td>
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<td>Communication, Broadcasting, and Global Positioning System”</td>
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<td><strong>Session Chairperson:</strong> Prof. Harjono Djojodihardjo, Chairman,</td>
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*Introduction of Member's Activities*

- **09:30-09:45** “Satellite Development and Utilization Programs in Australia”
  Dr. Brian J.J. Embleton, Executive Director, Cooperative Research Center, for Satellite Systems, CSIRO(Australia)

- **09:45-10:00** “Satellite Utilization Project for the Development of Local Areas”
  Mr. Virgilio Solis Santos, Economic Affairs Officer, Space Technology Applications Section, UN/ESCAP

- **10:00-10:15** “Satellite Development and Utilization Programs in India”
  To read ISRO paper by Dr. Vijay Trimbak Chitnis, Embassy of India

- **10:15-10:30** “Current Satellite Programs in China”
  Mr. Zhang Liangrui, Division Director of Dept. of Science and Technology Quality, CNSA (China)

- **10:30-10:45** Break

- **10:45-11:00** “Gigabit Satellite Project for realizing GII”
  Mr. Naoto Kadowaki, Manager, Gigabit Satellite Communications Sec., Space Communications Div. CRL(Japan)

- **11:00-11:15** “Outline of the communication mission of the ETS-VIII satellite”
  Mr. Shinichi Hama, Section Chief Space Communication Div., CRL(Japan)

- **11:15-11:30** “Planned Global Positioning Experiment of ETS-VIII”
  Mr. Naokazu Hamamoto, Senior Engineer, Office of Satellite Systems NASA(Japan)

- **11:30-11:45** “NASDA’s approach to regional cooperation in the area of satellite utilization and joint development”
  Mr. Tsutomu Shigeta, Associate Senior Engineer Office of Satellite Systems, NASDA(Japan)
11:45-12:00 “Status and Activities of Japanese Space Industry”
   Mr. Toru Omori, Executive Expert,
       Radio Operations Unit., NEC
12:00-12:15 “A study of mobil satellite communication application for Asia-Pacific Region “
     Mr.Yoichi Koishi, Manager
         Space Information Group, Toshiba Corp.
12:15-12:30 “ Satellite Utilization in the Communications
           - Compact and Low-Cost Ku-band VSAT -”
     Mr. Yoshitomo Sakato, Deputy Manager,
         Satellite Communications Systems Dept.
           Communication Systems Center
            Mitsubishi Electric Corp.
12:30-13:00 Q & A
13:00-14:30 Lunch

14:30-16:00 Discussion: “Towards UNISPACE-III”
    Session Chairperson: Prof. Shunji Murai, Tokyo University
                          1. Session Reports : by Each Session Chairpersons
                          2. Discussion
16:00-16:30 Break
16:30-17:00 Closing Plenary Session

    Closing Remarks : Prof. Yasunori Matogawa, ISAS
    End of the Meeting : Prof. Yasunori Matogawa, ISAS
III. Opening Plenary Session
OPENING ADDRESS

Mr. Kaname Ikeda
Director-General,
Research and Development Bureau,
Science and Technology Agency, Japan

I am very happy to join the opening of the 6th APRSAF. First let me extend a hearty welcome to all space agency representatives who have traveled far to promote cooperation in space. We are also honored with presence of European Space Agency representatives. We are also pleased to have Prof. Murai, Chairman of the Earth Observation session. Until this month, he served as Chief Professor at the Asia Institute of Technology in Thailand.

We are approaching the 21st century, and this year the United Nations will hold UNISPACE III for first time in 17 years. This is a very opportune time to exchange ideas on what space cooperation should be like in the Asian-Pacific region. This APRSAF meeting has two characteristics. First, it is a pre-event to UNISPACE III. In this three-day meeting, we hope you can develop a lot of suggestions that can be contributed to UNISPACE III. Prof. Murai has been asked to serve as chairman of the UNISPACE III remote sensing session. This has happened because of the support by our Asian colleagues. We are grateful to all of you for this. The second characteristic is the enlarged scope of topics compared to the past. In the past, the discussions concentrated on the possibility of cooperation in Earth observation, but this time, I hope that you will address such issues as space environment utilization, space communications, and education.

The fruits of Earth observation from space are already benefiting our daily lives. We hope that this will contribute to solving environmental problems facing mankind. ADEOS-II is being prepared for launch, and it is now possible to use remote sensing technology in a very advanced manner. Also, ISS construction began in Nov. 1998, and great expectations are developing for the further utilization of the space environment. As these advances are made in space development and utilization, we should actively seek opportunities for international cooperation. Asian countries are currently in a difficult economic situation, but we see hopes rising for development and utilization of outer space. It is imperative that we maximize the efficiency of resource utilization in the region.

I hope APRSAF continues to be a useful forum for exploring possibilities in cooperation and that various forms of practical cooperation will come out of this. Lastly, I strongly wish that this session will produce many fruitful results and that we contribute to space development not only here in the Asian-Pacific region but all around the world.
WELCOME ADDRESS

Mr. Isao Uchida,
President
NASDA

As a representative of one of the sponsoring organizations, I would like to express my warm welcome to everyone. We are very honored to be able to hold this Sixth APRSAF here at Tsukuba Space Center and to have representatives from 21 Asian-Pacific and European countries.

I wholeheartedly agree with Mr. Ikeda concerning the two points mentioned. Space development will contribute to the advancement of human society in the 21st century. I hope that this session will produce useful suggestions. As an implementation organization, NASDA will do its utmost in line with the government policy.

This is the first time an APRSAF session is being held here at Tsukuba Space Center. Yesterday you visited the Geographical Survey Institute, the National Research Institute for Earth Science and Disaster Prevention, and our Tsukuba Space Center. What were your impressions of the facilities you visited? In view of international cooperation in the future, it is important for you to become acquainted with the actual operations in the field.

Next October, NASDA will celebrate its 30th anniversary. Tsukuba Space Center construction started at the same time. The facilities at Tsukuba were intended to be our core research facilities. When NASDA was founded, we set two objectives for ourselves. One objective was to acquire basic space technology in rockets and satellites. The second objective was to acquire applications technology quickly. In space technology utilization, we emphasized meteorological satellite, communications satellite, and broadcasting satellite technology. We developed the Himawari, or Sunflower, satellite in close cooperation with the user organization, the Japanese Meteorological Agency. Data emanating from Himawari have been used by our Asian-Pacific neighboring countries from the start.

NASDA feels that one of the most important areas of international cooperation with APRSAF members is Earth observation. Next fall, we will launch ADEOS-II, and, in 2002 we plan to launch a land observation engineering satellite called ALOS. We are advancing technology so we can use these satellites effectively. We hope you can make use of the most of these satellites.

For the International Space Station, we are developing the Japan Experiment Module, JEM, which is to be completed in 2001 and be in operation in 2002. JEM will be a symbol of our dreams for the 21st century, so we recently gave it the nickname "KIBO", meaning Hope in Japanese. We welcome suggestions from various Asian countries on how they can use JEM, and will do our utmost to accommodate those requests. In closing, I hope this conference will be a valuable and memorable experience for all participants.
KEYNOTE ADDRESS 1
Contribution of Space Technology in the Asia-Pacific Region

Mr. Virgilio Solis Santos,
Economic Affairs Officer,
Space Technology Applications Section, UN-ESCAP,

Mankind has witnessed rapid developments in space technology since the historic expansion of human activity into space in the late 1950s. These days, it was taken for granted that news broadcasts covered events and activities without delay as they happened. We no longer marvel, if we ever did, at seeing high-quality pictures of monsoon damage in Bangladesh, volcanic eruption in The Philippines, rampaging floodwaters in China, the electoral process in some countries in Africa, or the inauguration of a president. We are no longer amazed at how easily we are able to communicate with relatives and friends overseas, nor do we ever wonder now at how convenient it is for us to withdraw some money from a cash-dispensing machine even beyond ordinary banking hours. We are able to adequately prepare for an impending typhoon as its track is monitored and the information brought timely to our homes. Indeed, space technology and its applications have revolutionized the way people live in society.

The applications of space technology for providing various types of services, such as communications, navigation, meteorology, among others, have become an integral part of the global scene. In all of these scenarios, ESCAP, through the Space Technology Applications Section, and under the auspices of the Regional Space Applications Program, is helping primarily developing countries of the region on their activities in space technology applications and projects.

ESCAP Activities in the Region - The Regional Space Applications Program of the Environment and Social Commission for Asia and the Pacific was launched during the first Ministerial Conference on Space Applications for Development which was held in Beijing in 1994. Through this program, activities and projects were launched through the Strategic Action Plan and other activities. This eventually led to the dynamic status of the region in terms of space technology development and applications. The region now has three major players with vigorous space programs, China, India, and Japan. Also Australia, Indonesia, Malaysia, Pakistan, the Republic of Korea, and Thailand are new emerging. Other countries in the region are developing their own space programs to support their economic and sustainable development activities.

The RESAP mandate, as launched at the Beijing Conference, emphasizes regional cooperation and capacity building anchored through specific objectives and a networking system which we have established through the years. Through these activities, ESCAP region has become so dynamic that now there are 11 remote
sensing ground stations which are in operation, and some meteorological ground stations in over 30 countries are receiving environmental and meteorological data on a sustained and continuous basis. There are at least 30 national remote sensing programs or centers in the region with specific programs and projects. In 1998 alone, the region has access to about 80 communications satellites, with provision for about 1,700 transponders for telecommunications and broadcasting activities. In the past two decades, the countries of the region have supported the Regional Space Applications Program and have contributed more than US$5.5 million in the past 5 years since the launch of the Ministerial Conference. In addition, about US$2.1 million have been contributed in kind.

RESAP is actually implemented, and the promotion of regional space cooperation is achieved, through a network mechanism that we have established in three tiers. The first, the Intergovernmental Consultative Committee, is a policy and planning body and provides the guidance and necessary budgets for the applications activities in Working Group on Remote Sensing, Geographic Information Systems, and Satellite-based Positioning. The second one is the Regional Working Group on Satellite Communication. The third one is the Regional Working Group on Satellite Meteorology and Natural Hazards Monitoring. The last one is the Regional Working Group on Space Sciences and Technology Applications. These Working Groups hold annual meetings, and for the past three months, three regional Working Group meetings have been held. The last one, the Regional Working Group in Remote Sensing, will meet on June 7, 1999.

The third tier is the Regional Information Service and Education and Training Network, which institutionalizes the information exchange among countries in Asia Pacific. Through this information exchange, we are assisting the publication of the Space Technology Applications newsletter where national activities, projects, and programs are printed. There is also the Asian-Pacific Remote Sensing and GIS journal which is more technical.

Through RESAP, we were able to assist developing countries in the region in their national capacity building efforts, through their human resource development. Since the launch of the Beijing Declaration, more than 100 medium- and long-term fellowships were provided, primarily from developing countries. About 19 seminars and workshops were conducted, with over 900 participants from 48 countries. There are thus many activities in which human resource development is emphasized.

ESCAP provides regular support for the training and fellowships to existing regional and national institutions in the region. We are collaborating with Gdjah Mada University of Indonesia, the Center for Space Science and Technology Applications in India, and the Wuhan Technical University in China.

Through advisory missions in which experts come from ESCAP or other countries of the region, we assist other countries in the development of their space policies and
national programs and activities. As an example, we facilitated the participation of Australia in the formulation of Sri Lanka's national space program. Through the years, we have conducted several workshops and seminars through collaboration and cooperation with host countries that provide local facilities, logistics, and other support.

ESCAP also contributes to regional cooperation and capacity building through pilot projects. In the past years, ten pilot projects that emphasize the application-pull rather than the technology-push approach have been implemented. One example is a project on GIS for arid zone development. This is a collaborative undertaking between China and Myanmar. Another is an ongoing project for fisheries development and management between India and Bangladesh. A final example is the ADEOS project that involved the cooperation of 14 countries in the region. Under the auspices of RESAP, ESCAP also conducted several studies, including the harmonization of various initiatives in space technology applications. Initiatives in the region contribute significantly to promoting regional cooperation and collaboration, and APRSAF is one of them. The harmonization of the various initiatives and activities in the region could be improved to promote collaboration among countries. A study conducted in 1997 established the dialogue forum, enabling participating countries to exchange information and enhance their regional cooperation and collaboration. The first dialog forum meeting was held in Mongolia after APRSAF-5 and resulted in a framework for collaboration among countries. ESCAP seeks to increase its linkages with these regional initiatives.

Future direction

ESCAP believes it is necessary to further prepare the region for expanded and practical uses of space technologies. In that regard, ESCAP’s challenge is how to prepare the region to harness space technologies and applications and how to enhance its activities to assist nations in the region in sustainable development efforts. Against this background, the Commission indicated the need to hold a Second Ministerial Conference in space applications. This Conference will be held from December 15 to 20, in New Delhi, India. Through this Second Ministerial Conference, it is hoped that the region will be able to develop a new phase of the implementation of the regional space applications program and be able to map out a blueprint for regional space development and cooperation in this field.
KEYNOTE ADDRESS 2 (1/3)

"National Space Policy"

Mr. Nik N. Nasruddin Mahmood,
Director,
MACRES (Malaysia)

The Malaysian Government's Vision 2020 envisages Malaysia to be a fully developed nation by the year 2020. One of the challenges identified in striving toward this goal is to create a society that is not only a consumer of technology but also a contributor to the scientific and technological civilization of the future.

This aspiration is being realized in Malaysia through the establishment of the ambitious Multimedia Super Corridor (MSC), an international IT hub, which constitutes the National IT Agenda. The Agenda is an evolving culture of IT utilization for work quality which aims at improving the lives of all Malaysians. It is formed on three important elements, people, infrastructure, and applications.

In realizing the importance of space technology not only for the realization of Vision 2020 for the nation but also as a component of the national industrial plan, the Government has charted a plan to invest in space industry and has outlined strategies toward its development. In March 1998, the Malaysian Government drafted the Blueprint for Aerospace Industry. The Blueprint recommended a legislative framework and strategy that will place the country in the forefront of the global aviation and space industries. A national policy is being drafted to further augment this Blueprint. To draft the national space policy, Malaysia first studied all available documents concerning the policies and programs adapted by successful space-faring countries.

SPACE POLICY STATEMENT

Based on this study, Malaysia developed the Malaysian Space Policy Statement, which seeks to enhance and strengthen space activities in relation to three basic peaceful applications related to civil, national security, and commercial sectors:

Civil Space Policy – Support peaceful utilization of space for mankind such as management of resources and environmental monitoring and development of indigenous and independent national capabilities.

National Security Policy – Support national defense policy and security requirements in an effort to protect peace, well-being, national sovereignty, and sovereign rights.

Commercial Policy – Promote development of commercially viable industries based on space technology.
PROGRAM OBJECTIVES

Six program components related to space application for development were identified. These are Satellite Communications, Remote Sensing, Satellite Meteorology, Space Science, Satellite Navigation and Positioning, and Industry.

The objectives of the National Space Program are to
- Create an effective system for managing natural resources and the environment and for mitigating disasters,
- Increase the competitiveness of Malaysian industry through development programs and through specific measures to develop and demonstrate new technologies,
- Act as an extension of the national defense program in safeguarding crucial national interests, and
- Pursue basic scientific knowledge.

SPACE PROGRAM COMPONENTS

Satellite Communications

The goals of Vision 2020 make it imperative that a modern, technologically advanced telecommunications structure be established in Malaysia to provide simultaneous and secure communications to every region in the country and between these regions and the rest of the world. Malaysia currently operates an extensive international and domestic satellite communications network. The launch of Malaysia's own Telecommunication Satellites MEASAT 1 and 2 marked the first milestone towards achieving the above goals. In order to make Malaysia a regional broadcasting hub, a broadcast center known as the ASIA BROADCAST CENTRE has been built to provide uplink and downlink for broadcast and production studios, state-of-the-art computerized subscriber management systems and multilingual video and audio programs. On November 1, 1998, a new Ministry for Communications and Multimedia was formed, which marked a new telecommunication era in Malaysia. Malaysia's new Communications and Multimedia Act repealed the existing Telecommunications Act 1950 and Broadcasting Act 1950. This act provides a more extensive legal framework to supervise and regulate the industry and is subsequently taking telecommunications to greater heights.

Remote Sensing

In view of MACRES' mission to attain national self-reliance and international excellence in the field of space remote sensing and related technologies, MACRES continues to play a leading role in coordinating the development and implementation of remote sensing and its related technologies in Malaysia. As the focal point for implementing the National Remote Sensing Program (NRSP), the Malaysian Center for Remote Sensing (MACRES) strives to:
- Upgrade the facilities, strengthen the capabilities, and coordinate the activities of remote sensing and related technologies in Malaysia and
- Promote greater utilization of remote sensing and related technologies for resources management, environmental protection, and strategic planning.

In implementing the NRSP, Malaysia envisions three segments: the User Segment, the Ground Segment, and the Space Segment:
- The User Segment involves developing skilled and trained manpower for operationalizing the technology for resources and environmental management and strategic planning.
- The Ground Segment involves implementing projects to acquire a satellite remote sensing ground receiving station.
- The Space Segment focuses on acquiring technological capabilities in satellite design and integration; sensor development; altitude and orbit control; and tracking, telemetry, and command (TT&C).

Satellite Meteorology
The existing satellite meteorological infrastructure and facilities are continuously being upgraded and enhanced with the ultimate objective of acquiring a full operational capability for monitoring and forecasting weather, environmental hazards such as forest fires and haze, agriculture-related phenomena.

Space Science
In Space Science, the objective is to strengthen public awareness of the significance and contribution of space science in our daily lives. Under this program, the first micro-satellite is scheduled to be launched at the end of this year and will be used to conduct scientific experiments in space and monitor the environment.

Industry
The Malaysia Government has identified three main strategies for developing relevant space technology industries: involvement of the Malaysian private sector in selected foreign space programs; establishment of formal linkages by Malaysian institutions with established space agencies; and strengthening of government-to-government relations on space programs with selected countries.

In view of future challenges faced in the era of globalization, the formulation of a comprehensive national space policy, encompassing both long-term and short-term objectives, is necessary for successfully implementing the space program. The presence of a space policy will enhance the effective management of natural resources and the environment, hence promoting the scientific and commercial activities in the country.
Conclusion

In implementing a national space program, an “Open Sky” policy within the context of peaceful uses of outer space has generally been accepted internationally. This means that the space technology in total is accessible to all nations irrespective of their economic, political, social, and cultural settings as long as they have the means to do so. The challenge that besets the developed and developing worlds, the rich and the poor nations alike, is therefore to adhere to this policy and thus make the space above us a truly common heritage of mankind, to be both exploited and guarded at the same time for the benefit of future generations.
KEYNOTE ADDRESS 2 (2/3)
“National Space Policy”

Mr. Luo Ge
Director General
Department of Foreign Affairs
CNSA (China)

CNSA STRUCTURE
The current CNSA has undergone numerous changes and is now quite different from the previous CNSA. First, there is absolute separation between governmental functions and enterprise operations. Second, CNSA now manages and coordinates all the space activities in China on a governmental level.

MAIN FUNCTIONS AND TASKS OF CNSA
Three main departments deal with the daily operations of space activities in China. They are the Department of System Engineers, International Cooperation Academic Exchange, and Science Technology Quality. CNSA is a governmental component, administrating all the space activities in China on behalf of the Chinese Government. The main functions and tasks of CNSA are described below:
- To research, formulate and implement national space policy, legislation, and regulations.
- To formulate research, and to formulate and implement the development plan and the strategy for the national space industry.
- To manage, on behalf of the Government, the national space science and technology space industry.
- To approve and examine significant national space projects, and to supervise intergovernmental space cooperation and technology exchanges.
- To originate and execute intergovernmental space cooperation agreements.
- To manage, on behalf of the Government, the international space organization affairs.
- To fulfill international duties.

CNSA administers, on a Government level, the space activities of forestry. Two large industry groups, the China Aerospace Science and Technology Group and the China Aerospace Electronics Group, are new companies to be established at the end of this month.

There are also several associated organizations. These include the Space Center of the Chinese Academy of Science, the Central Observatory, and telecommunications satellite ground stations of the Ministry of Information Industries.
Uniquely, we have universities and colleges located in Beijing, Harbin, and Shian developing human resources for the development of the Chinese space industry. There are over 300,000 employees dealing with space science technology and industry and more that 100 in studios, factories, and universities.

In the world today, space activities benefit all aspects of the national economic and social life. Space achievements in China are serving more and more areas. In these tasks, we can see applications benefits at the ministry level. The Ministry of Information Industry, China National Committee for AT&TR, is the international decade for natural disaster reduction.

The Chinese Academy of Science, China Association for Remote Sensing Applications, National Bureau of Meteorology, Ministry of Science and Technology, the Ministry of Land and Resources, and the National Bureau of Environmental Protection have very close relations to space activities. They are both Governmental departments and important applications departments in space technology.

The Chinese Government is attaching greater and greater importance to the development of the space industry in China. In order to build stronger and stronger space capacities in China, we will focus on the following targets for the 21st century: Environmental monitoring and over-all control, natural disaster prevention and mitigation and geoscience, and mutual benefits through international cooperation. I hope through APRSAF CNSA can broadly exchange views with counterparts from the rest of the world, exploring more potential cooperative activities, improving satellite launching activities, improving satellite performance, building up satellite applications systems, promoting satellite projects, and advancing space utilization and resources exploration.

In compliance with the monitoring of globalized economy and the Chinese strategy of revitalizing relations through science technology and education, we are open to discussing international cooperation with partners based on the following guiding policy. Implementing the strategy of sustainable development of revitalizing the nation through science and education, mutual benefit, complimentary arrangement. CNSA is willing to discuss and cooperate in projects fully utilizing the partner's capabilities. China has strong commitment in all its international collaboration activities, since we pursue the following basic policies:

Undertaking the obligations and the rights of membership and signatory state of the international conventions and agreements; actively and practically developing international cooperation on a market-oriented basis serving both domestic and international developments; and integrating the special national interests and the needs of building an independent space industry. Cooperation potential is open to both developing and developed countries, cooperating internationally both on the government level and industrial-academic level.
Our policy encourages international cooperation and exchange while adhering to the principle of nonmilitarization of space. CNSA welcomes cooperation but is limited to the following areas for international cooperation: Satellite applications, commercial launch services, space science and deep-space probes, space debris mitigation. Regarding the form or arrangement for international cooperation, CNSA utilizes the most suitable form for each individual cooperation project: participation in the UN and regional cooperation activities, bilateral cooperation, multilateral cooperation, commercial cooperation, and industrial and academic cooperation of any kind.
KEYNOTE ADDRESS 2 (3/3)
National Space Policy

Dr. Suvit Vibulsresth,
Deputy Permanent Secretary,
MOSTE (Thailand)

In Asia, many countries, especially developing countries, try to reap benefits of space technology, especially earth observation. Thailand is one such country, and through the past 20 years or more has benefited from this cooperation, starting from the Landsat program of NASA which provided a lot of data and training through the principal investigator program of ERTS-1. Later on, Thailand benefited through NOAA with the cooperation in providing Landsat data. Thailand has tried to cooperate in several ways. The first was the First Asian Conference on Remote Sensing, which was held in Thailand in 1980. Since then, two more have been held in Thailand, in 1988 and in 1995. This year, the 20th Asian Conference on Remote Sensing will be celebrated in Hong Kong. We really appreciate the initiative of Prof. Shunji Murai, who has been the main provider of international cooperation.

Besides the international cooperation, Thailand has also benefited significantly through cooperation with Japan in the MOS-1 ground receiving station, the MOU and JERS-1. In addition, Thailand has benefited a lot from cooperation with Canada, especially with the Canadian Center for Remote Sensing through provision of experts and training, and lately through a project on a small satellite through the Canadian Space Agency. France, one of the space powers, has also provided many fellowships to Thai university professors. At present, more than ten PhD graduates from French universities are now teaching in Thai universities. Also significant is the cooperation with China. One on-going project is multilateral cooperation in small satellites. This project was initiated by China with Thailand, Pakistan, Republic of Korea, and Iran participating. There is also an Expert Group in Remote Sensing in ASEAN. Under the ASEAN Committee on Science and Technology, remote sensing experts gather annually to talk about the progress in the region and cooperative schemes.

NEW DEVELOPMENTS IN THAILAND IN THE PAST YEAR

The Asian economic crisis started in Thailand, then went on to Korea and Indonesia. This year, we have hit bottom and economy will now go up again. Stocks in Thailand went from a low of 200 to the current level of 500, but its still a long way from the 1,700 level hit in the bubble year.

Space Technology in Thailand is changing because of government restructuring and civil service reforms. In the past in developing countries, there were only two
categories of government organizations, civil servants and state enterprise. Now, however, there is a third category in many countries called public organization. In January 1999, a law was promulgated that several works of the government should be placed under this new category to achieve more flexibility and attract more capable people. Remote sensing is one of the activities that will fall under the new category. The Ministry of Science Technology and the Environment has set up a committee to reform the Remote Sensing Division of the National Research Council and the Geographic Information System of the National Committee. Their activities will fall under a new organization tentatively called the Geoinformatics and Space Technology Development Agency (GISTDA). It consists of the GIS board and whose members are appointed by the Cabinet with half of the board members from non civil servants. Even foreigners can be board members if there is a substantial project to be undertaken. The Cabinet appoints the board members, and the board members appoint a director.

GISTDA will tentatively have six departments, the Administrative Department, the Coordination Department, the R&D Department, the Remote Sensing Department, the GIS Department, the Digital Systems Department that takes care of computers and develops software, and the Special Projects Department. These departments can participate in specific projects with companies or international organizations. The objectives are to develop and apply space technology and GIS; to establish common standards as the basis for setting up policies and measures in the management of space technology and GIS of the country; to analyze and investigate related areas including the investment projects, technical transfer and cooperative projects; and to facilitate the development of the infrastructure of space technology and GIS including human resource development, operation of ground satellite receiving stations for reception, processing and distribution, including related GIS data production, coordination, and dissemination.

The Board is appointed for up to four years but no less than two terms; the Director is appointed for four years. The Board approves the master plan, formulates the policy and budget, allocates funds, sets up rules and regulations for the smooth operation of the organization, and approves the fiscal plan, market plan, and annual budget and sets up special units for any special projects. The budget allocated by government can be kept in a fund called the fund for the Development and Application of Space Technology and GIS. This fund will comprise the budget and other assets of the existing Remote Sensing Division of NRCT and grants earmarked by the government from the annual budget. It may also include any grants from the private sector or from domestic, foreign, or international organizations. In addition, fees, dues, remuneration, service fees, or any other income from operations as well as any interest accrued. This new organization should be in operation before the end of this year.
SPECIAL LECTURE (1/4)

"International Cooperation in the Asia-Pacific Region"

Ms. Takemi Chiku,
Office for Outer Space Affairs, UN

Opportunities for Strengthening Cooperation through UNISPACE III

In recent years, many bilateral and multilateral initiatives have been taken in the region of Asia and the Pacific to promote space activities; to advance the knowledge of space and Earth Sciences; to expand space applications for socio-economic development; and to develop indigenous capabilities, particularly of developing countries, to conduct space research and applications for development. This year, we have enormous opportunities to consolidate those initiatives through UNISPACE III and to further enhance the international cooperation to promote the utilization of space science and technology to enhance human conditions.

Objectives and works to be accomplished by UNISPACE III

In December 1998, the General Assembly of the United Nations agreed that the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space, UNISPACE III, should be convened in Vienna, Austria, from 19 to 30 July 1999 under the theme “Space Benefits for Humanity in the twenty-first Century.” This Conference will be convened as a special session of the United Nations Committee on the Peaceful Uses of Outer Space, COPUOS, within the existing resources of the United Nations. It still aims to achieve goals of a UN global conference by addressing regional and global issues and concerns. It is also open to all 185 member states. In addition, all the IGOs and NGOs with observer status with COPUOS and the General Assembly, as well as many other organizations with space-related activities, are invited to participate in this conference. Unique to UNISPACE III, national space organizations and industries are encouraged to participate as partners of the United Nations to contribute to outcomes of the conference.

Objectives

The primary objectives of UNISPACE III are
1) to promote the effective use of space technology to assist in solving problems of regional and global significance, and
2) to strengthen the capabilities particularly of developing countries to use space science and technology for economic, social and cultural development.

A space exhibition is being organized by the American Institute of Aeronautics
and Astronautics, AIAA, at the conference site. There will also be events for young people. The Space Generation Forum is being organized by the alumnae of the International Space University to provide opportunities to young professionals and students to put forward their ideas and visions for space activities. Their recommendations will be considered by the government representatives for possible inclusion in the report of the conference.

Preparation status

The Advisory Committee reviewed and provided detailed comments on the full draft reports prepared by the Secretariat, including drafts of the executive summary of the report and the Vienna Declaration. The Secretariat has prepared and circulated the comments provided by the Advisory Committee.

