Aiming the stronger competitiveness of The Japanese space industry

- A brief introduction of USEF's space activity-

Hiroshi Kanai
Institute for Unmanned Space Experiment Free Flyer

1. Introduction

USEF, *Institute for Unmanned Space Experiment Free Flyer* was established in 1986 under auspices of Ministry of International Trade and Industry (presently METI: *Ministry of Economy, Trade and Industry*). It is a government funded non-profit organization in order to promote Japanese space industry's competitiveness. This article describes the feature of USEF and explains the various space programs which USEF have conducted in the past, together with future programs which is being planned. Historically, USEF's program has started in microgravity experiments and in recent years, its activity has expanded to remote sensing satellite development. Although most of the reader of this magazine may be interested in communication and broadcasting application, there will be many common areas among those, hoping to give some reference for the reader.

2. USEF's Role

USEF's role is to establish space programs according to the policy presented by METI, and to materialize the program. Specifically, USEF establishes the technical requirement for each program and select the contractor through proposal scheme. After the actual development is started, USEF acts as total program integrator and spacecraft operator. Although the number of engineer is rather limited(less than 20 engineers), most of them are from major space industries who has more than 20 years of experience. In addition, USEF has independent technical review board composed of outside members from academia and institutions. In that sense, USEF acts as integrating agent and catalyst among government, academia and industry. Because of its small size and flat organization, quick and timely decision making is always possible at USEF which enables efficient and effective project execution.

3. USEF's past and ongoing programs

Since its establishment, USEF have been continuing to conduct space projects which is most up to date to the requirement of the society at each times and endeavored to realize technical innovations for each project. Most of technical innovation which was developed in each program has been inherited to the

succeeding projects.

There are three major streams which USEF pursued in the past.

1) Microgravity experiment
2) COTS (Commercial off the shelf) electronic parts application for space
3) Next generation satellite bus and sensor development

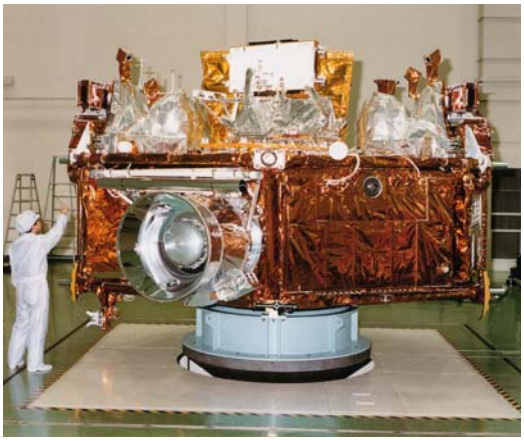
3.1 Microgravity experiment

a) SFU: Space Flyer Unit (FY 1987-1996)

The Space Flyer Unit (SFU) is an unmanned platform with reusable capability for experiments and observations in space.

Development started in 1987 as a cooperative project among three Japanese governmental agencies including MITI/NEDO (*New Energy and Industrial Technology Development Organization.)*, Ministry of Education/ISAS (*Institute of Space and Astronautical Sciences*) and Science and Technology Agency/NASDA(*National Space Development Agency of Japan*).

SFU was launched by NASDA'S H-II launch vehicle in March, 1995 and retrieved by NASA's space shuttle in January 1996 after successful operation on orbit. USEF's responsibility covered the development and operation of the SFU core bus module and industrial experiment equipments such as Gradient Heating Furnace, for Crystal growth of semiconductor material.



SFU

b) EXPRESS : Experiment Re-entry Space System (FY1990-1995)

The development of EXPRESS was started in 1990 as the first Japanese-German joint space program for the purpose of microgravity experiment and autonomous reentry, and was launched on January 15, 1995 by M-3SII rocket from the Kagoshima Space Center.

EXPRESS's capsule was not injected into the planned orbit due to rocket malfunction, and it had been found in Ghana, Africa instead of planned landing

place of Woomera, Australia after the reentry.

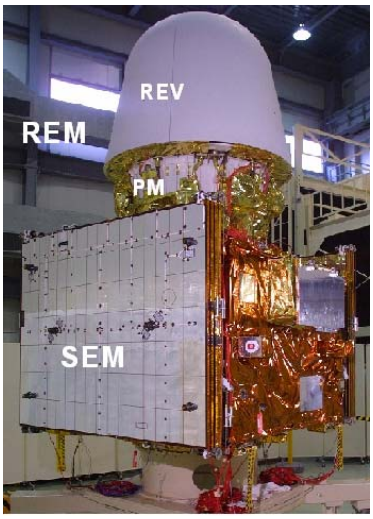
EXPRESS　Capsule

c) USERS Unmanned Space Experiment Recovery System　(FY1995~2005)

USERS is a autonomous reentry system from orbit after long duration space experiment. Development of USERS have started in 1995 under the contract from METI and NEDO. The USERS spacecraft consist of the Service Module (SEM) and the Re-entry Module (REM).

