Basic Plan
for Space Policy

- Wisdom of Japan

Moves Space -

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Established by

Strategic Headquarters for Space Policy

Contents

Introduction

This Basic Plan for Space Policy forged this time is based on the Basic Space Law established in May 2008 and is a Japan’s first basic policy relating to space activities.

Japan's use and R&D of space began from the "Pencil Rocket" project launched by Professor Itokawa of Tokyo University in 1955. Since then, approximately half a century has passed and Japan has reached to hold a position as one of the leading countries of the space development. Japan's outstanding performance such as continuous successful launch of H-IIA Launch Vehicles after overcoming all sorts of failures, HDTV images of the moon captured by "Kaguya" and experiments conducted by Japanese astronauts in Japanese experiment module “Kibo” of the International Space Station shows the sophisticated technological capability as well as helps to bring space activities closer to the Japanese people.

However, looking at the international trends, even China and India in addition to the space advanced countries such as United States, Europe and Russia have actively been participating in the use and R&D of space in recent years, and it is undeniable to feel a sense of crisis over Japan's use and R&D of space as mentioned below:

(1) Absence of general strategy for space at the country level

A lack of affiliation between research & development and its utilization/industrial promotion caused the whole government to fail to take advantage of the achievements of the use and R&D of space at the country level because it was not specifically positioned as a "national strategy".

(2) Insufficiency of Japan’s track record of space utilization

Not only in the Western countries, but also many countries such as Russia and China set information gathering for national security purposes by using satellites as one of the major objectives of their space policy. In Japan, on the other hand, space is partially utilized in civilian purposes in areas such as weather forecast, telecommunication and broadcasting. Yet, in other areas as well as from diplomatic aspects, Japan’s utilization of space should be pursued further. In particular, use of space for national

security purposes is limited in a generalized area.

(3) A lack of international competitiveness of industry

According to a private study, the space equipment industry in Japan has decreased by approximately 40% of sales and nearly 30% of workforce in the past decade. Space industry for major technologies, parts and system is not fully competitive internationally, and weakness of international competitiveness of space industry is showing a lack of practical accomplishment and experience. Most of Japan's operational satellites such as broadcasting satellite are imported from overseas and it is extremely unusual to export Japanese space satellites and rockets to foreign countries.

The Basic Space Law aims to solve these existing issues and stipulates that the government formulates Basic Plan for Space Policy. This law aims to powerfully work in a comprehensive and systematic manner to "change space policy from R&D-driven to utilization-driven underpinned by high technological capabilities", to "utilize in the area of national security" beyond the generalized theory while maintaining an exclusively defense-oriented policy in accordance with the principle of pacifism enshrined in the Constitution of Japan, to promote "space diplomacy" and "research and development of the forefront areas" and at the same time to forge "improvement of industrial competitiveness" while aiming to become "environment-friendly".

Chapter 1　Status of the Basic Plan for Space Policy

The Basic Space Law legislated by lawmakers was enacted on May 21, 2008 and entered into force on August 27, 2008, providing a major turning point for Japan's use and R&D of space. The Strategic Headquarters for Space Policy, led by Prime Minister as the Director General of the Headquarters, was established in the Cabinet with the enactment of the basic law to strategically promote the use and R&D of space for the entire nation.

This law also stands on a total of 6 fundamental principles; a peaceful use of space, improvement of the lives of the people, development of industry, progress of human society, contribution to international activities and appropriate care of the environment. It also stipulates a total of 11 basic measures; utilization of satellites for improvement of the quality of life of the Japanese people, formation of world peace and a safe and secure society in Japan, autonomous launch of satellites, promotion of space development and utilization by private businesses, maintenance and improvement of reliability, promotion of advanced space development and utilization, promotion of international cooperation, environment conservation, retainment of human resources, promotion of education and learning, and information control concerning the use and R&D of space.

The Strategic Headquarters for Space Policy is to draw up a basic plan for the use and R&D of space (Basic Plan for Space Policy) as a national strategy of Japan to fulfill these various principles of the Basic Space Law based on the Article 24 of the Law.

To promote the measures and policies in a comprehensive and systematic manner based on the Article 24 of the Basic Space Law, the use and R&D of space are stipulated as detailed below:

1. Presentation of the basic directions to promote the use and R&D of space
2. Measures and policies for the use and R&D of space to be conducted by the government in a comprehensive and systematic manner
3. Promotion of measures and policies based on the Basic Plan for Space Policy

As for the measures and policies, specific goals and its timeframe should also be established as a rule.

Due to the characteristic of the space development that it requires about 3 to 5 years to develop and supply equipment such as satellites, launch vehicles and necessary sensors, it is most often the case to require an appreciable period from the start of development to utilization. To comprehensively promote in a well-planned manner, the plan should be expected to cover a long period.

Taken these into consideration, the measures should be expected to take 5 years to advance in a comprehensive and unified manner while overlooking 10 years of the future. Further, the plan will be reviewed after 5 years of its formulation. However, it should be reviewed as needed based on a result of follow-ups.

Chapter 2　Basic Policy to promote the use and R&D of space

1. The promotion of the use and R&D of space with Japanese character

The value placed on the information in the 21st century is increasing than ever and the importance is rising as a foundation of social and economic development. Collection of wide-ranging information related to various socioeconomic activities, events concerning a secure and pleasant social environment, changes of meteorological phenomena and global environment and enhancement of knowledge can be done specifically by the use and R&D of space and will furnish far away from the earth with an efficient and systematic broad approach in a small amount of time. Further, the sophisticated technological capabilities are essential to employ information collection.

Space policies of major countries who are actively involved in the use and R&D of space are distinguished from others who aim at "taking a worldwide leading role", "taking initiative role in business", "focusing on the interests of security" and "displaying the country's national prestige".

Japan’s space development and utilization has been focusing on the research and development thus far, but Japan will change its policy to emphasize the space utilization and aim to maximize the possibility and potential capability of the use and R&D of space in various sectors in order to enhance the quality of life of the nation, ensure national security, and international contribution and cooperation, together with improvement of its capability of research and development.

Therefore, Japan will aim that space activities bring about improvement in quality of citizen life and international contribution to ensure good living standards for citizens by collecting necessary information to use space for national security and disaster relief, higher levels of productivity in agriculture and fisheries, realization of advanced personal navigation system as well as to use space for foreign diplomacy, monitoring disasters in Asia, solving global issues and contributing to gain human's intellectual property.

To realize this, it is important to promote improvement of the environment to exert maximum effort to make the most of private sector

vitality and competitive standing autonomously. At the same time, Japan must promote space science research and development for foundational and advanced technologies from a long-term perspective, and by actively exercising utilization of space as users of the public purpose. And, in cooperation with private sectors, it is important to make use of the results of the use and R&D of space toward improvement in the quality of service to the citizens and put into practical contribution to the world.

To draw out and execute the space policy, it is essential that all the government unites to promote it, together with the Strategic Headquarters for Space Policy as a gamemaker. From now on, the Basic Plan for Space Policy is considered as Japan's national strategy for the use and R&D of space in the medium- and long-term for promotion of comprehensive and systematic advancement of the policy.

For realization of these goals, the following 6 objectives are drawn out as an important pillar to promote the policy:

2. Six Basic Pillars for Japan's use and R&D of space

(1) Realization of a secure, pleasant and affluent society utilizing space

Japan's use and R&D of space have already become an essential factor of our daily lives in various use; daily weather forecast using meteorological satellites, data communication and satellite broadcasting using telecommunications satellites, cartography, natural resource exploration, utilization for agriculture and fisheries and disaster monitoring using land and ocean observing satellites, car navigation and measurement using positioning satellites (GPS).

However, except some sectors such as weather, communication and broadcasting, the application of satellites is still in a validation phase or in an early stage of practical applications. Therefore, it is the pressing issue to utilize the maximum potential of space to realize an even more secure, pleasant and affluent society.

For that reason, it is the goal for the use and R&D of space to respond to the various social needs such as ensuring of public safety, preservation and conservation of national land, facilitation of food supply, stability of natural

resource and energy supply, solutions of global environmental issues (realization of low carbon environment), enhancement of the domestic quality of life (realization of a healthy and long-lived society and convenience for the people), and sustainable development of industry and the creation of employment.

For the promotion of the policy, it is important to conduct of research and development of satellites including a series of satellites to realize utilization that responds continuously and effectively to the social needs, to pursue a effective and efficient use of satellites such as a combined use of various satellites or a multi-purpose use of one satellite, to increase value of utilization by collaborating not only with space segments but ground systems, to expand users as wide as potential ordinary citizens not limited to professionals and to increase the convenience of satellite data utilization.

(2) Enhancement of national security utilizing space

The utilization of space in the area of national security in Japan had been following the views of the Diet Resolution Concerning Peaceful Utilization of Space established in 1969 and limited to the satellites use of Japan Self-Defense Forces as mentioned that "the satellites only if those were widely prevailing and the equivalent functions of satellites (excerpted from the official government view announced in February 6th, 1985)". Therefore, it has been limited to the general usage such as for communication, meteorological, global positioning and information gathering.

However, foreign countries are believed to retain information gathering satellites that overwhelm the ability of commercial satellites, and also they retain early-warning satellites equipped with sensors to detect ballistic missile launches.

As Japan maintains an exclusively defense-oriented policy, for the function of information gathering to detect any indications of various situations in advance and for the purpose of enforcing warning and surveillance function of Japan's surrounding costal area and airspace, as well as securement of communication method for activities such as international peace cooperation, which is the primary role of Japan Self-Defense Forces, it is extremely important to use the space which does not belong to any country's territory and unconstrained by any conditions such as geomorphic

landscape. For that reason, on the basis of stipulation of the international agreements and the principle of pacifism enshrined in the Constitution of Japan with the Basic Space Law in mind, the new use and R&D of space are promoted to enforce the national security for the purpose of improving and reinforcement of information gathering functions and enhancement of warning and surveillance activities in light of the international situation, especially the circumstances in North East Asia.

Further, the position of the use and R&D of space in the entire defense capability will be determined in the Defense Guideline and the Mid-term Defense Program which will have been reviewed by the end of 2009. The consistency of promotion of the use and R&D of space is to be ensured in collaboration with the Defense Guideline.

(3) Promotion of Space diplomacy

The promotion of space diplomacy is to utilize Japan's distinguished science technology and the special characteristics of the use and R&D of space, which includes activities beyond national boundaries such as global information collection, into Japan's diplomacy (“Space for the Diplomacy”) and to exert efforts to promote smooth space development and utilization (“the Diplomacy for Space”).

1) Promotion of "Space for the Diplomacy"

Japan has used satellites to expand the use for the contribution of disaster monitoring in Asia, attempt to establish a remote education and telemedicine system and responding to global environmental issues caused by climate change and monitoring of the U.N. World Heritages. Further, Japan has built a collaborative cooperation with leading countries of the space development in the space science and International Space Station Program and proved a steady contribution.

For Asian countries, Japan has been contributive by providing a meteorological satellites, Himawari, to some 30 countries of the Asia-Pacific region for over 30 years since 1977 and helped to prevent disasters for approximately 2.2 billion people. The Asia-Pacific Regional Space Agency Forum (APRSAF) led by Japan was established in 1993, and Sentinel Asia started its operation in 2006 to deliver images of

stricken areas in the event of a disaster in the Asia-Pacific region. Through activities of Sentinel Asia and the International Charter “Space and Major Disasters” which is the similar international framework that delivers satellite images in times of disaster, images have been provided from Japan's Advanced Land Observing Satellite "Daichi" in events such as forest fire occurred in Australia in February 2009 and China Sichuan earthquake occurred in May 2008, as well as events occurred in countries such as Indonesia, Vietnam and Thailand for approximately 100 times in the last 3 years.

As for global environmental issues including climate change, Japan played a leading role for the establishment of the Group on Earth Observations (GEO), and in the future, Japan will participate in observing greenhouse gases and changes in climate and water cycle, as well as provide information including global topographic data, for the purpose of formation of the Global Earth Observation System of Systems (GEOSS) under international cooperation.

For monitoring the World Heritage Sites, Japan Aerospace Exploration Agency (JAXA) has been participating in UNESCO’s "Open Initiative on the use of space technologies to support the World Heritage" by providing satellite images.