Professor Shunji Murai, who will chair the Earth Observation Session of APRSAF 6, will also chair Committee 2 of the General Committee. The Earth Observation Session has direct relevance to Committee 2.

The Advisory Committee established a Drafting Group that will be responsible for preparing the entire report of the Conference, including the proceedings. The Advisory Committee also agreed on substantive agenda items.

The draft of the Vienna Declaration contains the nucleus of a strategy to face global challenges such as the acquisition and effective distribution of satellite data for scientific programs, disaster management, management of ocean and land resources, and the combat against poverty in rural and remote areas. Recommendations of the Preparatory Regional Conference held in Asia and the Pacific for UNISPACE III are also annexed to the draft of the Declaration.

The intention of UNISPACE III is to identify a limited number of sharply focused recommendations that can be implemented in a reasonable time frame. APRSAF representatives may wish to consider some of the recommendations in the draft Declaration with a view to developing concrete plans to realize some of those recommendations.

UNISPACE III provides unprecedented opportunities for various people to contribute to enhancing international cooperation in space activities. For government, it provides a forum to determine the directions and common objectives to be pursued in space activities into the next century. Particularly for developing countries, it provides an opportunity to specify their needs for socio-economic development that can be met by the use of commercially available space applications. UNISPACE III also provides an opportunity for industry, which plays an important role in expanding space activities, to contribute to the formulation of the international space policy framework by expressing their visions, ideas and concerns. Young professionals and students will also have a chance to present their ideas for space activities and visions for space before the top-level scientists and engineers as well as high-ranking policy makers.
This region has an excellent opportunity to follow up on the recommendations of UNISPACE III at the Second ministerial Conference on Space Activities for Development to be organized by ESCAP in India in November. This meeting will seize this opportunity to further enhance international cooperation in space activities so that space benefits can be brought down to the Earth to advance the social and economic conditions of all people in the region.

The issues to be discussed at UNISPACE III include the scientific knowledge of the Earth and its environment, space science and technology applications in various areas, benefits of basic space science and capacity building, information needs, economic and societal benefits, and promotion of international cooperation. In addition to all 185 Member States of the United Nations, all major space agencies and space-related international organizations, industry and the civil society are invited to participate as partners of the United Nations. Future leaders of space activities will also have opportunities to present their visions for consideration by the present decision-makers for space activities.

UNISPACE III will serve as an ideal forum to construct a practical, well-defined framework for the global society to maximize the benefits of space science and technology. Its Action Plan, as contained in the Vienna Declaration to be adopted by UNISPACE III, would serve as a practical blueprint for international space cooperation in the coming years to ensure that space technology will be effectively utilized in solving regional and global problems, such as natural disasters, mismanagement of natural resources, environmental degradation, underdevelopment of rural and remote areas, and to increase public awareness of the space benefits.

The Vienna Declaration would also include recommendations of the Regional Preparatory Conference for UNISPACE III for Asia and the Pacific, held in Kuala Lumpur, Malaysia, in May 1998. APRSAF may wish to examine those recommendations with a view to formulating concrete plans to implement some of them, such as by identifying operational needs of the countries in the region to bring space benefits down to the Earth and by developing sound strategies to support the activities of the United Nations affiliated Centre for Space Science and Technology Education for Asia and the Pacific. It may also wish to forward concrete proposals and suggestions which have not yet been considered by the preparatory bodies of the conference.
SPECIAL LECTURE (2/4)
“International Cooperation in the Asia-Pacific Region”

Mr. Gilbert R. Kirkham,
NASA Representative (USA) in Japan

NASA International Activities Overview.
Traditionally, NASA’s activities in the Asia-Pacific region have focused on Earth science. In this paper, I would like to invite you to consider some nontraditional areas of cooperation, such as human exploration and development of space, space science, and aerospace technology.

The Space Act, which founded NASA, requires that NASA collaborate with non-US organizations to gain the benefits of cost reduction and access to capabilities NASA doesn’t have. NASA also collaborates with non-US organizations when there are US foreign policy interests.

Modes of Collaboration
Modes of collaboration include scientist-to-scientist contacts on a personal basis, formal announcements of opportunity, bilateral and multilateral activities such as the UNISPACE conference and APRSAF, top-down direction from the administration or from senior foreign officials, and US foreign policy initiatives. An example of the last two is inclusion of the Russian Federation in the Space Program. The first three modes have been the most successful on a continuing basis.

NASA Guidelines for International Cooperation
International cooperation must be mutually beneficial and must meet NASA programmatic objectives; NASA generally does not collaborate with organizations when the collaboration is unilaterally beneficial to that organization. The projects must have scientific and technical merit, and the partners should be government agencies that are generally similar in their legal and financial resources. In fact, NASA’s most successful collaboration has been with organizations where the legal orientation of that organization is similar to that of NASA. Difficulties in collaboration in the Asia-Pacific region have arisen when the legal systems are different. There should also be clearly defined and distinct managerial and technical interfaces to minimize the complexity to the extent possible. While engaging in international cooperation, NASA must continually protect against sensitive technology transfers and take into account industrial competitiveness. This latter area has drawn a bit of attention lately, and some organizations have come to believe that further US cooperation could be difficult. However, while the technology transfer review procedures may become more cumbersome, the technology transfer issue will not necessarily impede the cooperation.
History of International Cooperation

Since its founding in 1958, NASA has concluded thousands of cooperative agreements with over 130 nations and international organizations. These agreements have covered projects such as joint ground and atmospheric research, flights of foreign scientific instruments on NASA missions, flights of NASA scientific instruments on foreign missions, space systems development, space operations, and data exchanges.

NASA's Foreign Partners

NASA has enjoyed long-standing, strong, and steady cooperation with Canada, Europe, and Japan. It has also cooperated with the former Soviet Union and Russia, but this cooperation has been subject to highs and lows. Other foreign partners include Asia and the Pacific Rim, Latin America, Africa, the Middle East, and newly independent states of the former Soviet Union.

Strategic Enterprises

About three years ago, NASA was reorganized into four strategic enterprises through which it implements its mission. The four strategic enterprises are Space Science, Earth Science, Human Exploration and Development of Space, and Aero-Space Technology.

The Space Science Enterprise has a long tradition of cooperation. Its activities have evolved from flying foreign instruments on NASA spacecraft to a mix of flying foreign instruments on NASA spacecraft; flying NASA instruments on foreign spacecraft; coordinated, complementary missions; sharing operations support; use of a variety of launch vehicles; and international science teams for data analysis. NASA is becoming increasingly interested in coordinated, complementary missions as a means of conserving scarce resources.

The Earth Science Enterprise is an inherently international Enterprise requiring global solutions to global problems. Costs of space access and costs of space activities in the remote sensing area are great. No single nation or region can afford the comprehensive systems required to understand Earth system science. Decision-makers around the world generally require the same kind of scientific knowledge base. Finally, we can calibrate and validate space-based observation systems more effectively through cooperation.

The Human Exploration and Development of Space Enterprise is highly international with partners contributing to development, research, and operations. Areas of cooperation include the International Space Station, Space Shuttle crews, Space Shuttle missions, life and microgravity research and applications, and overseas tracking stations and Shuttle landing sites. With the assembly of the International Space Station, we are entering a whole new era of advanced and enhanced opportunities for established partners and non-traditional partners to cooperate.
The Aero-Space Technology Enterprise has not had a great deal of international cooperation largely because the activities in this Enterprise are primarily US-focused. However, there are opportunities for cooperation, primarily in the areas of increasing air safety and capacity of global air systems, improving aircraft safety, and mitigating the detrimental environmental impact of aviation. Future opportunities for cooperation are likely to increase as we reach unsustainable levels of investment and we need to go outside the United States for cooperation and assistance.
SPECIAL LECTURE (3/4)
-International Cooperation in the Asia-Pacific Region-

Mr. Jean-Pascal Le Franc,
Assistant Director,
International Relations, CNES (France)

CNES INTERNATIONAL COOPERATION

This paper is divided into three parts. The first part presents CNES as an international cooperation-oriented space agency. The second part describes Earth observation and global change, which are natural areas for international cooperation, and includes the SPOT family, POLDER, and JASON. The third part reports the CNES strategy offering new tools for cooperation, specifically the PROTEUS platform and microsatellites.

CNES as an International Cooperation-oriented Space Agency

Founded in 1961, CNES is responsible for implementing programs approved by the French government, either through CNES or the European Space Agency. It also represents France at ESA and contributes substantially to ESA programs, both from financial and technical aspects; develops complementary programs in partnership with other entities (space agencies worldwide, French industry, etc.); supports, fosters, and contributes to the scientific community development; and promotes space techniques and applications for economic development.

CNES employs 2,500 people in four centers (Kourou, Paris, Evry, and Toulouse). Ariane-Space is still operating the Ariane 4 launcher. The first commercial launch of Ariane 5 is to be in July 1999, and it will carry two satellites, one of which is an Indonesian satellite.

CNES is very proud to be partnered with NASA in the Mars Sample Return program. The idea is to return Mars soil samples by 2008. CNES is participating substantially in the program. Of course, CNES is participating in Earth observation through the SPOT program. As the first contributor to the European Space Agency, followed by Germany and Italy, CNES can also undertake programs through ESA.

A very important meeting was held at the ministerial level about ten days ago to decide new programs for the European Space Agency, in particular the Ariane 5 follow-on and a living planet envelope program for Earth sciences which will allow ESA to be more active in this field. Another important point is the program on navigation, which is an initiative from the European Commission. ESA will participate in it very actively. Based on a decision of the European ministries,
Ariane 5, which is now able to place two satellites of three tons each into orbit, will evolve to being able to place two satellites of 5.5 tons into orbit by 2006 to follow the trend of increasing satellite size.

Earth observation and global change studies are important areas of international cooperation. The SPOT program is now ten years old. SPOT 1 was launched in 1986; SPOT 2, in 1990; SPOT 3, in 1993; and SPOT 4 in 1998. SPOT 5 is ready for launch in 2001 and will have 3-meter resolution and improved instrumentation for establishing digital terrain models. CNES is in charge of both the military and civilian programs, avoiding duplication and encouraging synergies between the programs. Beyond SPOT 5, CNES will go into a small satellite program.

France has set up numerous organizations in the ten years that it has been active in Earth observation and tries to cover the whole range, from research to industry, data processing, data distribution, training, etc.

CNES has been cooperating with Japan, such as in the ADEOS satellite which carried a French instrument called POLDER. POLDER is used for global change studies and different fields related to that.

CNES has also been cooperating with NASA, such as in the JASON satellite, which should follow the Topix-Poisoiden satellite. JASON is an oceanographic satellite, and Topix has already been able to detect the El Nino effect.

The evolution of the CNES strategy has led to new opportunities for cooperation. All space agencies have to cope with a stable budget and an increasing number of missions to be launched and therefore must try hard to reduce space mission costs. One way to do so is to go to small satellites.

One of the important axes we want to develop is minisatellites based on the PROTEUS platform. PROTEUS is supposed to be a multipurpose platform, mainly for low-Earth-orbit missions. It enables low recurrent costs and short lead times, which was not the case in the past with the bigger missions. A unique point of PROTEUS is that the development costs are shared by CNES and the industry (ALCATEL SPACE).

Numerous projects have already been flown using the PROTEUS platform including JASON (oceanography), COROT (astro-seismology), and SMOS (soil moisture). There are also PICASSO/CENA, a radiation budget project with NASA, and MEGHA/TROPIQUES, a tropical meteorology project with India. In addition, the PROTEUS platform will be used for the SPOT follow-on to reduce mass by a factor of five and hopefully to reduce costs as well.

Microsatellites are a suitable area for international cooperation and are important for developing new tools and to try to develop our space systems more quickly. The CNES goal is to fly two missions a year to support low-cost projects with a short development time. The launch costs will be low because up to eight microsatellites can be launched at one time using the Ariane 5 Auxiliary Payload Structure.
The DEMETER mission will be the first to employ a microsatellite. Demeter is now under development and will be used to study ionospheric disturbances of terrestrial and geophysical origin, including Earth tremors and volcanic eruptions. It is scheduled for launch into polar orbit in mid 2001.

Since we are so very small in such a large universe, it is fitting that we should work together.
SPECIAL LECTURE (4/4)
“International Cooperation in the Asia-Pacific Region”

Mr. Michel Giroux
Director
External Relations
CSA (Canada)

A General Approach to International Cooperation

Is the Asian-Pacific region so different from the western countries that international cooperation should be conducted in a different way?
This question should be considered from a number of angles. First, all countries engage in international cooperative activities for the same reasons. What are those reasons? Surely at the beginning of any significant program there are political and foreign policy reasons. Of course a major reason is that the cooperation must assist those countries in responding to the needs of their citizens. This tends to be forgotten, but it has to be a major reason for entering into cooperative agreements. Obviously, countries will want to share risk, as previously pointed out. Furthermore, all countries will want to acquire technology, develop our national space industries, reduce costs, gain prestige (which is itself a good enough reason).

Several conditions must be met for entering into a bilateral or multilateral agreement for cooperative activities and programs. It must again be recognized that these conditions are the same for all countries. The first condition for getting involved in space activities is to have money. Space is an expensive business, there is no question, even at a low level. Potential partners must share the same needs, and the timing is crucial. Another major condition is that individuals involved must trust each other. This is a very important condition. If there is no trust between the managers of the respective programs, it is very unlikely that the program will be started. A legal framework is absolutely necessary. Once you have defined your project and agreed upon the major terms and conditions, those terms must be couched on a legal document of some sort; there must be something to legally support the undertaking. It must always be remembered that the programs will last a minimum of five years, and more often 10, 12, or 15 years. Another condition is to have a lot of patience and determination to accomplish such a complex undertaking.

The reasons and conditions for international cooperation have been presented. After the legal documents are signed and the program starts, problems are certain to occur. The problems may originate in political changes in one country. The new political leaders may decide to stop the program for any reason. There may also be changes in priorities. As an example, the partner agency may no longer consider
Earth observation a priority. Given that programs are very expensive, a major economic recession might threaten a program. If nothing else, significant technology evolutions may eventually make your program obsolete and outdated so it can't be completed or launches or satellites may fail. All of these may have some effect on the international cooperation.

These reasons, conditions, and problems are common to all of us engaged in space activities. The challenge that we face individually as space professionals, working for our respective governments, is to make the magic of space cooperation work; whether we are big or small, whether or not we have a space agency, and whether we are engaged in all space activities or only a number of them.

In conclusion, the Asia-Pacific region offers very similar conditions to enhance space cooperation in a fashion similar to what exists in Europe. The region is independent in space activities in all areas with a mix of small and large space-faring nations that share many common needs of space utilization to increase the well being of the respective populations. Furthermore, as indicated by the APRSAF meetings, there is an increasing willingness to do more together. Canada wishes the countries of the region all the best and would feel privileged to be part of what is happening in Asia Pacific.
IV. Session-1: “Space Education and Public Relations”
SESSION 1: Space Education and Public Relations (1/3)

"Education, Training, and Research of Space Applications at the Asian Institute of Technology"

Professor Shunji Murai,
Tokyo University, Japan

My philosophy as a university professor is that without research you cannot become a center of excellence, thus A.I.T. is changing from a teaching university to a research university. However, education research is not enough because, due to the state of the economy, scholarships are down, the number of students has reduced, and we have to earn our own money to survive. Education is purely academic, but for training and research, we have had to become semi-commercialized to attract sponsors. I built a new building, opened by H.R.H. Princess Maha Chakri Sirindhorn of Thailand, and installed the training and research centers. In order to attract sponsors, the building was named the Space Applications and Technology Research (STAR) Program. This name replaces the former Natural Resources Program, which is very important, but it did not attract sponsors. Now NASDA has become a very good sponsor for our education, and we have remote sensing, GIS, GPS, space communication systems, and many space technology systems concentrated at A.I.T.

The educational program, which is under the school of Environmental Resources and Development, starts in January and lasts 20 months for a Master course of five terms. However, it is very expensive at almost US$25,000, which includes dormitory accommodation and food. For Japanese students it is considered reasonable, but for Asian students, it is too expensive, so sponsors are needed to provide scholarships. For the Doctoral course the cost is almost US$45,000, and we are sometimes criticized that only rich people can obtain Masters and Doctoral degrees, but we have to pay high salaries, otherwise we cannot keep high quality staff. We now compete with the University of Hong Kong and the National University of Singapore, but the A.I.T. faculty salaries are lower than at Singapore University.
The curriculum is based on computer-assisted teaching, digital-image processing, integration, challenges, etc., and we are going to establish automated mapping, GPS, and more advanced work. The faculty staff of 120 is quite an international community, and there are around 40 nationalities among the 1,200 Master and Doctoral students. Research activities were established jointly with the Asian Association of Remote Sensing (AARS) in 1997. The reason for this being that A.I.T. is just a single university whereas AARS has 23 member countries who form a cooperative human network. The benefits of including NGOs in our activities were that NASDA agreed to supply us with almost cost-free satellite data through AARS to support Asian societies.

The Asian Centre for Research on Remote Sensing (ACRoRS) is dedicated to the development and promotion of remote sensing activities in the Asia-Pacific region, and we receive not only students but also visiting researchers from there. The International Space University (ISU) and A.I.T. have an MOU, and we receive visiting scholars from ISU. We also have MOUs with other universities and hope to have an MOU with the Space Science and Technology Education Centre (CSSTE-AP) in Dehradun, India as we are very pleased to expand our activities. The objective of ACRoRS is not only research but also technical support, because some Asian countries have no budget to conduct research and have little experience in doing so.

One function of A.I.T. is to help developing countries in their research, and I act as a consultant on research and how to publish journal papers, etc. We promote research activities through research projects and build up a network for researchers. We also have a network between NASDA, NASA, and others, and recently held a video conference with NASA, the University of Hawaii, and NASDA's Earth Observation Center (Hatoyama).

Facilities at A.I.T. are almost the best in the Asian region. We have a NOAA data receiving station, a kinematic differential GPS station, and many computers and software varieties such as GIS and image processing. The NOAA receiving station is sponsored by the Japanese Research Group, and we provide a very inexpensive service to customers. We have an online service between Thailand and Japan and send data on a 2MB line at
US$10,000 per annum for almost 1 TB of data. Our station covers the Indian continent, The Philippines, a major part of Indonesia, and China, and we were able to monitor the forest fires in Indonesia as well as the floods in China and the Mekong Delta.

Thus, we expect some visitation sensor will be accepted here if CNES and the European Union agree to provide our service. Between Thailand and Japan, we have a 2MB line, between Japan and the US, a 45MB line, and a 15MB line between Japan and Europe, so we can connect through Japan, US and Europe. We are now collaborating with NOAA and the European Joint Research Center to use our data. Of course we have to earn money to carry out project research, which is mainly sponsored by Japanese agencies, but there are others. We are carrying out disaster management for a volcanic mountain in The Philippines as well as mapping projects, and the Asian highway is a very exciting project running from China to Istanbul. We are surveying the conditions of the 19,000km route, and there are inaccessible areas such as Afghanistan where we would not be able to drive because of the war.

Other projects include visitation monitoring as well as the sea surface temperature using our data. We have semi-automated geometric correction and atmospheric correction and are now making mosaics ourselves to make a network between Japan, Mongolia, and Thailand.

Regarding our training center, NASA is sponsoring five training courses each year. We have a lot of facilities including a GIS training center (GAC) and have 380 trainees this year. One training program is a caravan type program where a group of lecturers travel themselves. This type of course is very effective in that it enables us to reach a larger number of participants as compared with inviting a limited number of trainees due to the cost of supplying them with air tickets and accommodation. This year, we conducted such courses in Sri Lanka and Bangladesh and are open to invitations from all countries to teach these courses.

The STAR program, ACRoRS, and GAC are leading organizations for providing education, research, and training in geoinformatics, respectively,
to the people of South Asia, and A.I.T. welcomes other international or academic organizations to form networks in the field of geoinformatics.

Finally, A.I.T. plans to promote the further development of space technology, including the reception of high-resolution data, the design and development of a sensor and our own satellite, and satellite communication for the benefit of the Asian community.
SESSION 1: Space Education and Public Relations (2/3)

"ISU's Role in Space Education"

Dr. George P. Haskell,
Vice-President, International Space University (ISU)
Read by Mr. Michio Ozawa, ISU Japan Liaison Officer

Introduction
In many countries, the role of the university in society has changed considerably in recent decades. Universities are now seen primarily as service institutions educating a large fraction of the population, carrying out basic and applied research, training future researchers, offering continuing education courses, and providing consulting and other services. The services are considered to be essential for the economic well-being of the country and its citizens. This is true in the domain of space related activity just as in other domains.

This paper discusses the role of universities in ensuring that the space and space application sectors can maintain the high-quality professional work force they need. The special role of the International Space University (ISU) is considered in this context.

A Changing World
At the end of the 20th century, space activities are being carried out in a changing global context. The cold war has given way to a period characterized by regional alliances with only one dominant super power nation, and in which local instability appears to be endemic.

In economic terms, the gulf between the "have" and "have not" countries is widening. Many governments are giving a large role to the private sector, while globalization is forcing companies to operate on a world scale. The economic crises in Asia, South America, and Russia have shown in their different ways the limitations of unfettered capitalism which has been the dominant ideology since the collapse of communism in the Soviet Union. Who knows how this scenario will change and develop in the coming years and decades?
The Impact on Space Activities

Most of the trends mentioned above have had a direct effect on the way space activities are carried out. Most government agencies are encouraging the private sector to take a greater responsibility for space activities. Schemes range from cost-plus contracts, called “privatization,” to full transfer of responsibility and risk to the private sector, called “commercialization.”

In some domains, notably in the area of telecommunications, the private sector achieved its independence some time ago and now operates under commercial conditions, although regulation and licensing remain under government control. By the nature of their products, space telecommunications companies offer services on a global or at least regional basis. The process of globalization of the economy is also leading them increasingly towards multinational company structures.

Governments in space-faring countries are tending to concentrate more on basic sciences, new applications, human exploration, and technology development. In many countries, there is government support for the use of remote sensing data for practical benefits. At one end of the range are the large international programs aimed at global environmental protection, and at the other end of the range are the numerous focused efforts in developing countries to bring very specific economic and social benefits to local communities and individuals.

China and India have been leading the way through government inspired schemes in bringing the benefits of space telecommunications to their whole populations via tele-education and tele-health programs.

Space continues to be an arena in which foreign policies of governments are played out. The international space station, born out of cold war politics, is now seen as a means of developing closer ties between the USA and Russia. Any new major effort in human exploration of the solar system would probably require yet another radical transformation of the global political scene.
The Space Professionals

The above remarks indicate the magnitude and scope of the challenges faced by most professionals working in the space sector. Only the most junior specialists can remain insulated from these trends. As soon as they raise their heads from the laboratory bench or the workshop floor, they are exposed to these strong cross-currents.

It is common to consider two parts of the space community: the providers, who develop the space infrastructure; and the users, who deal with the output of the space infrastructure. I suggest that we should also consider a third important class of space professional, whom I call “the exploiters,” and who ensure that the full benefits of the space programs are delivered to society.

The Providers

Echoes of the call for “faster,” “cheaper,” and “better,” are reverberating around the world. All those engaged in spacecraft design and construction, launch systems and ground infrastructures need to acquire new skills in technology, quality control, risk management and other aspects of program management to bring this about. With emphasis on the call for “better” programs, the providers must learn to work more effectively with the users.

The concept of the engineer “on tap” (meaning at the service of the user) and not “on top” (meaning fully in charge) is often very difficult to embrace with enthusiasm, but it must become the normal way of working.

Fortunately, there is an honorable history of well-managed space science projects which have shown that creative interaction between users and providers can bear good fruit. Some lessons from these science projects can be learned for applications programs.

The Users

In order to reciprocate in the provider/user dynamics mentioned above, users must learn to become “intelligent customers.” Just as the providers must try to understand the user, the users themselves need to understand something of the world of the providers - their technical, financial and
political constraints and opportunities. Armed with this knowledge, they should be able to obtain a more useful product from the providers and perhaps even negotiate better deals with them.

In each field of application - Earth observation, telecommunications, navigation, etc.- the users must also constantly update their skills in data processing, informatics or other specialized areas as new space systems come on-line.

_The Exploiters_

The people described in this paper as the exploiters have to get very close indeed to the individuals or the communities which are the intended beneficiaries of the space endeavor. They must be able to work effectively within the full complexity of the political, administrative, commercial, social and religious forces that make up real life. They usually work with people who have no interest in the space component of the services and who need never know whether space played any role in delivering the benefits.

The Indian example of extremely close work at all stages with local communities and individual farmers, teachers and others is one that holds many lessons for others.

A totally different kind of exploiter is the business entrepreneur who has the knowledge, understanding and foresight to identify a market opportunity or a potential new market niche. Licensing, obtaining authorizations, and achieving compliance with regulations becomes the main challenge. Without this kind of preparation, the technical implementation of the corresponding space project would be futile.

_Education for Change_

The foundation on which the education of space professionals rests is, of course, the basic specialized education in all the fundamental disciplines - physics, law, engineering, economics, political science etc. The well established universities do this very well and there is every reason to believe that university professors will continue to update and improve their curricula as their disciplines evolve and grow. However, it can often take 3 or
4 years to make significant changes to an established university course, which is much slower than the speed of change in the world of space and its applications.

The next steps for students intending to make a career in space activities are specialized applied studies focused on space activities - rocketry, astronomy, data processing for Earth observation and a host of others. Once again, many established universities offer an excellent range of options in technical subjects, although offerings of business aspects of space and the social and political sciences are less abundant. Specialized institutions have also been set up, for example, ITC in The Netherlands, GDTA in France, and the new UN centers in India and Africa. There are many commercially available short courses.

The great complexity of space programs, the need to achieve the right mix of business, technology, politics and other factors represents a great management challenge. Future managers and leaders must include in their education the integrating studies that will enable them to see and understand the whole complex picture. This is where the International Space University (ISU) fits in. ISU takes post-graduate students and young professionals who are already educated in their own discipline and gives them a basic grounding in all the other disciplines encountered during a space program.

The courses do not convert them into specialists in another area, but rather give them a vastly broader perspective. The courses give them an understanding of how all these factors interact in real life situations, with emphasis on the international arena. Course participants learn, by working intensively with peers from two dozen countries, how to cut through formidable cultural barriers. Last but not least, ISU graduates find themselves part of a unique and active global network of like-minded space professionals.

Universities must also support the space sector by stimulating and assisting creative thinking among senior managers and leaders as they consider strategic alternatives. ISU contributes in this way through the Annual International Symposium. Each year ISU offers itself as an
independent, neutral forum for discussion and debate of an important topical theme.

Conclusion
The most important word in the title of this paper is “changing.” There is no reason to believe that we have reached a new steady state in the global context in which space activities take place. All institutions contributing to the education and training of space professionals - old established universities or new institutions like ISU - must be alert and willing to change if they are to continue to give good service to the space sector.
SESSION 1: Space Education and Public Relations (3/3)

"Space Education in Japan"
Professor Yasunori Matogawa,
Institute of Space and Astronautical Science (ISAS)

In the 1990's, Japan was faced with the reformation of its education system in order to cultivate the dreams of the younger generation and improve the competitiveness of our nation in the world community. From this viewpoint, the space agencies in Japan took steps to contribute to this effort.

In particular, the National Space Development Agency (NASDA) of Japan and the Institute of Space and Astronautical Science (ISAS) began promoting excellence in Japan's education system by enhancing and expanding scientific and technological competence. Thus, space education activities in Japan are mainly carried out by NASDA and ISAS, both in individual and cooperative activities depending upon the situation.

Cosmic College

Among the variety of activities is "Cosmic College," which is a six day program for eleven to thirteen year old students, corresponding to 5th grade Primary school to 1st grade Junior High school. The most important feature of Cosmic College is that it involves many active teachers from the Primary and Junior High schools of Japan, as well as scientists and engineers of ISAS and NASDA.

The college is held in March and August of each year and consists of two courses, the Space Scientist course and the Astronaut course. Each course is made up of approximately 30 students, who are invited from essay and painting contests of the announced title each year. Teachers give lectures and demonstrate experiments on such topics as Space Environment under Vacuum, Electromagnetic Waves, Solar System Exploration, Satellites, The Life of Stars, The History of the Universe, Extraterrestrial Intelligence, Astronauts from Launch to Return, and Star Watching. The students learn
how to make their own water rockets, which are now very popular in Japan, and they also learn something of how to design and make spacecraft. Well-known astronauts, such as Dr. Doi, attend these colleges for Q and A sessions on their training and experiences.

ISAS Open House
Another example is the "ISAS Open House," where the main campus of ISAS is opened one Saturday each summer vacation and attended by around 15,000 people. There are real models of launch vehicles on display, and satellites and spacecraft are exhibited together with the scientific and technological achievements of ISAS' efforts. Under the instruction of ISAS personnel, the visitors learn how to make and fly water rockets, and enjoy exhibitions, lectures, and refreshments for a whole day. In addition to Cosmic College and ISAS Open House, NASA and ISAS are developing a variety of space education activities, and information about these can be obtained from the public information offices of the respective agencies.

