Policies of Space Development in Japan

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Abstract

The history of Japanese space activity began in 1955. About forty satellites have been successfully launched up to now. At present, Japan has been promoting several significant programs, such as H-II launch vehicle program, space environment program and space station program. As for the earth observation, the Japanese first experimental earth observation satellite, namely, Marine Observation Satellite-1 (MOS-1), was successfully launched in Feb. 1987. And, It is scheduled to launch MOS-1b in 1990, the Earth Resources Satellite-1 (ERS-1) in 1992 and the Advanced Earth Observation Satellite (ADEOS) in around 1993. Also, Japan is planning to provide several sensors to the American and European Polar Orbiting Platforms (POP), which will be launched in mid-1990s.

Beyond the issues mentioned above, Space Activities Commission (SAC) is just working out the new space policy guidelines to meet future expected space activities needs of Japan in relation to the international activities. In this senses, Japan is moving towards the next generation of space activities inculuding the manned programs.

1. Japanese Space Policy

The history of the Japanese space activity began with the R&D of the sounding rocket in 1955. Since then, Japan has been making efforts to develop space science and technology. Although it was more than ten years after the launching of the Sputonik-1 when Japan launched her first satellite "Ohsumi" in 1970, Japan has succeeded in launching about forty satellites.

The Space Activities Commission (SAC) which was established in 1960 has been guiding Japanese space policy and also coordinating whole space activities in Japan. In Feb. 1984, the Commission set up

the fundamental guidelines of space policy. These guidelines include the long range development plan of the next 15 years.

Research and development on space science and technology is conducted mainly by National Space Development Agency of Japan (NASDA) and the Institute of Space and Astronautical Science (ISAS). NASDA is a government-financed corporation and responsible for developing and implementing practical applications of Japanese space activities. ISAS, on the other hand, undertakes overall research and development in the field of space science. Fig.1 shows the principal organization in Japanese space activities.

2. Current Development Program

(1) Launch Vehicle Development

Fig.2 shows the Japanese launch vehicles.

M launch vehicle has been developed for use in launching scientific satellites. The first M-3SII, the current version of M launch vehicle, was successfully launched in 1985.

N launch vehicle has been developed in cooperation with the United States and was used as Japanese main vehicle until H-I launch vehicle. N-I(N-II) has a capability of launching 130kg(350kg) satellite into a geostationary orbit. Seven N-I and eight N-II launch vehicles were launched, and the last N-II launch vehicle was launched in Feb. 1987, for the MOS-1 satellite.

H-I launch vehicle is expected to be served for demand of satellite launch in the later half of 1980s and has a capability of launching a 550kg satellite into geostationary orbit. The first H-I launch vehicle was successfully launched in Aug. 1987.

H-II launch vehicle is presently being developed and it has a capability of launching a 2,000kg class satellite into geostationary orbit. The first H-II launch vehicle is scheduled to be launched in 1992 and will cope with the expected demand of launching satellites in 1990s.

(2) Satellite Development

Table 1 and 2 represent satellite launch record and space development program in Japan.

Engineering test Satellite (ETS) has been developed aiming at the establishment of the basic technology of satellites needed for its future practical use. Five engineering satellites have been already

launched and ETS-VI is scheduled to be launched in 1992.

In order to meet the increasing and diversified demands in communication and broadcasting sectors and to develop these satellite technology, Japan developed six communication and three broadcasting satellites namely CS and BS series. Futhermore, another communication satellite, CS-3b, is scheduled to be launched in Sep. 1988. Two broadcasting satellites, BS-3a and BS-3b, are scheduled to be launched in 1990 and 1991.

In the field of meteorological services, Japan promotes to develop geostationary meteorological satellites (GMS). Three meteorological satellites were launched until today and GMS-4 is scheduled to be launched in 1989.

ISAS has launched seventeen scientific satellites to perform astronautical and exospheric scientific observation.

Earth observation satellite is described in next section.