In the area of space science, Japan has been working with the United States and Europe under a panhuman project such as space astronomy and solar system exploration. Further, in the International Space Station Program, Japan is not only conducting its activities in Japanese Experiment Module “Kibo” but also will play a significant role in supporting overall activities of the International Space Station with cargo transportation H-II Transfer Vehicle (HTV).

All these prior experiences and the contribution of Japan to the international society, including in disaster monitoring and space science are diplomatic assets which enhance Japan's international leverage and presence, as well as a source of its soft power. It is important for Japan to utilize this kind of power as a tool for diplomacy to assert itself in the international society. In this context Japan has set “human security” as one of the pillars of its foreign policy and has been actively promoting it.

Human security is a concept that aims to establish the world where people can live in dignity and peace through protection of them from transboundary threats such as natural disaster, environmental degradation and climate change, as well as through their empowerment to overcome these threats themselves. The use and R&D of space will be reinforced and used as a tool to realize "human security".

2) Promotion of "the Diplomacy for Space"

The demands for space use in Japan are inadequate to promote the use and R&D of space. It is necessary to find needs from outside Japan by developing a cooperative relationship with leading countries of the space development and putting efforts for diplomacy in addition to provide support to the space industry’s overseas activities.

When providing Japan's support to the space industry, Japan must pay attention to the status of foreign private corporations which have received orders from foreign countries by receiving strong support from their government. Also, Japan has to find demands of the use and R&D of space in foreign countries by putting diplomatic efforts as establishing a government-level bilateral relation and providing public funds such as Official Development Assistance (ODA).

For the use and R&D of space, it is undesirable to conduct the entire activity independently in consideration of the huge amount of money needed from development and launch of satellite. It is important to deepen a relationship with leading countries of space development more than ever to allow realization of efficient use and R&D of space by establishing a partnership for sharing responsibilities.

Further, even though the international rules for space have been established at international fora such as the Committee on the Peaceful Uses of Outer Space (COPUOS), Conference on Disarmament (CD), there are new challenges such as measures to space debris (hereinafter referred to as "debris") and future challenges of ascription of natural resources of the moon and space traffic management, which are important to conduct the use and R&D of space. In addition to the four treaties on space(Note), it is necessary for Japan to proactively participate

in formulating international rules for space.

(Note) The four treaties on space include "Outer Space Treaty", "Rescue Agreement", "Liability Convention" and "Registration Convention".

(4) Creation of vigorous future by promoting R&D of the forefront areas

Space given as a frontier to mankind has unlimited possibilities such as for accumulation of human intellectual properties, expansion of human frontier and the new usage of space energy. Without research and development of advanced science and technology, it is indeed impossible to give a challenge to the harsh space and realize these possibilities.

Promotion of the advanced research and development will bring in new technical breakthrough and at the same time, the achievement will enrich the life on the ground and demonstrate great potential to create a vigorous future. Further, these challenges would give hope and dreams to Japanese people, especially to children who are responsible for the next generation.

In addition, the advanced research and development should be considered as a challenge for all mankind and it is important for Japan to plan independently and take the initiative in international cooperation.

For space science such as space astronomy, solar system exploration and other studies, Japan has always achieved the top-level results in the world by unifying the space science, which has been conducted to unveil the solar system and space itself as well as to solve the mysterious origin of how life began, and the advanced engineering research for spacecrafts.

In the recent achievement of space astronomy, the Japanese X-ray astronomy satellite "Suzaku" has succeeded in high-accurate observation of the distortion of space-time around black holes, and the infrared astronomical satellite "Akari" has been used to help create a catalogue over the shining sky with infrared radiation. For the solar system exploration, Japan has achieved remarkable success of solar observation by the solar observation satellite "Hinode", asteroid probe by the asteroid explorer "Hayabusa" and moon exploration by the lunar orbiter "Kaguya".

And as a part of the International Space Station program, human space activities have been making considerable achievements; one is to provide sophisticated human space technologies of "Kibo", which was completed in

2009 and will start its utilization operation in the days ahead, other one is the outstanding performance of Japanese astronauts. Japan's human space technology is reaching its well-positioned situation to achieve useful outcome for people's living. For the research on space environment utilization, its achievement of space-medicine has used for medical treatment for the elderly and also for prevention study of osteoporosis and urinary calculosis, as well as to make effective application for medicine development using a high quality protein crystallization. Furthermore, it is expected that "Kibo" will be utilized for useful function for the world as a "geosphere observation and diagnosis station" that astronauts deliver information concerning weather, disaster, agriculture and fisheries in real time which is comprehensively organized from the ground after the information related to space and the earth is collected individually.

As a country who aims to establish a nation based on the creativity of science and technology, it is important for Japan to actively participate in the space science and human space activities to probe deep into space and expand the human's sphere of activities as a leading country of the space development based on the actual results and technical capabilities achieved so far.

Further, for the space solar power which may solve the worldwide environmental and energy issues confronting humankind, Japan has been involved in necessary research to realize space solar power with countries such as the United States through information exchange. Currently confirmation of each required principled technology has been in progress and it is important to apply step-by-step verification in the future toward the realization while ensuring its safety and economic efficiency.

(5) Fostering strategic industries for the 21st century

The space industry can be considered as an important base to support the space activities of Japan when promoting the use and R&D of space.

The space industry covers not only the space equipment industry but also the service industry using space for communication and broadcasting services, a cartological service using satellite images and a positioning service using navigation system. Also, the utilization of space is expanding to industries such as pharmaceutical industry, medical and bio industry for drug

development in "Kibo" using microgravity and development of safe and secure small-sized clinical instruments, but also for clothing, food and housing industries, which was remotely related to the traditional space activities. As mentioned, the utilization widely stretches out to many areas. There is an expectation that it would make a ripple effect to various industries that it would increase an added value of industries and create new innovation by fusing together with materials, technology and services of other industries.

However, the current situation is that the international competitiveness of Japan's space industry is weak and majority of the operational satellites that have been brought into Japan by the government and private companies are U.S.-made. Meanwhile, Japanese private companies had never received an order of any commercial satellite launch service neither from home nor abroad. However, Japanese private companies finally received orders for manufacturing commercial satellites and launching a Korean government satellite with H-IIA Rocket during 2008 and 2009, and it is still in an early stage for commercial deployment.

For satellites, Western countries have accumulated their performance in orbit based on the demands from the governments, and the results helped to increase the sense of customers' trust bringing the Western companies to gain higher share in the international market of man-made satellites as before. Japan has fewer demands compared to Western countries and the research is focused on research and development. For that reason, there is not enough actual performance on orbit and it is still in a validation phase and Japan has not been able to obtain any share.

In addition, some countries such as Russia, China and India have commercially deployed their rockets at a low price.

Further, it has been difficult for companies to maintain their profitability because the amount of production of space components and parts is so small and they are specialized goods.

Then domestic companies tend to withdraw from the business. On the other hand, importing space parts also causes many cases which include malfunctions caused by deterioration of quality and termination of supply due to sudden stop of production. Although Japan has accumulated technology in top-level in the world, the share in market is limited due to less experience in

orbital demonstration. Especially for observing sensors, in the area of optical sensors, which is implemented commercially, Japan has not gained much competitiveness.

In addition, as for test facilities necessary for research, development and manufacturing of satellites and launch vehicles, there are several problems including maintenance of aging facilities, and newly facilitating and refurbishment of facilities to eliminate the influence with development and production schedule.

According to a private study, the size of space equipment industry in Japan has decreased by approximately 40% in sales and nearly 30% in workforce in the past 9 years (from 1998 to 2006).

As explained above, it is the pressing challenge to enforce Japan's international competitiveness further to respond to the severe situation of the space equipment industry in Japan.

For the space utilization industry, public and private sectors provide funds to help development and operation of satellites and rockets. This is called Public Private Partnership (PPP). When the government makes policies such as for guarantee of product purchase, it leads to promote expansion of the space utilization service industry. In Japan, satellites for communication and broadcasting are independently launched and develop services, but in the utilization of satellite images, data from foreign satellites is mainly used.

In light of these circumstances, it is important to strengthen the international competitiveness by developing Japan's space industry into a strategic industry for the 21st century after the electric and electronic industries and automobile industry.

For the promotion of the policy, it is important to focus on strengthening technical ability, enhancing efficient development and production of private companies and developing new international markets, as well as to prepare for the maintenance and development of a space transportation method which supports Japan's autonomous space activities.

(6) Consideration for environment

The use and R&D of space provide benefit to the daily life of the people, but also have clues to solve the energy and the environmental issues such as global warming. On the other hand, the use and R&D of space themselves require consciousness toward the earth environment and at the same time toward the space environment.

For the aspect of the global environment, Japan's use and R&D of space are based on a pillar to contribute significantly to the global environmental issues such as climate changes. For that reason, implementation of the use and R&D of space must be based on the spirit and carried out with sufficient attention not to worsen the global environment.

For the aspect of the space environment, artificial materials such as spent orbital stage of launch vehicles and retired satellites left on the space and fragments caused by explosion and collision scattering in orbit, are infecting the operation of satellites and the human space activities at the International Space Station.

Chinese satellite fracture experiment of a ballistic missile in January 2007 and collision of the orbiting satellites of the United States and Russia in February 2009 caused a large amount of debris in space. The amount of debris is expected to increase further by chained collision of debris in the future.

In the future, as a country aiming to expand the use and R&D of space, Japan is required to take a lead in making a contribution to decrease the occurrence of debris caused by a launch of Japanese rockets and satellites and to increase the level of debris monitoring for preservation of the space environment in collaboration with the international society.

Chapter 3 Measures that the Government should take comprehensively and systematically for the use and R&D of space

1. Nine systems and programs for the use and R&D of space

For the promotion of the policy for the use and R&D of space, it is suitable to define the social demands of high expectation toward the use and R&D of space and set up a goal for countermeasures to satisfy these demands on the basis of the 6 objectives mentioned in Chapter 2. After that, it is reasonable to focus on achieving the goal and apply necessary policy through cooperation with public and private sectors in light of distribution of resources and cost-benefit performance.

Based on this philosophy, the social demands to be realized through the use and R&D of space and a specific goal to correspond to each demand for the next 10 years are summarized in this chapter and Appendix 1.

By combining efficiently and effectively various satellites, such as land and ocean observing satellites, data relay satellites, satellites for national security, global environment observing satellites, meteorological satellites, communication and global positioning satellites and scientific satellites, with programs of the International Space Station, or versatile utilization of individual satellite, the measures to be taken are consolidated into the following 9 systems and programs. The 5-year development and utilization plan of these satellites that overlooks the next 10 years from 2009 is formulated in Appendix 2.

Further, these systems and programs will be executed based on the opinions from the concerned industry-academic-government parties at the Committee Conference on Promotion of the Use and R&D of Space (tentative name and hereinafter referred to as "Committee Conference"), who are involved in research and development and utilization of space, and then the systems and programs are crystallized for the promotion. Evaluation will be conducted in an appropriate and timely manner and the results will be used for the promotion. Moreover, an appropriate space transportation system will be established to support these systems and programs at the same time of cultivating the space diplomacy and the space industry involved in common.

(1) Formation of utilization systems

A. Land and Ocean Observing Satellite System to contribute to Asia and other regions

As a satellite system that corresponds to the following major social needs and goals for the next 10 years, a land and ocean observing satellite system that contributes to Asia and other countries will be targeted for the promotion of the 5-year development and utilization plan.

1) Social needs and goals for the next 10 years

(a) Ensuring the public safety

- To correspond to the demands of "understanding information in the event of disaster in Asian region", information such as satellite images is provided when a disaster is occurred. However, it takes approximately one day for "Daichi" to provide images, which is insufficient to be used as an initial response to disasters, and also the resolution of images is insufficient to understand its detailed situation such as house and road damages. In addition, there is a limitation to satisfy the entire demands because information gathering satellites limit provision of images for a security purpose. For that reason, the followings are set as goals: (i) in case of disasters in Asian region, Japan will work together with stricken countries and others to basically take images within 3 hours after an occurrence of disaster, coupled with shooting from air planes, and then provide these images to stricken countries, also for the purpose to utilize them for relief activities by Japan, (ii) in case of disasters in Japan, images of stricken area will be taken to provide disaster relief agencies with detailed information such as house and road damages, along with the latest image archives. After that, image and information of crustal deformation will be provided to understand the status such as detailed situation of damage, a risk of secondary disaster and condition of rehabilitation and reconstruction, as well as to widely understand the stricken area. Further, in case of floods and sediment disasters, detailed information of house and road damages should be understood. For these purposes, maintenance and

utilization of satellites and sophistication of analysis method, such as using 4 to 8 units of optical and radar satellites, are targeted for better understanding of disaster condition.