---Open Discussion---

Mr. de Alwis:
I would like to ask Professor Matogawa when the Cosmic College activities are held, are they held in school vacation periods or do they conflict with normal school time?
Professor Matogawa:
They are in fact held during school recess periods in Spring and Summer. When NASDA and ISAS began this cooperative activity, we were concerned about the future of the Japanese school education system, and we wanted to supply nutrients to this system. At the moment, this activity is held only in Tsukuba, as this is the principal location of our agencies. However, our target is to encourage such events throughout Japan.

Mr. Giroux:
My observation is that we need to do a lot more in space education for children. I know that the majority of us are trying to do this, although we perhaps don't do enough. Regarding international cooperation in space education, we should do a lot more. In the West, NASA and CNES are presently looking at joint space education activities, and CSA is likely to become involved. Sharing the experiences of space education with others is a must, as we can learn from each other, and unlike building a space craft, this area is not so expensive. I would like to ask Professor Matogawa how many children attend these activities?

Professor Matogawa:
Each year around 15,000 people come to ISAS Open House and approximately half of them are children. As for Cosmic College, 120 children have graduated since it began.

Mr. Kirkham:
I would like to follow up on Mr. Giroux's comments and second them. This is an area in which UNISPACE activities would be very suitable, and given that part of APRSAF-6 is devoted to looking towards UNISPACE III, the delegates might consider some kind of international participation in UNISPACE III with specific regards to education and expanding space education opportunities throughout the world.
V. Session-2: "Space Environment Utilization"
SESSION 2: Space Environment Utilization (1/2)

“Outline of the International Space Station (ISS)”
Dr. Yasushi Horikawa,
JEM Project Manager,
Office of Space Utilization Systems, NASDA

The ISS is an international project involving the cooperative participation of Japan, USA, Canada, Russia, and eleven European Space Agency (ESA) member nations. The objectives of this project are to:
- develop a world-class orbiting laboratory for conducting high-value scientific research
- develop the ability to live and work in space for extended periods
- develop effective international cooperation
- provide a test bed for 21st century technology

This program is led by NASA, and between the partners of this project there is an International Governmental Agreement (IGA). This agreement specifies the roles and responsibilities of each partner, each of whom has their own Memorandum of Understanding (MOU) with NASA.

History of The Space Station Program

This program was initiated in January 1984, when US President Reagan proposed the construction of a manned space station and invited the participation of partner countries. In September 1988, Japan, US, Canada, and nine European countries signed an agreement on the development, operation and utilization of the Space Station. The program was redesigned in February 1993 in response to requests from US President Clinton, and following the break up of the Soviet Union, Russia was invited to participate in December 1993.

In January 1998, due to the increased participation of Russia and other countries, an amended agreement was signed between Japan, USA, Canada, Russia, and eleven European Space Agency (ESA) member countries. Finally,
on November 20th, 1998, the first element of the ISS, FGB “Zarya,” was launched from Baikonur in Russia. Two weeks later the second element, Node 1 “Unity,” was launched by NASA from the Kennedy Space Center, USA, on December 4, 1998 and connected to the first element.

Configuration

The forward sections of the ISS are being developed by Japan, USA, Canada, and ESA countries, while the rear sections are being developed by Russia. The central structure comprising two elements is already in space. The main infrastructure, such as solar paddles and truss, is being developed by NASA, and Canada will supply the remote manipulator system to assemble the components of the ISS. Japan will provide an experiment module (JEM), and the ESA countries will also provide an experiment laboratory. The ISS will be 110m wide, will 75m-long solar paddles, and will weigh a total of 415 tons. The solar paddles will generate 75kw for system and payload operations. During the assembly phase, the ISS will accommodate three crew members; when complete, it will accommodate seven permanent crew members.

Schedule

The current schedule will be reviewed in June 1999, and the next assembly schedule, the Russian Service Module attachment, is planned for November 1999, followed by other sequential element attachments in 2000. The first element of JEM is scheduled to be attached in October 2001, followed by other JEM elements in January and June 2002, and the overall completion of the ISS is expected in January 2004.

Japanese Contribution to the ISS Program

The reason we are participating in this program is that it enables us to conduct microgravity experiments for material and life sciences and research into long-term periods of staying in space. It also gives us the capability of astronomical and Earth observation from space. Apart from the scientific and technological experiments, we can also benefit from cultural and
psychological studies, and our participation fosters public awareness of space applications and encourages space education among the younger generation.

The Japanese Experiment Module (JEM) consists of a pressurized module for conducting material and life science experiments, and an exposed facility with ten attachment points for external payloads that can carry the observation equipment and other technological and scientific experiments. The payloads, or system equipment, can be handled by a remote manipulator system, and can easily be exchanged without any extra-vehicular activity by the astronauts. We also have logistics carriers that can be used as storage areas when attached. The length of the pressurized module is 10m, and the exposed facility, 5m. The manipulator is 10m in length and is very similar to the one used on the NASA Space Shuttle. To develop JEM, we constructed a ground-based engineering model to carry out performance and functional tests. All of these systems tests were completed in 1998, and we are now developing the flight hardware.

We are also planning a variety of experiments to be conducted in JEM. For example, in the pressurized module we will be conducting microgravity experiments in material and life sciences; in the exposed facility, we will be conducting various experiments such as space environment data acquisition, monitoring x-ray images in astronomical observation, optical communication, and Earth observation. Tsukuba Space Center will be used as the operations center for JEM.

Centrifuge Program

Another ISS program we are currently developing is a Centrifuge facility. As we are using the Space Shuttle to launch and deliver JEM to the ISS, we were asked by NASA to develop this facility in return for a reduction in launch costs. The Centrifuge is 2.5m in diameter and will rotate and create 0g-2g. Many life science experiments will be conducted in this facility and accommodation modules will also be developed. At present this facility is still in the design stage.
H-II Transfer Vehicle

In addition to the Centrifuge program we have also begun the development of the H-II Transfer Vehicle (HTV) in order to have transportation capability and access the ISS to provide logistics items. NASA has its Space Shuttles, Russia has its own space vehicles and the ESA countries have the Ariane Transfer Vehicle. The HTV, to be launched in early 2000, will be able to rendezvous and dock with the ISS some 400km above the Earth's surface and provide logistics items for both the pressurized and exposed facilities. The ISS is already a reality, and in the next few years further components will be launched and attached to it. Finally, in the year 2004, completion of the ISS will be achieved, and its operation and utilization will be available to all of its users.
SESSION 2: Space Environment Utilization (2/2)

"Current ISS Utilization Project"
Mr. Susumu Yoshitomi,
Deputy Director,
Space Utilization Research Center,
Office of Space Utilization Systems, NASA

The Space Utilization Research Committee (SPARC) was formed under the Space Activities Commission of Japan. Under the chairmanship of Dr. Sugamo, the committee developed Japanese space utilization plans. Currently, we are developing the JEM multi-user facility and other support equipment and conducting precursor mission flights on Space Shuttles and Mir. A new project, which began in April 1999, is the Applied Research Pilot Project for Industrial Use of Space, which was initiated to accelerate space utilization by industry.

JEM Facility
The material science facilities we are currently developing for JEM include a Gradient Heating Furnace (GHF), an Advanced Furnace for Microgravity Experiments with X-ray Radiography (AFEX), a Solution/Protein Crystal Growth Facility (SPCF), a Fluid Physics Experiment Facility (FPEF), and an Image Processing Unit (IPU). The life science facilities include a Cell Biology Experiment Facility (CBEF) and a Clean Bench (CB). All of these facilities are installed in racks, some of which remain undesignated at this time. One rack contains a minus 80 degree freezer and refrigerator, and the International Standards Payload Rack (ISPR) has an approximate size of 2m high, 1m wide, and 1m deep. In addition to these, there are also some storage racks in JEM.

Development Status and Launch Schedule
The GHF rack is in the proto-flight model manufacturing and test phase, the AFEX rack is in the engineering model phase, the SPCF rack is in the
engineering model phase, and one of the life science racks is in the flight model manufacturing and test phase. Three of these racks, the GHF rack, the SPCF rack, and the life science rack, are scheduled to be launched in 2001. However, this schedule is based upon Assembly Sequence Revision D, and if Revision E is approved later this year, this schedule will be put back by one year. Two of the exposed payloads are planned for launch next year, and another is planned for 2002.

Research in JEM

With the GHF facility, we will be able to conduct crystal growth experiments for high-quality semiconductors; using the AFEX facility, we will be able to observe inside molten samples and measure the flow rate with X-ray radiography. Using the FPEF under microgravity conditions, we will be able to observe Marangoni convection in real time for better understanding of its mechanism. The SPCF will be used for producing protein crystals for structure analyses on the ground.

In the life science experiments, we will conduct experiments using the CBEF and CB facilities to understand how the space environment (microgravity and radiation) affects plants and creatures.

In the exposed payload facilities, we will be able to collect data on heavy iron, high-energy light particles, and neutrons, and collect cosmic dust using the Space Environment Data Acquisition Equipment (SEDA). Using the Superconducting Sub-millimeter Wave Limb Emission Sounder (SMILES), we can collect data on atmospheric trace gases; with the Monitor of All-sky X-ray Image (MAXI), we can scan the sky for x-ray bursts and distribute the information throughout the world. The Laser Communication Demonstration Experiment (LCDE) will enable us to communicate with the JEM ground station and send the obtained data at laser bandwidths. The second objective of this equipment is to observe space debris using the laser.

Next Precursor Missions

Since 1992, we have conducted many space experiments using mainly the
Space Shuttle, and last year Dr. Mukai flew with the pioneer astronaut, John Glenn. In April 2000, we will have the opportunity to carry out experiments in the US Lab on the ISS, and will carry a Bonner Ball Neutron Detector (BBND) for this experiment. The purposes of this mission will be to contribute to the NASA Human Research Facility Project and provide neutron data. In December 2000, we will conduct a High-Density Protein Crystal Growth (HDPCG) experiment on STS-107.

The purposes of this mission will be to promote commercial applications in space and facilitate protein research activities on JEM. We are also discussing with the Russian partner the utilization of the Russian service module that is expected to be launched in December 2000. On this we will carry a Micro-Particles Capture and Space Environment Exposure Device and a High-Definition TV Camera. The purposes of this mission will be to contribute to space debris research and space technology as well as to demonstrate tele-medicine for astronaut health care.

**Space Environment Utilization Research and Promotion**

This is made up of Ground-Based Research Activities and JEM Flight Experiments. There are two major programs within the Ground-Based Research Activities. The first is the Ground Research Announcement of Opportunity (AO) program that was initiated in 1997. This year, we have the third AO and the process is still on-going. The second program is JEM Utilization Research in NASDA. In this program, we are conducting specific research themes such as Compound Semiconductors, Modeling of Diffusion Phenomena, Marangoni Convection, and some life science research such as Gene Expression in Osteoblasts.

We are also expecting other national research institutes or industrial institutes to conduct some basic research for space environment utilization. JEM Flight Experiments were approved by Dr. Sugamo and SPARC, and there are three categories, JEM Science Research, International AO Research, and the Applied Research Pilot Project for the Industrial Use of Space. For the JEM Science Research category, we have already selected 43
candidates and four exposed payloads, and the process is almost complete for the remaining two categories.

Grants on Ground-Based Research
This program is similar to the NASA Research Announcement and is limited to ground-based research. AOs are solicited and selected each year, and the maximum period is 3 years. The disciplines comprise Microgravity Science, Life Science, Space Medicine, Space Science, Earth Science and Technology Development (Engineering). There are two grant categories, Phase 2 Research, of up to 100M Yen per year, and Phase 1 Research, of up to 30M Yen per year.

--Q & A Session--

Question: I saw a robotic arm on the exposed module, was that manufactured in Japan?
Answer: Yes, the robotic arm is being developed by a Japanese contractor. The function of the robotic arm is very similar to the ones on the Space Shuttle and the Space Station, and the only difference is that ours is maintainable in orbit.

Question: Is it free to move all around the station?
Answer: No, only around the JEM module to manipulate our exposed module equipment.

Question: Will all of the astronauts be located in one accommodation module because there is no support system in yours?
Answer: During the early stages, our crew will stay in the Russian module, but when the assembly is complete, NASA will provide habitat modules.
Question: Later on will there be any opportunities for the international community not involved in the assembly stages to participate in the experiments?

Answer: That is now under consideration. Our utilization group and other partner user groups are considering how to invite non-participating countries, so that eventually these countries, particularly Asian countries, may perform experiments on the ISS.

Question: Congratulations to both speakers, they were excellent presentations, and I have been really looking forward to listening to them. As this is such a large project is there an international training center for all of the engineers and astronauts involved, and how is coordination managed?

Answer: In regards to training for the astronauts, each country trains its own astronauts. They then train at the US Johnson Space Center (JSC) in Houston for final training to work as a group for ISS operations. To develop this ISS program there are many coordination mechanisms among the partners. All partners participate as members of the control board at JSC. Each partner has interface coordination and there are bilateral meeting mechanisms.

Question: Could you explain the logo of JEM?

Answer: This logo shows a red circle on a blue background with a paper plane above it. The circle resembles the flag of Japan, but it represents the Earth, and the paper plane represents the future. The JEM module is called “KIBO,” which means “hope,” but we just want it to be called “KIBO.”
VI. Session-3: “Earth Observation”
SESSION 3 : Earth Observation

Opening Address
Professor Shunji Murai

Disaster Monitoring and Mitigation is one of the key issues of UNISPACE III which was suggested by the Asia-Pacific region, and this includes not only natural disasters but also man-made disasters. Environmental degradation and the mismanagement of natural resources are caused by many of the man-made disasters in the region. There are many other reasons, particularly poverty, poor education, inefficient politics, military conflicts, and even war.

Thus, we are very pleased to have many papers on Disaster Monitoring and Mitigation, and remote sensing is one of the best applications for disaster management in the Asia-Pacific region.

SESSION 3 : Earth Observation

Disaster Monitoring and its Mitigation
by Using Earth Observation Data (1/4)

“Application of Satellite Data for Forest Preservation”
Dr. Swoyambhu Man Amatya,
Deputy Director General
Department of Forest Research and Survey, Nepal

Nepal is a small country located between India and China with a total land area of 157,181 square kilometers. It is divided into seventy five administrative districts, and there are five geographic zones -- the lowland Terai, the highlands, low mountains, middle mountains, and the high Himalayas. Within the north-south distance of from one hundred to one hundred and fifty kilometers, the altitude of the country ranges from around sixty meters to the eight thousand, eight hundred and forty eight meters of Mount Everest. Thus, one can easily imagine the diversity of forest, flora, and fauna within this range. Forestry is one of the important natural resources in the country, and as around ninety percent of the population lives near this
natural resource, it will continue to remain important.

An assessment of natural resources is necessary, and we have found over the past fifteen to twenty years that remote sensing is a viable tool for efficient mapping and monitoring the natural resources of our country. The availability of high-resolution satellite data has efficiently increased the planning and management of natural resources, even at a local level. Moreover, computer image-based processing has become less expensive and more efficient. Furthermore, the integration of GIS with remote sensing data has added a new dimension in remote sensing applications in Nepal.

The Department of Forest Research and Forest Survey has been using remote sensing data in assessing the forest resources of the country since 1980, particularly in mapping, monitoring, and detecting forest cover changes. Remote sensing data was used in analyzing forest cover in the Terai districts in 1990-91 using Landsat TM and Indian Remote Sensing (IRS) data for forest cover mapping. Forest cover change analysis was carried out in the Sunsari district of the Terai using Landsat TM data in December 1991, comparing it with the data of January 1998 to see the change in that district.

The study showed that forest cover decreased drastically, more than five thousand hectares, and the river basin also decreased by around one hundred hectares during these seven years. Despite the problems of cloud and shadow in our country, remote sensing satellite data is the most efficient and cheapest way of monitoring the natural resources of the country. The Japanese Forestry Technical Association (JFTA) has been working closely with us in analyzing forest cover since 1998. In the future, we look forward to the establishment of a ground station in our region so that we may collect our own data as and when necessary.
SESSION 3 : Earth Observation

Disaster Monitoring and its Mitigation by Using Earth Observation Data (2/4)

“The Operational Service by Fire Information Monitoring Using Satellite Data”
Mr. S. Khudulmur,
Director
National Remote Sensing Center of Mongolia (NRSC).

The natural features of Mongolia, together with its specific economic and social characteristics, make it particularly vulnerable to natural disasters. Thus, the establishment of an early warning system is the key to an efficient organization of disaster monitoring. A receiving station was established at the Information and Computer Center of the Ministry for Nature and Environment in 1995, and we receive data on a daily basis.

In 1996, Mongolia had a huge number of fires. In the spring, we had four hundred and seventeen fires, and this created a very difficult situation for the government because they did not have sufficient information. The first fires began in February, and we approached the Mongolian Civil Defense Department with our information, providing a methodology for fire detection and monitoring.

In Mongolia, with its large area and small population, fire monitoring using satellite data is a most comprehensive and cost effective tool. Due to the large distances involved, monitoring by local people is ineffective, and monitoring by aerial survey is very expensive, so the only suitable alternative for Mongolia is monitoring by remote sensing. Since 1996, the NRSC has been supplying information to the State Emergency Commission, the Civil Defense Department, and provincial administrative units.
SESSION 3 : Earth Observation

Disaster Monitoring and its Mitigation by Using Earth Observation Data (3/4)

“Monitoring of Land/Forest Fires and Ocean Pollution by Remote Sensing”
Dr. Lim Hock,
Director
the Center for Remote Imaging, Sensing and Processing (CRISP),
the National University of Singapore

In Singapore, we established a ground station in September 1995, and we have been receiving SPOT, ERS, and RADARSAT data. Ocean pollution monitoring began with a very lucky case. In August 1996, a ship anchored off the west coast of Singapore discharged a large quantity of oil into the sea. This oil drifted onto the coastline of Singapore and resulted in the government spending around one million dollars to clean it up. Unfortunately for the ship, this was imaged by ERS and the authorities were able to successfully prosecute the owners of the ship.

We use ERS to analyze the oil pollution situation throughout our region. We also monitor regional land and forest fires by high-resolution SPOT data, try to determine whether the fires are natural or man-made, and supply the data to the Ministry of Environment.
SESSION 3 : Earth Observation

Disaster Monitoring and its Mitigation by Using Earth Observation Data (4/4)

“The Application of Satellite Data for Disaster Monitoring and its Mitigation”
Mr. Makoto Ono,
Senior Research Scientist,
Data analysis and Application Division,
Remote Sensing Technology Center of Japan (RESTEC)

In 1997, CEOS began a strategic implementation team chaired by Dr. Embleton. The purpose of the team was to seek an effective way of Earth observation data utilization. Under this team, an analysis group was started, and the purpose of the group was to find the gap between end-user requirement and data provision. The method of analysis was to set a virtual project in various areas to find actual problems, and one of the groups handled disasters. After one year of analysis, the project became an actual one, and some of the groups are still working very actively in seven areas of disaster monitoring.

In Japan, we have also completed some studies on disaster monitoring using satellite data. The disasters are categorized according to spatial area and timeline. Examples of long-term disasters are desertification and the “El Nino” phenomenon, and short-term ones are lightning strikes and soil avalanches. From the sensor design viewpoint, we have various systems and platforms from polar orbit satellites to geostationary satellites. If we use geostationary satellites, the maximum resolution is reduced to around 100 meters. However, in the future we will have 30-50 meter sensors. Using a geostationary satellite, we can observe any place at any time depending upon the satellite sensor performance. If we need higher resolution, a polar orbit is used, and although we can achieve one meter resolution, 20-30 meter is mostly used.

However, using the polar orbit satellite, we can only observe an area every three to five days at most. The advantages of space-borne systems are the ability for continuous observation, wide-area coverage, constant acquisition, and minimal maintenance. The disadvantages are low resolution, continuous monitoring in the case of geostationary satellite, the difficulty in interpretation of data from non-optical sensors, data systems that are often located far from
the disaster area, and limited observation chances from polar orbit satellites, thus requiring many satellites for continuous observation.

When acquiring RADARSAT images of disasters, we are able to use partial scene data almost immediately for local action. However, it takes about three days to obtain full scene data. We generally cannot detect oil spills using RADARSAT when the sea-surface wind exceeds 7 or 8 meters. Using RADARSAT, we encounter several problems. One is the command path, which requires us to place an order 24 hrs prior to the operation. However, from the engineering point of view this can be solved.

The data transfer system is also expensive due to the use of communications satellites to transfer large amounts of data. An alert path has not been established, so there is no effective way to send information of an oil spill to the local action entities. Data analysis technology should also be improved, when the present technology cannot detect oil spills.

Finally, the method of action planning using satellite data has not yet been established, and should be determined from case studies.

---Panel Discussion---

Dr. Takashi Moriyama, NASDA

The objectives of this panel discussion are to focus upon the restriction factors for obtaining the data for disaster monitoring and mitigation. The involvement and support of users in developing countries is an important objective of APRSAF-6, as is the link with the private sector who have advanced knowledge to interface directly with users.

Mr. Makoto Higashi, RESTEC

RESTEC is not one hundred percent private sector, but I try to think of myself as a businessman. I have seen many case studies of using Earth observation data to disaster response, but very few operational uses of the data. Thus, my question is, are we really making ourselves ready to monitor disasters and mitigate the damage sufficiently? There are three probable hindrances to this, and I present them as food for thought.

Regarding imaging frequency, one single satellite can image a particular
point on Earth, if it is nadir viewing, only once every 20-40 days. If the satellite has oblique viewing capability of plus/minus 30-40 degrees then it can image the point once every 2-3 days. Thus, it is quite clear that no single satellite can monitor disasters sufficiently, so all satellites that are available need to be used if we are really serious about monitoring disasters.

Many of the ground stations in Asia receive perhaps three or four satellites out of the seven or eight available. Of course, there are financial considerations, as the more you receive the more you have to pay. Thus, the satellite operators should improve their usage agreements. For example, the IRS program is a constellation reception agreement which includes B, 1D and 1C, while SPOT charges separately for each of its 1, 2 and 4 satellites. If we were really serious about obtaining the data for application, then constellation agreements would be part of the solution.

The second issue for improvement is the programming request deadline time, RADARSAT has a 29hr deadline before the satellite passes over, after which you cannot do anything about it, SPOT has a 16hr deadline, and IRS has 30 days. Unless these deadlines are brought down to six hours or so, satellite usage cannot help much, so there must be some new standards.

The third point is that making the image to show the disaster is one thing, but measurement of the damage is another. Interpretation of these images requires expertise through training. Unless we have the experts to interpret the images of particular disaster damage, then we can only do little. We need specific training in specific damage before we can be truly operational.

Mr. Ishibashi, Weathernews

Currently Weathernews is the largest private weather company in the world, and in Japan we serve over one thousand customers in terms of disaster mitigation related businesses. Most of the effort is by the use of geostationary satellites GMS and NOAA. I do not believe that any satellite technology could solve all the problems of disaster mitigation programs, but I think that there is a definite hunger on the part of the private sector to provide better satellite technology and more usage to improve the service of disaster mitigation.

The main hindrance is undoubtedly the delay in using the data for disaster mitigation. While we are often able to supply the data on disaster to a customer in less than fifteen seconds, there is a large gap in using this data in a meaningful way, as was mentioned previously. Thus the private sector is aware that new technology is needed to help its customers provide a better service.
Dr. Rikimaru, President, Air-Graph Co.
Our test site for emergency response application of remote sensing is the lower Mekong river basin, where agriculture and social facilities are seriously affected by flooding every year. The Japanese Institute of Irrigation and Drainage (JIID) and the Mekong River Committee Secretariat (MRCS) are both involved in this monitoring flood conditions and inundation mapping joint-project.

The peak condition of the flooding in the Laos area lasts for only one or two days. However, in our first year we had to wait two weeks to order RADARSAT data so our attempts were unsuccessful. The following year we discussed this problem with RESTEC and RADARSAT and initiated an emergency response system where we were able to order data in 24 hrs. This new system enables us to receive the data much quicker and be able to take emergency action as needed, which is necessary in the case of flooding disasters.

Discussion guidelines by Mr. Moriyama, NASDA
Satellites cannot do everything that we require, so we need to combine them with satellite infrastructures, space ship and air-borne measurement, and also existing ground-based measurement such as GPS, water meters, and rain gauges. Data utilization facilities also need to be interconnected between the related data users in order to exchange knowledge and information. A virtual network is essential for using satellite data in an efficient way.

We need to know how to adapt the satellite data to develop a hazard map and apply it to disaster mitigation. Mitigation also means some preparations for the disaster and also some predictions. Before the disaster warning, it is not so difficult to use the satellite and airborne measurement data and integrate it into a hazard map. In areas where disasters occur frequently, it is easy to develop a hazard map. However, when a disaster occurs, the problem is in acquiring the data within one or two days to input the data into the database and update the variations.

Satellite data acquisition is always the principal restricting factor in obtaining the measurements we require. At this time, the main consideration of disaster monitoring is that observation frequency is one of the major obstacles to adapting the satellite measurement data to disaster mitigation because the number of satellites is insufficient. Each agency operates observation satellites, but they are not enough to cover the necessary observations, so we need an integrated system between space, airborne, and
ground data, and to coordinate operations nationally and internationally to make the data available for application. Ground receiving and processing facilities are necessary to provide data on a real-time or quasi-real-time basis, as are online data systems.

Although we would like an ideal number of satellites, we should also consider the social and economic benefits. Thus, in general, we should consider five issues relating to the adaptation of satellite data to disaster applications:

1. Data continuity; using the same data structure and software tools.
2. Data acquisition time; quick data processing services and online provision for the users.
3. Standardized data format; data formats, mediator structures, data qualities, data catalogues, and data access protocols should be standardized to promote multiple data use between the various kinds of users.
4. Education and training; demonstrations, hands-on training, seminars, CD ROMs, and joint research are very efficient ways of training users in the various regions.
5. Low data cost; pricing policies.

These are the major issues to be discussed in the application of satellite data for disaster monitoring, and more practically for application to agriculture, city planning, and environmental preservation.

Dr. Lim Hock

For disaster management applications, the present satellite systems are not ideal as they were designed for resource management. However, if we combine all the satellites that we have, they can provide very useful information. Of course, we cannot hope to get everything immediately, but getting good data every now and then helps a lot. When there is an event, we find that we have the first chance of getting an image from SPOT, then RADARSAT, the reason for this being that we receive two SPOT satellites and the sensors can be moved over a greater range. RADARSAT also has multiple beams, but they are narrower and much more rigid, as there are only seven positions to choose, so it is often difficult to get the right angle.

Another issue is how we work with the satellite providers. We work closely and successfully with SPOT, and they allow us to program the satellite. This is not done directly, but we program our observation requirements and send them to their computer in Toulouse, which then beams the program to the satellite.

For this procedure, there is a time delay of around 16 hrs, which is acceptable. Using RADARSAT, we have experienced difficulty getting urgently
needed data in the past as they required detailed information regarding the disaster. Now the response time is quicker, down to around 29 hrs. Yet another issue is how we deliver the data to the users, as the data we receive is governed by copyrights, distributions rights, etc. Unless some agreement is worked out beforehand, it is not possible for us to hand over the data to the users. For disaster applications, better arrangements need to be implemented for ground stations to be able to pass on the data directly to disaster management agencies.

Dr. Amatyana

The situation in Nepal is somewhat different as we do not have our own satellite or ground station, and we depend upon LANDSAT and IRS data. The main concern for us is whether or not we will be able to afford to obtain data for monitoring disaster situations such as avalanches in the Himalayas and water flows in high-altitude lakes due to the social and economic situation of our country. The applications that we see in Nepal are very limited because of this, and we have to analyze each situation before using data.

Mr. Khudulmur

In Mongolia, we only use data from NOA, so we are not familiar with the problems of using data from other satellites such as SPOT, LANDSAT, or RADARSAT. We do know that obtaining data from these satellites is costly, and we do not have the budget to do so.

Mr. Rikimaru

Before we detect the disaster conditions, we need to know the normal conditions in that particular area for comparison.

Mr. Ishibashi

In the private sector, our competitor is our customer, which means that if no one is using our service then it is pointless, so we need to do more, quickly, easily, and inexpensively. In coping with technical issues, we are sometimes afflicted by the PCCI syndrome, which means Perfectly Correct but Completely Irrelevant. This means, for example, that if we provide a completely accurate forecast, yet it arrives five minutes later, then it becomes irrelevant. This is the type of the problem we have to overcome.
Dr. Embleton:
I would like to echo the comments made by Dr. Lim Hock, that the systems with which we are dealing were not primarily designed for disaster management, and to use those systems introduces all sorts of questions in terms of their technical limitations and operational capabilities. The system outlined by Dr. Moriyama is certainly an objective to which we should be striving, utilizing the present systems in an integrated way to provide thematic disaster maps for practical application.