(3) Activities in Micro-Gravity R&D in Outer Space

In research and development activities utilizing the space environment especially micro-gravity, material processing and life science experiments are to be initiated from the view of general scientific and engineering experiments.

The First Material Processing Test (FMPT) is scheduled to be conducted in 1991. The FMPT will cover 34 experiment items in the field of material processing and life science with a Japanese payload specialist aboard the Space Shuttle. (Fig.3)

Also, Space Flyer Unit (SFU), which will be three months in operation in space and retrieved, is scheduled to be launched in 1993. (Fig.4)

Futhermore, Japan participates in the Space Station Program proposed by the United States with the Japan Experimental Module (JEM), which will be launched in 1995 and connected to the Space Station manned base. JEM is expected to be served as multipurposes laboratory in space for the material processing, life science and astrophysics. (Fig.5)

3. Activities in Earth Observation

(1) Development of Earth Obervation Satellite

Japan has the development program of earth observation satellite. The first one is Marine Observation Satellite-1 (MOS-1) Program.

MOS-1b Program, the Earth Resources Satellite-1 (ERS-1) Program, the Advanced Earth Observing Satellite (ADEOS) Program and Polar Orbiting Platform (POP) Program are following. Fig.6 shows scenario of these programs. Detail of these programs are as follows.

MOS-1, MOS-1b Program

Marine Observation Satellite-1 (MOS-1), Japanese first earth observation satellite, is an experimental satellite which purpose is to establish the fundamental technologies for earth observation system and to carry out practical observation of the earth, primary the ocean. MOS-1 was successfully launched by N-II launch vehicle on Feb.19, 1987. MOS-1 carry three sensors and Data Collection System (DCS). These sensors are Multispectrum Electronic Self Scanning Radiometer (MESSR), Visible and Thermal Infrared Radiometer (VTIR) and Microwave Scanning Radiometer (MSR). MOS-1b is successive satellite of MOS-1 and has exactly same missions as the MOS-1. MOS-1b is scheduled to be launched in 1990. Fig.7 shows the outlook of MOS-1.

ERS-1 Program

The main objective of the Earth Resources Satellite-1 (ERS-1) is to explore non-renewable resources by using remote sensing technology. In addition to it, the satellite observation system monitors land-use, agriculture, forestry, fishery, environmental protection, prevention of natural disasters, surveillance of coastal region, etc. It is planned that ERS-1 will be launched in 1992. ERS-1 will carry the following mission instruments.

- Syntetic Aperture Radar (SAR)
- Optical Sensor (OPS)
  - Visible and Near Infrared Radiometer (VNIR)
  - Short Wave Infrared Radiometer (SWIR)

Fig.8 shows conceptual profile of ERS-1.

ADEOS Program

Recently, Japan decided to launch the Advanced Earth Observing Satellite (ADEOS) around 1993 as the next generation earth observation satellite. ADEOS will carry two advanced optical sensors as core sensors. In addition to these core sensors, ADEOS will carry additional sensors to provide the international community with opportunity to embark their sensors on ADEOS, and contribute to the

progress of the earth observation. Futhermore, ADEOS will conduct experiment on earth observation data relay using the Engineering Test Satellite-6 (ETS-VI) to enhance global observation capability. Two core sensors which ADEOS will carry are Ocean Color and Temperature Scanner (OCTS) and Advanced Visible and Near-Infrared Radiometer (AVNIR). Fig.9 shows conceptual outline of ADEOS.

POP Program

As the part of space station program, NASA and ESA are planning to launch Polar Orbiting Platforms (POP) in mid-1990s. In reply to the Annoncement of Opportunity (AO) issued by NASA and ESA, Japan is now proposing to embark the Advanced Microwave Scanning Radiometer (AMSR) and the Intermediate Thermal Infrared Radiometer (ITIR) on POP.