Further, at the same time of disaster occurred in Japan, images will be taken in cooperation with a information gathering satellite in addition to the above mentioned satellite. Along with the past archived data, a land and ocean observing satellite system which can be used to contribute to Asia and other regions by providing images of a wider area and an information gathering satellite which can be used to provide analyzed information based on higher resolution image data will be utilized in a mutually complementary manner.

- To respond to the demands of "prediction and monitoring crustal deformation", as a country which is located in the area of one of the world's most active crustal deformation (movement of ground), GPS-based control stations installed in approximately 1,200 locations all over Japan are used to receive GPS satellite data and for monitoring the deformation. On the other hand, although a validation approach for utilization of a L band radar sensor has been carried forward, it has not been able to put in practical use due to the circumstances that there was a time gap between updates of the satellite and it was unable to be used for observation for a few years in addition to its fewer numbers of operation. In the future, crustal deformation will be broadly and densely monitored with the accuracy of 1 centimeter, by utilizing broadly analyzed results of satellite image obtained by acquiring information of the ground surface widely over a long duration continuously with high frequencies, in combination of specified point information provided by GPS-based control stations. This will enable monitoring by condition of a surface rather than a point. Prediction accuracy in crustal deformation and volcanic activities will be improved in the future, especially when a massive crustal deformation is predicted or a volcanic activity becomes increased. In the case, GPS receivers are used for temporary observation on site and conduct monitoring of target area at least every 3 hours. Also, by providing satellite image including information about discolored water as soon as possible, the satellite utilization will be realized as a method to monitor submarine volcano

activities.

(b) Preservation and management of territorial land

To answer to the demands of "gathering of land information", Japan has been recording and gathering images of the land from satellite. However, the operation of satellite is not serial, and gathering and provision of data was not conducted in a continuous and integrated way. For that reason, except for some of the empirical approach such as updating topographic maps on a scale of one to 25,000, the utilization is still insufficient as a whole. In the future, it is aimed that optical and radar sensors using a series of satellites are used to continuously and widely observe the land and the data is utilized as basic information for national land preservation and management, agriculture and forestry and environment by collecting and distributing them systematically. For example, by comprehensively improving image quality with enhanced resolution of optical stereo vision sensor by more than twice, Japan is to realize to make more detailed map and to expand its utilization for local governments and private sectors along with the areas of forest management and environment management.

Further, attempts have been made to monitor illegal logging and the World Heritages from "Daichi" showing that there is a potential to expand the utilization of Japanese satellite images in overseas.

(c) Facilitation of food supply (Updating agriculture and coastal fishing activities)

- To respond to the demands of "understanding growing condition and quality of grain and other agricultural products", satellite images can be analyzed to understand the growing condition and estimate of rice quality, such as rice's contents of protein and water, and its actual utilization has already started in some areas. Approach will be made in the future to improve the estimate accuracy and pursue the sophistication for farm management. Further, irrigated rice damages caused by disasters are currently assessed visually, but it is expected to have fewer loss assessors as decreased number of farmers, and it is a challenge to improve the method of loss assessment. Japan will aim to establish a loss assessment method using high-resolution satellite images to enable overall evaluation of

irrigated rice in Japan, and organize a system that can deploy the method in all prefectures, which is still in a validation phase at 14 prefectures. In addition, constant monitoring of conditions related to crop productions in the major area of breadbasket in the world will be realized to use for Japan's food supply strategy as basic information.

- To respond to the demands of "understanding fisheries", Japan will aim for healthy development of a fishing industry and stable supply of marine products by giving contribution to improve a prediction of occurrence of red tides harmful to coast fishing and aquaculture industry. Specifically, enhancement of resolution on optical sensors will allow not only to schematically determine the occurrence of red tides over the wide area of Tokyo Bay, but also to spot detailed damage condition, for example in the Tokyo Bay estuary.

(d) Facilitation of natural resources and energy supply

For the demands of "exploration of oil and mineral resources in land and seabed areas", satellite data has been used for natural resources exploration in continental areas, but its analysis ability has not reached its full potential. For that reason, an ability to detect minerals that make up geological layers that contain oil, and minerals such as rare metals, is improved by three times from the current ability of 10 types to 30 types. Also, it is aimed for continuous and wide area observation using a highly sensitive sensor to precisely and efficiently detect the possible areas of oil and minerals and upgrade the exploration method of resources contained in continental areas.

Further, there are various resources and energy existed over the Japan's territorial seas, said to be the world's 6th largest size, and exclusive economic zone, as well as possibly two hundred nautical mile of the continental shelf. There is an expectation to secure these resources, but the utilization is still limited that "Daichi" is used to observe the oil slick phenomenon (a release of crude oil from the sea floor and becoming an oil slick on the water surface) in a validation phase. In the future, Japan is to aim for improving the detection ability of oil slick by enhancing the sensor resolution and contributing to natural resources exploration of seabed in the water territories in Japan. The collected information will be utilized as basic information for the Japan's strategy to secure resources and energy.

(e) Others

To respond to maritime events such as smuggling in Japan's surrounding ocean area, illegal operation of foreign fishing boats, suspicious vessels, major accidents at sea, or sea piracy on sea lanes bound for Japan, the research and development of ocean monitoring system utilizing a satellite will be conducted. For example, the images taken from satellites as well as from airplane constantly or at least every 3 hours collaborating with a ground system to identify the target vessels would be effective.

2) 5-year development and utilization plan

To realize the above goals, the following measures will be taken:

- As the "ASTER sensor" equipped on the American earth observatory satellite Terra and "Daichi", both of which are currently in operation, will be used to gather information in the event of disasters and territorial land information as well as investigation of oil and minerals, it will be aimed to operate "Daichi" as a series and improve the abilities of optical sensors (including hyper spectral sensor) and radar sensors with wide adaptability and high resolution, advance the analysis method, and conduct the research and development to reduce process time as well as research and development of satellites. As a first step to do this, "Daichi-2" will be launched, equipped with L band radar which is unique technology of Japan to promote the utilization of a satellite.
- To conduct observation of Asia with great frequency and high resolution, It will be aimed to improve resolution of optical, radar sensor and small-sized satellite (ASNARO (tentative name)) in low cost. To realize this, Government will work together with private companies to research and develop a satellite and promote a launch of small-sized demonstration satellite equipped with optical sensors.
- A data relay satellite "Kodama" will be used to support global data transmission of "Daichi" and promote continuous securement of a data relay satellite necessary for continuous data transmission by "Daichi" series.
- For ocean monitoring, Government will conduct research and development of a method to gather information of marine navigation

necessary to secure vessel safety in collaboration with satellite images and information gathering system of marine navigation on the ground.

B. Global environmental change and weather observing satellite system

As a satellite system to respond to the following major social needs and goals for the next 10 years, a global environmental change and weather observing satellite system will be implemented and the 5-year development and utilization plan will be promoted:

1) Social needs and goals for the next 10 years

(a) Ensuring public safety

To answer to the demands of "high-precision weather forecasting", various observation data of the multifunctional transport satellites "Himawari-6" and "Himawari-7" have been utilized for weather forecasting and prediction of tracks of typhoons and its strength. However, currently there is a challenge that it is difficult to predict a very local and torrential downpour. For that reason, there is an expectation to enhance the total forecast accuracy. Japan will aim to increase the observation frequency for the distribution of clouds and moisture by the current 30 minutes to by 10 minutes and continue to provide information to people. Japan will also increase the accuracy of weather forecasting by doubling the sensor resolution and gathering detailed information to utilize the data for disasters such as very local heavy rain.

(b) Facilitation of food supply (advancement of deep-sea fishery)

To realize healthy development of the marine products industry and stable supply of marine products, it is essential to conduct scientific investigation to improve the forecast evaluation accuracy for the condition and movement of fishery resources. As one of the methods, utilization of observed data for sea temperature, oceanic current and ocean color provided by satellites has reached its practical realization. However, the current situation only allows seeing the comprehensive condition of oceanic current and other information. Therefore, in the future, Japan will aim to prepare a structure for easy data access and to improve the productivity of fishery and realize efficient support of

operation, together with having regional fishery information with the increase of spatial resolution by the sensors boarded on Japan’s satellites.

(c) Resolving the global-level environmental issues (realization of low carbon society)

In collaboration with land and ocean observing satellite system to contribute to Asia and other regions, Japan will respond to the following demands:

- To respond to the demands of "gathering information of global distribution and the amount of absorption and emission related to greenhouse gases such as CO_2 and methane gas", distribution of greenhouse gases concentration had been measured at limited locations (approximately 280 locations) on ground. However, Japan's Greenhouse gases observing satellite "Ibuki" launched in January 2009 enabled observation at 56,000 points globally and it was in a phase to observe and analyze the globe cyclopaedically. Further, among the land and ocean observing satellite system to contribute to Asia and other regions, "Daichi" has been used for the development of evaluation methods of greenhouse gasses emissions from forest degradation. In the future, "Ibuki" would be used for continuously detecting more detailed greenhouse gasses absorption and emissions in each region and absorption by forest ecosystem while continuous observation of the global distribution of greenhouse gases concentration and improvement of sensor ability by twice as much as the present ability to increase the measurement point and its accuracy. It would enable precise understanding of the change in absorption and emission of greenhouse gases caused by the change of climate condition and logging and providing scientific evidences for the emission reduction of greenhouse gases in the future which the entire world must tackle with. Also, by improving the resolution performance of "Daichi" and then detecting more detailed changes in forests and vegetation as sinks of greenhouse gases, “Daichi” would be utilized for gathering information and verifying the Reducing Emissions from Deforestation and Forest Degradation (REDD) in developing countries. Through these activities, Japan will aim to

contribute to the global warming countermeasures effective for the next phase of the Kyoto Protocol.

- To respond to the demands for "understanding the global water circulation and environmental changes", Japan has been conducting the observation of precipitation distribution related to water cycle and clouds and aerosol distribution related to the global environmental changes in international frameworks using overseas satellites, but it requires continuous observation to see the long-running changes and it is expected for the further improvement of prediction accuracy. For that reason, Japan will aim to improve the accuracy by doubling the current ability to measure the global precipitation distribution and improve the ability for higher accuracy by more than twice as high as the current ability for clouds and aerosol distribution in international frameworks for the future. Also, Japan will aim to clarify and establish methods for generating mechanism of abnormal meteorology such as El Nino, desertification and torrential rainfall, and to establish the clarification and forecast methods for global environment changes and water circulation mechanism by understanding them continuously, globally and in more details, as well as to conduct disaster prevention by providing necessary information quickly and properly.

2) 5-year development and utilization plan

To realize the above goals, the following measures will be taken:

- As for the "AMSR-E sensor" equipped on the American earth observatory satellite "Aqua" and "PR sensor" equipped on the American tropical rainfall measuring mission "TRMM" which are currently in operation, it will be aimed to continue the global observation of the water cycle which is a major cause of the global environment changes and continue to observe the amount of rainfall and moisture, and also advance research and development to enhance the ability of sensors and the analysis method as well as the research and development of satellites. Of the Global Change Observation Mission (GCOM), GCOM-W will be launched at first. Then, research and development of the Dual-frequency Precipitation Radar sensor (DPR) will be advanced to observe a perpendicular

distribution in the precipitation area and equipped on the American Global Precipitation Measurement (GPM) satellite for launching

- Further, of the GCOM, while improving the ability of the global imager sensor to understand the amount of clouds, aerosol and vegetation and advancing the research and development of GCOM-C including enhancement of analysis method, Government will conduct the research and development of the Clouds Profiling Radar CPR) sensor to observe a perpendicular distribution of clouds and aerosol and their movement and equip the sensor on the European Earth Cloud, Aerosol and Radiation Explorer "Earth CARE Mission satellite" for launching.
- While "Ibuki" will be used for measuring a concentration distribution of the global greenhouse gases which is a cause of the global warming as well as the global temporal variation, Government will advance research and development to improve the analysis method and ability of sensors.
- While "Himawari-6" and "Himawari-7" will be used for continuous weather forecasting, the geostationary global environment observation satellites "Himawari-8" and "Himawari-9" with twice higher resolution of a sensor than those of "Himawari-6" and "Himawari-7" attempt to improve weather forecasting accuracy for very local heavy rain. Further, "Himawari-6" and "Himawari-7" have an air traffic control function as multifunctional transport satellites and will be used this function continuously.