However, the long-term solution is to actually design a system that is going to deliver the kind of information we require to manage and mitigate disasters. It is also timely that we should consider this now, as we are coming to the end of the international decade for the mitigation of natural disasters and hazards. To go forward with a plan for the next decade would be a very good outcome. Disasters happen throughout the world without warning, so a system specifically designed to provide us with information to manage these disasters would be in operational use almost continuously.

Another point that became clear to me from earlier reports, is that the request for information from the service providers to the customers is a diversion from the planned acquisition programs that many of the satellite system operators are working on now.

Mr. Pradhan:
In most countries in South-East Asia, satellite data remains under the control of the Government's Defense Ministries and is not easily available for professionals. Forums such as this should recognize that these government institutions which control space agencies and satellite surveys should be more open, and provide this useful information freely for the professionals and institutions to enable them to use it for the benefit of society.

I agree with the issues outlined by Dr. Moriyama, as they are of particular concern to our own agency ICIMOD in Nepal. For us, the major problems in remote sensing are training and education, and the cost of the data, which is the main hindrance in utilizing the data. Copyright is another issue that adds to this problem. If a developing country buys information it should be available for use within the whole country, not just within a particular agency, or even sometimes within a few sections of an agency. Copyright should be reexamined, as it is very taxing for a poor country if the data is not allowed to be used for the benefit of different agencies. Rather than the duplication of data purchases, being able to use the same data in different agencies would
lower costs significantly. We get a very good discount on IRS data, but it is still very expensive for us.

There should be some mechanism by which the data is affordable in line with the social and economic situation of a country. In a sense, not having easy access to the data is like waiting for a disaster to happen. In Nepal, we have benefited from the help of international agencies when disasters have occurred, but being able to fully map and monitor our disaster prone areas would in many cases mitigate them beforehand.
(This paper is a special contribution submitted by our New Zealand Colleague who did not come to APRSAF-6, but the Secretariat expresses sincere appreciation for such contribution)

"Application of Satellite Data for the Preservation of Land Environment"

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Introduction
New Zealand Government-funded research, science and technology investment into the new millenium concentrates upon fourteen target outcomes. Four of these relate specifically to the environment:
* Sustainable use of natural resources;
* People living in safe and healthy environments;
* Healthy, diverse and resilient ecosystems;
* New Zealand in the global biophysical environment.

Satellite data is an important input for each of these outcomes and current remote sensing and image processing research is contributing to all of them. New Zealand has a series of stringent laws embodied in the Resource Management Act, which require local bodies, districts, and regions to monitor environmental parameters and to police problems and effect changes when and where required. Like all organizations, those in New Zealand have to find the most cost-effective methodologies to undertake these investigations. Often, satellite data, at the appropriate scales and resolutions, can be the most effective tool.

Current and future research projects
Our current major research includes:
Use of full-polarisation, multi-wavelength SAR to measure biomass, specifically the above-ground bound carbon in various ecosystems.
The New Zealand response to curbing CO2 emissions includes a commitment to conserving and replanting forest and shrublands/scrublands. Knowledge of the carbon bound in exotic forest
plots is relatively easy to calculate but C accumulation in the mixed-species scrublands is a more complex problem. A study with full-polarisation, multi-wavelength SAR has shown good correlation between total backscatter power and total above-ground vegetation carbon, although the relationship is species-specific. Subsequent work has demonstrated that full-polarisation, single wavelength imagery can be used as an effective method of species discrimination. This suggests, but does not in itself prove, that multi-polarisation imagery could be used for species discrimination and subsequent estimation of the above-ground vegetation carbon.

Edge detection algorithm development for forest mensuration

Forestry is one of New Zealand's most important exports and the forestry companies want to keep very accurate and timely inventory of their standing assets. Currently, they rely on aerial mapping and are often hindered by persistent cloud cover. We are developing methodologies for mapping forest inventory using SAR data. The current C-band satellite data does not work well for New Zealand forestry but L-band data from historical JERS-1 imagery works very well.

Satellite data for landslide mapping

We have investigated the use of both optical and SAR satellite data for mapping landslides. Assuming cloud-free data can be obtained, then optical data is excellent for this application. Our investigations into the use of C-band SAR data were inconclusive due to a dearth of landslides in our test area for the full duration of the project. [Within weeks of the final report, a major storm caused flooding and landslides, exactly where we had hoped to map them!] Using SAR data to map landslides in our pastoral hill country will be more difficult that using optical data, but SAR data collection at any time, day or night, means we need to always consider its use in emergency situations.

Baseline mapping for marine discharge events

In New Zealand, the responsibility for oil spill response depends on the effective interaction between a variety of agencies in central, regional, and local government, industry and other public bodies, especially the Maritime Safety Authority (MSA) and the Regional Councils.

With the cooperation of ESA and Radarsat, we have obtained C-band SAR imagery over five of New Zealand's major port areas. With simultaneous ground and sea observations we are investigating how useful these could prove in the New Zealand environment. We know that this methodology is used routinely overseas, but the New Zealand
maritime environment has relatively high average wind speeds. This places some constraints on the likelihood of oil detection with SAR data on a number of given days per year. We expect the research to achieve:
* Baseline data for each of the eight major New Zealand ports, vitally useful for mapping and monitoring in the event of a disastrous spill event.
* Knowledge of the ability of ERS and Radarsat C-band SAR data to detect oil in the New Zealand marine environment
* A practical demonstration, and training for, how to cope with an oil spill, especially a methodology for, and response times achieved, through the Hobart (ACRES) receiving station and the viability and speed of automated processing and intra-New Zealand delivery procedures.

Interferometry for mapping and geophysical studies

Interferometry has become a widely used method for mapping terrain and, in optimum conditions, can yield height and slope models, as well as indications of continuous deformation and earthquake dislocation. Our interferometric research concentrates upon:
* considering the degrading effects of vegetation on the interferometric pairs;
* using differential interferometry, attempting to detect and verify the measurement of continuous deformation in the Taupo Volcanic Zone, in the central North Island.

In the future, we see interferometry as a viable technique for the retrieval of biophysical parameters from the vegetated environment.

Our Future Research Plans include:

On-shore Off-shore dynamics in peri-urban embayments:
The ENVIROSAT Announcement of Opportunity
This research will investigate the relationship between seasonal human activities and climatic conditions on the run-off and subsequent along-shore environment conditions, in a mixed urban/rural/recreational/conservation area of New Zealand, with a view to developing an operational monitoring/early warning system. The Bay of Plenty test site has predominant current patterns moving sediment and nutrients across the area so that any discharges from land use affect the inner bay area, especially Tauranga Harbour. The proposal aims to take a holistic approach to environmental monitoring. Using the MERIS sensor on Envisat, we hope to:
* correlate periods of sea lettuce growth in Tauranga Harbour with variations in one or more other parameters, perhaps sea surface temperatures and run-off from the dairy farms of the Hauraki Plains
* check ebbs and flows of nutrient availability and chlorophyll activity and
  the area and correlate it with times of increased population in the summer
  (holiday) season
* investigate the processes which may assist algal blooms
* check the effect of water table changes on the consequences of run-off from
  farming areas, especially Hauraki Plains and the Piako swamp
* with the visual impact of the image data, and with the use of the media-
  www, augmented by other traditional information dissemination
  mechanisms, to bring these truths and consequences to the attention of
  both the authorities and the public, in a most effective way.
SESSION 3: Earth Observation

Earth Observation Data Application (1/7)

“Case Study in China”
Professor Huadong Guo,  
Director,  
Institute of Remote Sensing Applications (IRSA),  
Chinese Academy of Sciences (CAS)

In the past twenty years, China has launched meteorological satellites and territory satellites and has set up a ground receiving station in Beijing capable of receiving LANDSAT, RADARSAT, ERS-1/2 and other satellite data. An airborne Earth observation system was also established, including 128 channel imaging spectrometry, 3D imager, CCD camera and L-band SAR. In the future, we plan to develop a multifrequency SAR system.

Two weeks ago, China launched the FY-1C, and we have just received the first cloud images from this. We will also be launching some small meteorological and ocean study satellites, as small satellites are economical and quick to develop.

Using data from spaceborne and airborne Earth observation systems developed at home and abroad, extensive application studies have been conducted in agriculture, forestry, hydrology, geology, oceanography, urbanization and other fields. Growth status monitoring and yield estimation of crops in summer and fall have been performed for the whole country.

In southern China, we use radar to estimate the rice crop, and using the 3x3m and 6x6m radar we can classify 14 types of land cover. Dynamic investigation into land resources in China has been conducted. By comparing the present day images and images made ten years earlier, we are able to see the increase of urbanization, the increase of forests, and the decrease of agricultural areas.

We also use satellite images for forest classification and volume predictions. For natural hazards, especially for the unprecedented floods of the middle reach of the Yangtze River in 1998, real-time monitoring and disaster situation assessment have been made. The data are also used to discover favorable mineral deposit prospects and oil fields in the exploration of metallic ore deposits as well as oil and gas resources.

North China is very dry, and we can use satellite data to detect areas high in soil moisture and then find ground water. North Western China is very rugged...
country and very far to travel to and difficult to survey. Now, using remote 
sensing, we can stay in the laboratory and complete our surveys and 
topographical maps. In areas of desertification near the Great Wall, we have 
been able to find ruins of parts of the wall buried under the sand as we are 
able to penetrate the sand using satellite imaging. In the study of 
obeanography, primary productivity, ocean pollution and underwater 
topography have been studied. City planning investigation on a large scale has 
also been conducted.

The above-mentioned applications have achieved significant results, 
reflecting that Earth observation technology has tremendous application 
potential and practical usefulness in resources, environment, natural hazards 
and other fields.
SESSION 3: Earth Observation

Earth Observation Data Application (2/7)

“Remote Sensing Activities for Resource Monitoring and Management in Indonesia”
Professor Harijono Djojodihardjo,
Chairman,
LAPAN(Indonesia)

Indonesia has a unique environment, and comprises some 17,000 islands located between the Pacific and Indian oceans and two continents, Asia and Australia. It is a unique maritime continent, and as its geographical information is not well documented, remote sensing has become essential. It is also vulnerable to natural hazards such as floods, earthquakes, volcanic eruptions, drought, and land and forest fires. The government of Indonesia realizes that to have better knowledge for successful sustainable development, it is essential to have access to sophisticated technology that can provide comprehensive, accurate and real-time information related to the condition of natural resources and the environment.

The technology, which is progressing rapidly in relation to extracting information on natural resources and environmental conditions, is the "Remote Sensing and Geographic Information System." This system has been applied extensively in Indonesia, particularly over the last five years. Many government agencies and private companies have utilized remote sensing and GIS technology in various sectors. These include forestry (fire detection, forest inventory), agriculture (crop yield assessment, monitoring of areas in vulnerable food situations), geologic exploration (mining, oil and gas exploration), marine and coastal management (mangrove, coral reef, and oil spill monitoring) and hazard mitigation.

R&D and Operational Activities
Remote sensing technology and GIS have played significant roles in natural resources management, environmental monitoring, and assessment in Indonesia. Model application methodologies developed through R & D activities on remote sensing, since the experiment on the acquisition and processing of low-resolution Landsat satellite data (MSS), have been applied
by various users for directing and executing the national development policy for natural resources and environmental management and monitoring. To strengthen these capabilities, the government has installed a remote-sensing ground station for acquiring Landsat-TM, SPOT 1 and 2, ERS 1 and 2, and JERS-1 in Parepare, South Sulawesi.

The National Institute of Aeronautics and Space (LAPAN) acts as the national focal point in the development of remote sensing satellite technology and its application in the country, and not only carries out R&D but also serves various agencies' requests for either data or information. LAPAN also provides specific information such as crop acreage monitoring, hot spots, drought, ITCZ and SPCZ positions, which are submitted to the government periodically.

Infrastructure Development and National Coordination

Infrastructure development activities have been carried out to enhance the capability in technoware (H/W and S/W), brainware (human resources), orgaware (coordination, organization links), and infoware (information changes and awareness). In the present conditions, purchasing H/W and S/W to develop the technology capability or capacity proposed to empower each governmental agency (forestry, agriculture, etc.) has been given lower priority than the other activities.

Human resources development (HRD) is very essential because it is the “heart” and the agent of development. The program related to HRD is intended to provide opportunities for people who have capabilities for continuing formal higher education (master or doctorate). The programs are also designed for Remote Sensing and GIS training courses dedicated to senior university students, NGO activists, and provincial employees.

The orgaware development is designated to strengthen the organization links and coordination among institutions involved in the utilization of remote sensing, either in R&D or operational activities. The development currently being carried out encompasses the establishment of the National Coordination Agency for Hazard Mitigation (BAKORNAS-PB), the Indonesian Forest Fire Mitigation Task Force, the Earth Observation Center, the One-Gate policy for R&D management, etc. The One-Gate policy for R&D activities is intended to coordinate them for a better synergy.

Pilot Projects

Pilot projects have been established to enhance the effectiveness of a number of comprehensive methodologies and models for natural resources and
environment monitoring and management. During the last five years, the following large pilot projects have been established:

- Land resources evaluation Project,
- Marine resources evaluation project,
- ADRO program for verifying RADARSAT data for applications such as fishery and coastal zone assessment,
- Development of prototypes for the uses of ERS-SAR data for applications such as land use, forestry, and coastal zone assessment,
- Satellite for Rice in Indonesia (SARD) project,
- Satellite technology transfer in Indonesia (SATTIN),
- COREMAP (Coral Reef Rehabilitation Management and Planning),
- Remote Sensing Priority and Integrated Research (RUT).

In the near future, there will be some important projects for future development such as the Transboundary Haze Pollution Model and Control (THPMC), satellite monitoring for economic development, LAPAN ground station upgrade, SARI project, MREP second phase, and SATTIN second phase.

International Cooperation

International cooperation with Indonesian agencies includes the following:

- Acquisition of remote sensing satellite data from EOSAT, ESA, SPOT Image, RSI,
- Technical cooperation in processing technology and quality control with DLR (Germany), ISRO (India), NASA and RESTEC (Japan), and ACRES and AUSLIG (Australia),
- Model development under regional institutions such as the ASEAN Expert Working Group on Remote Sensing, IGBP, and ESCAP; and
- Cooperation with NASA on establishing a data acquisition and data processing facility for the Japan Earth Resources Satellite (JERS-1) system.

In the near future, it is expected that international cooperation based on mutual interests and benefits will enhance the progress of S/W development, facilities development and upgrading, exchange of personnel and experts, and joint workshops.

Challenges, Opportunities, and Future Programs

The Indonesian remote sensing ground station in Parepare, South Sulawesi, which has been in operation for almost six years, has the capability of
receiving up to 100MB/sec. However, after 2001, new remote sensing satellites with higher downlink bit rates will be launched. Therefore, there is a need to upgrade this facility.

Other impending challenges include the Millenium bug, an expected increase in user needs due to government decentralization under the “Autonomy Program,” and enhancing our human resources towards a certain level of self-reliance whilst in the midst of globalization. Future programs include the upgrading of Indonesia’s remote sensing satellite ground station to receive the data from ALOS, ADEOS-2, Landsat-7 and other remote sensing satellites.
SESSION 3: Earth Observation

Earth Observation Data Application (3/7)

"Activities in Space Technology Application in Vietnam"
Dr. Hoang Viet Giao,
Scientific Secretary,
National Council for Space Technology Application (Vietnam)

Vietnam is some 330,000 square kilometers in area, located in a monsoon region, with some rather complicated land forms and geological conditions, and has a population of some 80 million in an agro-based economy recovering from many years of rehabilitation.

There is an urgent need of precision data identifying and enumerating natural resources for the purposes of environmental management, disaster monitoring and sustainable development planning. Remote sensing technology is playing an important role in planning various sustainable development activities by providing speedy and timely information on major land use patterns, soil water resources, forest inventory, flooding, vegetation, coastal changes, erosion, accretion, etc.

Remote Sensing Data and Facilities

Different types of remote sensing data have been used for investigating natural resources of the regions with high priority for economic and social development, for example the high plateau, the Mekong river and the Red river delta. At present, SPOT and LANDSAT TM images are frequently used for operational applications.

Remote Sensing Applications
Agriculture

The most notable results include the use of LANDSAT and SPOT imagery to update land use/land cover maps in support of the integrated area development and land use planning programs of the government. Remote sensing data (satellite and aircraft) is used regularly at different intervals of time for land use inventory of the whole country. Land use/land cover maps at a scale of 1:250000 were prepared using satellite data, and large-scale land use/land cover maps were prepared using aerial photographs at scales of 1:50000 and 1:10000 for development planning.
Water Resources
The continued use of satellite imagery has been beneficial for studying surface water distributions and mapping river course changes. Remote sensing data was also used to map flood plains in the Mekong delta. Pilot projects for flood mapping using RADARSAT and JRS-1 data have been completed.

Forestry
False color transparencies of LANDSAT and SPOT images were projected against existing maps to determine the location of classified forest lands. A very significant application of remote sensing in forestry is to monitor forest fires using high-resolution NOAA/AVHRR data acquired from the receiving stations in Vietnam.

Meteorology
Vietnam installed a station in Hanoi and receives the high-resolution meteorological satellite images of the geostationary GMS-5 as well as the polar satellites of NOAA. The new high-resolution HRPT NOAA and GMS-5 PDUS receiving and pre-processing system was installed to replace the GMS WEFAX system in operational applications, and the Satellite Meteorology Group developed its own software, SIP ver.1.0. In the future, we plan to increase research on the application of meteorological satellite data in the monitoring of large rain causing systems, convective cloud subsystems, flooding, and especially research on the application for tropical storms.

Integration of Remote Sensing and GIS Technology
One of the hindrances to the transfer of GIS technology to the application sphere is the time-consuming digital capture of spatial data. A project for software development in digital image processing is being implemented under the sponsorship of NASDA.

Plan for Future Development in Space Technology Application
Efforts are being concentrated on establishing a mechanism for remote sensing data delivery. Apart from the existing receiving stations for GMS and NOAA/AVHRR, another station for acquiring images from Russian satellites is to be established. A project for GIS technology transfer at the provincial level is being continued, and emphasis is being placed on developing expertise on a national level. In this aspect, Vietnam has benefited from the cooperation of many countries and international organizations such as NASDA, the Regional Remote Sensing Program, and ESA.
SESSION 3 : Earth Observation

Earth Observation Data Application(4/7)

“Emerging Challenges in South Asia in Geoinformatics”
Mr. Pramod Pradhan
Division Head,
MENRIS-ICIMOD, Kathmandu, Nepal

The South Asia Region comprises Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. These countries established a regional organization, SHARK, whose headquarters is in Kathmandu. Recently we held a GIS forum in Kathmandu, discussing the various issues on how we can promote Geoinformatics, Remote Sensing and GIS in the region. During the forum, we found that the many presentations outlined the growing areas of usage, which included elections, marketing, taxation, navigation, railways, security, and health.

The growing areas reported for future applications were the use by governments of the region for automating their surveys and data providing agencies, using remote sensing technology for designing large-scale programs, and developing GIS application training for professionals and technical personnel. We also acknowledged the growing use of the internet for GIS training and applications.

Looking at the region, there are some very strong national remote sensing programs in India, and there are also some smaller programs in Pakistan and Bangladesh. In terms of IT sectors, India is very strongly represented, and the good thing is that smaller countries like Nepal, Bangladesh, and Bhutan have very liberal data policies. In Nepal, any information, even at the scale of 1:500 or 1:100, is immediately released by the government. This is a trend which we see as promoting the use of remote sensing and GIS technology in the region.

At the present time, a lot of foreign funding is available for projects, such as land-use mapping in Bhutan, forestry mapping in Pakistan, and urban mapping in Nepal, which emphasizes the usage of remote sensing.

Looking at the weaknesses in the region, the decision and policy makers are still lacking an awareness of how to utilize this technology, and as the market is still immature, the private sector has yet to become fully involved in this activity. Some of the countries do have this awareness, but for the region as a whole it has yet to be fully appreciated.
The region has great potential in terms of technical personnel and academic institutions, many of which offer courses in geoinformatics, and we look to this kind of technology for providing better services to the community and development of the economies in the region. In the past, IT and telecommunications development was regarded as being only suitable for developed countries, however, this has become well-developed in South East Asian countries and the subsequent drop in prices for hardware has made it more suitable for use in our own region.

The question now is whether or not it will be actually used in the South Asia region, but with the international cooperation that we are now experiencing we have the opportunity to develop this for the benefit of the entire region.

Geoinformatics has established a coalescence of many interests and fields in the region. Each of these fields has its own societies, institutions, agencies, and academic disciplines which collectively form a large information network, and their coalescence has led to the realization of new institutional structures. A new series of regional and international conferences are being organized: GIS Forum South Asia '99 in Kathmandu; Map India '99 in New Delhi; Geoinformatics Beyond 2000 in India and Pakistan. There are also new structures in government agencies to promote this technology, and interdepartmental committees and steering committees are being established for better coordination and policy formulation.

In the media there is now regional acceptance of GIS magazines, and there is regional acceptance of academic programs such as the MENRIS program of ICIMOD-Nepal, the CSSTE-AP program of Dehradun-India, and the STAR program of AIT-Thailand.

There now needs to be a regional GIS strategy to make geographic information an important resource for the development of the South Asian economy. It is also important that the market for this information be harmonized and realized for the planning and monitoring of governmental and non-governmental programs, and detail level data needs to be harmonized to ensure the uniform administration of national and international development programs.

A regional strategy could accelerate the process of coalescence by the reorganization of government departments, avoiding duplications, mistakes and false starts, and by providing uniform administration in the various programs. Most of the participants of the recent forum agreed that there should be a comprehensive list of geographically related data holdings in governmental and non-governmental agencies. However, the reasons why
there are not is due to a lack of mandate in the governments, institutional monopolies, and the official Secrets act. Most governments do not encourage repackaging the data and receiving financial benefits from selling it, thus they do not promote this information.

Conclusion

The role of governments should be to increase access to geographic data through the internet, directories (meta data), compatibility and standardization policies, build institutional capacity, and change attitudes and approach. The concepts of a National Spatial Data Infrastructure and a Regional Geographic Information Infrastructure must be promoted and accepted by South Asian nations. This will be a basis for all geoinformatics development and related activities, and will play a greater role in facilitating geospatial data not only within the region but also beyond the South Asia region.
SESSION 3: Earth Observation

Earth Observation Data Application (5/7)

"Philippine Tropical Forest Resources Information Analysis Technology"
Professor T. P. M. Liao
Senior Environmental Management Specialist,
Environmental Management Bureau (The Philippines)

This case study focuses on Mangrove Forests. Mangrove forests are unusual as they depend on both ocean and land for survival. The ocean tides fertilize the forests and the rivers leave behind minerals forming sediment rich marshes, likewise mangroves provide forest resources such as charcoal fuel wood, etc. They protect the environment from wind and water erosion and create an environment rich in fauna, like fish, birds and reptiles. There are estimated 15 to 16 million hectares of mangrove forest in the world, and the plan for studying Mangrove forests was conceptualized as early as 1972, when LANDSAT-1 was first used for evaluating the physical properties and natural resources of the world.

In The Philippines, remote sensing is being used in several areas of concern, such as forestry (inventory, mapping degradation, and the evaluation of forest reserves), land resources evaluations (land-use planning, wasteland definition, and population), agriculture (crop area analysis, yield estimation, disease and pest monitoring, and soil mapping), water resources (watershed management, surface water monitoring, and marine resources), geological features, and mapping and cartography. The decision to undertake this study was made by the Department of Environment and Natural Resources (DENR) in cooperation with the Japanese Ministry of Agriculture, Forestry and Fisheries with assistance from the Japanese Forest Technical Association (JAFTA).

The development of information technology, and evaluation of forest resources using remote sensing technology and satellite imagery was launched in 1990 as a ten year project. The aim of this project was to develop a forest resources management plan for environmental monitoring and forestry protection. The strategies for implementation were made up of three project components. Phase 1 was a wide-area tropical forest resources survey carried out in Myanmar and The Philippines. Phase 2 was the development of a
tropical forest management planning information service system in Cambodia. Phase 3 was the development of tropical forest resources information analysis technology in Myanmar and The Philippines. The project themes were the classification of afforestation, disaster area identification, landscape assessment, mangrove forest conservation, land conservation, watershed management, and forest management.

In The Philippines, two areas in central Luzon, Marinduque, 24,000 ha. and Sorsogon 17,000 ha., were studied on the basis of a large concentration of Mangrove forests, comparing changes in the patterns of LANDSAT data over the past 10 to 20 years. All of the LANDSAT TM image data came from NRCT in Thailand and the MSS data came from EROS in the USA. The method of the study involved the use of remote sensing technology in the preparation of images showing vegetation indexes, land uses, and the classification of forest for analytical survey (LANDSAT TM). The Mangrove forest distribution was evaluated over a ten-year period using overlay processing. The constraints in implementing this project were that the satellite image data obtained were insufficient, scattered clouds and shadows along the coastline hindered the identification of mangrove forest, for colored images all vegetation covers consisting of coconut forest, brush on the land, and Mangrove forest had common colors (red) making classification difficult, and a lack of relevant data to study secular changes.

Conclusion

The use of remote sensing satellite images for the classification and identification of forest resources provides valuable information, and is important to the country's information technology assessment for forest resources management. We look forward to the development of tropical forest information technology analysis, and the problems related to resource-based evaluation will be addressed using the latest information technology assessment with satellite evaluation and scientific analysis of the countries forest resources.
SESSION 3 : Earth Observation

Earth Observation Data Application (6/7)

“RADARSAT and Related Application Development”
Mr. Florian Guertin,
Program Manager and Director,
Data Acquisition Division, CSA (Canada)

The RADARSAT-1 was based on partnership. It was funded by the Canadian government, designed and built by the Canadian Space Agency (CSA), launched by NASA, and operated by CSA. The data was received and archived by the Canada Center for Remote Sensing (CCRS) and processed and distributed worldwide by the private sector, by RADARSAT International. The application and the technology development were done jointly by CSA, CCRS, and industrial partners.

RADARSAT-1 is the first Canadian satellite. It was launched in November 1995 and has been in operation since April 1996, recently completing its first three years. To date, the satellite has responded to more than 74,000 requests, close to 100,000 minutes of SAR on-time was achieved, and 20,000 products were delivered directly to users in 57 countries where there are 472 commercial clients. This service is supported by 12 operational network stations around the world: three in North America, three in Europe, and six in the Asia-Pacific region including one to cover the Antarctic area.

RADARSAT was basically designed for ice monitoring as its main application, which requires a very high repeat factor. This is why it has a different incidence angle, a swath capability of 500 km, a fine mode of 9m high resolution, covering an area of 50 by 50km, and this is what makes RADARSAT-1 unique. At the Canadian latitudes, it is possible to cover the same area every two or three days with RADARSAT-1. If you go further north, it is possible to cover the same area everyday.

Operational Statistics
The data users fall into three categories: the Canadian government, which has three subcomponents, CSA, CCRS, and the Ice Center; the commercial user RSI; and NASA/NOAA. The US and Canadian governments are very large users of the data, and looking at the on-time, the governments tend to have more systematic coverage, where in Canada it is mainly used for ice monitoring and in the US mainly for science.
Operational Success Highlights
The main success of RADARSAT-1 is in ice monitoring, where the data can be provided to the Ice Center within 90 minutes of satellite acquisition. This is to produce charts aiding the navigation of ice-infested waters, and to achieve this kind of delivery requires an electronic infrastructure.

Another area of success has been disaster management, which is often hit and miss as the satellite may not be at the right place at the right time, or there may not be the infrastructure to deliver the data within the required time frame. One area that was not expected was the detection of natural oil seepage. From a commercial point of view, geological exploration has been the main area of application. Other areas include coastal zone mapping and tropical forest management.

Global Coverage Highlights
RADARSAT-1 has provided a very large coverage. In the ScanSAR wide beam mode, we have covered all the world's continents, continental shelves, and polar caps. In the ScanSAR narrow beam mode, we have covered North America, Europe, and Australia. More than 50% of the globe has been covered in stereo-coverage using Standard-7 and 2 Beam pairs, and over 140 capitals and major cities of the world have been covered by the high resolution Fine Beam mode. Perhaps one unique achievement is that all of the oceanic islands in the world have been covered by RADARSAT-1.

Science Highlights
From a scientific point of view, the RADARSAT-1 Antarctic mapping mission has been the main success. Not only was the whole continent of Antarctica covered but it was also possible to cover 25% in the stereo pair and interferometry modes. It was possible to produce the first map of Antarctic ice streams. New ice streams were discovered and extensive large snow-dune fields were identified. Now the interferometric data is being used to measure the ice velocity for assessing ice cap shrinking and understanding global climate changes.

Applications Development Program
The RADARSAT User Development Program was to promote the use of RADARSAT-1 data and assist industry to develop products and services. The User Education and Training Initiative Program was to train Canadians in the application of RADARSAT-1 and other Earth Observation data. The Earth Observation Pilot Projects Program was to develop industrial capability for
providing operational services. At the international level there was the Application and Development Research Opportunity Program, which was to raise the awareness and promote the use of RADARSAT-1 data worldwide (200 projects completed).