(2) Reception, Processing and Distribution System of Data

In Japan, data from earth observation satellites has been received at NASDA Earth Observation Center (EOC), which is located in Hatoyama, Saitama Prefecture about 50km north-west of Tokyo. The task of EOC is receiving, recording, processing data, putting out computer compatible tape (CCT) and photo products, inspection and evaluation of quality and retrieval and supply of the data. EOC is now receiving and processing the data from Landsat-4,5 and MOS-1. SPOT-1 data reception will be started this summer.

The data, which is received from Landsat-4,5 and MOS-1 and processed, are distributed publicly to users through the Remote Sensing Technology Center of Japan (RESTEC). The distribution system is shown in Fig.10.

4. Conclusion

Japanese space activities have entered a new stage and Japan is capable of promoting various projects both scientific research and practical application. Through these activities, Japan will be able to contribute to global space development program for the 21st century. While the focul point of new policy are still under discussion of the committee for long-range space policy under SAC, major approach will be expected as follows:

	goals	activities
by 1995	a. Development of Space Science and Technology b. Initiation of the Development of Space Infrastructure	• Space Science • H-I, ETS-VI, JEM • R&D on New Space Transportation System • Advanced Communication Satellite • Advanced Earth Observation Satellite
1995 ~ 2010	a. Deployment of Space Infrastructure	• DRTS • Operation of JEM (manned activities) • COP, POP, OMV, STS • Exploration of the Moon

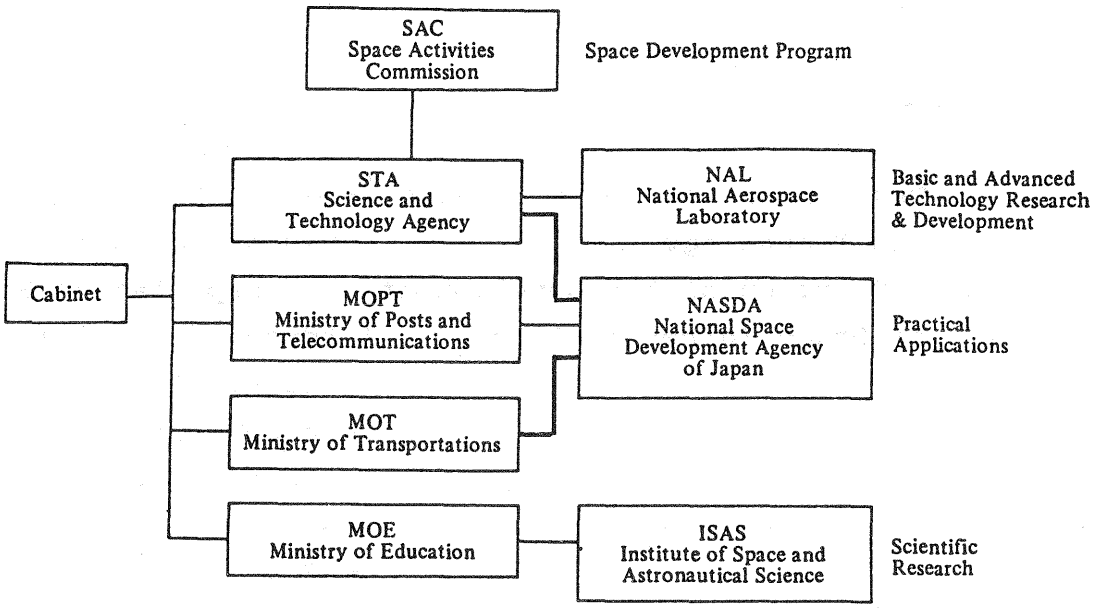
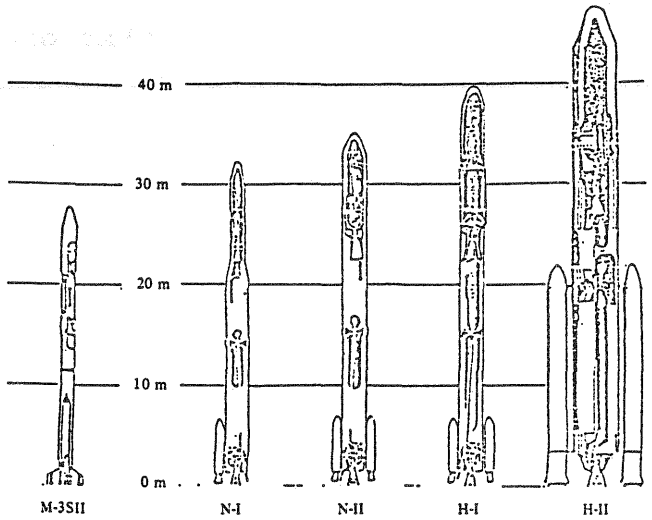