C. Advanced telecommunication satellite system

As a satellite system that corresponds to the following major social needs and goals for the next 10 years, an advanced information and communication satellite system will be implemented for the promotion of the 5-year development and utilization plan.

1) Social needs and goals for the next 10 years

(a) Ensuring the public safety

To respond to the demands of "securing a communication method in case of disasters", commercial communications satellites are used in the event of disasters for disaster information distribution and communication by the government and local public agencies. However,

it requires a ground-based station for a satellite (receiving antenna and special equipment), and communication via general methods such as widely used mobile phones holding a hundred million subscribers becomes disconnected when there is damage to portable base stations on ground. For that reason, Japan will aim to conduct research and development to enable satellite communication only by mobile phone terminals and to use both a ground system and a satellite system and bring it to a validation phase using engineering test satellites.

2) 5-year development and utilization plan

To realize the above goals, the following measures will be taken:

- It will be aimed to advance research and development on an interference avoidance technique, coordination technique of a ground system and a satellite system and large deployable antenna technique to enable to use the same frequency band in the ground system and satellite system in an attempt of realizing a ground/satellite commonly used mobile phone system in which mobile phone terminals can be used for communicate via both ground and satellite communication.
- Further, Government will conduct a utilization and validation experiment of high speed Internet communication in the Asia-Pacific region and isolated islands using the ultrahigh-speed Internet satellite "Kizuna", as well as utilization and validation experiment of mobile telecommunications from the engineering technology satellite VIII type "Kiku-8".

D. Positioning satellite system

As a satellite system that corresponds to the following major social needs and goals for the next 10 years, a positioning satellite system will be implemented for the promotion of the 5-year development and utilization plan.

1) Social needs and goals for the next 10 years

(a) Enhancement of the domestic quality of life (Improving convenience)/ Ensuring the public safety

To respond to the demands of "realization of highly accurate positioning", currently services using a positioning satellite system such

as car navigation systems are widely spread and the utilization of a positioning satellite has been expanding, but it has not been able to pinpoint a location of people. For that reason, Japan will aim to achieve highly accurate positioning using a Quasi-Zenith Satellite System and improve its convenience by creating new applications such as a seamless personal navigation that works with satellite and ground systems, and to realize safety of the country and people to response to the needs of "ensuring the public safety" in the future. Further, by establishing a structure using 3 satellites after validation of technology and ability of a Quasi-Zenith Satellite System, supplementation and backup of systems for GPS become possible. Also, by using 7 satellites, a self-contained satellite positioning system can be established that covers the East Asia and Oceania region.

2) 5-year development and utilization plan

To realize the above goals, the following measures will be taken in cooperation with the government's "Basic Plan for the Advancement of Utilizing Geospatial Information" and "Action Plan for the Advancement of Utilizing Geospatial Information":

- For a Quasi-Zenith Satellite System that is a core of a positioning satellite system, Government will conduct technical and utilization verification and promote measures for system verification, as well as to promote a new usage that links with ground systems such as a personal navigation system with help of both public and private sectors.

E. Satellite system for national security

As a satellite system that corresponds to the following major social needs and goals for the next 10 years, we will promote a 5-year development and utilization plan of satellite system for national security purposes.

1) Social needs and goals for the next 10 years

After the launch of North Korean missile Taep'o-dong in August 31, 1998, Information Gathering Satellites were introduced mainly for national security purposes in light of diplomacy and defense as well as for crisis management in case of wide-scale disasters. Since then, a creation of four-satellite systems, two optic and two radar, in order to take images of

a specific location on earth more than once a day was set as a goal. However, this four-satellite system is yet to be fully established until now.

Further, the use and R&D of space for national security purposes have been limited to "generally-used satellites and those with equivalent functions".

From now on, it will be aimed to enhance the information gathering functions by increasing opportunities to take images areas of interest, improving quality of images and shortening time for information-sharing, as well as to reinforce functions for surveillance and reconnaissance activities in nautical and airspaces surrounding Japan. With this in mind, it will be aimed to promote new policy for the use and R&D of space for national security purposes including research of sensors for an early-warning system.

2) 5-year development and utilization plan

To realize the above goals, the following measures will be taken:

(a) Expansion and reinforcement of Information Gathering Satellites' functions

In the next 5 years, Government will establish the aforementioned system of four satellites and increase the amount of information by increasing the frequency of image-taking improving the quality of information through enhancement of the resolution of optical and radar satellites which exceeds the level of commercial satellites. Government will also improve data timeliness by shortening the processing time and shorten time required between the time of a request and distribution of products. By making these efforts, Government should be able to improve and reinforce the function of Information Gathering Satellites and intensify information gathering abilities required for the support of national security purposes in light of diplomacy and national defense and the crisis control management in case of major disasters.

(b) New use and R&D of space in the national security field

Government will aim to steadily promote research of sensors for an early-warning system and research of radio property for a validity check of a radio information gathering function in space.

(2) Promotion of research and development programs

F. Space science program

As a program that corresponds to the following major social needs and goals for the next 10 years, space science program will be implemented for the promotion of the 5-year development and utilization plan.

1) Social needs and goals for the next 10 years

(a) Creation of scientific achievement to lead the world (accumulation of intellectual assets)

To respond to the needs of "continuous creation of world-leading achievement in science research", Japan has made world-leading achievements in space science such as space astronomy and solar system exploration. The achievements in space science are a basis of the entire use and R&D of space. In the future, Japan will take a close collaboration with other fields beyond space science and aim to promote the study based on a reinforcement of the structure to promote participation of excellent scientists of universities, as well as to continuously create world-leading achievements.

2) 5-year development and utilization plan

To realize the above goals, the following measures will be taken:

- Aiming to create scientific achievements leading to understanding space itself, Government will launch the Radio Astronomy Satellite "ASTRO-G" for scientific observation and conduct research and development of the next generation X ray Astronomy Satellite "ASTRO-H", while conducting an X ray observation by "Suzaku" and infrared observation by "Akari" both of which are currently in operation.
- As a solar system exploration, It will be aimed to create scientific achievements leading to understanding of the solar system and earth (including atmosphere and magnetosphere). Targeting the sun, moon, terrestrial planet (Mercury, Venus and Mars), Jupiter and its satellites and asteroids, a Venus probe "PLANET-C" will be launched for scientific observation, and research and development of the Mercury exploration project "Bepi Colombo" and the follow-on mission after "Hayabusa" will be conducted, while conducting

magneto spherical observation by the currently operating magnetosphere exploration satellite "Akebono" and the magneto tail observation satellite "GEOTAIL", asteroid samples collection by "Hayabusa", a solar observation by "Hinode" and lunar exploration by "Kaguya".

- To realize lower cost, faster and challenging research of space science, Small Scientific Satellite will be used. Around a set of three small scientific satellites will be launched every 5 years to respond to the various requests of scientists.
- To respond to the use by various scientists, data collected by science satellites will be accumulated and published.
- Other than satellites, as the research of various flying methods of vehicles and a part of the science and engineering research utilization the followings will be promoted:
  - Astronautical engineering study and its flight demonstration to renovate flying methods of large balloons and Sounding rockets, as well as space and astronautical science using these methods.
  - Space biology and microgravity science for creation of scientific achievements in biological science, material science and fluid science, using the microgravity environment in Sounding rockets and "Kibo".

G. Human space activity program

As a program that corresponds to the following major social needs and goals for the next 10 years, the human space activity program will be targeted for the promotion of the 5-year development and utilization plan.

1) Social needs and goals for the next 10 years

(a) Enhancement of the domestic quality of life (realization of a healthy and long-lived society)

In order to satisfy the needs of "realization of a healthy and long-lived society", the prevention study of osteoporosis and urinary calculosis and effective application of high quality protein crystallization for drug development have currently been conducted by applying the research achievement of space medicine for the senior citizen medical care, but they are not for practical use yet. For that reason, from now Japan will

aim to achieve practical results through the use of the microgravity environment focusing on the issues for the life of people and the solutions for social issues such as medical care for elders, problems of nursing care and drug development.

(b) Creation of scientific achievement to lead the world (accumulation of intellectual assets and expansion of activity area of humans)

To respond to the needs of "continuous creation of world-leading achievement of science research", Japan has achieved results to lead the world in the structural survey by "Kaguya" and space science utilizing the microgravity environment in "Kibo". Japan has also been undertaking various efforts to expand the activity domain of humans through the solar system exploration and activities in the International Space Station. In the future, Japan will focus on continuously creating the world leading results in the fields such as biological science, materials/fluid science and space environment utilization science. Further, by promoting the space activities of humans and robots, Japan will aim to expand the activity domain of humans and realize the moon exploration using robotics by around 2020, with a view of cooperation of robots and humans.

2) 5-year development and utilization plan

To realize the above goals, the following measures will be taken:

- Japan will focus on issues to respond to the social demands in drug development and medical fields and food, energy and nano material fields and to promote the space environment utilization close related to people's life such as realizing better life for people and corresponding to issues concerning clothing, food and housing as well as excretion issues in the aging society. In addition, as the only participant in the International Space Station Program in Asia, Government will promote the international cooperation with Asian countries by providing them with the opportunities to use "Kibo" for experiments.
- In the scientific research utilizing microgravity, Government will continue the selection and promotion of researches aiming to achieve the scientific results to lead the world as well as to promote

the commercial use by private companies and the accumulation of technologies that leads to the future human space activities. And It will be aimed to promote new technology development for the basic experiment such as space solar power by utilizing the characteristics of "Kibo" equipped with the exposed experimental platform unique among the other partners of International Space Station Program.

- In addition, "Kibo" will be used as a "geosphere observation and diagnosis station" to deepen the understanding of the human's homeland, the Earth. And Japan will contribute to the world's environmental observation within the framework of international cooperation led by Japan by installing sensors such as "SMILES" (a sensor to diagnose the ozone layer at the mid and low latitudes) to observe the earth on the exposed experimental platform of "Kibo" for gathering and transmission of information.
- The utilization of "Kibo" will be promoted, conducting maintenance and operation of "Kibo" consistently, and a H-II Transfer Vehicle will be launched to the International Space Station every year in order to conduct transportation of goods necessary for operating the Space Station (laboratory equipment water, food, etc.) based on the international agreements.
- Government will conduct the examination of the moon exploration with robots technologies in perspective of human space activities. (See item 2, (4), (2), (b) in Chapter 3.)

H. Space Solar Power Program

As a program that corresponds to the following major social needs and goals for the next 10 years, a Space Solar Power Program will be targeted for the promotion of the 5-year development and utilization plan.

1) Social needs and goals for the next 10 years

(a) Resolving the global-level environmental issues (realization of low carbon society)

To respond to the demand of "realization of energy to support the low carbon society", renewable energy power (for example, solar power generation and wind-generated power) has been used on earth, but there are some stability issues, and the utilization of energy to overcome these issues has not been realized in space. In the future, research and development of the technology necessary to realize the

solar power generation system in space for clean and stable energy utilization without any geopolitical influences, Japan will aim to have prospects for practical application within the next 10 years, comparing with the progress of the renewable energy development on earth.

2) 5-year development and utilization plan

To realize the above goals, the following measures will be taken:

- Government will examine the system for the development of space solar power program from a comprehensive point of view in collaboration with related institutions, and also conduct demonstration of technologies for the energy transmission technology in parallel. Based on the result, Government will conduct ample studies, then start technology demonstration project in orbit utilizing "Kibo" or small sized satellites within the next 3 years to confirm the influence in the atmosphere and system check.

I. Small demonstration satellite program

As a program that corresponds to the following major social needs and goals for the next 10 years, a small demonstration satellite program will be targeted for the promotion of the 5-year development and utilization plan.

1) Social needs and goals for the next 10 years

(a) Continuous development of industry and creation of employment

To respond to the demands of "expansion of new industry and space related industry as well as creation of employment", it is required to expand industrial areas besides the space equipment industry under the current situations. Also the space industry is the important strategic industry to steadily promote the systems and programs of A to H described above. With these in mind, it is important to eliminate technical risks of new technologies from the viewpoints of reinforcement of industrial structure, improvement of international competitiveness and advancement of the use and R&D of space. For that reason, Japan will aim to promote demonstration of leading-edge technologies utilizing small satellites and to promote support for small and medium-sized companies, venture companies and universities to develop micro satellites, which leads to the development of new industries and space related industries and creation of employment.