GlobeSAR-1 was to expand the range of applications of RADARSAT data and increase its use internationally (10 countries in Asia and Northeast Africa). GlobeSAR-2 was to demonstrate the use of RADARSAT-1 for applications specific to Latin America requirements (11 countries). The key areas identified for GlobeSAR in Asia were agriculture, archaeology, coastal zones, forestry, geology, hydrology, and oceans. In Latin America, GlobeSAR focused primarily on land use, land cover mapping, topographic mapping, coastal processes, and sea ice monitoring in the southern part of the hemisphere. The approach used for GlobeSAR was that it was a joint endeavor with the host country, which was responsible for identifying the site, selecting the research teams and investigators, project management, as well as the coordinators from lead institutions.

**RADARSAT Program Future Direction**

In future there will be the continued availability of SAR data with RADARSAT-2 and RADARSAT-3, which will offer enhanced capabilities. The Canadian government will continue its role in technology development and as anchor tenant to meet its own radar data needs. There will be more focus on the increased use of radar data for large volume near-real-time applications, and emphasis on information solutions, operational use, market demands and strategic partnership both at the national and international levels.
SESSION 3 : Earth Observation

Earth Observation Data Application (7/7)

“Earth Observation Data Application”
Mr. Atsushi Ono,
Special Staff to the Manager,
Office of Earth Observation Systems, NASDA

The first Japanese Earth Observation Satellite, the Marine Observation Satellite (MOS-1), was launched in 1987. Subsequently, four more Earth Observation Satellites were launched, MOS-1b, JERS-1, ADEOS, and TRMM. NASDA's operation of JERS-1 was successfully completed last year, and we hold many archives of the data it acquired.

To promote the development of applications, NASDA carries out joint programs with both local and international organizations. Among these joint research projects using Earth Observation data, the Geographical Survey Institute is developing a mapping application which will be used with the ALOS satellite to be launched in 2002.

The Maritime Safety Agency has a sea-ice-monitoring project to supply information to shipping on sea ice conditions and movement. The Environment Agency has a national program to survey the existing vegetation in the whole of Japan, which, until now, relied wholly on a purely visual method. The Ministry of Agriculture, Forestry and Fisheries uses 6,000 employees to manually measure rice fields; in the future, this will also be carried out using Earth Observation data. The Ministry of Construction is planning to establish a National Land Management Agency that will be responsible for disaster monitoring, urban planning, etc., and they too will be developing applications to suit their needs. There is also joint research with several local governments on the projects of environmental, agricultural, fisheries, urban development, and water resource management.

Each of these projects involves the development of new applications using Earth Observation data. NASDA also has joint-research pilot projects with Thailand and Indonesia. The project with NRCT in Thailand includes four applications, city planning with DM classification maps, agricultural planning with classification maps, production models for agricultural products, and shrimp farm mapping. NASDA has a cooperative research agreement with NRCT and is also involved with four other agencies in Thailand in application research and development, this also includes assistance in training at AIT and
the supply of equipment for image analysis. The joint-research project with LAPAN in Indonesia focuses on applications for monitoring rice, rice crop area, rice crop growth development, rice yield estimation, and pest disease detection and identification.
---Panel Discussion---

Dr. Takashi Moriyama (NASDA)
I would like our panelists to focus upon practical data applications.

Mr. Makoto Higashi (RESTEC)
There is one point I would like to make, that in the true sense there is no such thing as an application in remote sensing, there is only re-engineering the operational process. There is a misunderstanding that by talking to people and listening to people we may be able to find an application from our existing operational process and Earth Observation data, but what really occurs is the creation of a completely new operational process with the Earth Observation data deeply imbedded in it. This means that the re-engineering of the operational process is always very customized, you cannot just talk to someone and find something. You have to work with the person who has a serious interest in making the change, and it is always pioneering work.

As examples, the Canadian Ice Service more than halved their operational costs since they started using RADARSAT, and in the European Union there has a project to monitor crops not only for yield estimation but also to prevent the disbursement of subsidies when they are not warranted. Other examples include oil monitoring in Norway, and the measurement of rice fields in Japan using satellite data instead of manual measurement. These applications that create a whole new process, and do not simply change an existing process, are the kinds of applications which will drive everyday usage.

Mr. Ishibashi (Weathernews Inc.)
In the field of remote sensing data delivery to the customer, we have been concentrating on group casting, and point-to-point casting among researchers, but what needs to be done is narrow casting by cable TV and broad casting by terrestrial and satellite communications. The infrastructure is there, but it is not utilized for the general public.

At the Nagano Winter Olympics, using our STAGE application, we used remote sensing data for the public to be able to navigate from one area to another. To create interest in Earth Observation remote sensing, particularly in children and members of the general public who are interested in learning about it, we need to be able to present this data in a more entertaining way; we need applications which have a more entertaining approach. I call it the
"Infotainment" approach; the information itself is nothing but data, but the presentation is more entertaining and interesting to the viewer. We need to look at data applications not only in terms of scientific usage but also in terms of being informative, interesting and entertaining to the population at large, which, for the most part, would certainly enjoy it and appreciate its usefulness.

Looking at GMS data, everyday there are 9 million requests for Himawari Geostationary Satellite data. If you consider this in terms of internet access in Japan, it is three times that of the most popular search engine on the web. These requests are from the general public, if the applications are there, they will use them, and that is the point I wish to make.

Mr. Atsushi Rikimaru (Air-Graph Co.)

About Forest Canopy Density Mapping Using a Semi-Expert System:

This mapping model is an analysis system for forest canopy density (FCD) mapping using satellite data from the biophysical forest model. The details of this model include the TM data, vegetation factor, shadow factor, temperature factor, and the basal factor. The test results from eight areas in four countries indicated more than 90% accuracy in some cases.

Unlike the conventional statistical method, the FCD model indicates the growth phenomena of forests. The degree of forest density is expressed in percentages, i.e. 10% FCD, 20%, 30%, and so on. FCD data indicates the intensity of rehabilitation treatment that may be required. The method also makes it possible to monitor the transformation of forest conditions over time, including degradation.

Additionally, it can assess the progress of reforestation activities. This methodology, involving a software system developed by ITTO, JAFCA, and Air-Graph, is very suitable for forest management. Normally, the use of satellite data requires the knowledge of a remote sensing expert, which often makes it impractical for use in some countries and some areas. The FCD system can be used by foresters themselves quite easily, thus it is termed "semi-expert," and its use and distribution are unrestricted and more practical. It is distributed freely to ITTO countries, and the training time needed for foresters to use it is only two or three days. Such a type of system is an ideal example for practical technology transfers in the future.

Professor Shunji Murai

About Proposal for the Development of RICESAT:

Rice is the most important crop in Asia, in fact you could say that in all Asian countries rice is very much a part of the culture. On the occasion of the Asia-
Pacific Regional Space Agency Forum (APRSAF-6) held at NASDA Space Center, Tsukuba, Japan, on 25-27 May 1999, the following experts met and discussed the possibility of the development of RICESAT for monitoring rice growth in Asia, using multi-frequency and multi-polarization synthetic aperture radar (Multi-F/P SAR):
Professor Shunji Murai, IIS, University of Tokyo, Japan;
Dr. Suvit Vibulsretth, MOSTE, Thailand;
Mr. Nik Nasruddin Mahmood, MACRES, Malaysia;
Professor Harjono Djojodihardjo, LAPAN, Indonesia;
Mr. Virgilio Santos, ESCAP/UN;
Professor Chen Shu-peng, IRSA/CAS, China;
Professor Guo Huadong, IRSA/CAS, China;
Mr. Pramod Pradah, ICIMOD, Nepal;
Dr. Lim Hock, CRISP/NUS, Singapore;
Dr. Hoang Viet Gao, VNC/STA, Vietnam; and
Dr. Gi-Hyuk Choi, KARI, Korea.

In principal, we all agreed to this proposal, although this does not mean a commitment on behalf of the governments. Due to the prevalence of clouds during the monsoon season, an optical sensor will not function correctly, and together with frequency and delivery problems, existing SAR satellites are too expensive for many countries to use. Please note that we are not criticizing RADARSAT, if they are agreeable perhaps we can work together and they can sponsor our RICESAT.

The Asian Association of Remote Sensing will celebrate its 20th anniversary this year, thus we have come of age and would like to launch our own satellite. Previously we have only been users, now we would like to become developers. The objective of RICESAT is to monitor the growth of rice to predict rice production in Asia using Multi-F/IP SAR data. Our Chinese colleagues have had experience of using airborne multi-frequency, multi-polarization SARs, and they would like to cooperate with us, particularly in designing a small sized SAR sensor. The characteristics of the Multi-F/P SAR are two frequency bands (C and L-band) and two combinations of polarization (HH and HV), in total four bands. Depending on the swath, the resolution will be 10 to 20m, and the revisit time, less than ten days for an altitude of 600km and a swath of 100 to 150km. For the satellite berth, we expect the NASDA sponsored mission, demonstration test satellite, in 2005, where our satellite will become an extra passenger.

Regional cooperation is very important as NASDA regulations require a
Japanese contact point, thus the Institute of Industrial Science (IIS), University of Tokyo, will be the contact point. The Secretariat will be ACRORS/AIT in a network with AARS members, and as we have no funding at this stage, we also hope to attract the interest of the private sector to sponsor our project. The provisional partners to support the development of RICESAT are: IIS, University of Tokyo, in collaboration with Japanese private industry; MACRES, Malaysia; GISDA, Thailand; IRSA, China (mainly technical support); LAPAN, Indonesia; CRISP, Singapore; KARI, Korea; and VNC/STA, Vietnam. We also hope that other Asian countries will join us and participate in this project.

At the Asian Conference on Remote Sensing, we are always hearing that Asia is a very poor region, so the philosophy and spirit behind RICESAT is "friendship first, money second." This means that the rich pay more money, but the poor can join us. In Asia, we may be multi-cultural but we have one important target in common, and that is rice. There are no military or political issues or equipment involved, RICESAT is only for peaceful use, self-funded, cost-sharing, data-sharing, and we can establish our own data policy and decide whether or not we have a data copyright.

Conclusion

An Asian-supported satellite, namely RICESAT, should be launched for rice monitoring in Asia as a symbol of friendship among Asian remote sensing scientists. Thus far, we have not had any satellites based on friendship, commercialism yes, but none based on friendship; this cooperation among Asian countries can thus be regarded as our dream.
SESSION 3: Earth Observation

Future Mission on Earth Observation (Project Introduction) (1/6)

“Development of Space Infrastructure for the Conservation of Land and Earth Environment”
Mr. Nik Nasruddin Mahmood,
Director,
MACRES (Malaysia)

Operationalization of Earth observation technology normally implies moving from an academic environment, studying its principles and technology (sensors, systems and techniques of image processing), to an analysis of what is needed and how the technology can be used to solve practical problems and information requirements for sustainable development. However, when addressing the same subject in a developing country like Malaysia, it implies additional facets of capacity building, encompassing human resources and infrastructural development, and institutional arrangement.

In order to address these three requirements, Malaysia implemented a national Earth observation program, of which the Malaysian Center for Remote Sensing (MACRES) is one component. The objective is to develop this technology and operationalize it for our national development, covering the areas of resource management, environmental management, strategic planning, etc. This program involves all of the relevant government agencies in the country as well as industry with the aim of capacity building. One particular project we are now implementing is Satellite Image Map (SIM) Production covering the whole country. Another project is to establish an online data communication network, whereby the users can link directly to the system.

To implement the operationalization program, we have divided it into three segments, user, ground and space. The user segment addresses building the capacity to use these technologies (remote sensing, GIS, GPS,) in their related areas; the ground segment is to develop our own data reception capability; and the space segment is to develop our capability in satellite design, satellite integration, subsystem development, sensor development, etc. We are in the process of building a ground station and have received allocations for sensor development and acquiring airborne support systems to complement the data we acquire from satellites.
National Resource and Environmental Management Program (NAREM)

Another program, to indicate the level of operationalization which we would like to reach, is the National Resource Environmental Management (NAREM) program, whose objective is to develop an operational resource and environmental management computer-based system, using remote sensing and related spatial technologies. It is being implemented under the request of the National Economic Planning Unit (EPU) of the Prime Minister's Office. The NAREM system encompasses three subsystems, NASAT, NAMOS, and NADES. The first component, NASAT, is a satellite-based information extraction system which contains basic data derived from both satellites and ancillary sources. The creation of this database will involve geo-coding, digitizing format conversion, data editing, data security, data access and format conversion to other systems. The second component, NAMOS, focuses on using Geographic Information System (GIS) and expert system techniques for modeling in the spatial domain. This enables the production of derived composites from NASAT. The third component, NADES, is a decision making tool for integrated development planning, incorporating not only resource and environmental information but also economic and socio-economic information. It is designed to provide the decision-makers with the facility for accessing, querying, and analyzing the database for integrated development planning. NAREM is linked with other information systems that have been developed in the country. MACRES is the lead agency for the NAREM program and it communicates directly with the EPU for guidance.

Total Forest Fire Management Plan (TFFMP)

The general objective of TFFMP is to provide an operational system for the management of forest fires. The specific objectives are:

i) to develop an Early Warning System using remote sensing and GIS technologies;

ii) to develop a forecasting model with input of meteorological data and resources/environmental database for the generation of Forest Fire Sensitivity Maps;

iii) to develop the capacity in data analysis and the interpretation of remote sensing data pertaining to forest fires/open burning detection, monitoring and damage assessment; and

iv) to establish a live communication system to support forest fire fighting teams, emergency services, and government regulatory authorities.

TFFMP consists of three components, Early Warning, Detection and
Monitoring, and Mitigation Measures. The Early Warning component is aimed at producing maps that indicate areas which are susceptible to forest fires. The main task involves the development of an environmental database for forest fire management; GIS spatial modeling that takes into account factors such as meteorological conditions, forest types, soil types, and forest fuel, and producing forest fire risk maps. The risk maps would enable the authorities to take appropriate preventative and mitigative actions when meteorological conditions favor forest fires. The Detection and Monitoring component is carried out using Earth observation satellites such as SPOT and Landsat TM, meteorological satellites such as NOAA, aerial surveillance using airborne scanners, and ground surveillance. The Mitigation Measures are inter-agency activities carried out through the Forest Fire Management and Coordination Center (FMMCC). The FMMCC plays an important role of communication, control and command between the regulatory agencies and the fire fighting forces on the ground and in the air.

Conclusion

Capacity building towards the operationalization of Earth observation for environmental and natural resource management constitutes a major challenge for many developing countries. Towards this end, emphasis should be given to manpower development, satellite data accessibility and an integrated institutional framework. The developed world with its abundant resources and vast experience in these areas has an important role to play in making this technology operational in developing countries.
SESSION 3: Earth Observation

Future Mission on Earth Observation (Project Introduction) (2/6)

"Earth Observation in the 21st Century, including the HYPERSAT Project"

Dr. Brian J. J. Embleton,
Executive Director,
Cooperative Research Center for Satellite Systems,
CSIRO (Australia)

When we look at the requirements for Earth observation systems, we are bound by scientific, social, political and economic drivers. There are many reasons for designing our own Earth observation systems, and these translate into requirements for observations. We evaluate the capabilities of the observational systems, decide what needs to be changed, require commitment for change, implement the changes, monitor the progress, and then feed this progress back into the assessment of the requirements. This is precisely the process adopted by my organization, CSIRO, in driving its research in multispectral and now hyperspectral techniques. In terms of observing systems, there are sources of data from many places and we do not solely rely upon space-based systems. The space-based systems that we do develop have to compliment other observing systems and deliver data that we can convert into information systems that are complimentary.

Looking towards the next century, the Australian Resource Information and Environment Satellite (ARIES) project is founded upon the cooperation between a government research organization, a private sector organization, and a government operational group which is responsible for data reception and image production capability. The project itself is based upon twenty years of remote sensing research, so it is the operationalization of a long period of R&D. Auspace, a company operating in Australia, is actually a subsidiary of Matra Marconi Space, so this brings a sophisticated company perspective with a research organization, and with an operational ground support and delivery system for this project.

Going back to the analysis of requirements, why hyperspectral? Most of the remote sensing systems from space sample the spectra of reflectances. What we want to achieve, ideally, is a continuous spectrum so that we can move from
discrimination, classification of regions, discrimination of different environments, different vegetation types, different mineralization, to actual identification. Thus, hyperspectral means the identification of those things that we cannot see by working on the ground alone.

The system being developed will provide a radical new style of mineral abundance map and regolith mineralogy. These maps will provide quantitative measurements of minerals present in areas of up to 50% vegetation cover. ARIES will also allow participants to produce a range of new style vegetation maps to discriminate different tree and crop species or abundance with quantitative measurements of the condition, stress, leaf moisture, and regrowth. The plans for the satellite are to have a 30m Hyperspectral resolution and 10m in Pan; spectral coverage through the visible to short wave infrared region, each band being around 16 nanometers; signal-to-noise ratios of 400:1 at 2100nm and 600:1 at VSNIR; a swath width of 15km with 30 degs. off-axis pointing; on-board storage of 1,000 images, 44Gb; and nodal crossing around mid-day. The satellite will be in a Sun-synchronous polar orbit, 500 km, with a mass of 450kg, using a proven platform and under Australian management and control. Operationally, it will be controlled from Australia, satellite mission control center with data reception, and we are planning high latitude data stations also. Central archiving will be conducted in Australia, from which the data will be distributed worldwide. ARIES has backing from government, industry and users, and the application and product developments are the keys to commercial success. The involvement of CSIRO ensures that there will be an ongoing research program to continue enhancing the products that are derived from the data. The financing is close to finalization, and it will be operated as a commercial business.
SESSION 3: Earth Observation

Future Mission on Earth Observation (Project Introduction) (3/6)

"Utilization of KOMPSAT-1 data"
Dr. Keun-Ho Chang,
Korea Aerospace Research Institute (KARI)

The Korean Multipurpose Satellite, KOMPSAT-1, is an Earth-observation remote-sensing satellite. There are three payloads: a high-resolution panchromatic (6.6m GSD) Electro-Optic Camera (EOC) with a 17 km swath for cartographic missions; an Ocean Scanning Multi-Spectral Imager (OSMI), 6 bands, 1km ground sample distance and 800km swath; and a Space Physics Sensor (SPS), detector for cosmic rays, ionospheric electron temperature detector. The orbit is Sun-synchronous at 685km altitude with a 10.50 a.m. equator ascending time, three-day revisit period, and 30 deg. tilting.

KOMPSAT-1 finished final assembly and functional tests in March of this year, and passed the launch and orbit environmental test by the middle of May. It will be sent to the launch site in July, and launched using a Taurus rocket from Vandenberg AFB, California in October '99.

KARI, funded by the Ministry of Science and Technologies (MOST), holds the central role in Korea's space activities, and from this year has come under the control of the planning board of the Prime Minister. KARI belongs to the Public Science and Technology Research Council, and it consists of four divisions. The Satellite division is in charge of developing and operating KOMPSAT-1.

As our institute is a government institute, we are not allowed to carry out any commercial activities and plan to establish a non-profit data distribution company within our institute. The ground receiving stations will deliver the data to this company, and then it will be distributed to non-commercial user groups, commercial user groups, and overseas user groups.

The data policy of KOMPSAT-1 has two main objectives, maximizing data utilization and simplifying access, and the analysis of KOMPSAT-1 data. Users are classified into two categories, non-commercial and commercial users. For the non-commercial users, for example, government organizations and universities, data will be supplied at the minimum cost, whereas for commercial users it will be supplied at market value. Non-commercial overseas users will require an MOU.
The purpose of data acquisition is the periodic renewal of cartographic data of Korean territory and collecting global ocean data. The basic data processing for distribution and archiving is Level 1R for the EOC with radiometric calibration and Level 1 for the OSMI with radiometric and geometric calibration. KARI will also consider allowing some ground stations in South East Asia, Australia, Europe and North America to receive KOMPSAT-1 data to promote worldwide data utilization.

The KOMPSAT-II program began in January 1999 and will contain a high resolution camera with 1m GSD. Following this, an environmental satellite is planned for the future.
SESSION 3: Earth Observation

Future Mission on Earth Observation (Project Introduction) (4/6)

"RADARSAT-II Project"
Mr. Pierre Hebert,
Project Manager of RADARSAT-II,
Canadian Space Agency (CSA)

Canada is embarking on a new-generation commercial SAR Earth Observation satellite mission following the success of RADARSAT-1. The program is a joint undertaking of the Canadian Space Agency and MacDonald, Dettwiler and Associates. The RADARSAT-II project is well on the way, and the engineering process has been ongoing for more than one year.

In addition to the definition of the mission capability, we also conducted a number of major reviews of the program. When CSA considered the evolution of competing systems, it became very obvious that major technical enhancement was required to RADARSAT-1 in order to maintain Canadian leadership in commercial SAR systems. The state of the art technology that will be implemented in RADARSAT-II includes a fully active phased-array antenna for the SAR itself; a high-power X-band downlink margin which will allow reception by 3m ground receiving station antennas, which will mean lower costs for new stations; onboard GPS receivers for better positioning accuracy; 10 millisecond delay between imaging modes; Yaw-steering for zero-Doppler shift at beam center; solid-state recorders; encryption; and a very precise attitude control system.

By definition, one of our main objectives in RADARSAT-II was to ensure that data continuity would be provided to RADARSAT-1 users. This is being achieved by having RADARSAT-II provide all of the imagery modes of RADARSAT-1 as well as also using the system architecture of RADARSAT-1. We are actually building upon the infrastructure of RADARSAT-1, and the implementation of the new capabilities will require fairly minimum modifications to existing sites.

One of the objectives of the project is to achieve a high degree of commercialization and privatization in the program. The mission capabilities that feature improved technology and that are directly related to the delivery of services and products are suitable for a large market. For example, RADARSAT-11 will provide high-resolution imagery targeting the mapping
and surveillance market. We will also provide a more frequent revisit capability, and this is achieved by introducing more maneuverability at the spacecraft level. Multipolarization will also be available as well as shorter planning time. More precisely, RADARSAT-II’s key innovations include the provision of a 3m ultra-fine resolution, which will be the highest resolution for any commercially available SAR system. To improve the revisit time, we will have a rapidly rotating right-left looking capability, and will be able to reorient the satellite within ten minutes. Regarding multipolarization, we will be providing selective polarization and full polarimetry.

The RADARSAT-II phased-array antenna is a very complex structure and definitely state of the art. It uses over 10,000 radiating elements that are feeding 640 transmit/receive modules. By coupling these radiating elements in pairs, we can actually control the phase and multipolarization capability on the spacecraft. A further improvement is the attitude control system that will give an accuracy of 0.01 degrees from the knowledge point of view, the orbit position plus/minus 60m in real-time and 15m in post-process stage. Image location knowledge is 300m at downlink and better than 100m in the post-process stage.

Availability of the data and response to the user requests are very crucial to the success of RADARSAT. From the preliminary design requirements, we will be providing 12hrs or better in an emergency situations and 3 hours on the receive side. As far as the program is concerned, we have completed the preliminary design review at the bus and payload level, and next week we will be doing the ground system requirement review, thus we are well on schedule for a launch in February 2002.
SESSION 3 : Earth Observation

Future Mission on Earth Observation (Project Introduction)(5/6)

"The CHAMP Mission"
Dr. Hans-Joachim Kroh,
International Cooperation,
DLR (Germany)

The Challenging Mini-Satellite Payload (CHAMP) is a small future mission of the German Earth Observation program. The concept of a small mission is that it is basically faster, cheaper and better. Dramatic mission costs and development time reductions are made possible by concentrating on one or a very few core mission objectives, thus reducing the complexity of the payload and the requirements for the satellite bus. Once the complexity and mass of the payload have been reduced, low-cost launches can be utilized. These reductions also mean a reduction in development time, which means that the latest technology can be used for the payload. An additional advantage is that risk is distributed over more missions. Clearly, not all scientific objectives can be achieved through small missions. In astrophysics for example, higher resolution implies larger diameters of telescopes, and radar satellites usually need antennas of several square meters.

The CHAMP mission's objective is to investigate the Earth's gravity and magnetic field as well as the neutral atmosphere. The total cost is around $35M; development time, 3 years; total mass, 500kg; launch date, 1999/2000 on COSMOS; mission duration, 5 years; ground control, DLR; principle investigator and management, Ch. Reighber and GFZ Potsdam; and project partners, GFZ, DLR, CNES, NASA/JPL, TU, LETI, and USAF. International cooperation is very strong and also very effective on small missions.

For its main scientific objective, gravity field measurement, CHAMP is at an altitude of around 300km and "sees" at least six GPS satellites. That information allows you to measure the trajectory known in all three dimensions with a precision of a few centimeters. With that information, you can conclude the gravitational field of the Earth. CHAMP, as a free-falling test mass, measures very precisely the gravity field and its inhomogeneities (deviations from spherical symmetry) by determining the deviations of CHAMP's trajectory from a circular or ellipsoidal orbit. CHAMP not only measures the average global field but also detects part of gravity's time-dependence (repetition rate of gravity field measurements - every 3 months).
The average field measurement over 3 to 5 years leads to a very accurate (1cm) geoid model down to a spatial resolution of 1,000km (inhomogeneities of that scale, long wave-lengths). The geoid is the special surface of equal gravitational potential close to sea level. The expected accuracy of CHAMP data is at least one order of magnitude better than today’s values. Precise data on the gravity field and geoid imply data on mass density variations and therefore provide an enormous amount of information on processes on the Earth, e.g. mean ocean circulation patterns, the ratio of water/ice distribution, and sea level changes.

The data also provides information on processes above the Earth, e.g. atmospheric redistribution, and processes in the Earth, e.g. flow pattern, crust and mantle dynamics (earthquakes are tremors in crust and upper mantle). Thus, it is clear that high-precision gravity data are indispensable for climate modeling and disaster management.

CHAMP is the first such mission and paves the way for follow-on missions of higher resolution. In 2001, the NASA mission GRACE involves the launch of two small satellites making strong use of CHAMP technology.

Regarding the prospects of small missions, the next generation of cost-effective telecommunications buses may possibly be used for a large variety of small missions (EO, space science, etc.) without major modification. With further cost reductions and further miniaturization and higher reliability in sight, small missions will become an indispensable part of EO and other space fields.

Satellite-based Earth Observation (remote sensing) so far has used almost exclusively the information contained in the electromagnetic field and its spectrum (optical, radar, etc). Future remote sensing will also to a large extent study the information contained in the Earth’s gravitational field.
SESSION 3: Earth Observation

Future Mission on Earth Observation (Project Introduction) (6/6)

"ADEOS-II, ALOS, and GCOM - Earth Observation
Future Missions of NASDA"

Mr. Naoya Tomii,
Senior Scientist,
Office of Earth Observation Systems, NASA

In the present day, we do not have the knowledge to fully understand the Earth's global climate mechanism and the impact of the human population on the Earth's environment. Research and the use of Earth Observation data acquired from space is expected to greatly contribute to solving such environmental problems as global warming, deterioration of the ozone layer, and deforestation in tropical rain forests, etc. However, in addition to solving global environmental problems, Earth Observation data from space is also expected to contribute to improving living standards and to sustainable development of the Earth through crop predictions, disaster monitoring, land-use survey, fisheries predictions, weather forecasting, etc.

NASDA is committed to pursue each objective in establishing an Earth Observation system. This system includes satellites, sensors, ground segments and other components. Consequently, through the development of this system, NASDA missions are contributing to solving the global environmental problems and contributing to improving the quality of life globally, regionally, and nationally. NASA has three goals for mission achievement: the contribution to Earth science, the promotion of the practical use of Earth Observation data, and the advancement of technology development of satellite sensors and ground systems.

The purpose of developing an Earth Observation system is to contribute to Earth environment change study and climate change prediction by expanding our understanding of the Earth's environment. Environmental protection maintains and develops the quality and vitality of society and its economic well-being, and stabilizes and develops international society as a whole.

NASDA has established objectives to advance Earth science by the Earth Observation system. These are, first, to advance application development as
well technological development, second, to support global observation with continuity, third, to advance application research and promote Earth science with Earth frontier research, and fourth, to continue the ADEOS sensors with ADEOS-II and successor missions in the series.

The purpose of developing an Earth Observation system is to contribute to the advance of human society and its economic well-being as well as its material and spiritual wealth. To achieve this, the practical utilization of data will be promoted for solving such issues as population, food, resources, environmental change and natural disasters. Consequently, NASA is promoting the practical use of Earth Observation data through Earth Observation system development. This mission consists of: i) developing a demonstration satellite to precede a series of Earth Observation satellites for practical data use; ii) supporting autonomous utilization of Earth Observation data by government agencies; and iii) enhancing Earth Observation user services.

The advancement of technology development for an Earth Observation system consist of: i) mission-oriented satellite development; ii) mission-oriented sensor development; iii) research and development of new technologies for Earth Observation satellites and sensors; and iv) development of efficient ground segments.