Fig.1 Principal Organization in Japanese Space Activities



Item		N-I	N-II	H-I	M-3SII
Payload capability	GEO (kg) LEO (kg)	130 1,200 (3 stage)	350 2,000 (2 stage)	550 3,000 (2 stage)	 700
Dimension	Overall length (m) 1st stage dia. (m) Fairing/spacecraft dia. (m)	33 2.4 1.7/1.4	35 2.4 2.4/2.2	40 2.4 2.4/2.2	27.8 1.4 1.7
Lift off weight (tons)		90	135	140	61
1st stage	Engine Propellant	MB-3 LOX/RJ-1	MB-3 LOX/RJ-1	MB-3 LOX/RJ-1	M-13 Solid
Strap-on-booster	Motor x Number Propellant	Castor-II x 3 CTPB*	Castor-II x 9 CTPB*	Castor-II x 9 CTPB*	SB-735 Solid
2nd stage	Engine Propellant	LE-3 N_2O_4/A-50	AJ10-118FJ N_2O_4/A-50	LE-5 LOX/LH_2	M-23 Solid
3nd stage	Motor Propellant	TE-M-364-4 Solid	TE-M-364-4 Solid	Newly developed motor Solid	M-38 Solid
Guidance system		Radio	Delta inertial	inertial	Radio

* Carboxy-terminated polybutadiene

Fig.2 Japanese Launch Vehicles

Table 1 Launch Record

C Y	NASDA Vehicles			U. S. Space Transportation System (Delta, Shuttle)	ISAS Vehicles (M series)
	N-I	N-II	H-I		
1970					▲OHSUMI
1971					▲TANSEI ▲SHINSEI
1972					▲DENPA
1973					
1974					▲TANSEI-2
1975	▲ETS-I				▲TAIYO
1976	▲ISS				
1977	▲ETS-II			▲GMS (Delta) ▲CS (Delta)	▲TANSEI-3
1978	▲ISS-b			▲BSE	▲KYOKKO ▲JIKIKEN
1979	▲ECS*				▲HAKUCHO
1980	▲ECS-b*				▲TANSEI-4
1981		▲ETS-IV ▲GMS-2			▲HINOTORI
1982	▲ETS-III				
1983		▲CS-2a ▲CS-2b		△SEPAC (SL-1)	▲TENMA
1984		▲BS-2a ▲GMS-3			▲OHZORA
1985					▲SAKIGAKE ▲SUISEI
1986		▲BS-2b	▲EGS MABES JAS-1		
1987		▲MOS-1	▲ETS-V		▲GINGA
1988			▲CS-3a		
TOTAL	7	8	5	3	17
	23 (NASDA)				17 (ISAS)
	40				

Table 2 Space Development Program in Japan

LV / FY	M Vechile For Scientific Missions	H-I Vechile 550Kg into g. o.	H-II Vechile 2ton into g. o.	U. S. Space Shuttle
1988	▲EXOS-D	▲CS-3b		
1989	▲MUSES-A	▲GMS-4		
1990		▲BS-3a		▲IML ▲SEPAC
1991		▲ERS-1 ▲BS-3b	▲H-II Test Fright	▲FMPT
1992			▲ETS-VI ▲SFU	▲GEOTAIL