2) 5-year development and utilization plan

To realize the above goals, the following measures will be taken:

- As a strategic industry that supports Japan's space development and utilization, the Japanese unique strength of miniaturization techniques will be utilized as a part of increasing competitiveness in space related industries, launch small satellites (100 kg to 1 t) and micro satellites (under 100 kg) in collaboration with small and medium size companies, venture companies and universities, and the latest technologies in orbit such as satellite system technologies and parts/components will be demonstrated.
- Government will provide support for production and expand opportunities to launch micro satellites developed by small and medium size companies, venture companies and universities.

2. Promotion of specific measures in each area

(1) Promotion of the use and R&D of space to support realization of a secure, pleasant and affluent society

To realize a secure, pleasant and affluent society, the following four systems will be mainly used:

A. Land and ocean observing satellite system to contribute to Asia and other regions

B. Global environmental change and weather observing satellite system

C. Advanced telecommunication satellite system

D. Positioning satellite system

Further, building the satellite data utilization system will be promoted to improve and expand convenience of satellite data utilization for specialists and general users.

1) Building the satellite data utilization system

The "satellite data utilization system" is a comprehensive name of a series of hardware/software and human resources from receiving satellite data to providing necessary data to users. This is equivalent to an infrastructure on the earth for providing observation data by satellites.

The data handled by satellites can be classified into "image data"

(acquired by optical sensors and radar sensors of land and ocean observing satellites), "positioning data" (transmitted by positioning satellites), "communication data" (handled by communication satellites) and "other measurement data" (such as observation data of greenhouse gases in the atmosphere and X-ray emission from celestial objects). Currently, the use of image data is widened in various operations of the national and local government such as maintenance and modification of registration book of the cultivated acreage survey in Japan, update of topographic maps on a scale of one to 25,000 and gathering information of flooded areas promptly in the event of floods. For that reason, particularly "image data" should be focused and, therefore, "satellite data" mentioned here means "image data". However, "image data" intended for the national security is not covered here.

(a) Collecting users' opinions

To provide a place for ongoing understanding of the utilization needs of satellites, the Committee Conference will be used in which relevant government agencies and related parties in industries and universities participate. The Committee Conference will figure out the status of satellite utilization in relevant government agencies and other organizations, collect various opinions based on actual experiences such as improvement of satellite operation methods, functions and utilization methods of new satellites and sensors, and promote the measures and policies by reflecting these opinions to the future development and utilization of satellites.

(b) Satellite data utilization system for improvement of user convenience

Currently, the satellite data is stored, maintained and provided by multiple institutions, and searching and ordering data is conducted for each satellite and mounted sensor. Therefore, it is difficult for general users to find out where to access for necessary data without having knowledge about satellites and sensors. For example, if there is an interface that allows access to various satellite data from a single online search, the convenience for specialists and general users will be improved. In addition to the search, if the system to obtain the required data with a single operation is realized, the convenience increases

much more.

To realize this kind of environment, Japan will promote measures and policies to prepare data archive and data distribution system. For the promotion of the measures and policies, concerned parties including relevant government agencies and private companies will understand the demands of users and examine a distributed system by connecting data administrators on the network and specific methods of search and distribution, on the premise that the data directly sent from satellites will be maintained by data administrators of each satellite. Government will aim to achieve maximum effects with fewer budgets by utilizing know-how of private sectors while using the existing system assets as far as possible.

(c) Creating of standard data policy

For a preparation of the satellite data distribution system, it is necessary to examine the way to provide data in consideration of a balance between the method of data provision from a viewpoint of usage promotion and the market deployed globally on a commercial basis and also in consideration of usage purposes, image resolution as well as a use fee.

Further, it is necessary to organize the way of thinking to process information by secondarily adding other information to the provided satellite data and providing data to the third party, in collaboration with the movement of the related areas such as "Basic Plan for the Advancement of Utilizing Geospatial Information".

Besides the above, it is necessary to create and publish guidelines as standard data policies for provision of satellite data including preparation and standardization of metadata and security policies such as preventions of database falsification, and to prepare an environment for a safe use by showing requirements for the data use.

The concerned parties of relevant government agencies and private companies will examine these measures and summarize them into a standard data policy within one or two years.

(2) Promotion of the use and R&D of space to reinforce the security of Japan

To reinforce the national security, the following measures will be taken in

addition to the ones stipulated in "E. Satellite system for national security":

1) New use and R&D of space in the area of national security

In Japan, a sufficient level of expertise on the use and R&D of space is yet to be accumulated in the defense sector. For this reason, cooperation between related institutions is important to actively utilize the leading civilian technology (“spin-on”).

Further, sensors which are necessary for an early-warning system to detect ballistic missile launch have a variety of use such as detection of forest fire. The Japanese government as a whole will therefore seek to promote effective utilization of these technologies by combining functions of defense purposes together with functions for other purposes.

2) Data management for national security

As commercial imaging satellites already reached high resolution ability, other countries have set rules to regulate general use of high resolution image information, such as "shutter control" (a regulation of shooting, distribution and sales of images of important facilities for security purpose) and sales restriction of images which exceeds certain levels of resolution. Taking into consideration the future advancement of the research and development of higher resolution imaging satellites, Government will examine to create necessary rules from the viewpoint of national security in collaboration with the Committee on the Advancement of Utilizing Geospatial Information.

(3) Promotion of the use and R&D of space contributing to diplomacy and diplomatic effort for space

Diplomacy will be covered by the whole system programs of A to I.

1) Contribution to the Asia-Pacific region

- In Asia, Japan will establish a leadership by utilizing the leading role in the APRSAF and the position as the only participant of the International Space Station program in Asia.

  Further, by linking the operations in the APRSAF and the bilateral cooperation utilizing various support tools such as ODA properly, Japan will provide contribution so as to show the Japan’s presence, such as providing public funds for construction of ground reception stations for

earth observation satellites, not to mention the provision of satellite images through the Sentinel Asia.

- APRSAF was established to provide a framework among space institutions in the Asia-Pacific regions led by Japan and it has conducted various exchanges and operations. Because there is a great expectation to Japan from related countries, it is effective to use the APRSAF when providing contributions to the use and R&D of space in these areas. On the other hand, the APRSAF can be used to establish the government level space network such as hosting an international ministerial-level meeting in regard to space by taking opportunities of ministerial-level meetings for science technology in Asia.
- In the future, when considering efficient utilization of a Quasi-Zenith Satellite System, Government will examine its characteristics of providing positioning information not only to Japan but also to the Asia-Pacific regions.
- By proceeding observation by "Himawari", Japan will provide further contribution to monitor disasters and the environment of the Asia-Pacific regions by providing higher resolution images more frequently.
- By utilizing approaches made to the Asia-Pacific regions, Japan will develop the contribution to other countries in Middle East, Africa and South America where the demand for the use and R&D of space has been increasing.

2) Contribution to the global environmental issues

- Japan can provide further contribution to the global environmental issues by utilizing "Ibuki" which was launched in January 2009 to observe the greenhouse gases, and satellite clusters GCOM used for observation of climate and water cycle changes which is to be launched in the future, as well as "Himawari-8" and "Himawari-9" with enhanced function of the global monitoring function. Japan will take initiative in the international discussions concerning the construction of international frameworks of global environment observation and monitoring not only through obtainment and publication of data from satellites but also through transmission of data analysis results.
- Japan has been contributive to the global environmental issues caused by the climate changes. In addition, Japan will take active participation in new challenges such as decreasing space debris as a space

environmental issue.

- Japan will aim for mid-and-long term development of human resources to take a leading role as a chairman for international for a including COPUOS through providing opportunities to gain experience in international diplomacy for people having knowledge in space areas as well as enhancing education of space science and engineering in universities and other educational institutions.

3) Enhancement of bilateral relation

- Between the U.S. and Japan, there is long-term and multidisciplinary collaborative cooperation such as complementary and reinforced cooperation in the positioning information of the U.S. GPS constellation and the Japanese Quasi-Zenith Satellite System, collaborative cooperation in the GX rockets, as well as participation in a cooperative program to share parts in development of a satellite and its launch in the areas of earth observation and space science. Japan will establish a Japan-U.S. space forum to discuss further collaboration in the space field to promote this closer relationship.
- Between Europe and Japan, there is cooperation such as mutual accommodation of strategic parts, technical adjustment between the Japanese Quasi-Zenith Satellite System and European satellite system Galileo, as well as participation in a cooperative program to share parts in development of satellites and these launches in the areas of global observation and space science. Each of European countries helps each other in the areas of their specialty independent from the U.S., and Japan will try to establish a space forum to deepen cooperation in space governance, space science and space utilization (for example, collaboration between land and ocean observing satellites of Japan and Europe which work in a different time zone).
- In relation to other leading countries of the space development and utilization (Russia, China and India, etc.), Japan will establish close relationship with them based on the technical capabilities of each country.
- In relation to developing countries, Government will collect and analyze information not only from overseas offices of relevant ministries and agencies but also from private companies and establish plans of important areas and items for the future support projects. Government

will also try to seek for demands of the use and R&D of space in each country by utilizing governmental funds via ODA and Japan Bank for International Cooperation (JBIC).

Japan has to support the demands as a whole; therefore, Governmetn will clarify a person in charge of a support project and reinforce collaboration among domestic relevant ministries and agencies including Japan International Cooperation Agency (JICA) and JAXA as well as collaboration among overseas offices (local offices of Japanese embassies, JICA, JAXA, Japan External Trade Organization (JETRO), JBIC, etc.) and among Japanese government and the overseas offices. Also, Japan will organically combine multiple support programs of Japan such as providing governmental funds, technical cooperation and cultivation of human resources.

Government will use top-level sales and the network of diplomatic establishments abroad for exploitation of a new market abroad.

- Japan will provide assistance to developing countries under the concept of "human security" that is a pillar of Japan's foreign diplomacy. When providing support, it is important to pay attention not only that the assistance should promote each country's use and R&D of space but also that its effects should result in the protection and enrichment of people's lives and livelihoods from various threats such as disasters, environmental degradation and climate changes.

(4) Promotion of the world's leading research and development

As the world's leading research and development, the following programs will be promoted:

F. Space science program
G. Human space activity program
H. Space solar power program

To advance these programs, following measures will be promoted:

1) Promotion of space science research challenging for scientific discovery

For promotion of space science program, scientific research and engineering research will be conducted in an integrated manner with not

only the collaborations of JAXA and researchers of universities at the individual level but also the utilization of inter-university institutes. Also, the system of space science researches will be reinforced by the collaboration and unification of various fields in earth science, plasma science, astronomy using observation facilities on the earth and a large accelerator such as in the international linear collider concept. With these efforts, It will be aimed to continuously create world's leading scientific achievements and utilize the evaluation and selection process of themes and contents in the space science areas as well as promote and maintain the principles of independence, democracy, openness and international cooperation.

Further, the results of advanced technologies will be applied actively for space development utilization fields and industries other than the space science.

2) Promotion of human space activity

(a) International Space Station Program

As for the operations of the International Space Station, a specific plan after 2016 has not been made internationally, and it is still in a phase to discuss about extending its operation among the international partners of Japan, U.S., Russia, Europe and Canada. Government will comprehensively determine the extension of its operation after 2016 in consideration of the utilization results, Japan's future plan for human space activity and the status of each county.

(b) Moon exploration with robot technologies in perspective of human space activities

The moon has a similar origin as the earth and plays an important role for scientific elucidation of the origin and evolution of the solar system, and the possibility of resource utilization is uncertain. Therefore, the moon will be the main target of the solar system exploration in the immediate future.

Government will conduct the examination of the Japanese-original, extensive and long-term moon exploration to lead the world to solve the origin and evolution of the moon and to investigate the possibility of scientific use and resource utilization of moon, in perspective of manned activities on the moon which enables sophisticated judgment at the place

Specifically, while taking the following plans into consideration in perspective of collaboration of robots and human activities, Government will take approximately a year to make a full-scale effort to consider significance, goal, target achievement, research and development items, technical steps, medium- to long-term schedule and cost estimates. In addition, while keeping original goals, Government will pay attention to the movements of each country and consider possibilities of international cooperation, and at the same time, Government will promote these activities under a proper structure of evaluation system.