It was launched from Tanegashima Space Center on September 10, 2002, and it performed the Super-conductive Bulk Material Processing Experiment (SMAP) using three of the Super-conductive Bulk Processing Gradient Heating Furnaces (SGHF) installed in the REM. After the experiment completion, the reentry capsule, so called Recovery Vehicle (REV) of the USERS Spacecraft, has been de-orbited and splashed down in Northern Pacific, east of Ogasawara Islands, and was successfully recovered on May 30, 2003,after approximately 8.5 months of on-orbit operation with Superconductive crystal.

The micro-gravity conditions during the experiment operation and the actual operability of the USERS were satisfactory, and an unmanned on-orbit experiment infrastructure has been verified and established



USERS　Spacecraft

Capsule Recovery

3.2 COTS (Commercial off the shelf) electronic parts application for space

- SERVIS : Space Environment Reliability Verification Integrated System
(FY 1999~)

Space Environment Reliability Verification Integrated System (SERVIS) is being developed under the contract with NEDO. The purpose of the project is to establish a parts database, parts evaluation guidelines and equipment design guidelines to utilize commercial-off-the-shelf parts and technologies (COTS) instead of obsolete MIL quality parts under space environment so that they can be utilized for space applications.

SERVIS project has started in 1999, and the SERVIS-1 satellite was launched on Oct. 30, 2003, and data from the payloads has been accumulated and analyzed. SERVIS-2 satellite is to be launched in June, 2010.

Considering the importance of continuous COTS verification, METI funded SERVIS-3 project starting FY 2010.

SERVIS-2 Spacecraft

3.3 Next generation satellite bus and mission development and utilization

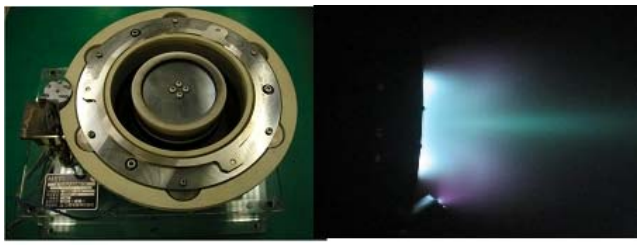
a) ASER : Advanced Satellite Engineering Research Project (FY2003~)

ASER project has been started in FY2003 under the contract from METI and NEDO. The purpose of the project is to develop key technologies for the next generation large scale high power advanced satellite bus.

5 subsystem technologies have been developed, namely

1) High capacity thermal control system technology using 3-dimensional heat pipe network
2) High thrust electric propulsion system
3) Precise correction experiment of the onboard crystal oscillator clock controlled by ground atomic clock
4) Large size composite structure manufacturing technology
5) High energy density Lithium-Ion battery system

The development result was applied to Quasi Zenith Satellite System (QZSS) which is being developed by JAXA and will be launched in 2010.



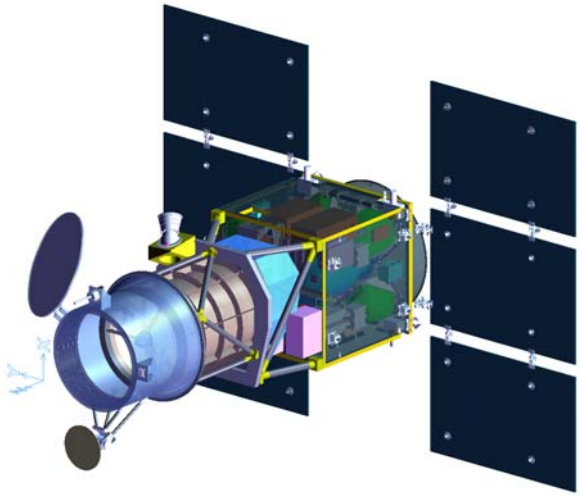
250mN Hall Thruster

175AH Lithium Ion Battery

b) ASNARO :Advanced Satellite with New system ARchitecture for Observation (FY2008~)

ASNARO Project, started in FY2008, is to establish next generation small satellite bus system based on open architecture technologies and manufacturing methodologies to drastically reduce the cost and the development period with adoption of up-to-date electronics technologies. The satellite bus system is composed of building block style of subsystem with the Space Wire network, and use high performance COTS, and improved verification test method.

The first mission is earth observation with high performance optical sensor whose resolution is expected to be less than 1 m from 400km to 600km orbit, and the total weight of the spacecraft is approximately 400kg. The spacecraft targets and takes user required images automatically with bus control system, and down link the data through high data rate X band advanced data transmission system.



ASNARO

4. Looking towards the future

In addition to the above ongoing projects, USEF is conducting following R&D projects considering the future trend of space development and utilization.

4.1 SSPS: Space Solar Power System (FY 1993~)

USEF has participated the NEDO's "New Sunshine project" started in 1993, and conducted technical survey on space solar power system as a candidate for future regenerative energy source. Since that time, USEF has continuing SSPS system concept study and key technology development of microwave energy transmission and from 2009, started the project aiming microwave energy transmission technology verification in cooperation with JAXA. SSPS has many spin-off technologies such as robotics for large structure construction, attitude control of flexible body and multi satellite formation flying technologies.

