PRESENT STATUS OF JAPANESE ERS-1 PROJECT

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I. INTRODUCTION

Earth Resources Satellite 1 (ERS-1) will be launched in the FY 1990 with the H-1 rocket from Tanegashima Space Center. ERS-1 will seek to firmly establish remote sensing technologies from space by using synthetic aperture radar and optical sensors, as well as primarily exploring for non-renewable resources and also monitoring for land use, agriculture, forestry, fishery, conservation of environment, prevention of disasters, and surveillance of coastal regions. ERS-1 is a joint project in which the main responsibility for the development of the mission equipment is assumed by the Agency of Industrial Science and Technology, MITI, and the Technology Research Association of Resources Remote Sensing System, while that for the satellite itself and launching rocket is assumed by the Science and Technology Agency (STA) and the National Space Development Agency (NASDA). In relation to this project, users have maintained a close working relationship with the manufacturers after submitting their requirements in 1984 on the specifications of the mission equipments.

II. OUTLINE OF ERS-1

Table 1 shows the orbit parameters of ERS-1. The mission equipments which will be fitted on ERS-1 are Synthetic Aperture Radar (SAR), Optical Sensors (OPS), Mission Data Recorder (MDR), and Mission Data Transmitter (MDT).

The salient characteristics of ERS-1 are as follows:

(1) Both the Synthetic Aperture Radar and the Optical Sensors are mounted on the same satellite.

(2) The Optical Sensors have two wave ranges: a visible and near infrared region and a shortwave infrared region.

(3) The Optical Sensors have a capability of stereoscopic imaging.

Table 2 shows the parameters of SAR. It has L-band and H-H polarization, its off-nadir angle is 35 degrees, its spatial resolution is 18m x 18m approximately, and its swath width is about 75 km.

Table 3 shows the provisional parameters of the Optical Sensors.

Figure 1 shows the development schedule for ERS-1. The project started in 1984, and now we are in the process of the basic design. In FY 1990 (around February 1991, to be more specific), we are planning to launch it from Tanegashima Space Center. Figure 2 shows a configuration of ERS-1 in orbit.

III. USER'S REQUIREMENTS FOR SAR

A. Off-Nadir Angle

In order to investigate the mutual relationship among the roughness of earth surface, image distortions, and the incident angle to earth surface, we developed SAR simulation software. We examined 3 test areas as representatives of flat, intermediate, and rugged topography with this simulation software, and users came to the conclusion that for ERS-1's SAR system, the desirable off-nadir angle will be between 40 and 50 degrees, and larger than 45 degrees if possible.

We performed a feasibility study about the off-nadir angle of over 40 degrees, and it turned out that we will not be able to secure an adequate S/N as well as S/A with over 40 degrees off-nadir angle because of restrictions of hardware, so we decided to adopt an off-nadir angle of 35 degrees.

B. Frequency Band

With regard to the selection of frequency band, users wanted L-band for the reason of its greater penetration and greater effectiveness for geomorphological analysis. Also, given the conditions related to electrical power, it was easier to realize SAR with L-band. Thus, there was no problem in deciding to select L-band.

C. Polarization

With regard to polarization, only one mode is permitted, and an overwhelming majority wanted H-H polarization which is effective in observation of physiography and which was also used by Seasat SAR and SIR-A.

D. Spatial Resolution

On the question of spatial resolution, many users expressed a strong desire for a spatial resolution of about 20m because that would enable us to discriminate detailed physiographic features, which, in turn, would bring about a wide range of possibilities for data utilization. When the manufacturers examined the feasibilities, it became clear that it is possible to realize a spatial resolution of approximately 18m, so the decision was made for this figure.

IV. SUBJECTS TO BE DETERMINED

The subjects that we are examining at the present time include:

- How to operate the mission equipments.
- How to select the areas to be observed.
- How many and where to set data receiving stations.

Table 1. ERS-1 orbit (preliminary)

Item	Descriptions
Orbit	Sun synchronous
Altitude	568 km
Inclination	97.7°
Recurrent period	44 days
Local time of descending node	10:30±30 min.