- As a first step (around 2020), it will be aimed to realize robotic exploration on the moon by advanced robots such as a bipedal walking robot utilizing the Japanese specialty in robot technologies as a preparation to construct the base for scientific exploration.
- As the next step, it will be aimed for the development of full-scale exploration in collaboration with humans and robots by utilizing the base for manned scientific exploration.

Establishing footings for human space activities through this plan will bring in various significances such as exertion of leading scientific technologies, accumulation of human intellectual assets, most advanced technological power including accumulation of industrial power for the future and development of human resources, securement of national benefits and improvement of international presence through enhanced diplomatic power as an advanced country, as well as a value to have dream, confidence and pride for the people. On the other hand, it requires a large amount of funds to cover the entire activities individually, and it is essential to consider the Japanese culture that values a human life more than anything. For that reason, it is necessary to make efforts step by step toward the improvement of ability to conduct manned spacecraft activities by utilizing achievements through activities of the International Space Station program and constructing base technologies from longitudinal perspectives.

3) Promotion of the leading research and development contributive to the measures for the environment and energy problems

(a) Space solar power program

The space solar power program is a new energy system which

generates energy by collecting solar energy in space and sending it to the earth to use it as electricity. The space solar power generation in space is not influenced by the weather nor time of day, and it can stably generate power with approximately 10 times higher efficiency than that of solar photovoltaics on the ground.

To realize economically-efficient space solar power generation compared to a solar power generation and other energy system on the ground, various advanced techniques are required such as those to efficiently gather energy in space, send out energy efficiently and safely from space to the ground, and transport goods to space economically and structure large scale constructions.

To nail down these technical challenges, "H. Space solar power program" will be promoted based on the research to date.

Further, Government will determine its development toward the practical use in consideration of system examination, technical verification, comparison with competitive technologies and necessary expenses in this program.

(5) Fostering space industries as a strategic industry

The space industrial development will be covered by the entire systems and programs of A to I.

1) Reinforcement of international competitiveness

(a) Promotion of reinforcement of international competitiveness in space equipment industries such as satellites, rockets, and parts/components.

To maintain independent space activities and reinforce international competitiveness toward increase of sales in the space equipment industries such as satellites and rockets, it is necessary to maintain and reinforce a basis for competitive power such as base technologies and facilities usable for industries in consideration of international market competitiveness. For that reason, the following measures and policies will be promoted:

- To improve performance of satellites and rockets, increase their reliability and reduce their costs, Government will make efforts to

the continuous research and development and demonstration on orbit using small satellites of improving system technologies such as formation flight technologies of satellites and to improve performance of rockets, and parts and components such as satellite observation sensors and avionics of rockets, by using the most advanced technologies of information communication.

- To ensure stable procurement of strategic parts and components, it will be aimed to accelerate the domestic production of strategic parts, securing a second source for single source parts and utilizing commercial parts including applying the excellence technologies possessed by mid and small companies and universities. Further, it will be aimed to reinforce the international competitiveness further by properly applying the most advanced commercial parts with high quality and performance.
- Government will promote structured accumulation and maintenance of technical information such as design standards of space equipment and reliability technology as a shared infrastructure, and sharing and utilizing it within government, industry and academia.
- It will be aimed to conduct appropriate maintenance, upgrade and repair of test facilities and equipment which are infrastructure necessary for the research and development of satellites and rockets in order that space industries and organizations can use them whenever they want and then extend their use to private companies further.
- To maintain independent abilities of tracking and controlling of satellites and rockets, Government will maintain and develop technologies necessary for these activities as a base technology, and advance utilization of the leading information communication technologies as well as appropriate maintenance and upgrade of facilities and equipments. Further, for smart operation of satellites, Government will develop a transportable data receiving system and integrated high-speed data processing system. In addition, from a viewpoint to maintain independent and stable operations of Japan's satellites, Government will make efforts to secure the positions for satellites on stationary orbit and frequencies through the International Telecommunication Union (ITU).
- To gain predictability of corporate activities and promote an efficient

development and production of space equipment by companies which leads to cost reduction, Government will propose medium- to long-term satellite development and utilization plan indicated in Appendix 2, and examine cross-sectional schemes in systems and programs for miniaturization of satellites and parts/components, series production, commonization and standardization, as well as promotion of block buy, productivity increase and investment of companies.

(b) Expansion of the base for the space utilization industry and promotion of international competitiveness reinforcement

To expand the base of the space utilization industry and reinforce the international competitiveness, the following measures will be taken:

- As one of measures to secure an initial demand to launch a new service in the space utilization industry, Government will examine to purchase a commercial service, and promote PPP activities for help of the private sectors entry into public service.
- For satellite image data which can be a significant business resource for the space utilization industry, Government will secure data accessibility in a form that users are easy to use and conduct continuous data provision and user support, as well as create ideas to promote innovation of the space utilization industry by providing utilization examples of satellite data.
- Through these utilization promotion measures, Government will create new business and data usage applications and make efforts to expand the base of space utilization by promoting the entry of venture companies which can be new providers of space utilization. Moreover, Government will pay attention to the international trend of new space utilization business such as space travel.

(c) Promotion of research and development for reinforcement of international competitiveness

As a research and development to reinforce international competitiveness in space industries, the measures based on the following points of view will be promoted. At the same time, small satellites will be actively used based on "I. Small demonstration satellite program".

- Government will establish and share research and development

goals and roadmap plans with public and private sectors in consideration of international market competitiveness and promote research and development based on them.

- It is important to conduct both short-term development and mid- to long-term development. The former is the research and development leading to the enhancement of competitiveness of systems and the securement of independency with the aim of increasing cost competitiveness, reliability and performance, and the latter is the research and development of latest technologies including fundamental research to create international competitiveness in the future.
- For a technology with high technical risks to be installed on practical-use satellites, Government will make a package plan ranging from the research and development to actual demonstration featuring a demonstration plan in space to demonstrate it in advance using small satellites.
- Industries competitiveness will be increased by reinforcing collaborations with industries in the areas of the latest research and development in space science and applying the achievements to industries.

(d) Promotion of international market development in perspective of using top-level sales

Domestic demands from public and private sectors are insufficient to benefit satellite and rocket industries. Therefore, it is necessary to develop international markets such as those of the U.S. where there has already been an enormous market and the Asia/Pacific areas and Africa where a future growth is expected. Further, it is necessary to draw up strategies from a comprehensive viewpoint including the operation , systems on the ground, utilization service ,application and human resource development, not to conduct the market development of a satellite alone.

With these in mind, the development of the international market will be promoted under the following strategies:

- To cope with demands of other countries and explore a market for the Japanese space equipment and application, Government will work together with overseas diplomatic facilities to reinforce

community-based promotion and information gathering activities in collaboration with companies. By analyzing the needs obtained through these activities, Government will advance market development in consideration of promoting satellites and application systems as a total package.

- Based on the analyzed results of activities for finding needs as described above, Government will develop international market by efficiently conducting top-level sales.

2) Promotion of construction of space transportation system to support independent space activities

The space transportation system is an essential technology to allow Japan to launch satellites to space independently as needed. From this viewpoint, H-IIA/H-IIB rockets are developed and operated as Japan's backbone rockets, and are used for launching Japan's important satellites including information gathering satellites, land observing satellites, meteorological satellites and the H-II Transfer Vehicle for the International Space Station. In addition, M-V rockets are used for launching scientific satellites that contribute to the accumulation of Japan's intellectual assets, and after termination of the operation, the solid rocket system technology is will be maintained.

The operation of the backbone rocket H-IIA has already transferred to a private sector and the rocket is used to provide a commercial launch service by the private sector. However, it requires continuous share acquisition in commercial markets to conduct economical use and R&D of space. Therefore, Government will continue to promote improvements such as the increase of reliability to maintain and enhance international competitiveness continuously, and promote measures to efficiently cope with the various demands of satellites which are to be increased in the future by using most appropriate rockets.

(a) Promotion of rocket development and utilization that correspond to the satellite development and utilization plan, advanced research and development and world's satellite demands

(i) Basic support

To maintain the ability to launch necessary satellites to space independently, domestically-developed rockets will be used basically

when launching government-affiliated satellites like other countries. Also, Government will encourage to use domestically-developed rockets when Japanese private companies launch their satellites.

In order to achieve stable and efficient commercial launch service after the transfer of rocket operation to a private sector, Government will make consideration to systematic procurement and promotion of investment by a private sector and take necessary measures to maintain safety for commercial launch service in accordance with the medium- and long-term development and utilization plan of satellites as mentioned in Appendix 2.

(ii) Establishment of transportation system associated with the development and utilization plan of satellites

- **H-IIA series rockets**

For H-IIA/H-IIB rockets, Government will continue to position them as the Japan's backbone rockets and use them for launch of satellites constantly. To improve financial support for the Japan's use and R&D of space and maintain and improve international competitiveness in the commercial launch service, It will be continued to improve the technologies for increasing reliability, operation ability, launch performance and safety and to make efforts for cost reduction at the same.

- **GX rockets**

For GX rockets, there is significance to promote from five viewpoints; 1) providing efficient transportation as midsized rockets, 2) back-up rockets for backbone rockets, 3) establishing strategic cooperation of Japan and the U.S., 4) industrial development toward the entry of private sectors into the use and R&D of space, and 5) acquisition of technology in the liquefied natural gas (LNG) propulsion. However, there are some issues at the present to clarify a technical feasibility of LNG propulsion system, mission demands including the national security, and entire development plan with necessary cost. Therefore, the government will determine whether its development will be started or not, based on the prospects in technical aspects, demands, the whole picture of the plan and necessary

expenses.

- **Solid rockets**

  Japan has been accumulated many unique technologies in the solid rocket system, which is an important technology for short-term satellite launch. Its technology has been maintained even after the termination of M-V rockets operations. Government will promote solid rockets as a part of methods to maintain flexible and efficient support for the demands of small satellites in the area of space science and earth observation as mentioned in Appendix 2 by utilizing the accumulated technology.

(iii) Maintenance and development of base technologies

To maintain Japan's competitive space transportation system and its technology which stands on independency for the future, Government will make efforts to maintain and develop base technologies through measures and policies in the Chapter 3, 2, (5), 1).

(iv) Research and development of future transportation system

To respond to various transportation demands which will be required in the future, it is important to conduct its research and development.

For that reason, Government will examine future transportation systems including a reusable transportation system, orbit transfer vehicle and air-launch system, as well as advance research and development to establish its base technology. At the time, it is necessary to collaborate with improve activities of the H-IIA rockets and examination of moon exploration by robots in perspective of manned activities.

(b) Promotion of maintenance and development of launch sites

Launch sites are an important infrastructure that ensures Japan's independent access to space. In addition, it is necessary to maintain their conditions so as to use the sites anytime even from a viewpoint of improving international competitiveness in commercial launch service by private sectors.

In Japan, the launch sites are maintained and operated by JAXA, and some of the facilities at the sites are old and are required to take appropriate actions against aging.

For that reason, Government will make efforts to maintain and enhance functionalities by conducting the maintenance and upgrading of the facilities at the launch sites, and examine restrictions in the period of launch and improvement of environment at the launch sites.

Further, Government will investigate and examine the way of maintenance and development appropriate for the launch sites from a long-term perspective to correspond to future demands of satellites and development and utilization of rockets.

3) Promotion of industrial activities

(a) Utilization of abilities of small and medium companies, venture companies and universities

For the further advancement of the space industry, it is extremely important to utilize abilities of excellent technologies developed by small and medium size companies and venture companies as a new leader of technology. Further, it is also important to promote cooperation among government, industry and academia more than before.

Government will make efforts to expand the base for the space development industries by promoting future utilization of commercialized technologies into space and vise versa and enhancing utilization of satellite data. In addition, for the promotion of participation in the space development and utilization, Government will support small and medium companies, venture companies and universities which have new technologies and ideas under new concepts in the way of manufacturing support of micro satellites, attempting to expand opportunities for launching satellites and sharing facilities.