The middle-term scenario of Earth Observation satellites envisions contribution to Earth science. The ADEOS series is NASA's core mission for global observation with continuity. ADEOS-II is succeeding in and expanding atmospheric and oceanic observation of ADEOS missions. It is now time to start developing the successor of ADEOS-II, the Global Change Observation Mission (GCOM). GCOM will continue for 15 years the observation of the energy and material cycles, the ozone and green house gas.

NASA will make the best use of international cooperation. GCOM-A1, B1 will keep the current framework of cooperation. ATMOS-A1/ Global Precipitation is a cooperative mission with NASA. ATMOS-B1/ Earth Radiation is a cooperative mission with ESA. The objective of the ADEOS missions is to contribute to the understanding of water and energy cycles. The objective of GCOM missions is to improve the accuracy of predictions of the long-term climate and to monitor the atmosphere environment and the state of the ground surface. NASA will perform observation and develop data sets focused on energy and material cycles, the ozone layer, and green house gas over a long period, about 15 years.
The second middle-term scenario of Earth Observation satellites envisions promoting practical use of EO data. The ALOS series is NASDA's core mission for demonstrating practical data use. The missions of the ALOS series are:

- to develop the technologies necessary for future Earth Observation;
- to acquire global data; and
- to demonstrate cartography, regional observation, disaster management support, resources survey, land management, etc.

NASDA will make the best use of international cooperation for promoting ALOS data use. After the successful demonstration, specific operational satellites will be realized by accomplished technologies. Furthermore, information-gathering satellites will be realized by ALOS development technologies as an operational satellite. Data will be used mainly for domestic purposes.

The third middle-term scenario of Earth Observation satellites is advanced engineering development. Future advanced land observing satellites sensor technology, super-high resolution optical sensor technology, multi-channel optical sensor technology, and super-high resolution Synthetic Aperture Radar will be investigated. Advanced satellite bus and component technologies, data compression technology, and data transmission technology will also be investigated.
VII. Session-4: "Satellite Utilization Projects in the Field of Communication, Broadcasting and Global Positioning System"
SESSION 4: Satellite Utilization Projects in the Field of Communication, Broadcasting, and Global Positioning System

Introduction of Members Activities (1/11)

"Satellite Development and Utilization Programs in Australia"
Dr. Brian Embleton,
Executive Director,
Cooperative Research Center for Satellite Systems,
CSIRO (Australia)

The contemporary operating environment in Australia involves these activities: Reusable rocket systems planned for Woomera; a launch complex planned for Christmas Island in the Indian Ocean; a regulatory framework for space activities in Australia and by Australian operators overseas; commercial satellite plans, e.g. Optus, ARIES; a cooperative research center for satellite systems - Fed-Sat mission; new tracking facilities and satellite tracking technologies being installed; and a significant infrastructure for applications research.

Small-Sat Space Missions
Why Microsat missions? For us it means an affordable and manageable access to space. With the technological advances, we can do very smart things with microsatellites. The three reasons why we have embarked on this program are risk, expenditure and time to fruition. Another significant aspect of the program is the opportunity for cooperation through multiagency applications. It is also a stepping stone for us to pursue more complex and demanding space projects.

I thought that if we started small, we would be able to go bigger and bigger; in fact, we will go smaller and smarter. The era of the large, expensive missions is on the wane. Of course, there is still room for large, complex systems, but they are not as popular today as they were, say, ten years ago. Why are we looking at microsatellites? Analysis tells us that after a rapid decrease during the first decade of space, there has been no significant reduction in the cost of access to space for three decades. We can look at current launch systems and their costs and observe that there is no evidence that smaller launch systems offer cheaper access to space. The average launch
cost for a standard payload of 500kgs is around US$7M, so break-throughs in mass reduction will make access to space more affordable for more nations and industries, and that will impact on an expanded market for space products and services.

The Cooperative Research Center for Satellite Systems

The Cooperative Research Center for Satellite Systems (CRCSS) is based on cooperation between universities, companies and government research organizations. There are seven core partners including the University of South Australia, CSIRO, Queensland University, the companies of Auspace and Vipac, the University of Newcastle, and the University of Technology in Sydney. There are other companies involved, DSpace, Codan and Space Innovations Ltd, in the UK. CRCSS started operations on the 1 January 1998, and during the first year established links with Optis Communications, the Australian Space Research Institute, NASDA, NASA, CSA, JPL, the Geological Organization of Australia, and with many universities in Australia, Singapore, Korea and the USA.

Fed-Sat

Fed-Sat is an international mission led by Australia. The platform, subsystems and engineering are coming from the UK; GPS, HPC, magnetometer and science, from the USA; magnetometer and science, from Japan; Attitude Control System (ACS), from Canada; and extendable boom camera and star camera, from South Africa. The mission characteristics for Fed-Sat are: launch mass 58kg, low-Earth orbit, and Polar orbiting. It is a small box and will be launched as an auxiliary payload in November 2000.

Mission experiments include communications, satellite systems, space science and navigation. Importantly, Fed-Sat is an Australian Centenary of Federation Project. The communications payload is wholly Australian developed and will operate in the Ka-band and the UHF-band working through a base-band processor, with applications to internet and ATM networks, multimedia broadcasting retrieval, channel measurements, simple cheap communications for remote areas, outback education, tele-medicine, emergency messaging, low-rate monitoring, tracking and location, and paging.

The main functions of the communications payload include a two-way Earth-Satellite-Earth link in the UHF-band and the Ka-band, onboard data storage, processing and cell/packet switching, a cross-link between the base-band processor and the platform S-band via the onboard data handling system, and
interaction/support for other experiments via the satellite platform. The UHF-band will have a receive and transmit module with antennas; similarly for the Ka-band. One of the applications we have identified for the UHF-band, why we are promoting this, and why it is of interest to Korea, Singapore and other countries in the Asian region, is its usefulness to acquire data from mobile or remote area terminals.

One of the applications we have identified is ARGO, the Array for Real-Time Geostrophic Oceanography. Within 5 to 10 years there will be literally hundreds and hundreds of recyclable buoys measuring salinity and temperature profiles in the oceans. That information is going to be transmitted to satellites for use by the research community, the long-term climate-change community, and for developing real-time models of oceanic circulation. Organizations involved with CRCSS in this experiment include CSIRO Marine Research, Bureau of Meteorology Research Center, Scripps Institute of Oceanography, and NOAA. Through ESCAP, we have promoted this particular payload as a common payload, and it has been subject to extensive discussion through the regional working group on space science and technological applications. The advantages that this payload has are that it is two-way messaging; with forward error control and automatic requesting techniques it can actually trigger the terminals to respond to requests for data. It can switch them on, switch them off, and tell them that it will be there on a certain time on a certain day, thus avoiding the problem of having to have continuous transmission from mobile terminals.

Just to summarize Fed-Sat: communications research, oceanographic research, commercial opportunities for all of the partners involved, it represents a significant area for collaboration, and of course PR and education.

One of the other experiments we will be conducting using the GPS system is Precise Orbit Determination, and with post-processing in place we will be able to determine the orbit of the satellite to better than 50cm. The technology and performance at this level is a minimum requirement for active limb sounding and ocean altimetry. In terms of limb sounding, we can look at the correlation between the GPS data and the radiosonde data. The Omega system is being wound down, and its use for radiosonde applications will be reducing over the next few years. However, we do have a more flexible and more productive system coming into place using GPS, and there is a very good correlation in terms of temperature versus altitude.

One of the applications we have in mind is to use the occultation of the radio signals from GPS to Fed-Sat, to sound through the ionosphere and through the
atmosphere to learn something about the properties of these belts. In terms of GPS meteorology, using similar techniques of limb sounding, it is possible to measure air temperature profiles and moisture profiles through the atmosphere as inputs to weather forecasting.

One other activity in our science program is to investigate space weather, as Fed-Sat will be launched in 2000 and operating during a period of maximum Sun-spot activity. This investigation is very important to us in terms of understanding the effects of space weather on the atmosphere, the impact of magnetic radiation from the Sun on other satellites, on electric grids, and the general effect on the plasmasphere around the Earth.

Of course we have commercial objectives as well, and we want the users of the data from microsatellites to procure the technologies from centers such as ours. We want to develop instruments and payload specialization, do something that is unique to us and the region, serve a market segment, domestically but obviously with international appeal, and we want to be sure that what we do develop in terms of space activities are integrated into our mainstream economy.

Regarding the future, CRCSS conducts an extensive education and training program and research in microsatellite technologies, and provides project coordination and management. Importantly it is a focal point in Australia for space activities. In terms of regional initiatives, there are common payloads, bilateral and multilateral ventures, and work through the Asia-Pacific caucus to which ECSAP has been a catalyst for a lot of our activity.

Future projects need to be applications driven. There will be great opportunities for applying modest, low-cost, quick-to-realize space solutions to hazard mitigation, postal zone monitoring, and simple, cheap and effective communication systems for remote areas. I am looking to the future where we can talk about having clusters of microsatellites, and at the same time building an awareness campaign for the benefits of space technology to the region.
SESSION 4 : Satellite Utilization Projects in the Field of Communication, Broadcasting, and Global Positioning System

Introduction of Members Activities (2/11)

"Satellite Utilization Projects for the Development of Local Areas"
Mr. Virgilio S. Santos,
Economic Affairs Officer,
Space Technology Applications Section,
UN/ESCAP

With the launch of the regional space applications program in 1994, a set of regional strategies and an action plan were introduced during the Beijing Declaration which called for a study to assess the current status of satellite communications activities in the regions and their applications. This was carried out with a view to improving rural telecommunications, rural health care, education, disaster monitoring and relief; preventing other disasters; monitoring and managing natural resources; and development planning. Through this particular program, ESCAP established four regional working groups, including the regional working group on satellite communications applications which prepared a project proposal on integrated rural-capacity building through the development and application of the satellite-based community tele-service center (CTC) concept. There were many discussions in the annual meetings of this regional working group. The coordinating office was then in Indonesia. They held discussions with the IPU and then came up with a proposal on this aspect. ESCAP then assisted the working group in terms of looking for a funding institution. The government of the Netherlands was generous in supporting this project, which was primarily aimed at targeting the rural development issues at hand. ESCAP engaged a consultant from the region, and a study was then conducted.

Another outcome of this project was the organization of a regional seminar in New Delhi in October 1998 dealing with the use of satellite communications for applications in rural development and capacity-building, with emphasis on persons with disabilities. The participants at that meeting recognized the strong potential of the CTC concept and recommended exploring its establishment in rural areas.
What exactly is CTC? Based on the report created by the consultant of the original study, CTC is a new type of interface between the community's communications infrastructure and their potential applications. It can provide certain services such as disaster warning, communication, distance education, tele-conferencing, tele-healthcare, vocational training, and internet access. While some of these applications may seem to be high technology for certain areas, it is a way of bridging the gap between highly urbanized areas of certain countries and the rural underprivileged and underdeveloped sectors.

CTC should have computers which would provide such services as word processing, spread sheets, database information provided by the local community and adjacent municipalities, several training components in computer literacy skills, communications facilities and infrastructure, telephone and fax. The report also indicated the preliminary design of the CTC, specifying a minimum of 1,000 population, and the minimum services and hardware required such as training rooms, telephones, fax machines, and computers with CCD cameras, all of which are multiplexed through a V-SAT unit via a satellite modem. It is expected that when a CTC is established in a rural area, it will contribute to rural capacity-building in that area.

Following this study report, ESCAP was then mandated to follow up the recommendations proposed by the working group when it held its fourth meeting in Iran in March 1999. The members recommended that ESCAP assist them in soliciting support from donors for CTC projects and agreed to draft a proposal for a CTC demonstration project using the GIGABIT satellite of Japan. They also recognized the need for a seminar workshop to learn more of high-speed communications satellites for application in their CTC projects. As interim projects, it was also proposed to establish CTC study areas in the participating countries.

In this regard, ESCAP is making a proposal to Japan's Ministry of Posts and Telecommunications for the use of the ETS-VIII satellite. Each rural CTC project would require a minimum of approximately US$200,000 for the basic infrastructure, and the four or five countries involved in the initial venture would have to solicit the support of the private sector in acquiring these funds. This would also involve the collaboration of local communities, local governments, NGOs, and institutions dealing with local populations. The involvement of Japan would be desirable in providing access to GIGABIT and ETS-VIII and supporting a seminar workshop in the latter part of this year or early next year.
SESSION 4: Satellite Utilization Projects in the Field of Communication, Broadcasting, and Global Positioning System

Introduction of Members Activities (3/11)

“Satellite Development and Utilization Programs in India”

Dr. V. T. Chitnis,
Counselor,
Embassy of India, Tokyo

The last four decades of global space efforts have demonstrated the relevance of space for accelerating the process of cultural, social and economic development. India was among the first few countries, particularly in the developing world, to realize the importance of space technology to solve the real problems of man and society. The Indian Satellite Program made its beginning when Aryabhata, the first Indian satellite, was launched on April 19, 1975. By the end of the 70's, India demonstrated without ambiguity the efficacy of space systems for national development and developed the endogenous capability of Indian scientists and engineers to build necessary hardware within the country. The decade of the 80's saw the Indian satellite program making headway in establishing operational space systems like INSAT for providing telecommunications, television broadcasting, meteorology, disaster warning services, and the Indian Remote-Sensing Satellite (IRS) system for natural resources monitoring and management.

INSAT Satellite Systems

The Indian National Satellite System (INSAT) is one of the largest domestic satellite systems in Asia today. Planned self-reliance in the field of satellite communications, applications and technology is the goal of the INSAT system. It provides domestic long-distance telecommunications, meteorological earth observation, data relay, broadcasting, mobile satellite services, etc.

The first generation INSAT satellites (INSAT-1) were built by a US company. The last in the series, viz. INSAT-1D, was launched on June 12, 1990. The second generation INSAT satellites (INSAT-2) were built by the Indian Space Research Organization (ISRO). Presently, INSAT-1D and INSAT-2A satellites are in inclined orbits and are used sparingly. INSAT-2B, 2C, and 2E, are fully operational. In order to augment the transponder capacity, ISRO acquired
a satellite, ARABSAT-1C, and the satellite has been moved to the INSAT location of 55 deg. E and renamed INSAT-2DT.

The INSAT-2 series consisted of five satellites, INSAT-2A, 2B, 2C, 2D and 2E. INSAT-2A and 2B have a single-sided solar array and carry the full complement of Met payloads. INSAT-2C has a double-sided solar array and does not carry any Met payloads. It carries Ku-band transponders and a Mobile Satellite Service (MSS) transponder in addition to 18 C-band and extended C-band transponders. INSAT-2E, the last of the second generation INSAT series of satellites, carries a modified VHRR with Visible, Thermal IR and Water Vapor channels and a three-band CCD Camera with a ground resolution of 1km. INSAT-2E was launched on April 3, 1999, and has recently been declared operational. INSAT-2E carries 17 transponders; 12 operating in the normal C-band frequency and 5 in the lower extended C-band. Seven of the normal C-band transponders have wide beam coverage and the remaining 10 have zonal coverage. Nine C-band transponders of INSAT-2E have been leased to INTELSAT for a period of 10 years.

In the INSAT third generation, five satellites, INSAT-3A through 3E, are planned to be built by ISRO beginning in 1999. INSAT-3B, which is planned to be launched at the end of 1999, will have 12 extended C-band transponders, three Ku-band transponders and a mobile service satellite transponder. INSAT-3A, which is scheduled for launch in mid 2000, will have 12 normal C-band transponders, six extended C-band transponders, six Ku-band transponders, and meteorological payloads (VHRRs, CCD Cameras, and Data Relay Transponders). INSAT-3C will have 24 normal C-band transponders, six extended C-band transponders, MSS and Broadcast channels. INSAT-3D will carry an advanced meteorological payload comprising imagers and sounders. The configuration of INSAT-3E is being finalized. Thus, it can be seen that there will be a vast enhancement of INSAT services in the coming years.

Role of INSAT in National Development
INSAT has brought in a revolution in telecommunications, television broadcasting, radio networking, meteorological services, disaster warning and a host of other services. For example, the telecommunication network under INSAT is providing more than 5,800 two-way speech circuits with 382 Earth stations set up in the country, including those located in inaccessible regions and the off-shore islands. In addition, there are several hundred Very Small Aperture Terminals (V-SATs), installed by the National Informatics Center and private networks catering to corporate houses. Thus, INSAT has been
playing a major role in improving the telecommunication infrastructure, a crucial element for industrialization.

Television in India now reaches more than 65% of the geographical area of the country through 800 TV transmitters linked via INSAT. Regional services providing programs in different languages have also been introduced. Educational programs totaling over 100 hours are telecast every week. It is important to note that a channel on INSAT has been exclusively reserved for training and developmental education. A pilot project was started on November 1, 1996, in the tribal district of Jhabua in Madhya Pradesh that is aimed towards demonstrating satellite-based developmental communication and training. This project has now been further expanded to cover more villages in Jhabua and also a few more villages in the adjacent districts.

INSAT has also brought in substantial improvements in meteorological services with the availability of cloud cover images from VHRRs and correction of meteorological data from about a hundred unattended data collection platforms. The prediction of cyclone formation and advanced warning on the location being affected has helped in saving several thousand lives.

Indian Remote Sensing Satellites

The Indian Remote Sensing Satellite (IRS) system is carrying out the indispensable task of resources survey and monitoring. The IRS system was established with IRS-1A, launched in March 1988. It is significant that today India has a constellation of four remote sensing satellites, IRS-B, IRS-1C, IRS-1D and IRS-P3, in operation. IRS-1B, launched in August 1991, carries two cameras, the Linear Imaging Self-Scanners (LISS), with resolutions of 36m and 72m. IRS-1C and IRS-1D, launched in December 1995 and September 1997, respectively, carry a Panchromatic camera (PAN) with a resolution of 5.8m, the best in the world for a civilian remote sensing satellite so far. In addition, they carry an LISS camera with 23.5m and 70.5m resolutions and a Wide Field Sensor (WFS) with a resolution of 188m.

These payloads form a unique combination providing data for a variety of applications. Further, they have advanced capabilities such as stereo viewing and on-board data recording. The IRS-P3, launched by India's PSLV during its third developmental flight in March 1996, carries a WIFS and an oceanographic payload, namely, a Modular Optoelectronic Scanner (MOS) developed by the German Space Agency, DLR. It also incorporates an X-ray astronomy payload.
India has already planned the launch of three more remote sensing satellites in the coming three years; IRS-P4 for ocean remote sensing, IRS-P5 for cartographic applications and IRS-P6 for resources survey. The IRS-P4 with an eight-band Ocean Color Monitor (OCM) and a Multifrequency Scanning Microwave Radiometer was launched yesterday on the PSLV from Sriharikota. The IRS-P4 OCM will have the highest ever spatial resolution for ocean/coastal applications (350m, 1420km swath). The IRS-P5 will carry a 6.6 Ghz channel, after a gap of more than a decade (NIMBUS-7 carried a similar channel).

Resources Management Through IRS

The IRS has brought in a sea of change in the country's resources monitoring and management techniques. Data from IRS is used for the estimation of acreage and yield of important crops like wheat, rice, sorghum, oil seeds and sugarcane. The estimates are available about a month before the harvest, thus helping in proper procurement planning and price fixation. A biennial forest survey is now made using satellite data.

IRS data helps in issuing warnings on drought conditions. Flood mapping is done using satellite data, and flood-risk zones are identified for taking up flood control measures. Land-use and land-cover mapping for agro-climatic planning, waste land mapping and its classification for possible reclamation, preparation of hydro-geomorphological maps for locating sites for drilling bore wells, monitoring and development of irrigation command areas, snow-cover and snow-melt run-off estimation of Himalayan rivers for optimal use of water for irrigation and power in the downstream projects, etc., are now carried out using IRS data.

Urban planning, alignment of roads and pipelines, detection of underground fires in collieries, marine resources survey, and mineral prospecting are some of the other applications of IRS data. One unique application of data from IRS, however, is in the Integrated Mission for Sustainable Development (IMSD) which was initiated in the country in 1992. IMSD, covering 176 districts, is aimed at generating locale-specific prescriptions, derived from IRS data and collateral socio-economic data, for development at the micro-level. The impact of IMSD is already seen in areas where prescriptions generated under IMSD have actually been implemented.

Conclusion

India has taken great strides in the development and application of space technology. Space systems now form an important component of the national
developmental infrastructure. The coming years will see enhanced capabilities in the INSAT and IRS systems, increasing the role they play in the national developmental tasks, and we look forward to international cooperation in this important area of science and technology.
SESSION 4 : Satellite Utilization Projects in the Field of Communication, Broadcasting, and Global Positioning System

Introduction of Members Activities (4/11)

“Current Satellite Programs in China”
Mr. Zhang Liangrui
Division Director
Department of Science and Technology Quality
CNSA (China)

The development aim of Chinese satellites is firstly to establish long-term and standard operations for satellites and their applications, which are composed of communications satellites, resources satellites, meteorological satellites and ground systems. Secondly, CNSA seeks to give priority to projects which gradually promote sustainable development of the national economy. Thirdly, CNSA desires to develop international cooperation according to the principals of equality, in particular in the field of space science research and satellite and ground equipment development. Fourthly, CNSA would like to set up a satellite command platform, shorten satellite development periods, reduce costs and prolong satellite life, and to develop practical small satellites. The DFH-3 is a second-generation communications satellite with 24 transponders used for television, telephone, telegram, fax and data transmission, and has an operational life of 8 years.

DFH-3 was launched in 1997 in a geosynchronous orbit. The ZY-1, China’s first generation resources satellite, is an Earth observation satellite to be used for monitoring changes in land resources; estimating losses caused by floods, droughts, and earthquakes; and finding countermeasures. It can also be used to probe underground resources for development. It is planned to be launched in August 1999, under a bilateral agreement.

The HY-1, an experimental satellite equipped with an OCM and CCD camera, will be used for oceanographic experiments and resource exploration, and is expected to be launched in 2001. The FY-2, a first generation meteorological satellite set in geostationary orbit, was launched in 1997. The FY-1 is a first generation sun-synchronous meteorological satellite used for atmospheric, cloud, land and ocean data. The first two satellites of this type were launched in 1998 and 1990. The SJ-5 is a small scientific-experiment satellite equipped with 11 experimental payloads and was launched on May 10, 1999.
SESSION 4 : Satellite Utilization Projects in the Field of Communication, Broadcasting, and Global Positioning System

Introduction of Members Activities (4/11)

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SESSION 4 : Satellite Utilization Projects in the Field of Communication, Broadcasting, and Global Positioning System

Introduction of Members Activities (5/11)

Gigabit Satellite Project for Realizing GII
Mr. Naoto Kadowaki
Manager,
Space Communications Division,
Communications Research Laboratory (CRL)
Ministry of Posts and Telecommunications (Japan)

The present trend of the information structure is towards multimedia, interactive, and borderless services. Borderless services are applied for not only among countries but also between the types of service provided such as voice, image, and data. Thus, satellite communications systems have great advantage and are expected to play a very important role in the future. They have wide coverage, multicast capabilities, flexibility of linking, and compensate for the drawbacks of wired systems.

CRL began research and development of the required technologies to realize a wide range of access services from Mbps to Gbps which are required by the various types of users, as well as economic wide area accessibility which is not affected by terrestrial conditions. They envisaged a satellite communications service which is friendly to terrestrial high-data-rate (HDR) services such as B-ISDN, and global networking by intersatellite links which do not require specific Earth gateways or stations for relay purposes.

To categorize the present communications systems, the fiber optic network can carry a very high data rate, but it does not have wide accessibility. In contrast, satellite communications systems have a very wide area coverage. The mobile satellite systems which are being employed at this time, e.g. Iridium or Global Star, have good accessibility, but do not carry high-data-rate traffic. In early 2000, global multimedia services will commence using such satellites as Spaceway, Cyberstar, and Teledesic. These systems can carry about 10Mbps in medium traffic. However, there is a large area to cover with HDR satellites, so the Gigabit satellite can fill the large gap in these systems.

While the ka-band multimedia services will soon begin, in the future, around 2010, very high capacity HDR system will be required, so in between these two
time frames it is very important to demonstrate the new generation of technologies. Thus, we plan to develop an experimental satellite for Gigabit communication systems and launch and demonstrate it in around 2005. The required technology for wide area coverage and Gigabit rate capability is a Scanning Spot-Beam Antenna system, which will provide narrow beam width, and multiple, steerable beams. For higher throughput with a multibeam antenna system, we require on-board switching and multimedia communications. The On-Board ATM Switch will realize this technology and also be fiber-optic-network friendly. For efficient global networking, we require a GEO satellite constellation and ultra-high capacity connection, thus a GEO-GEO Optical Inter Satellite Link (ISL) is necessary. The Scanning Spot-Beam Antenna (SSBA), the On-Board ATM Switch, and the GEO-GEO Optical ISL are the three key technologies in realizing the Gigabit Satellite System. The major specifications of the Gigabit satellites are:

- Access link - Ka-band
- Active phased-array antenna - SSBA, Diameter 2m, 400 W for 4 beams.
- On-Board Switching – High-speed intermediate frequency switch systems, regenerative ATM switch systems.
- Optical Intersatellite Link - 1.2Gbps HDR system.
- Mission Payload - 900kg.

The coverage of the satellite by four steerable beams, each of which covers 300km in diameter, will be most of the Asia-Pacific region, or all of the visible areas from the satellite. Fixed-beam mode or scanning-beam mode can be selected as required in orbit. The satellite can be a part of the terrestrial ATM network, expanding it over a very wide area. With this satellite system, Japan has already proposed a collaborative program with Asia-Pacific countries. Its applications include tele-medicine, home care, distance learning by HD video, high-speed internet access, disaster monitoring, access to digital libraries, agricultural monitoring and diagnostics, and gathering and delivering oceanic data. These applications can be used at very high transmission rates, 1.5 to 155Mbps uplink and 155Mbps downlink. Finally, we welcome all kinds of proposals for international cooperation with these satellites.
SESSION 4: Satellite Utilization Projects in the Field of Communication, Broadcasting, and Global Positioning System

Introduction of Members Activities (6/11)

"Outline of the Communication Mission of the ETS-VIII Satellite"
Mr. Shinichi Hama
Section Chief
Space Communication Division,
CRL, Ministry of Posts and Telecommunications (Japan)

The most significant parts of the ETS-VIII satellite are the two large, deployable 13 m diameter antenna reflectors, which is the present trend of satellite communications where smaller ground terminals and larger satellite antennas are required. The main objectives of the ETS-VIII project are mobile satellite communication using hand-held terminals and mobile digital audio broadcasting by satellite. In order to achieve these, we need a large geostationary satellite with large deployable reflectors. The ETS-VIII has beams that are electrically made by the onboard beam forming circuits. The target of the beams is Japan, and outside of this area the output is reduced.

The frequency of the geostationary satellite is 2.6 GHz uplink and 2.5 GHz downlink, EIRP (equivalent isotropically radiated power) is 63.8dBW and the polarization is LHCP. We installed two types of switches on the satellite, one is an onboard processor (for circuit switching) for voice communication and low-speed data communication, and the other is a packet switch. For data communication using the onboard processor, data rates up to 32kbps/carryer are possible. For packet communication using the packet switch, the total data rate is 512kbps with forward error correction (FEC) or 1024kbps without FEC. Both communications modes adopt the QPSK modulation scheme. Two electrically steerable beams are formed by active phased-array antennas and beam-forming networks (BFNs) to cover Japan's mainland effectively. The diameter of the footprint for 42dBi gain is about 400km. Some areas outside of Japan could be covered by controlling the altitude of the satellite and by using a larger antenna in the ground terminal. Three options are possible for communication; as a through repeater, making use of the onboard processor, and making use of the onboard packet switch.
The engineering model is just beginning testing, and the onboard equipment is being developed cooperatively by the Communications Research Laboratory (CRL), the National Space Development Agency of Japan (NASDA), the Advanced Space Communications Research Laboratory (ASC), and Nippon Telegraph and Telephone Corporation (NTT). A ground station will also be built in Japan. The satellite will be placed in a geostationary orbit at longitude 146 deg. East in 2002. Three years of system experiments will then be carried out, followed by applications experiments.
SESSION 4: Satellite Utilization Projects in the Field of Communication, Broadcasting, and Global Positioning System

Introduction of Members Activities (7/11)

"Planned Global Positioning Experiment of the ETS-VIII"
Mr. Naokazu Hamamoto
Senior Engineer
ETS-VIII Project, NASDA

The main mission of the ETS-VIII satellite is communications and broadcasting systems for mobile users. The secondary mission is to establish and arrange navigation technology using a geostationary satellite. Thus, NASDA and CRL are involved in developing this equipment. The satellite is very large, weighing approximately one ton, and the design life is ten years for the satellite and three years for the experimental mission equipment. In the positioning experiment, we use a small antenna of 1m diameter, with which we can transmit L-band and S-band navigation signals from the satellite.