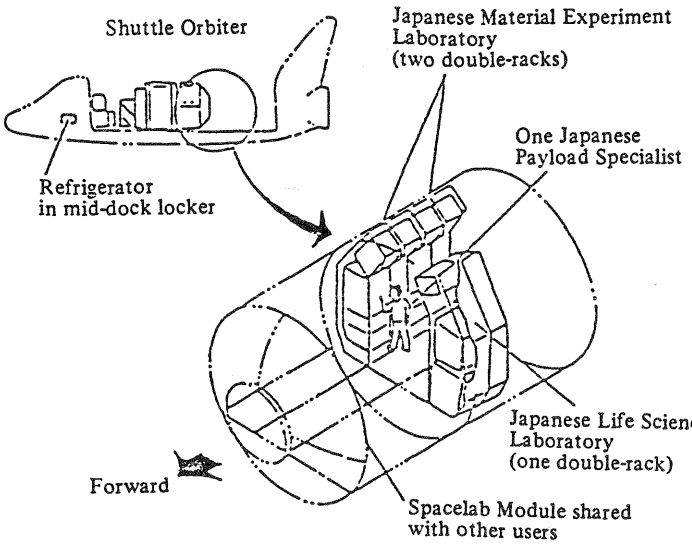


Fig.3 FMPT

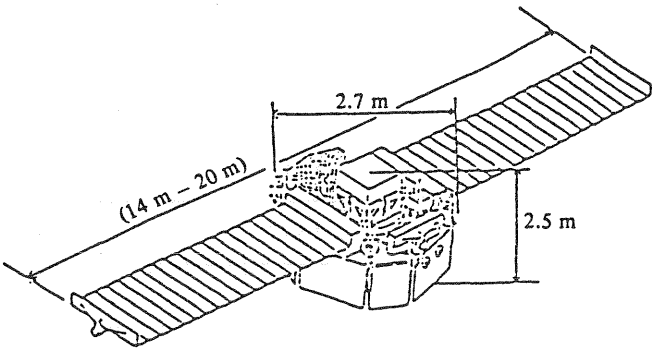
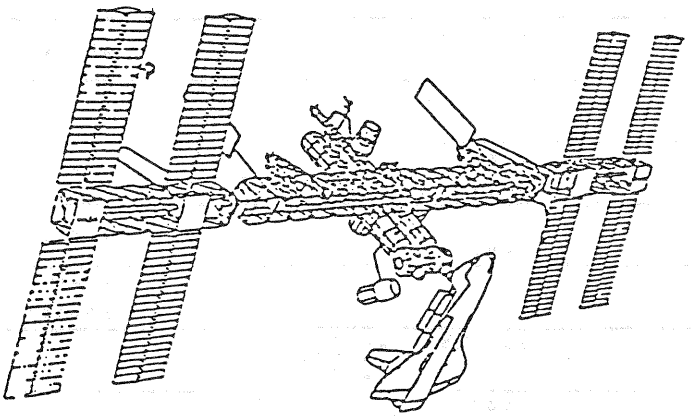
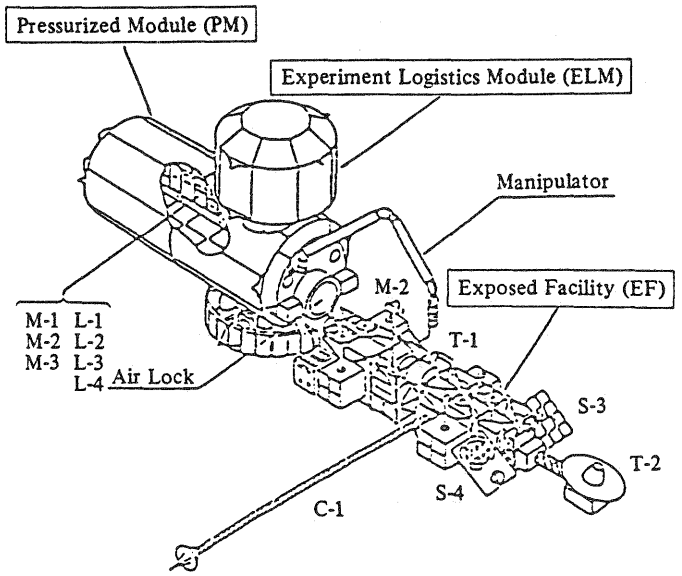