4.2 ALSET : Air Launch System Enabling Technology

ALSET project is a research and development of a basic technology that enables the achievement of Air Launch system for the small satellite which is expected to increase in the future. Air-Launch System is a method which carries the rocket by the aircraft, and releases the rocket at high altitude, thus enables the satellite launch without the launch complex. Starting 2009, USEF started key technology development and survey of other matters such as legal constraints.

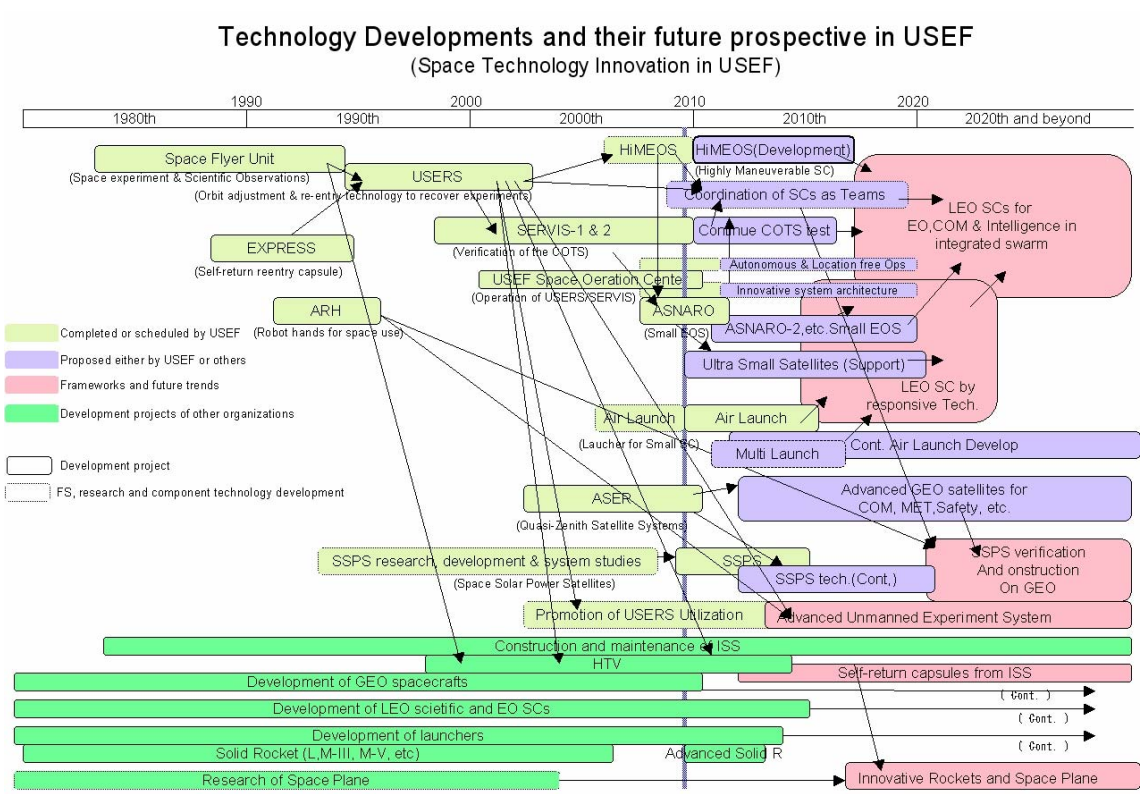
Air Launch System

4.3 Other research projects

USEF has been engaged with several other future survey projects such as Highly maneuverable satellite system with large propulsion subsystem which enables frequent orbit change, new concept observation satellite system using phase repeating orbit instead of conventional sun synchronous orbit, and formation flying system and constellation satellite technologies for multiple satellites.

In the field of global activity, USEF has been keeping close contact with East Asian and African government organizations for the potential future cooperation in space technology.

Following chart depicts USEF's innovation road map since its start.



5. Conclusion

As discussed, USEF has been developing space projects in order to promote the industrialization of Japanese space development. USEF will promote innovation in space technologies to enable the formation of space business model which will enable to get into the global market. Repeating this cycle, we hope to strengthen the space industry in spiral manner.

USEF has achieved many space program successes in spite of relatively small organization and budget. However, this fact does not necessarily justify the USEF's present structure into the future especially we have Basic Space Law and the Basic Plan for Space Policy now in force, which clearly states to review of the functions of JAXA and other organizations involved in space related activities.
Moreover, current Government Revitalization Office under the Cabinet Office is going to re-evaluate the entire independent Administrative Agencies and Public Service Corporations such as USEF. Considering these backgrounds,

Considering these backgrounds, and based on our past achievements, accumulated technology and project management capability, we are prepared to serve to the advancement of Japan's space development and utilization in most suitable framework and structure.