(b) Actions on taxation and finance, and other measures

The operations related to the use and R&D of space generally require enormous amount of investment, and the return of the investment takes a long time under the competition among ground systems. Further, there are major operational risks such as a failure of rocket launch and a limited

remedy to recover satellite functions in orbit in case of malfunction due to harsh environment in space. It is also necessary to note that insurance does not cover the whole damage. Therefore, it is necessary to consider equalization of competition conditions internationally to expand investment by private sectors including research and development investment of companies and to promote newcomers as well as to promote international development of the space industry. For that reason, Government will make efforts to actively utilize general measures and policies of each ministry including actions on taxation and finance as well as other measures not limited to space.

Further, because the space industry handles important technologies, sensitive technologies and information related to rockets and satellites, it is necessary to apply appropriate measures such as export control, internal direct investment regulation and sensitive information control for sound space industry developments.

(i) Taxation

- R&D tax incentives
- Taxation for the promotion of investments in small and medium-sized enterprises
- Tax system for angel
- Exemption from customs

  Customs are exempted for parts/components of rockets for satellite and satellite launching which are difficult to manufacture in Japan. (Until the end of fiscal 2010)

In addition, export exemption is applied to a consumer tax for launch service.

(ii) Financial

- Export finance of JBIC and trade insurance of Japan Trade Insurance
- Utilization of policy finance institutions such as Development Bank of Japan and Japan Finance Corporation for research and development of space equipment and space-related services

(6) Preservation of the environment

Preservation of the environment covers the entire systems and programs of A to I.

1) Consciousness of the earth environment

For the use and R&D of space, it is necessary to pay attention to the impact to the earth environment by the space activities themselves.

In the future, Government will continuously manage and improve factors which may influence the environment by constructing environmental management systems and promoting the development and utilization aiming to control emissions of wastes and chemical substances in accordance with the related environment regulations of ISO 14000 series, while keeping balance with the environmental measures and policies.

Further, as an example of spin-offs of space-related technologies into environmental fields, application of rocket's insulation to insulation paint for ground construction materials and application of power generation systems for space to low-pollution and efficient power generation systems on the ground are considered. Government will contribute to conserve the global environment by actively encouraging spin-offs of space-related technologies.

2) Preservation of the space environment

To deal with the issue of debris from a viewpoint of preservation of the space environment, it is necessary for Japan to observe the space objects to understand the population of debris, and make efforts to limit the generation of debris caused by Japan's use and R&D of space, as well as conduct research and development of technology to remove already existing debris. Further, Government will make continuous efforts for the space weather forecast including solar wind, because some natural phenomena such as solar wind may influence the space utilization.

(a) Understanding distribution conditions of debris

For understanding of debris population, Japan conducts observation of debris using a space observation facilities which is currently retained by JAXA and other organizations. However, the ability to detect orbital objects is limited to about 1 meter in size at most in low-Earth orbit, and Japan does not have the higher accurate ability to detect the sub-meter class orbital objects which would potentially cause break-up of satellites in

case of the collision. In the future, it will be aimed to observe sub-meter class debris especially in low-Earth orbit and determine the orbital characteristics of them. These works will be done in collaborating with the facilities owned by the Ministry of Defense and the data supplemented by the other countries.

(b) Minimizing generation of debris

For minimization of debris generated by Japanese space activities, it is effective to prevent separation of parts and components from satellites in operation and to prevent break-up of mission-ended satellites, JAXA has voluntary registered the Space Debris Mitigation Standard and tried to comply with it. On the other hand, the establishment of debris mitigation guidelines has been conducted by the United Nations and other international organizations. In 2002, the Space Debris Mitigation Guidelines was established by the Inter-Agency Space Debris Coordination Committee (IADC), and in 2007, "UN Space Debris Mitigation Guidelines" was endorsed by COPUOS.

Also in the U.S. and Europe, debris mitigation guidelines have been registered and debris mitigation works has been concluded along with them. The International Organization for Standardization (ISO) has been conducting standardization on debris mitigation area. Government will promote preservation of the space environment by participating in the international frameworks and keeping international cooperation to limit generation of debris.

Government will also reduce the debris generated by Japanese space activities by collision avoidance maneuver which is supported by knowledge of debris population, and by debris mitigation activities complied with the international standards. Further, Government will promote research to protect satellites from collision with debris, and to limit objects surviving atmospheric re-entry to minimize the ground casualties.

(c) Removal of debris

IADC and other groups have pointed out that increase of collision rate among debris would invite the chain reaction of mutual collision among

debris. For this issue, it is required not only to reduce the generation of debris but also to remove existing debris positively. In Japan, the technology to capture and remove the orbital objects is still in the research phase.

As a next step of this approach, Government will promote the research to demonstrate the technology to capture debris and remove it from its orbit using small satellite, with coordinating among international communities.

(7) Investment in human resources responsible for the next generation and facilitation of public participation

Facilitation of investment in human resources responsible for the next generation and public participation will cover the whole system programs of A to I.

1) Cultivation of engineers and researchers supporting the next generation

To promote the use and R&D of space, it is necessary to cultivate and secure excellent human resources who retain advanced knowledge and practical development experience in the space science and are capable of overlooking the entire earth from a wide and universal point of view. Especially, now that the industry has been downsized, it is difficult to maintain and secure excellent engineers with development experience in the space science although it is an extremely important issue to hand down technological capabilities. Therefore, it is important to continuously cultivate deserving human resources in universities and maintain and enhance available educational and research functions as well as to maintain and hand down the human technological basis necessary to continue the use and R&D of space in the space industries and organizations. For that reason, the following measures and policies will be promoted:

・ Enhancement of space education and research in universities and other educational institutes

Not only by enhancing partnership of researchers in the JAXA and universities in the individual level but also by enhancing partnership with universities themselves, Government will strengthen space

education and research in universities and other educational institutes. To do this, Government will provide opportunities to use the research facilities of JAXA and other organizations and realize maintenance and development of frameworks to promote educational research using a university sharing system to conduct collaborative research in specific assignments and projects.

・ Cultivation of practical-type engineers and researchers in collaboration with the space agency and universities

By utilizing the inter-university research institute system of JAXA, Government will encourage researchers and students of universities across the nation to participate in the forefront of the project and cultivate human resources with the knowledge of practical methodology of system development including *monozukuri* (product manufacturing).

・ Cultivation and securement of human resources from long-range perspective

By promoting measures and policies for continuous development of the space industry and enhancement of international competitiveness such as proposing the development and utilization plan of satellites from long-range perspective, Government will work on the improvement of capabilities of researchers and engineers while keeping the human technological basis in space organizations and industries.

・ Enhancement of human resource cultivation in Asia

By promoting collaboration with universities and research institutions at the core locations of human resource cultivation in Asia and collaborative development of small satellites conducted under APRSAF, as well as accepting human resources such as exchange students from Asia, it will be aimed to produce human resources who can support the space development and utilization in Asia by using Japan's space technology.

2) Promotion of child education and public relations to appeal the lure of space

Educating young people who lead the next generation to gain right knowledge and understanding about space is important in expanding the

base of human resources engaged in the future use and R&D of space and maintaining continuous support of Japanese people for promotion of the space development. the following measures and policies will be promoted in collaboration with local educational institutions by promoting the projects to appeal children responsible for the next generation and utilizing the activities by the JAXA's space education center:

(a) Expansion of opportunities for real experience and simulated experience

・ Field trip to the facilities at launch sites during sightseeing and school excursion

In collaboration with travel agencies, the Tanegashima Space Center will invite young people for sightseeing and school excursion to feel the lure of space by actually seeing and toughing the facilities at the rocket launch site and knowing the actual fields of the use and R&D of space.

・ Enhancement of opportunity to meet with astronauts and scientists

Astronauts and scientists/engineers will visit educational institutions to give lectures to nurture dreams, hopes, curiosity and inquiring mind for children. Communication with the International Space Station will be provided to enhance the quality of classes about space science.

・ Utilization of science museums and Internet

Teacher training at science museums and cultivation of volunteer educators will be supported, and the events with school and local science museums such as experience-based classes about space science and space classes from the International Space Station will be promoted. Further, the Internet broadcasting of rocket launches will be conducted and digital archive contents will be improved.

(b) Enhancement of space education

・ Support for educational material enhancement

Learning activities in social study institutions such as science museum will be supported. Also, utilizing space food and messages from astronauts as educational materials, providing information to

offer opportunities to learn about space at home with parent and child, and improving collaboration with overseas space agencies and international institutions will be enhanced.

- Utilization of vital power of private sectors and various groups

  To promote the space development and utilization, Government will work with private sectors and various groups to try various measures to show the space science achievements to Japanese people. Government will show the lure of space to them by improving cooperation with mass media by providing data of space institutions and opportunities to take pictures for movies and TV dramas.

3) Promotion of public participation measures

Enhancing interests of people is important to gain understanding of the use and R&D of space which requires enormous amount of national expenses. The following public participation measures will be promoted to expand the base of space utilization based on the fact that the use and R&D of space are becoming to be utilized not only by some experts but also by general public.

- Public participation contests

  To expand public participation opportunities in the use and R&D of space, Government will promote and support public participation activities such as an artificial satellite contest to find new ideas to use satellite and a space robot contest in collaboration with the organization hosting the Robot Contest.

- Approaches to seek for people's wisdom widely for new measures to use space, space policy and use and R&D of space

  To make the use and R&D of space closer and more useful for people's lives, the government will make efforts to seek people's wisdom.

- Efforts to obtain various supports and donation

  For the use and R&D of space, Government will examine various approaches to obtain support of not only government funds but also donation from Japanese people. Also, to make space more closely to the people, the name of satellites will be asked to the public.

Chapter 4 Promotion of Measures Based on the Basic Plan for Space Policy

(1) Structure to promote the measures and policies based on the Basic Plan for Space Policy

The measures and policies based on the Basic Plan for Space Policy will be promoted by relevant ministries as a whole centering on the Headquarters' secretariat under the Strategic Headquarters for Space Policy in the Cabinet. Further, in compliance with the supplementary provision of the Basic Space Law, Government will transfer the functions of the secretariat office of the Strategic Headquarters for Space Policy in the Cabinet to the Cabinet Office and prepare for necessary law revisions based on the results of examination in regard to the nature of the administrative structure and the institutions related to the use and R&D of space such as the JAXA.

(2) Retaining budgets and human resources necessary for implementation of the measures and policies

Based on the Section 7, Article 24 of the Basic Space Law, Government will make efforts to take necessary actions to realize smooth implementation of the Basic Plan for Space Policy by budgeting its expenses within the extent of the nation's finances each year in order to secure funds necessary for conducting the Plan. At the same time, the government will make efforts to promote activities in private sectors as well as secure necessary budgets and human resources for the steady implementation of the measures and policies included in the Plan. For the annual budget, Government will make efforts to improve its efficiency and conduct rationalization based on the financial circumstances while keeping harmony with other political measures in Japan.

(3) Follow-up of implementation status and public announcement of measures and policies

The specific implementation status of the measures and policies based on the Plan will be followed up (investigation of implementation progress of measures and policies) in cooperation with the relevant ministries headed by the Strategic Headquarters for Space Policy, and the results are publicized on the Internet. Further, based on the results of follow-ups and opinions in the Committee Conference, the Plan and the contents of measures and policies will be reviewed as needed.

(4) Reinforcement of investigation and analysis functions about international trends

For the promotion of Japan's use and R&D of space, it is absolutely imperative to grasp the demands and needs of foreign countries such as for disasters and the global environment and to lead to effective international contribution. Further, from a viewpoint of creating the world leading scientific achievements and cooperation with foreign countries, it is necessary to grasp the trends of use and R&D of space in foreign countries. In addition, from a viewpoint of reinforcing international competitiveness of Japan's space industries including satellite predictions, launch services and broad range of data utilization obtained from satellites, it is also important to grasp the international trends such as the use and R&D of space of the leading countries in the space development, its expansion and deployment to overseas countries and potential needs of the developing counties.

In consideration of these circumstances, Government will make efforts to investigate the use and R&D of space trends in foreign countries and to reinforce the analyzing ability.

(5) Development of laws related to the space activities

In accordance with the rules of the Basic Space Law, Government will prepare for the development of laws based on the results of examination about the nature of the legislation related to the space activities.

(6) Ensuring linkage and consistency with political measures other than the space policies

To promote the Plan, Government will secure the consistency with political measures other than the space policies such as the Science and Technology Basic Plan, the Economic Growth Initiative, the Basic Plan on Ocean Policy, the Basic Plan for the Advancement of Utilizing Geospatial Information and political measures of the relevant ministries.