Fig.4 SFU





Code	Mission Name
M-1	Material science experiment
M-2	Space processing for advance material
M-3	Commercial space processing test
L-1	Biology and mediume (Non human)
L-2	Space Medicine
L-3	CELSS
L-4	Biotechnology
S-3	High energy cosmic ray experiment
S-4	Comic ray burst observation
C-1	Radio frequency interference (RFI)
T-1	Space environment test
T-2	Large antenna system technology

Fig.5 Space Station and JEM

Calendar Year	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000~
Satellite Launch Schedule	▲ MOS-1			△ MOS-1b		△ JERS-1	△ ADEOS		△ NPOP-1		△△ EPOP NPOP-2	△ JPOP		
Satellite Allocation Concept	Japanese Sensors / Japanese Expendable Satellite Bus					Japanese Sensors / Non-Japanese Sensors / Japanese Expendable Satellite Bus					Japanese Sensors / Non-Japanese Sensors / Japanese Platform			
									Japanese Sensors / Non-Japanese Sensors / Non-Japanese Platform					

Fig.6 Scenario on Earth Observation Programs

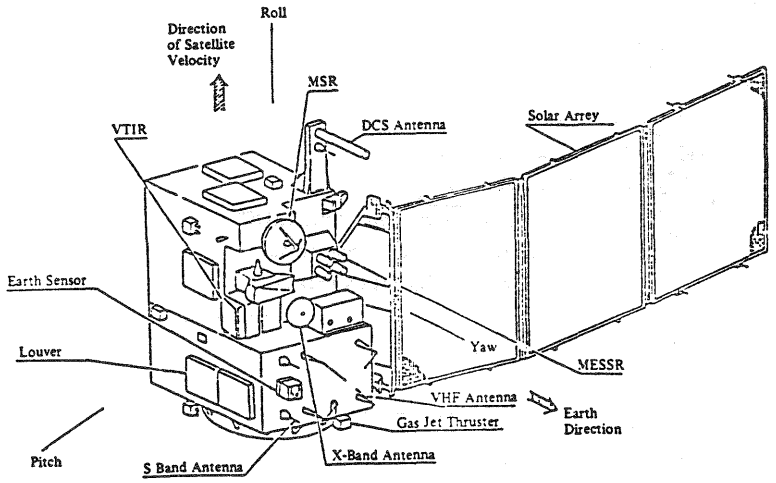


Fig.7 MOS-1

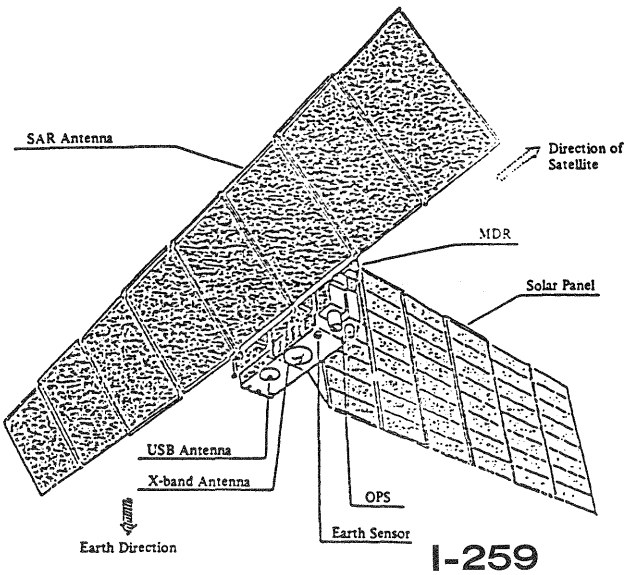


Fig.8 ERS-1

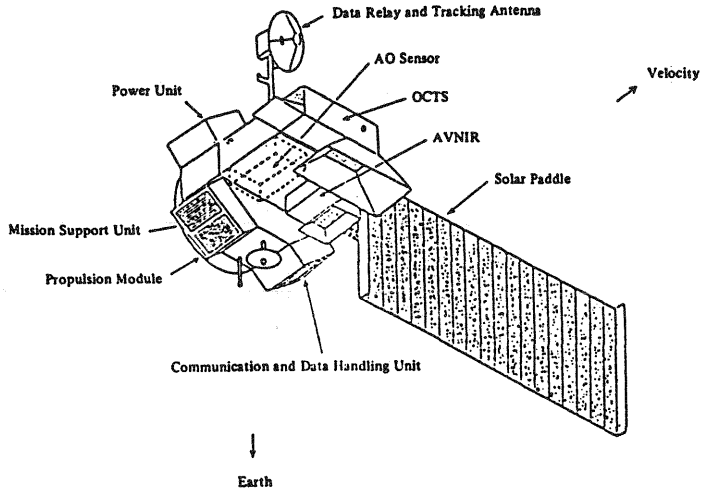


Fig.9 ADEOS

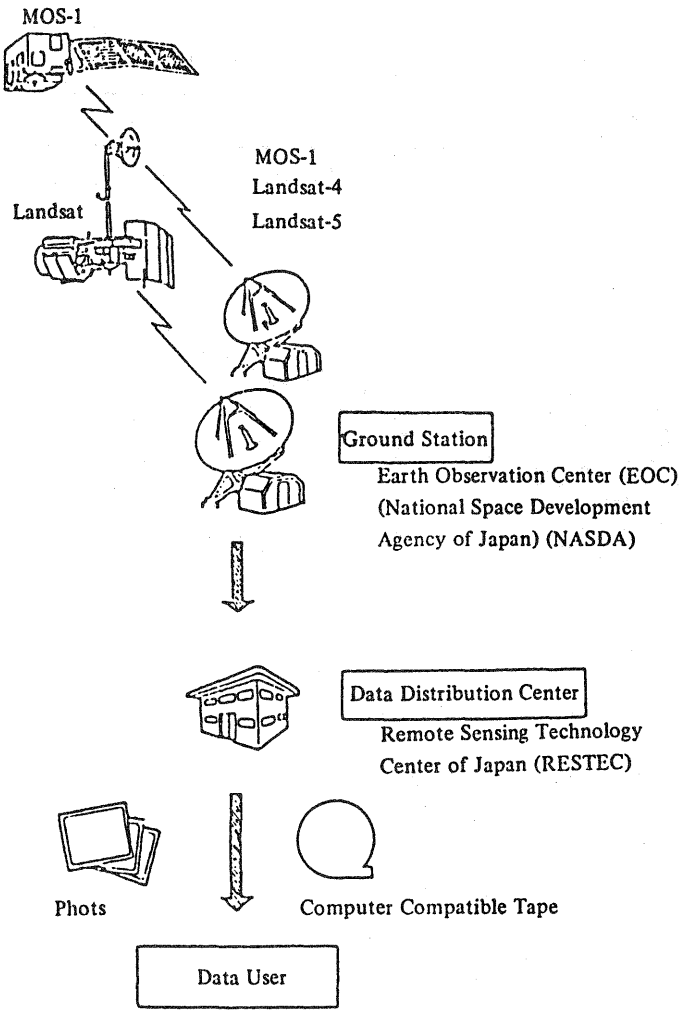


Fig.10 Data Distribution System