Table 2. Characteristics of SAR (preliminary)

Item	Characteristics
Frequency	L-band
Polarization	H-H
Spatial resolution	18m x 18m (approximately)
Swath width	75 km (approximately)
Off nadir angle	35°
Quantization	3 bit
Antenna size	2.2m x 12m (electrical dimension)
Transmitter power (peak)	1.1 kW
Noise equivalent σ_0	$\leq$ - 20.5 dB
S/A	$\geq$ 14 dB

Table 3. Characteristics of OPS (preliminary)

Item	OPS (VNIR)	OPS (SWIR)
Wave length	4 bands	4 bands
IFOV	18m (approximately)	18m (approximately)
Swath width	75 km (approximately)	75 km (approximately)
Stereoscopic imaging	Base height ratio 0.3	-

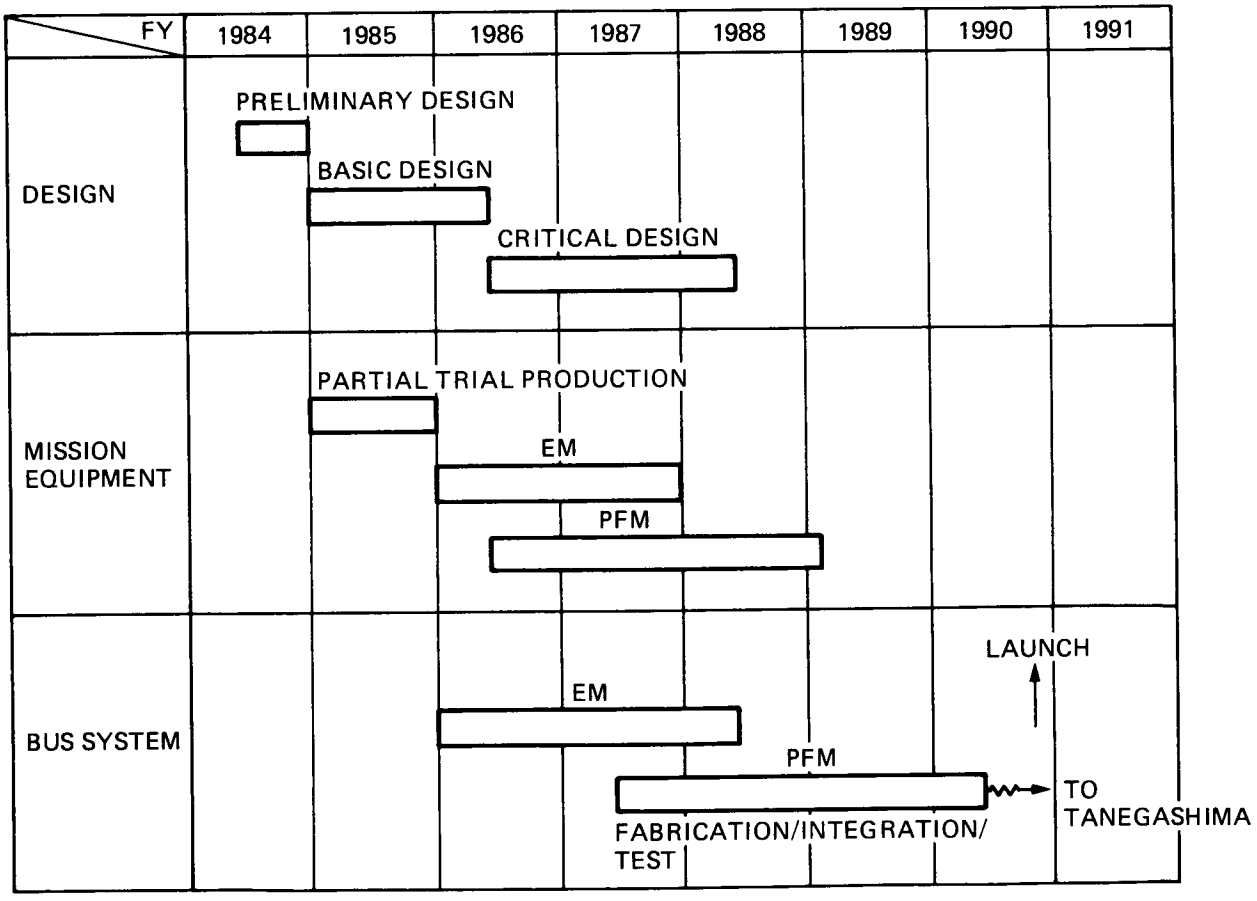

Figure 1. Development schedule of ERS-1

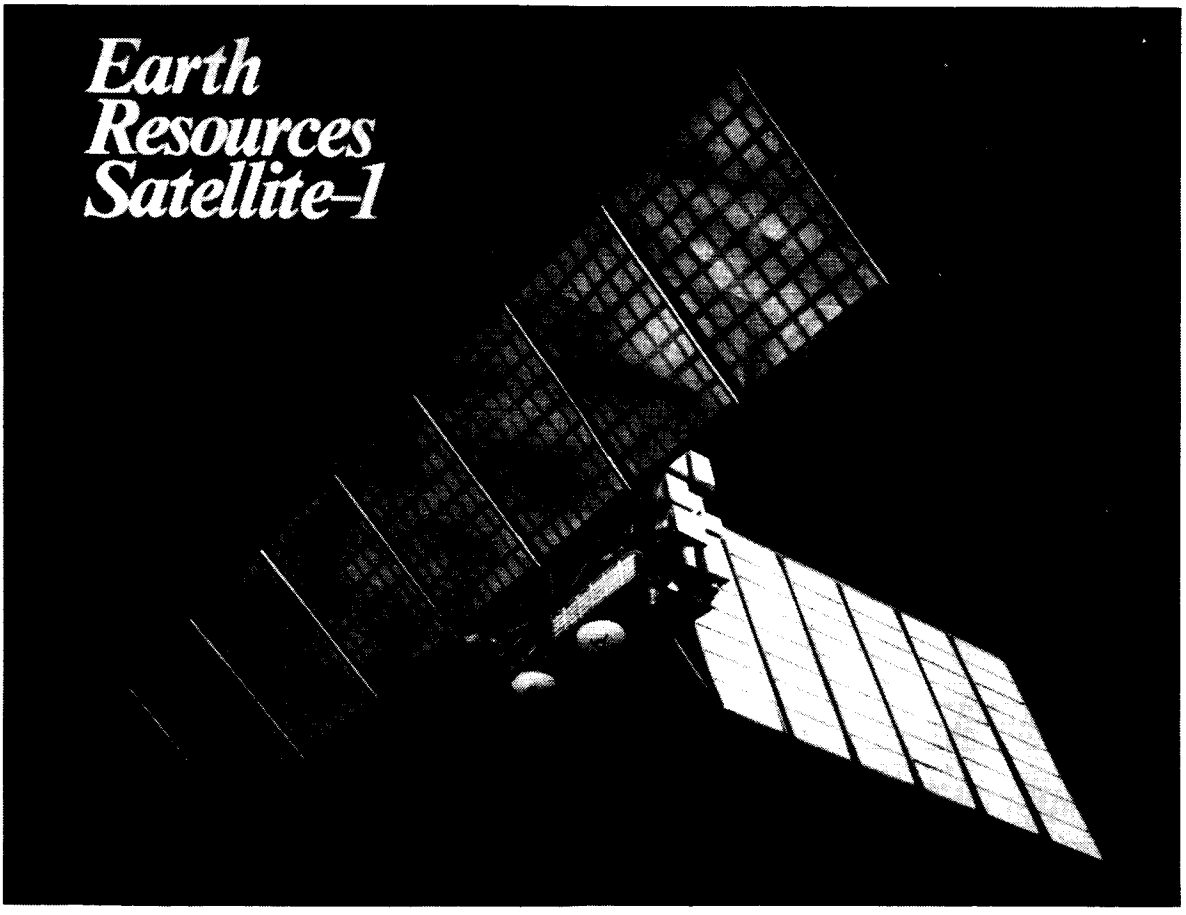

Figure 2. ERS-1 in orbit configuration (preliminary)