There are two types of positioning systems using satellites, a non-geostationary system and a geostationary system. In the non-geostationary systems, the advantage is global service, while geostationary systems only provide regional service. However, a geostationary system satellite has constant visibility at one fixed point, which is very good for positioning accuracy. Another advantage of using a geostationary satellite is low cost. If we can use one satellite for communications, broadcasting and positioning then we can reduce the cost of the positioning systems.

Considering these advantages of using a geostationary system, we plan to conduct experiments using the ETS-VIII. We are aiming at high accuracy, and while the methodology is nearly the same as when using a non-geostationary system, it is not quite the same so we will have to optimize the software to use a geostationary system. As this is a new experimental satellite, we also have some new ideas, so we expect to develop some new applications for positioning systems.

Furthermore, in Japan we do not have experience in using a geostationary satellite for positioning systems so we will be able to establish management techniques in this field. The experimental system will use L-band and S-band frequencies, and the onboard atomic clock is a key technology produced in the
USA. A laser reflector will provide an optical ranging method, which will enable us to compare this method with the radio wave systems and calibrate the radio wave systems. The objectives of the experiments include obtaining an accuracy of less than 30cm in ranging.

Using new time comparing equipment, the time difference between the onboard clock and the ground clock will be less than 1ns, and we will conduct experiments for highly accurate orbit determination of the satellite. The L-band service area is quite wide, and covers Japan, Asia, and Australia. We can also transmit in S-band signals, and as the frequency is a little higher than L-band, the coverage is a little narrower. The L-band frequency is not the same as the GPS systems and is shifted a little so as not to interfere with them.

The configuration of our experimental system is roughly divided into four sections. One is the clock and carrier generation section, consisting of an atomic clock and a synthesizer to produce carrier wave signals. The base-band processing unit produces navigation messages to transmit to ground stations, and the time-comparing equipment compares atomic clocks on the satellite and on the ground. There is also a modulation and RF section, L- and S-band transmit power amplifiers, and an S-band receiver which enables us to retransmit signals from one ground station to others. We can also combine the GPS systems in our experiments, and expect to conduct joint experiments with other countries in the Asia-Pacific region, which we hope will lead to the development of new applications in geostationary positioning systems.
SESSION 4: Satellite Utilization Projects in the Field of Communication, Broadcasting, and Global Positioning System

Introduction of Members Activities (8/11)

"NASDA's Approach to Regional Cooperation in the Arena of Satellite Utilization and Joint Development"
Mr. Tsutomu Shigeta
Associate Senior Engineer
Office of Satellite Systems, NASDA

NASDA Satellite Mission Application Center
NASDA's Satellite Mission Application Center was established one year ago in the Office of Satellite Systems. The major activity of the Center is to create new satellite missions and further promote the utilization of space technologies. It is also a point of contact within NASDA for coordinating cooperative activities and is presently conducting a satellite system conceptual study of NASDA missions and MDS series satellites; planning for satellite utilization experiments, including ETS-VIII and Gigabit; conducting several research activities and studies to promote space-based technologies; and encouraging the establishment of user communities by organizing workshops and symposiums.

The Utilization of ETS-VIII for Communications Experiments
The ETS-VIII is expected to be used by the countries of the Asia-Pacific region. As a preliminary survey NASDA contacted many institutions in the region to learn of their ideas on the use of the satellite. The objective of the survey was to invite proposals and attractive and unique ideas on how the satellite can be utilized most efficiently, as well as to encourage participation in these joint experiments. Many proposals on the utilization of the ETS-VIII were received. One proposal from Australia suggested utilizing the ETS-VIII’s high-precision clock signal and communications functions for conducting the experiment of a satellite-based augmentation system for aircraft navigation. Proposals from The Philippines included using it to collect sea-surface data, and to collect forest management reports and images of forest fires and illegal logging, etc. Mongolia suggested using it to supply communications between the Remote Sensing Ground Truth site and its data processing facilities in

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Ulaanbaator. ESCAP proposed using it in a prototype experiment for the CTC program.

The coverage of the ETS-VIII is dependent upon whether a mobile terminal, a node-type antenna, or a 1m parabola antenna is used. NASDA also conducted a feasibility study of controlling the attitude of the satellite to increase this coverage. Use of the L-band for navigation is broad enough to cover most countries in the region, including Australia. Japan is now considering announcement opportunities (AO) for joint experiments. A satellite link will be provided as necessary equipment, and ground station equipment would principally be supplied by the applicant. Satellite access time may be limited according to the total number of experiments, and the period of the satellite experiments would be for several years after its launch in 2002.

Utilization of the Gigabit Satellite

NASDA also surveyed the ideas for utilizing the Gigabit satellite, and many proposals were made for multimedia experiments. One example from Korea suggested connecting Korea and Japan in application experiments of tele-education, interactive multimedia, advanced tele-medicine, and ATM interconnection.

Joint Development of the MDS Series Satellite

The objectives of the MDS are to demonstrate advanced missions and to verify advanced mission instruments in space. The MDS will be jointly developed by NASDA and mission applicants, and MDS missions will be selected by AO's. MDS-1 and MDS-2 are now being developed; the mission of MDS-1 is to verify commercial parts in space, and MDS-2 has been selected for a space-based LIDAR instrument. NASDA is considering periodically conducting two types of AO. The first is a mission research AO, where once the mission proposals are selected NASDA and the applicants will conduct joint research. The second is a mission instrument AO, which means the joint development of MDS Satellites. MDS is a single mission with a satellite weight of around 500 to 1000kg, which implies a weight allocation of mission instruments of from 100 to 300kg. For satellite development, NASDA provides the satellite bus, testing, integration and launch.

Last year, we conducted mission research, and eight research missions were selected from 46 proposals, including two proposals from two countries in this region, Thailand and Malaysia. The conditions of applying for the MDS AO are as follows. The applicant must have the capability of carrying out the MDS mission research; to establish a suitably qualified research team for
conducting the cooperative research with NASDA; partially fund the cooperative research within their capability; and belong to a Japanese agency, or in the case of foreign researchers, apply with a Japanese institution as partner.

Conclusion

NASDA is exploring future cooperative activities with the countries in the region for future satellite missions, with the Satellite Mission Application Center as a focal point. For the successful implementation of joint cooperative activities, active participation, as well as establishing satellite user communities, are important. In this regard, NASDA will try to continue its close cooperation with countries in the region, with the hope that it may provide the opportunity of satellite utilization, joint development and launch opportunities as previously introduced. NASDA wishes to invite ideas for the application experiments utilizing ETS-VIII and Gigabit, as well as proposals for the MDS missions.
SESSION 4: Satellite Utilization Projects in the Field of Communication, Broadcasting, and Global Positioning System

Introduction of Members Activities (9/11)

"Status and Activities of the Japanese Space Industry"
Mr. Toru Omori
Executive Expert
Radio Operations Unit, NEC(Japan)

The activities of the Japanese Space Industry include areas of manufacturing and developing launch vehicles, satellite space vehicles, ground facilities, operational services, software, and some of the space-station type activities. Encompassing these activities, the total annual revenue in 1997 was approximately US$4B, a revenue trend which has been growing gradually over the past 20 years. Looking at these activities inside and outside the country, most of the revenue came from domestic government spending, with less than 20% coming from outside the country. Around 170 Japanese aerospace companies, ranging from small to large, belong to the Society of Japanese Aerospace Companies (SJAC), a non-profit organization, and of those, 70 are space-manufacturing companies. These companies primarily function as a pivotal point between the government agencies and industry, tracking and monitoring industrial activities and promoting industry to the broader business community and international concerns.

Self Motivated Activities of the Space Industry

Knowing that space technology can facilitate the improvement of many aspects of social and economic development, for several years we have toured the countries in the region looking at environmental disasters, making regional surveys, making proposals, and developing a regional satellite system. We have visited most of the Asian countries and some in Africa to gain first hand knowledge of the situations. There are many government development programs utilizing technological solutions. Following the completion of these programs, when their benefits begin to appear, the responsibility of industry is to utilize them further for social and economic benefits.

To apply these new technologies, Japanese industry came to the conclusion that we have to help solve these regional problems. These problems of population pressure, poverty, environmental degradation, and disasters are
the main issues in the Asia-Pacific region, and we are committed to supporting ESCAP in attaining sustainable development in the region.

Asian regional Satellite System Proposal

This region holds around 25% of the Earth's land area and contains more than 50% of its population. Space technology and a regional satellite system can help build higher regional capabilities, even though it will take time. The industrial version that we propose is a further extension of the NASDA or CRL development programs. The applications that we concentrate on are telemedicine, vocational training, data transmission of environmental disasters, and government communications systems.

What we propose is very similar to the Gigabit satellite system and is essentially a multimedia-type communication satellite. After visiting many countries in the region, we learned that the same concept was being planned and promoted in each country by ESCAP, namely the CTC program, so we decided to work closely with this program team with the aim of building rural capability. As many areas do not have electricity, we have developed a mobile CTC system with its own solar power generators that follow the Sun's azimuth and elevation angles. It contains the necessary satellite terminal and additional electronic equipment. Another feature is that existing C/Ku-band V-SAT antennas can be adapted to the CTC system. After implementing this system, we also need to track the benefits of the applications to see if they are improving the areas socially and economically.

Conclusion

We need to have a long-term view of attaining economic development and social stability in the region, and to establish a regional cooperative scheme to integrate the applications based on space technology with information technology and social science. We also need to strongly support the ESCAP CTC concept and take advantage of the free test beds provided by NASDA, and CRL.
SESSION 4: Satellite Utilization Projects in the Field of Communication, Broadcasting, and Global Positioning System

Introduction of Members Activities (10/11)

“A Study of Mobile Satellite Communication Applications for the Asia-Pacific Region”
Mr. Yoichi Koishi
Manager,
Space Information Group,
Toshiba Corp (Japan)

In the Asia-Pacific region, there are many countries with large populations, which mean that they are large potential markets for the future. Users of mobile communications need hand-held terminals and mobile terminals to receive the communication and broadcast signals from the satellite. Initially, we considered which satellite and which orbit is suitable for mobile communications, GEO systems or LEO systems. In the conventional GEO system, there are already several applications being used, and the LEO system in the form of Iridium and Teledesic will be operational soon. The GEO system is preferable for high-density regional and non-time-dependent applications, such as broadcasting, and LEO is preferable for global low-density traffic and time-dependent applications, such as the internet. In the Asia-Pacific area, the GEO system is preferable due to the high population density. For mobile communications, the frequencies required are S-band and K-band. An S-band satellite requires large antennas of 6 to 20m in diameter. However, these considerations can be met.

Toshiba is building such a large mesh reflector for the ETS-VIII under contract with NASA, and this type of reflector can easily be expanded to accommodate changing requirements. Another application of the mobile communication services is the quasi-geosynchronous satellite with high elevation angles, which allow for the broadcast of navigation signals and benefits mobile communications and broadcasting due to good satellite visibility. This type of satellite also offers a wider coverage area, and both Japan and Eastern Australia can enjoy good access.

In the 21st century, the trend that brings benefits to the users of mobile communications is likely to be a mixture of GIS, GIS and GPS technologies.
Furthermore, hand-held terminals will become multifunctional, including navigation as well as communication. The technology for the 21st century will be established by such satellites as the ETS-VIII and Gigabit satellites, and we are pleased to be able to cooperate with NASDA and CRL in these endeavors. We also look forward to cooperative efforts with countries in the region, particularly in terms of fostering sustainable development and bringing social and economic benefits to the communities as a whole.
SESSION 4: Satellite Utilization Projects in the Field of Communication, Broadcasting, and Global Positioning System

Introduction of Members Activities (11/11)

"Satellite Utilization and Communications - Compact and Low Cost Ku-Band V-SAT"
Mr. E. Nakamura
Government Space Programs Department
Mitsubishi Electric Corp (Japan)

After the Kobe earthquake in 1995, the initial basic information concerning the extent of the disaster was unavailable due to the damage to communication lines. This situation highlighted the need for a low-cost portable V-SAT terminal for disaster recovery purposes, as our previous portable V-SATs consisting of a 75cm dish antenna were not so suitable. The requirements for the new V-SAT terminal were that it could be used by one person, installed within one hour following a disaster, and developed in a short time period with low-cost. In a remote disaster area where communication lines are unavailable, this system will provide communication through terminals and satellites.

In this system there are two types of terminals, the “All-in-one” portable terminal and the fixed or transportable terminal. The fixed or transportable terminal would be placed in a main office or center, and the portable terminal could be used in any location, either using a car battery or a solar array battery for power. The fixed or transportable terminal consists of a 75cm offset parabola antenna with a conventional outdoor unit (ODU) and a small, lightweight 16/32kbps indoor unit (IDU). The “All-in-one” portable terminal consists of an IDU, ODU and antenna in one package. The antenna is a 55-by-55cm flat-panel planar array, and the LNB, HPC (1W) and modem are situated behind the antenna. Total weight is 16kgs, without the telephone attachment and carry bag.

In conclusion, the development of such a small and portable V-SAT Ku-band terminal, which is equivalent in size to a lap-top computer, has opened up endless possibilities for applications in remote areas. These can easily be used in areas where electricity is unavailable, for disaster situations, tele-medicine applications, etc. Mitsubishi would like to develop a satellite utilization program using this small and ultra-light V-SAT through the channels of ETS-VIII in coordination with the Earth Science and Technology Organization (ESTO) and NASDA.
VIII. Recommendations to UNISPACE III

1. The member agencies, being invited to the sixth session of the Asia-Pacific Regional Space Agency Forum (APRSAF) in Tsukuba Japan, 24-27 May 1999;

2. Considering that the United Nations will organize the third United Nations conference on the exploration and peaceful uses of outer space (UNISPACE III) in Vienna in 19-30 July 1999 in order to present a unique opportunity to exchange information and ideas to advance the human condition using space technologies and its applications;

3. Also considering that the second Ministerial Conference on Space Application for Sustainable Development for Asia and the Pacific will be held following UNISPACE III, and will provide a greater opportunity for countries in Asia and the Pacific to discuss regional issues as well as provide a convenient forum for translating the recommendations at the global event into the regional arena.

4. Noting that the sixth session of APRSAF was successfully organized with many participants and with the productive discussions on space activities and its possibility in the twenty first century;

5. Recognizing that human resources with appropriate knowledge and skills and wide public awareness are essential to maximize the benefit derived from space activities;

6. Recognizing that it is essential to promote use of remote sensing data in order to maximize the space benefit derived from remote sensing which is useful means for environment, natural resources and disaster management;

7. Recognizing that following points are essential subjects to be solved;
   (1) Data availability and transfer of current and future missions
   (2) Delivery time for data acquisition
   (3) Networking within Asia-Pacific region
   (4) Education and training including tele-education
   (5) Low data cost
   (6) Development of Asian supported satellite (i.e. RICESAT)
   (7) Regional cooperation

8. Recognizing initiatives and proposals introduced from many agencies and industries in the field of space communications which could enhance their capabilities and maximize space
benefit for our daily life;

9. Considering that the following recommendations could be presented to UNISPACE III by the member agencies through their respective governments:

10. Therefore, recommend the following as the outcome of this session for which action should be considered:

(1) To encourage information exchange on public awareness in order to share experiences and know-how to stimulate children’s interests widely, since they will shoulder the space activities in the coming century.

(2) To ensure continued support for human resources development.

(3) To promote space technologies such as remote sensing & GIS, satellite communications and GPS in the application to;
   - earth observation in critical area in Asia-Pacific region with respect to environment, natural resource and disaster
   - education and training on space technologies and applications including distance education through high speed communication links.

(4) To strengthen regional and international cooperation for joint development sharing benefits of space technologies with a focus on low cost and users driven sensor/satellite development, satellite data reception and dissemination, data processing and analysis, and access of data and information

(5) To communicate closely with industries and encourage them to play an active role in social and economic development through space activities.
IX. Report of APRSAF-6

1. The Sixth Session of the Asia-Pacific Regional Space Agency Forum (APRSAF-6) was held in Tsukuba, Japan, 25-27 May 1999. APRSAF-6 was jointly organized by the Science and Technology Agency of Japan (STA), the Institute of Space and Astronautical Science of Japan (ISAS) and the National Space Development Agency of Japan (NASDA).

2. APRSAF-6, chaired by Prof. Yasunori Matogawa, ISAS, was aimed at providing opportunities for exchange of views and information on, and to discuss, initiatives taken by the member agencies before UNISPACE III meeting to be held in Vienna, Austria on 19-30 July 1999.

Opening Session

3. The opening session was chaired by Prof. Matogawa. Chairperson’s remarks were followed by opening remarks, by Mr. Kaname Ikeda, Director General, Research and Development Bureau, STA and welcome address by Mr. Isao Uchida, President, NASDA.

4. Mr. Virgilio Solis Santos, ESCAP, made a keynote address titled “Space Technology Applications: Moving the Asia-Pacific Region Towards the Twenty-first Century.”

5. Mr. Nik N. Nasruddin Mahmod, MACRES, Malaysia, Mr. Luo Ge, CNSA, China and Mr. Suwit Vibulsresth, MOSTE, Thailand made keynote addresses on National Space Policy titled “Towards Creating a National Space Policy”, “China Space Policy” and “National Space Policy” respectively.

6. Ms. Takemi Chiku, UNOOSA introduced UNISPACE III titled “Opportunities for Strengthening Cooperation through UNISPACE III”.

7. Mr. Gilbert R. Kirkham, NASA, USA, Mr. Jean-Pascal Le Franc, CNES, France and Mr. Michel Giroux, CSA, Canada introduced their international cooperation activities in the Asia-Pacific Region titled “NASA’s International Activities”, “CNES International Cooperation” and “International Cooperation in the Asia-Pacific Region: A Canadian Perspective” respectively.

Session 1 - Space Education and Public Relations

8. The first session on Space Education and Public Relation, chaired by Mr. H.S.P. de Alwis, Arthur C. Clarke Institute for Modern Technologies, Sri Lanka, commenced with the presentation, made by Prof. Shunji Murai of University of Tokyo, on Education, Training and Research of Space Applications at the Asian Institute of Technology (AIT). Prof. Murai
explained how the Space Technology Application and Research (STAR) Program was made a very successful program in both academic and financial aspects.

9. This program was well supported by the activities in connection with the Asian Center for Research on Remote Sensing (ACRoRS) and also with Asian Association on Remote Sensing. The STAR program also helps the researchers in developing countries.

10. The second presentation was made by Mr. Michio Ozawa, the ISU liaison officer, on behalf of Dr. George P. Haskell, Vice President, International Space University. The paper described the complexity of the space application program in a changing world. As most space applications programs have become commercially viable there is a need to find the right mix of business, technology, politics and management challenges. These could be achieved only through successful launch of education program through universities and other related institutions.

11. The paper also focused the ISU’s contribution to education for future managers of space program which is based on understanding the complexity of the tasks ahead of them.

12. The last presentation of the first session was made by Prof. Matogawa on Space Education in Japan. He explained the involvement of NASDA and ISAS to promote space science education among school children in Japan.

13. The activities of Cosmic College and various programs coordinated in collaboration with NASDA and ISAS were also presented. Prof. Matogawa explained the importance of space education for school children to continue with future space programs in Japan. Same is applicable to all countries which are planning to achieve successful results in the future in space science and technology.

14. At the end of the three presentations, few minutes were allocated for comments, observation and questions. Few participants commented the efforts made by NASDA and ISAS for the promotion work that are being carried out for school children.

Session 2 - Space Environment Utilization

15. The session was chaired by Prof. Matogawa and consisted of two presentations. The one was “The Outline of the International Space Station Project and Japan’s Contribution” and the other was “Current ISS Utilization Project.”

16. The first topic was presented by Dr. Horikawa, JEM Project Manager of NASDA. Dr. Horikawa started his talk with introducing the objectives of ISS and the framework for international cooperation.
17. History of ISS program was reviewed, and the baseline configuration of ISS and its assembly schedule was then given.

18. On the basis of consideration about general significance of space environment utilization in Japan, the importance of Japan's participation in ISS through JEM was stressed. Typical hardware and Exposed Facility Payloads which are to be installed onto JEM were described together with the concepts and the status of development of Centrifuge Accommodation Module and H-II Transfer Vehicle.

19. The second speaker was Mr. Susumu Yoshitomi, Deputy Director of Space Utilization Research Center, NASDA. He sketched current ISS Utilization Project in more details. Multi-User Facilities as well as its rack configuration were introduced. JEM Payload accommodation were then described.

20. The present status of a variety of research and experiments to be carried out in JEM were given, for the examples, In-situ Observation of Molten Samples with X-Ray Radiograph, Crystal Grow Experiments for High Quality Semiconductors and so forth.

21. The structure for research and promotion activities of NASDA's ISS utilization was illustrated, and Grants on Ground-based Research were introduced.

22. Through these two presentations, the concept, current status of construction, and the schedule of ISS and JEM were generated as well as the detailed items of experiments on board.

Session 3 - Earth Observation

23. The Earth observation session has been organized and chaired by Prof. Murai by inviting seventeen presentations in the three sub-divided subjects followed by panel discussions moderated by Mr. Takashi Moriyama, NASDA.

24. The major topics of the session were disaster monitoring & mitigation, data application, and future missions.

25. The session focused on how to facilitate Earth observation data transfer to users, especially in developing countries as well as private sectors. The APRSAF member agencies have interest in using Earth observation data operational applications such as disaster monitoring and mitigation, natural resource management, infrastructure planning and GIS application.

26. The seventeen excellent presentations were made by those representatives of the member agencies on the above mentioned topics, and identified the major obstacles for promoting
data utilization, especially in developing countries.

27. Future Earth observation missions were also introduced by CSIRO/Australia, MACRES/Malaysia, KARI/Korea, CSA/Canada, CNES/France and NASA/Japan. Invitations to PACRIM 2 mission was also introduced by NASA/USA. As we can observe, in the beginning of the twenty first century, many varieties of space measurement data will be available.

28. Those data of future missions are expected by users in Asia and Pacific for applications to sustainable development of the environment, natural resources and disaster monitoring by resolving the essential obstacles above.

29. Again, the Earth observation session was very fruitful and constructive. The session chair would like to extend sincere appreciation to all the participants for their efforts to support and contribute to the sixth APRSAF meeting.

Session 4 - Satellite Utilization Projects in the Field of Communication, Broadcasting, and Global Positioning System

30. The speakers in the session, which was chaired by Prof. H.Djojodihardjo, the Chairman of LAPAN, Indonesia, have presented encouraging and impressive progress in satellite technology development in Australia, India, Japan and Korea, and the progress and projection of communication, broadcasting, and global positioning satellite technology utilization for various development applications in the Asia-Pacific Region.

31. Specifically, UN/ESCAP through its Space Technology Applications Section, has elaborated a satellite utilization program for integrated rural capacity building, known as Indigenous Rural Capacity Building through development and application of the Satellite-based Community Telescience Center (CTC) concept. The project will be funded by the Government of the Netherlands to address rural development issues.

32. Through the creation of the Cooperative Research Center for Satellite Systems, an indigenous technology development relevant to national goals and serving as the basis for the growth of a domestic space industry has progressed well in Australia.

33. Within this framework, a FedSat microsatellite will be launched in the year 2000, which reflects the benefits of technological advances in arriving at small satellite with enhanced capabilities.

34. India has reported also its impressive progress in its satellite program, marked by the recent achievements of the successful launch of IRS-P4 satellite for ocean monitoring on May 26 1999.
35. Of particular interest is the development of two new satellites by Japan, the Gigabit and ETS-VIII satellites, largest satellites developed thus far, with enhanced capabilities incorporating state of the art technologies and modern visions.

36. Space industries in Japan also foresee that space technologies development in Japan will provide opportunities for countries in the Asia Pacific region to cooperate and hence will contribute to building up of Asian indigenous capabilities for the region's sustainable economic development and social stability and prosperity.

37. The meeting was informed that Japan is considering to provide opportunities for the utilization of Japanese engineering satellites to the countries in Asia and the Pacific for experimental purpose. Such opportunities will provide significant contribution toward the promotion of space development in the region and very desirable. ESCAP requested Japan to hold a workshop to provide information necessary for consideration by these countries being interested in the utilization.

38. Japan has informed the participants of its plan to take the initiatives to provide countries in the Asia-Pacific region to carry out experiments using ETS-VIII and Gigabit satellites. Information on the terms and conditions to take advantage of such opportunity, such as partnership with Japanese researchers, is available from NASDA.

39. Japan also reported its interesting initiatives using Mission Demonstration Satellites (MDS), which would provide opportunities for cooperation with countries in the Asia-Pacific region.

Closing Session

40. APRSAF-6 was successfully organized with 40 presentations and 108 participants in total from 21 countries and a international organisations including CNES of France, DLR of Germany and Japanese space industries.

41. The presentations and discussions provided updated information on space technology and its applications in the region, and provided good opportunities for exchange of views what we can do for human kinds in the twenty first century together before UNISPACE III.

42. APRSAF-6 ended with an understanding that there should be a continuing effort for information exchange and holding discussions on the possibilities of future cooperation among space related organizations and industries to bring mutual benefits to countries of the Asia-Pacific region.
II. Organization Chart
AUSTRALIA - ORGANISATION CHART

Department of Industry, Science and Resources

- Space Policy Unit
  - Space Licensing and Safety Office
- Cooperative Research Centres Program (62 Centres)
  - 61 other Centres
- CRC for Satellite Systems
- Research Divisions include:
  - Earth observation
  - Telecommunications
  - Climate Change
  - Radio Astronomy
- CSIRO
- Australian Centre for Remote Sensing
  - Earth Observation Reception Facilities
Government Space Activities in Canada

GOVERNMENT SPACE ACTIVITIES

- CANADIAN SPACE PROGRAM
- NATIONAL DEFENCE
  - MILITARY SATELLITE COMMUNICATIONS
  - SAPCE-BASED RADAR
  - SEARCH AND RESCUE

CANADIAN SPACE AGENCY
- SPACE SYSTEMS
- SAPCE TECHNOLOGIES
- SPACE SCIENCE
- ASTRONAUT PROGRAM
- SPACE OPERATIONS

OTHER GOVERNMENT DEPARTMENTS
- COMMUNICATIONS RESEARCH CENTRE (INDUSTRY CANADA)
- CANADIAN CENTRE FOR REMOTE SENSING (NATURAL RESOURCES CANADA)
- NATIONAL RESEARCH COUNCIL OF CANADA
- NATURAL SCIENCES AND ENGINEERING RESEARCH COUNCIL OF CANADA
- ENVIRONMENT CANADA
- FISHERIES AND OCEANS CANADA
Organization of Space Activities in China

State of Council
Space Leading Group  Central Military Committee

Commission for Sci.&Tech.

CNSA  COSTIND
CASC  CSL'TTCGC

Hainan Space Center  Jiuquan Satellite Launch Center
Xian Radio Engineering Lab  Xichang Satellite Launch Center
Beijing Industrial Environment Lab  Taiyuan Satellite Launch Center
Beijing Control Engineering Lab  Xian Satellite Tracking Control Center (XSSC)

Remote Sensing Application Lab

CALT  SHBOA  CAST  CGWIC
Deutsches Zentrum für Luft- und Raumfahrt e.V.

General Assembly

Senate
State Secretary Neumann (Chairman)

Executive Board
Prof. Dr. Kröll (Chairman)
Prof. Dr. Blum (Vice Chairman)
Prof. Dr. Bachem
Prof. Dr. Herziger
Prof. von Tein

Scientific-Technical Council

Business Unit
Prof. Dr. Kröll
Space
Space Strategy
ESA Council
Aeronautics
Corporate Strategy
Corporate Planning
Energy Technology
External Relations

Business Unit
Prof. Dr. Bachem
Management
Space Programs
Space Projects
Space Related Research
Institutes and Facilities

Business Unit
Prof. von Tein
Management
Aeronautics and Energy Technology Programs
Aeronautical Projects
Aeronautics and Energy Technology Related Research
Institutes and Facilities

Business Unit
Prof. Dr. Herziger
Technology Transfer
Innovation
Industrial Cooperations

Business Unit
Prof. Dr. Blum
Controlling
Corporate Structures
Finance and Personnel
Infrastructure
Quality Assurance
Project Management
Organization of Space Activities in India

PRIME MINISTER

INSAT
COORDINATION
COMMITTEE

DEPARTMENT OF SPACE

PLANNING COMMITTEE
NATIONAL NATURAL RESOURCES
MANAGEMENT SYSTEM

NATIONAL NATURAL
RESOURCES MANAGEMENT
SYSTEM (NMRMS)
REGIONAL REMOTE
SENSING SERVICE
CENTRES (RASSC)

NATIONAL
REMOTE SENSING
AGENCY (NRSA)

INDIAN SPACE
RESEARCH
ORGANISATION

PHYSICAL
RESEARCH
LABORATORY
(PRL)

NATIONAL
MESOSPHERE-
STRATOSPHERE-
TROPOSPHERE RADAR
FACILITY (NMRF)

ANTRIX
CORPORATION

VIRRAM
SARABHAI
SPACE CENTRE
(VSSC)

SPAR
CENTRE

ISRO
SATTELITE
CENTRE (ISAC)

SPACE
APPLICATIONS
CENTRE (SAC)

LIQUID
PROPLUSION
SYSTEMS CENTRE
(LPSC)

ISRO
INERTIAL
SYSTEMS
UNIT (ISU)

ISRO TELEMETRY
TRACKING AND
COMMAND NETWORK
(ISTRAC)

INSAT MASTER
CONTROL FACILITY
(MCF)

DEVELOPMENT AND
EDUCATIONAL
COMMUNICATION
UNIT (DECU)
ORGANIZATION OF AEROSPACE ACTIVITIES IN INDONESIA

PRESIDENT

NATIONAL COUNCIL FOR AERONAUTICS AND SPACE OF THE REPUBLIC OF INDONESIA (DEPANRI)

CHAIRMAN:

PRESENTER OF THE REPUBLIC OF INDONESIA

VICE CHAIRMAN:

MINISTER OF STATE FOR RESEARCH AND TECHNOLOGY

SECRETARY:

CHAIRMAN OF LAPAN

MEMBERS:

- MINISTER OF FOREIGN AFFAIRS
- MINISTER OF DEFENCE AND SECURITY
- MINISTER OF INDUSTRIES AND TRADES
- MINISTER OF COMMUNICATIONS
- MINISTER OF TOURISM, ART AND CULTURE
- MINISTER OF EDUCATION AND CULTURE (in progress)
- MINISTER OF STATE FOR NATIONAL DEVELOPMENT PLANNING
- CHIEF OF STAFF OF INDONESIAN AIRFORCE

NATIONAL INSTITUTE OF AERONAUTICS AND SPACE (LAPAN)

CHAIRMAN

DEPUTY CHAIRMAN FOR ADMINISTRATION

DEPUTY CHAIRMAN FOR REMOTE SENSING

DEPUTY CHAIRMAN FOR AEROSPACE TECHNOLOGY DEVELOPMENT

DEPUTY CHAIRMAN FOR ATMOSPHERIC AND IONOSPHERIC RESEARCH

PLANNING AND ORGANIZATION BUREAU

REMOTE SENSING TECHNOLOGY DEVELOPMENT CENTER

ROCKET AND SATELLITE CENTER

ATMOSPHERIC RESEARCH CENTER

AEROSPACE DEVELOPMENT ANALYSIS CENTER

GENERAL AFFAIRS BUREAU

REMOTE SENSING APPLICATION DEVELOPMENT CENTER

PROPULSION CENTER

IONOSPHERIC RESEARCH CENTER

AEROSPACE INFORMATION CENTER

GROUND SEGMENT AND AEROSPACE MISSION CENTER

NOTE: SPACE AND SPACE RELATED ACTIVITIES CONDUCTED BY THE MINISTRIES AND INSTITUTIONS ARE BASED ON THE POLICIES ADOPTED BY DEPANRI
Schematic Chart of National Organizations for Space Activities in Japan

Cabinet
  - Prime Minister's Office
    - National Public Safety Commission
    - National Police Agency
    - Science and Technology Agency
  - Ministry of Education
  - Ministry of International Trade and Industry
    - Agency of Industrial Science and Technology
  - Ministry of Transport
    - Maritime Safety Agency
    - Japan Meteorological Agency
  - Ministry of Posts and Telecommunications
  - Ministry of Construction
  - Ministry of Home Affairs
    - Fire Defense Agency
  - National Aerospace Laboratory
    - National Space Development Agency of Japan (NASDA)
    - Institute of Space and Astronautical Science (ISAS)
    - Mechanical Engineering Laboratory
    - Electrotechnical Laboratory
    - Electronic Navigation Research Institute
    - Meteorological Satellite Center
    - Communications Research Laboratory (CRL)
    - Telecommunications Advancement Organization of Japan (TAO)
    - Geographical Survey Institute
Organization of Space Activities in the Republic of Korea

Prime Minister

Cabinet

Ministry of Science and Technology
- Korea Advanced Institute of Science & Technology (KAIST)
  - Satellite Technology Research Center (SatRec)
- Korea Meteorological Agency (KMA)
  - Remote Sensing Research Laboratory
  - Satellite Division

Ministry of Information & Communication
- Korea Telecom-Satellite Business Center
- Radio Research Laboratory (RRL)

Ministry of Maritime Affairs and Fisheries
- National Maritime Police

Ministry of Construction & Transportation
- National Geography Institute

Ministry of Agriculture & Forestry
- Agricultural Science Institute

Korea Research Council of Public Science & Technology (KRCP)

Korea Aerospace Research Institute (KARI)

Korea Ocean R&D Institute

Korea Research Council of Fundamental Science & Technology (KRCF)

Korea Astronomy Observatory (KAO)

Korea Research Council of Industrial Science & Technology (KRCI)

Electronics & Telecommunication Research Institute (ETRI)

Radio & Broadcasting Technology Laboratory
MACRES ORGANIZATION CHART

DEPUTY DIRECTOR (DEVELOPMENT)

DEPUTY DIRECTOR (ADMINISTRATION & FINANCE)

DEPUTY DIRECTOR (OPERATIONS)

DIRECTOR

IMAGE PROCESSING & APPLICATION DIVISION

SPATIAL DATA ANALYSIS DIVISION

SOFTWARE DEVELOPMENT DIVISION

HARDWARE DEVELOPMENT DIVISION

SENIOR DEVELOPMENT LABORATORY

CORPORATE DIVISION

PLANNING DIVISION

DATA & INFORMATION DIVISION

SYSTEMS & CONFIGURATION DIVISION

DATA RECEIPTION DIVISION

CARTOGRAPHIC LABORATORY

OPTI-CHEMICAL LABORATORY
Organization of Space Activities in Mongolia

- Government
  - Ministry of Science, Education & Culture
    - Academy of Sciences
      - Institute of Informatics
  - Ministry of Nature and Environment
    - National Remote Sensing Center
  - Ministry of Infrastructure Development
  - Ministry of Agriculture & Enterprises
    - Mineral Authority
  - Remote Sensing Laboratory
  - Land Management Agency
  - Department of Geodesy and Cartography
  - Telecommunication Authority
  - Geological Remote Sensing Center
Organisational Structure of International Center for Integrated Mountain Development and MENRIS Programme in Nepal

BOARD OF GOVERNORS

SUPPORT GROUP

DIRECTOR GENERAL

DIRECTOR OF PROGRAMMES (DEPUTY DIRECTOR GENERAL)

MOUNTAIN FARMING SYSTEMS DIVISION

MOUNTAIN NATURAL RESOURCES DIVISION

MOUNTAIN ENTERPRISES AND INFRASTRUCTURE DIVISION

MOUNTAIN ENVIRONMENT & NATURAL RESOURCES INFORMATION SYSTEMS DIV.

MANAGEMENT COMMITTEE

INFORMATION, COMMUNICATION AND OUTREACH DIVISION

ADMINISTRATION AND FINANCE DIVISION

INSTITUTIONAL STRENGTHENING UNIT

MENRIS PROGRAMME

SYSTEMS AND COMPUTING

GEO-INFORMATION SYSTEMS

REMOTE SENSING

DATABASE AND NETWORKS

CAPACITY BUILDING
New Zealand Science System Structure

Government

Policy
[Policy Advice]

Ministry of Research Science & Technology

Foundation for Research Science & Technology

Funding
[Purchase]

Science Operations
[Ownership]

Treasury

Royal Society of NZ

The wider community

Research Organisations

Crown Research Institute
Manaaki Whenua Landcare Research
National Institute of Water & Atmosphere
Institute of Geological & Nuclear Sciences
Forest Research Institute
Institute for Crop and Food Research Ltd
Horticulture and Food Research Institute
Pastoral Agriculture Institute
Industrial Research Ltd
Institute of Environmental Science & Research

Other
Universities
Research Associations
Government Departments
Museums
Private Sector
Individuals
Organization of UN Office in Vienna

- UNITED NATIONS OFFICE AT VIENNA
  - OFFICE FOR OUTER SPACE AFFAIRS
    - COMMITTEE SERVICES AND RESEARCH SECTION
  - DIVISION OF ADMINISTRATIVE AND COMMON SERVICES
    - SPACE APPLICATIONS SECTION
  - OFFICE OF THE DIRECTOR-GENERAL
    - UNITED NATIONS INFORMATION SERVICE
III. Technical Tour Program

*Monday, May 24, 1999*

*Technical Tour* was a half day bus tour to Research Institutes in Tsukuba Science City, as per following schedule:

13:10-18:00  *Technical Tour*  by “Chartered Bus”

13:10       Meet at Tsukuba Daiichi Hotel Lobby

13:15       Departure

13:15-13:30  Move to The Geographical Survey Institute (GSI)

13:30-15:00  Facility Tour at GSI

15:00-15:15  Move to National Research Institute for Earth Science and Disaster Prevention (NIED)

15:15-16:15  Facility Tour at NIED

16:15-16:30  Move to National Space Development Agency of Japan (NASDA) Tsukuba Space Center (TKSC)

16:30-17:45  Facility Tour at NASDA/TKSC

17:45-18:00  Move to Tsukuba Daiichi Hotel

18:00       Arrive at Tsukuba Daiichi Hotel
### Abbreviations

<table>
<thead>
<tr>
<th></th>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>1.</td>
<td>AARS</td>
<td>Asian Association of Remote Sensing</td>
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<tr>
<td>2.</td>
<td>ADEOS</td>
<td>Advanced Earth Observing Satellite</td>
</tr>
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<td>3.</td>
<td>ADS</td>
<td>Asian Development Bank</td>
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<tr>
<td>4.</td>
<td>AFEX</td>
<td>Advanced Furnace for microgravity Experiment with X-ray radiography</td>
</tr>
<tr>
<td>5.</td>
<td>AIT</td>
<td>Asian Institute of Technology</td>
</tr>
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<td>6.</td>
<td>ATIS</td>
<td>Assembly, Integration and Test Center</td>
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<td>7.</td>
<td>ALOS</td>
<td>Advanced land Observing Satellite</td>
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<td>8.</td>
<td>AMSR</td>
<td>Advanced Microwave Scanning Radiometer</td>
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<td>9.</td>
<td>AMSU</td>
<td>The Advanced Microwave Sounding Units</td>
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<tr>
<td>11.</td>
<td>APIC</td>
<td>Asia-Pacific International Space Year Conference</td>
</tr>
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<td>12.</td>
<td>APT</td>
<td>Automatic Picture Transmission</td>
</tr>
<tr>
<td>13.</td>
<td>ARIES</td>
<td>Australian Resources Information and Environmental Satellite</td>
</tr>
<tr>
<td>14.</td>
<td>ASC</td>
<td>Advanced Space Communications Research Laboratory</td>
</tr>
<tr>
<td>15.</td>
<td>ASEAN</td>
<td>Asian Expert Group on Remote Sensing</td>
</tr>
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<td>16.</td>
<td>ASO</td>
<td>Australian Space Office</td>
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<td>17.</td>
<td>ATM</td>
<td>Asynchronous Transfer Mode</td>
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<td>18.</td>
<td>AVHRR</td>
<td>Advanced Very High Resolution Radiometer</td>
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<td>19.</td>
<td>CAS</td>
<td>Chinese Academy of Science</td>
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<td>20.</td>
<td>CAST</td>
<td>Chinese Academy of Space Technology</td>
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<tr>
<td>21.</td>
<td>CB</td>
<td>Clean Bench</td>
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<tr>
<td></td>
<td>Acronym</td>
<td>Description</td>
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<tr>
<td>22</td>
<td>CBEF</td>
<td>Cell Biology Experiment Facility</td>
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<tr>
<td>23</td>
<td>CEOS</td>
<td>Committee on Earth Observation Satellite</td>
</tr>
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<td>24</td>
<td>CIECS</td>
<td>China International Exchange Centre for Space Science and Technology</td>
</tr>
<tr>
<td>25</td>
<td>CNES</td>
<td>Centre Nationale d'Etudes Spatiales, France</td>
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<tr>
<td>26</td>
<td>CNSA</td>
<td>China National Space Administration</td>
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<tr>
<td>27</td>
<td>COMETS</td>
<td>Communications and broadcasting Engineering Test Satellite</td>
</tr>
<tr>
<td>28</td>
<td>COMPUOS</td>
<td>Committee on the Peaceful use of Outer Space</td>
</tr>
<tr>
<td>29</td>
<td>COPUOS</td>
<td>Committee on Peaceful use of Outer Space</td>
</tr>
<tr>
<td>30</td>
<td>COSPAR</td>
<td>Committee on Space Research</td>
</tr>
<tr>
<td>31</td>
<td>COSSA</td>
<td>CSIRO Office of Space Science &amp; Application</td>
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<tr>
<td>32</td>
<td>CPR</td>
<td>Cloud Profiling Radar</td>
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<tr>
<td>33</td>
<td>CRISP</td>
<td>Center for Remote Imaging, Sensing and Processing National University of Singapore</td>
</tr>
<tr>
<td>34</td>
<td>CRL</td>
<td>Communication Research Laboratory</td>
</tr>
<tr>
<td>35</td>
<td>CSA</td>
<td>Canadian Space Agency</td>
</tr>
<tr>
<td>36</td>
<td>CSIRO</td>
<td>Commonwealth Scientific &amp; Industrial Research Organization</td>
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<tr>
<td>37</td>
<td>CTC</td>
<td>Community Tele-Service Center</td>
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<tr>
<td>38</td>
<td>DENR</td>
<td>Department of Environment and Natural Resources</td>
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<tr>
<td>39</td>
<td>DIAL</td>
<td>Differential Absorption Lider</td>
</tr>
<tr>
<td>40</td>
<td>DPR</td>
<td>Dual Frequency Precipitation Radar</td>
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<tr>
<td>41</td>
<td>DRTS</td>
<td>Data Relay Test Satellite</td>
</tr>
<tr>
<td>42</td>
<td>DSMM</td>
<td>Department of Survey and Mapping of Malaysia</td>
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<td>43</td>
<td>EA</td>
<td>Environment Agency</td>
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<tr>
<td>44</td>
<td>ELF</td>
<td>Extra Low Frequency EO Earth Observation</td>
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<tr>
<td>45</td>
<td>EOC</td>
<td>Electro-Optical Camera</td>
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<td></td>
<td>Acronym</td>
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<tr>
<td>46</td>
<td>EPU</td>
<td>Economic Planning Unit</td>
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<tr>
<td>47</td>
<td>ERIM</td>
<td>Environmental Research Institute of Michigan</td>
</tr>
<tr>
<td>48</td>
<td>ESA</td>
<td>European Space Agency</td>
</tr>
<tr>
<td>49</td>
<td>ESCAP</td>
<td>Economic and Social Commission for Asia and the Pacific</td>
</tr>
<tr>
<td>50</td>
<td>ETS</td>
<td>Engineering Test Satellite</td>
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<tr>
<td>51</td>
<td>FAO</td>
<td>Food and Agricultural Organization</td>
</tr>
<tr>
<td>52</td>
<td>FFMCC</td>
<td>Forest Fire Management and Coordination Center</td>
</tr>
<tr>
<td>53</td>
<td>FORESC</td>
<td>Forest Research &amp; Survey Centre</td>
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<tr>
<td>54</td>
<td>FPEF</td>
<td>Fluid Physics Experiment Facility</td>
</tr>
<tr>
<td>55</td>
<td>GAC</td>
<td>GIS Application Center</td>
</tr>
<tr>
<td>56</td>
<td>GCOS</td>
<td>Global Climate Observing System</td>
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<tr>
<td>57</td>
<td>GDOS</td>
<td>Global Disaster Observation Satellite</td>
</tr>
<tr>
<td>58</td>
<td>GHF</td>
<td>Gradient Heating Furnace</td>
</tr>
<tr>
<td>59</td>
<td>GIS</td>
<td>Geographic Information System</td>
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<tr>
<td>60</td>
<td>GISTDA</td>
<td>Geo-Informatics and Space Technology Development Agency</td>
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<tr>
<td>61</td>
<td>GMS</td>
<td>Goestationary Meteorological Satellite</td>
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<tr>
<td>62</td>
<td>GODAE</td>
<td>Global Ocean Data Assimilation Experiment</td>
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<tr>
<td>63</td>
<td>GOFC</td>
<td>Global Observation of Forest Cover</td>
</tr>
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<td>64</td>
<td>GOIN</td>
<td>Global Observation Information Network</td>
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<tr>
<td>65</td>
<td>GOOS</td>
<td>Global Ocean Observing System</td>
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<tr>
<td>66</td>
<td>GOSSP</td>
<td>Global Observing Systems Space Panel</td>
</tr>
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<td>67</td>
<td>GPS</td>
<td>Global Positioning System</td>
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<tr>
<td>68</td>
<td>GSD</td>
<td>Ground Sample Distance</td>
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<tr>
<td>69</td>
<td>GSLV</td>
<td>The Geostationary Satellite Launch Vehicle</td>
</tr>
<tr>
<td>70</td>
<td>GTOS</td>
<td>Global Terrestrial Observing System</td>
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<tr>
<td>71</td>
<td>HAC</td>
<td>High Accuracy Clock</td>
</tr>
<tr>
<td>No.</td>
<td>Acronym</td>
<td>Description</td>
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<tr>
<td>72.</td>
<td>HDDT</td>
<td>High Density Digital Tape</td>
</tr>
<tr>
<td>73.</td>
<td>HIRS</td>
<td>The High Resolution Infrared Radiation Sounder</td>
</tr>
<tr>
<td>74.</td>
<td>IACG</td>
<td>Inter-Agency Consultative Group</td>
</tr>
<tr>
<td>75.</td>
<td>IAF</td>
<td>International Astronomical Federation</td>
</tr>
<tr>
<td>76.</td>
<td>IAU</td>
<td>International Astronomical Union</td>
</tr>
<tr>
<td>77.</td>
<td>ICIMOD</td>
<td>International Center for Integrated Mountain Development</td>
</tr>
<tr>
<td>78.</td>
<td>ICC</td>
<td>Intergovernmental Consultative Committee</td>
</tr>
<tr>
<td>79.</td>
<td>ICSU</td>
<td>International Council of Science</td>
</tr>
<tr>
<td>80.</td>
<td>IGNOU</td>
<td>The Indira Gandhi National Open University</td>
</tr>
<tr>
<td>81.</td>
<td>IGOS</td>
<td>Integrated Global Observing Strategy</td>
</tr>
<tr>
<td>82.</td>
<td>ILAS</td>
<td>Improved Limb Atmospheric Spectrometer</td>
</tr>
<tr>
<td>83.</td>
<td>IMG</td>
<td>Interferometric Monitor for Greenhouse Spectrometer</td>
</tr>
<tr>
<td>84.</td>
<td>INSAT</td>
<td>Indian National Satellite</td>
</tr>
<tr>
<td>85.</td>
<td>IPS</td>
<td>Image Processing Systems</td>
</tr>
<tr>
<td>86.</td>
<td>IPU</td>
<td>Image Processing Unit</td>
</tr>
<tr>
<td>87.</td>
<td>IRS</td>
<td>Indian Remote Sensing Satellite</td>
</tr>
<tr>
<td>88.</td>
<td>IRSA</td>
<td>Institute of Remote Sensing Applications (China)</td>
</tr>
<tr>
<td>89.</td>
<td>ISAS</td>
<td>The Institute of Space and Astronautical Science, Japan</td>
</tr>
<tr>
<td>90.</td>
<td>ISDMTF</td>
<td>Information System Development for the Management of Tropical Forest</td>
</tr>
<tr>
<td>91.</td>
<td>ISRO</td>
<td>Indian Space Research Organization</td>
</tr>
<tr>
<td>92.</td>
<td>ISS</td>
<td>International Space Station</td>
</tr>
<tr>
<td>93.</td>
<td>ISTP</td>
<td>International Solar Terrestrial Physics</td>
</tr>
<tr>
<td>94.</td>
<td>ISU</td>
<td>International Space University</td>
</tr>
<tr>
<td>95.</td>
<td>ISY</td>
<td>International Space Year</td>
</tr>
<tr>
<td>96.</td>
<td>ITR</td>
<td>Institute for Telecommunications Research</td>
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<tr>
<td>97.</td>
<td>JAFTA</td>
<td>Japanese Forest Technical Association</td>
</tr>
<tr>
<td>98.</td>
<td>JEM</td>
<td>Japanese Experimental Module</td>
</tr>
<tr>
<td>99.</td>
<td>JERS</td>
<td>Japanese Earth Resources Satellite</td>
</tr>
<tr>
<td>100.</td>
<td>JICA</td>
<td>Japan International Cooperation Agency</td>
</tr>
<tr>
<td>101.</td>
<td>JOFCA</td>
<td>Japan Overseas Forestry Consultants Association</td>
</tr>
<tr>
<td>102.</td>
<td>JSF</td>
<td>Japan Space Forum</td>
</tr>
<tr>
<td>103.</td>
<td>KARI</td>
<td>Korea Aerospace Research Institute</td>
</tr>
<tr>
<td>104.</td>
<td>KAST</td>
<td>Korea Advanced Institute of Science and Technology</td>
</tr>
<tr>
<td>105.</td>
<td>KOMPSAT</td>
<td>Korea Multi-Purpose Satellite</td>
</tr>
<tr>
<td>106.</td>
<td>LAPAN</td>
<td>National Institute of Aeronautics and Space Indonesia</td>
</tr>
<tr>
<td>107.</td>
<td>LCDE</td>
<td>Laser Communication Demonstration Experiment</td>
</tr>
<tr>
<td>108.</td>
<td>LEO</td>
<td>Low Earth Orbit</td>
</tr>
<tr>
<td>109.</td>
<td>LISS</td>
<td>Linear Imaging Self Scanners</td>
</tr>
<tr>
<td>110.</td>
<td>MACRES</td>
<td>Malaysian Centre for Remote Sensing</td>
</tr>
<tr>
<td>111.</td>
<td>MDS</td>
<td>Mission Demonstration Test Satellite</td>
</tr>
<tr>
<td>112.</td>
<td>MELCO</td>
<td>Mistubishi Electric Corp.</td>
</tr>
<tr>
<td>113.</td>
<td>MESSR</td>
<td>Multispectral Electronic Self Scanning Radiometer</td>
</tr>
<tr>
<td>114.</td>
<td>MLS</td>
<td>Microwave Limb Sounder</td>
</tr>
<tr>
<td>115.</td>
<td>MoEnv</td>
<td>Ministry of the Environment</td>
</tr>
<tr>
<td>116.</td>
<td>MOS</td>
<td>Marine Observation Satellite</td>
</tr>
<tr>
<td>117.</td>
<td>MOSTE</td>
<td>Ministry of Science, Technology and Environment of Thailand</td>
</tr>
<tr>
<td>118.</td>
<td>MPA</td>
<td>Maritime and Port Authority of Singapore</td>
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<tr>
<td>119.</td>
<td>MRAM</td>
<td>Mineral Resource Authority of Mongolia</td>
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<tr>
<td>120.</td>
<td>MSA</td>
<td>Maritime Safety Authority</td>
</tr>
<tr>
<td>121.</td>
<td>MSC</td>
<td>Multimedia Super Corridor</td>
</tr>
<tr>
<td>122.</td>
<td>MSR</td>
<td>Microwave Scanning Radiometer</td>
</tr>
</tbody>
</table>
123. MSS   Multispectral Scanner System
124. NAMRIA National Mapping and resource Information Authority
125. NAL   National Aerospace Laboratory (Japan)
126. NAREM National Resources and Environmental Management
127. NASA  National Aeronautics and Space Administration
128. NASDA National Space Developing Agency of Japan
129. NCCRS National Coordinating Committee for Remote Sensing (Philippines)
130. NGDC National Geophysical Data Centre
131. NEC   NEC Corp.
132. NNRMS National Natural Resources Management System
133. NODC  National Oceanographic Data Centre
134. NRCT  National Research Council of Thailand
135. NRSA  National Remote Sensing Agency of India
136. NRSC  National Remote Sensing Center (Mongolia)
137. NRSCC National Remote Sensing Center of China
138. NTT   Nippon Telegraph and Telephone Corporation
139. OCTS  Ocean Color & Temperature Scanner
140. ODUS  Ozone Dynamics Ultraviolet Spectrometer
141. OIC   Operational Inter-Communication System
142. OICETS Optical Inter-Orbit Communication Engineering Test Satellite
143. OPR   Operation Process Re-engineering
144. OSMI  Ocean Scanning Multi-Spectral Imager
145. PAN   Panchromatic Camera
146. PCRF  Protein Crystallization Facility
147. Ph.D. Doctor of Philosophy
148. PMEL  Pacific Marine Environmental Laboratory
149. PSLM  Polar Satellite launch Vehicle
150. QUT   Queensland University of Technology
151. RESAP Regional Space Applications Programme
152. RESTEC Remote Sensing Technology Center, Japan
153. RSA   Russian Space Agency
154. SAC   Space Activities Commission (Japan)
155. SAF   Space Agency Forum
156. SAFISY Space Agency Forum on International Space Year
157. SAR   Synthetic Aperture Radar
158. SAS&R Satellite Aided Search and Rescue
159. SaTRec Satellite Technology Research Centre
160. SCOF  Solution Crystal-growth Observation Facility
161. SEAMBO South-East Asian Ministers of Education Council
162. SEDA  Space Environment Data Acquisition Equipment
163. SFU   Space Flyer Unit
164. SGLI  Super Global Imager
165. SIS   Space Information System
166. SJAC  Society of Japanese Aerospace Companies
167. SMILES Superconducting Sub-millimeter Wave Limb Emission Sounder
168. SOCC  Satellite Operation Control Centre
169. SPCF  Solution/Protein Crystal growth Facility
170. SPARC Space Utilization Research Center
171. SPARRSO Space Research and Remote Sensing Organization, Bangladesh
172. SPS   Space Physics Sensor
173. STA   Science and Technology Agency (Japan)
<table>
<thead>
<tr>
<th>Code</th>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>174</td>
<td>STAR Program</td>
<td>Space Technology Applications and Research Program</td>
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<tr>
<td>175</td>
<td>SSTCC</td>
<td>State Science and Technology Commission of China</td>
</tr>
<tr>
<td>176</td>
<td>SURC</td>
<td>Space Utilization Research Committee</td>
</tr>
<tr>
<td>177</td>
<td>TCDC</td>
<td>Technical Cooperation among Developing Countries</td>
</tr>
<tr>
<td>178</td>
<td>TCE</td>
<td>Time Comparing Equipment</td>
</tr>
<tr>
<td>179</td>
<td>TFFMP</td>
<td>Total Forest Fire Management Plan</td>
</tr>
<tr>
<td>180</td>
<td>TDRS</td>
<td>Tracking Data Relay Satellite</td>
</tr>
<tr>
<td>181</td>
<td>TMI</td>
<td>TRMM Microwave Imager</td>
</tr>
<tr>
<td>182</td>
<td>TOMS</td>
<td>Total Ozone Mapping Spectrometers</td>
</tr>
<tr>
<td>183</td>
<td>TOPC</td>
<td>Terrestrial Observations for Climate</td>
</tr>
<tr>
<td>184</td>
<td>TRMM</td>
<td>Tropical Rainfall Measuring Mission</td>
</tr>
<tr>
<td>185</td>
<td>TT&amp;C</td>
<td>Tracking Telemetry and Command</td>
</tr>
<tr>
<td>186</td>
<td>UHF</td>
<td>Ultra High Frequency</td>
</tr>
<tr>
<td>187</td>
<td>ULF</td>
<td>Ultra Low Frequency</td>
</tr>
<tr>
<td>188</td>
<td>UNCED</td>
<td>United Nations Conference on Environment and Development</td>
</tr>
<tr>
<td>189</td>
<td>UNDP</td>
<td>United Nations Developing Program</td>
</tr>
<tr>
<td>190</td>
<td>UNESCO</td>
<td>United Nations Educational Scientific and Cultural Organization</td>
</tr>
<tr>
<td>191</td>
<td>UNOOSA</td>
<td>United Nations Office for Outer Space Affairs</td>
</tr>
<tr>
<td>192</td>
<td>UTS</td>
<td>University of Technology, Sydney</td>
</tr>
<tr>
<td>193</td>
<td>VHF</td>
<td>Very High Frequency</td>
</tr>
<tr>
<td>194</td>
<td>VIRS</td>
<td>Visible Infrared Scanner</td>
</tr>
<tr>
<td>195</td>
<td>VLBI</td>
<td>Very Long Baseline Interferometry</td>
</tr>
<tr>
<td>196</td>
<td>VSAT</td>
<td>Very Small Aperture Terminal</td>
</tr>
<tr>
<td>197</td>
<td>VTIR</td>
<td>Visible and Thermal Infrared Radiometer</td>
</tr>
</tbody>
</table>
198. WEDOS  World Environment & Disaster Observation Satellite
199. WMO   World Meteorological Organization
200. WCRP  World Climate Research Programme