9 major social needs and current situation of development and

main social needs	current state	goals for the next 10 years correspond to the social needs
【Secure the Public Safety】		
Understand information in the event of disaster in Asian region	【Disasters in Asian region】 Through activities of Sentinel Asia and others, satellite images have been provided from Japan's Advanced Land Observing Satellite "Daichi" to stricken countries（so far approximately 100times）. 【Disasters in Japan】 Satellite images are provided from information gathering satellites and "Daichi" when earthquake and other disasters occurred. However, it takes approximately one day for "Daichi" to provide images, which is insufficient to be used as an initial response to disasters, and also the resolution of images is insufficient to understand its detailed situation such as house and road damages. In addition, there is a limitation to satisfy the entire demands because information gathering satellites limit provision of images for a security purpose.	【Disasters in Asian region】 Japan will work together with stricken countries and others to basically take images within 3 hours after an occurrence of disaster, coupled with shooting from air planes, and then provide these images to stricken countries, also for the purpose to utilize them for relief activities by Japan. 【Disasters in Japan】 Satellite images of stricken area will be taken to provide disaster relief agencies with detailed information such as house and road damages, along with the latest image archives. After that, image and information of crustal deformation will be provided to understand the status such as detailed situation of damage, a risk of secondary disaster and condition of rehabilitation and reconstruction, as well as to widely understand the stricken area. Further, in case of floods and sediment disasters, detailed information of house and road damages should be understood.
Predict and monitor crustal deformation	Frequent earthquakes and volcanic activities in Japan threaten citizens ' lives and properties, because Japan is located in the area of one of the world ' s most active crustal deformation (movement of ground). GPS-based control stations installed in approximately 1,200 locations all over Japan by the Geographical Survey Institute are used to receive GPS satellite data and for monitoring the deformation. On the other hand, although a validation approach for utilization of an L band radar sensor has been carried forward for 15 years, it has not been able to put in practical use due to the circumstances that there was a time gap between updates of the satellite and it was unable to be used for observation for a few years in addition to its fewer numbers of operation for a quick response to the occurrence of earthquakes and for monitoring the transition of volcanic activities. Furthermore, the verification for utilization of optical sensor has been carried out for monitoring submarine volcano activities, the effectiveness of which has already confirmed if the discoloration of sea water by the eruption is widely observed.	Crustal deformation will be broadly and densely monitored with the accuracy of 1 centimeter, by utilizing broadly analyzed results of satellite image obtained by acquiring information of the ground surface widely over a long duration continuously with high frequencies, in order to detect crustal deformation, to monitor the color of volcanic lakes and to study the mechanism of those activities, in combination of specified point information provided by GPS-based control stations. This will enable monitoring by condition of a surface rather than a point. Prediction accuracy in crustal deformation and volcanic activities will be improved in the future, especially when a massive crustal deformation is predicted or a volcanic activity becomes increased. In the case, GPS receivers are used for temporary observation on site and conduct monitoring of target area at least every 3 hours. Also, by providing satellite image including information about discolored water as soon as possible, the satellite utilization will be realized as a method to monitor submarine volcano activities.

utilization plan of satellites and other assets / goals for the next 10 years (1/8)

＜reference＞

goals which the sensor, satellites etc. should achieve in order to fulfill the 10-year goals	user organization	expected satellites in 10 years
【Disasters in Asian region】 ○Improve the resolution：approximately 1m resolution of both optical and radar satellite which are necessary to gather information detailed situation such as house and road damages in case of floods and sediment disasters.（maintaining 50km observation width） ○Increase the frequency of image-taking：take images within 3 hours by radar satellites which can take images even at night and under bad weather（provide images within 4 hours）. The optical satellites will be used to collect more detailed information on the situation in a complementary manner. ・To take images every 3 hours of 24 hours in a day ⇒ 4 radar satellites (4 optical satellites as complement) (note 1) It is aimed to shorten time to provide images taken by "Daichi-2" within 1 hour. (note 2) A factor other than the number of satellites was not considered at above estimation, such as the inclination of their orbit which can increase the frequency of image-taking at the air field above our territorial land. ○Upgrade the methods of analysis (with comparing with latest data) and shorten processing time (approximately 1 hour) 【Disasters in Japan】 Take images of stricken area in shorter time by utilizing both IGS and satellites mentioned above.	【Disasters in Asian region】 Ministries and Agencies related to Japan Disaster Relief Team, such as MOFA, MPA,FDMA, MOD 【Disasters in Japan】 Cao (Disaster Management), CIRO, MPA, MIC（FDMA）, MLIT, MOD	【Disasters in Asian region】 "Daichi-2, 3" (optical, radar) and, later that, 2-4 satellites as series of "Daichi" Continuously ASNARO (tentative name) certification satellites（optical, radar）and, later that, 2-4 satellites continuously 1-2 Data Relay Satellites continuously 【Disasters in Japan】 IGS (optical, radar) and satellites mentioned Above
The improvement of those major points mentioned below will contribute to the increase of the accuracy of prediction, etc. ○Improve sensor performance: Sensor performance should be improved in order to realize more accurate observation. ① Successive operation of L band radar sensors ② Improvement of spatial resolution of optical sensors (color, 10 meters -> less than 5 meters) ○Improve observation frequency: Achievement of quick delivery of satellite image data (optical & radar), (usually in several days -> more than once per day) ○Advance analyzing method: Advancement of data processing system, advancement of prediction method tying up with other ground observation method.	【Earthquake】 MLIT (GSI, JMA), MEXT (Headquarters for Earthquake Research Promotion) 【Volcano】 MLIT (JMA, JCG, GSI)	"Daichi-2, 3" (optical, radar), later that, 2-4 satellites as series of "Daichi" continuously ASNARO (tentative name) certification satellites（optical, radar）and ,later that, 2-4 satellites continuously

9 major social needs and current situation of development and

main social needs	current state	goals for the next 10 years correspond to the social needs
【Secure the Public Safety】		
High-precision weather forecasting	Weather observing satellites have been used for the observation for the distribution of clouds and moisture and for weather forecasting and prediction of tracks of typhoons and its strength using other observation data such as precipitation distribution and sea surface temperature. However, currently there is a challenge that it is difficult to predict a very local and torrential downpour. For that reason, there is an expectation to enhance the total forecast accuracy.	Necessary data will be acquired successively with improving forecast accuracy, in order to deliver weather forecast that is indispensable to everyday ' s life. Furthermore, to cope with a very local phenomenon whose forecast is extremely difficult today, Japan will aim to increase the observation frequency for the distribution of clouds and moisture by the current 30 minutes to by 10 minutes and continue to provide information to people. Japan will also increase the accuracy of weather forecasting by doubling the sensor resolution and gathering detailed information to utilize the data for disasters such as very local heavy rain.
Secure communication methods in case of disaster	To respond to the demands of "securing a communication method in case of disasters", commercial communications satellites are used in the event of disasters for disaster information distribution and communication by the government and local public agencies. However, it requires a ground-based station for a satellite (receiving antenna and special equipment), and communication via general methods such as widely used mobile phones holding a hundred million subscribers becomes disconnected when there is damage to portable base stations on ground.	Conduct research and development to enable satellite communication only by mobile phone terminals and to use both a ground system and a satellite system and bring it to a validation phase using engineering test satellites.
Ocean monitoring	Maritime events such as smuggling, illegal operation of foreign fishing boats, suspicious vessels, major accidents at sea occur in Japan ' s surrounding ocean area, and sea piracy on sea lanes bound for Japan is concerned.	Research and develop ocean monitoring system utilizing a satellite（For example, the images taken from satellites as well as from airplane constantly or at least every 3 hours collaborating with a ground system to identify the target vessels would be effective.）

utilization plan of satellites and other assets / goals for the next 10 years (2/8)

＜reference＞

goals which the sensor, satellites etc. should achieve in order to fulfill the 10-year goals	user organization	expected satellites in 10 years
The improvement of those major points mentioned below will contribute to the achievement of the forecast accuracy of very local heavy rain and torrential rain. ○Prepare appropriate number of satellite: The observation for the distribution of clouds and aerosol that depends on overseas satellites today in spite of one of necessary data to forecast weather will be successively carried out by domestic satellites to realize much more accurate data acquisition. ○Improve sensor performance: ①(Visible and infrared radiometer) Improve observation resolution from 1 kilometer to 0.5 kilometer in visible area and from 4 kilometers to 2 kilometers in infrared area, for monitoring clouds, moisture and ice floe. ②(Microwave radiometer) Improve observation resolution from 6 kilometers to 5 kilometers for monitoring sea surface temperature, sea winds and precipitation. (R & D will be carried out to realize much higher resolution near future.) ③(Second-generation global imager) Improve observation resolution from 1 kilometer to 0.25 kilometer for monitoring the amount of clouds and aerosol. ④(Dual-frequency precipitation radar) Improve rain sensitiveness of 3-D observation in precipitation area from 0.7 mm/h to 0.2 mm/h by using dual frequency, which will enable to observe snow. ⑤(Cloud profiling radar) Improve the minimum sensitiveness 10 times from 26dBZ to 35 dBZ for monitoring the vertical distribution of clouds and aerosol and their movement, which will enable to observe about 90 % amount of clouds. ○Improve observation frequency: Clouds and moisture by radiometers for visible and infrared rays will be observed more frequently from every 30 minutes to every 10 minutes. ○Advance forecasting method: Forecasting method should be made advancement in cooperation with other ground observation data.	(Weather forecast) MLIT(JMA) (Utilization) MLIT, MOD, MEXT and others, local governments and private sector.	"Himawari-8, 9" (visible and infrared radiometer) Global Change Observation Mission (GCOM-W(microwave radiometer)), later that, 1satellite continuously GCOM-C(global imager sensor), later that, 1 satellite continuously Global Precipitation Measurement (GPM (dual-frequency precipitation radar) cooperated with NASA) Earth Clouds, Aerosols and Radiation Explorer (EarthCARE(cloud profiling radar) cooperated with ESA)
○ Research and development of mobile phone which can be used for communicate via both ground and satellite communication Research and development to enable to use the same frequency band in the ground system and satellite system in an attempt of realizing a ground/satellite commonly used mobile phone system in which mobile phone terminals can be used for communicate via both ground and satellite communication. ・an interference avoidance technique ・coordination technique of a ground system and a satellite system ・large deployable antenna technique ○ Conduct a utilization and validation experiment of high speed Internet communication in the Asia-Pacific region and isolated islands using the ultrahigh-speed Internet satellite "Kizuna"	(R&D) MIC/NICT, MEXT / JAXA (assumed operator) private sector	After research and development on the ground, bring it to a validation phase using engineering test Satellites
Research and develop a method to gather information of marine navigation necessary to secure vessel safety ○ Collaborate between satellite and information gathering system of marine navigation on the ground	MLIT(JCG), MOD	Consider to use satellites which can be utilized at Asia and other regions

9 major social needs and current situation of development and

main social needs	current state	goals for the next 10 years correspond to the social needs
【Preserve and manage national land 】		
Gather land information (cartography, land transition monitoring, etc.)	The geographic characteristics of Japan are huge area of mountains and forests which reaches 70 % of total land, very long shorelines and several thousands of isolated islands. While Japan has been recording and gathering images of its land from satellites, the operation of satellites has not been serial, and gathering and provision of data has not been conducted in a continuous and integrated way. For this reason, except for some of the empirical approach such as updating topographic maps on a scale of one to 25,000, the utilization of such data is still insufficient as a whole. In foreign countries, the potential of demand for Japanese satellite data is still low. Attempts have been made to monitor illegal logging and the World Heritages sites from "Daichi" in overseas, but the provision of obtained satellite data to foreign countries has been limited.	It is aimed that optical and radar sensors using a series of satellites are used to continuously and widely observe the land and the data is utilized as basic information for national land preservation and management, agriculture and forestry and environment by collecting and distributing them systematically. For example, by comprehensively improving image quality with enhanced resolution of optical stereo vision sensor by more than twice, Japan is to realize to make more detailed map and to expand its utilization for local governments and private sectors along with the areas of forest management and environment management. Further, attempts of satellite data delivery to foreign countries are a potential to expand the utilization of Japanese satellite images in overseas.
【National Security】		
Surveillance and Reconnais-sance	Satellite system which is capable of acquiring images of a specific location on earth more than once a day by optical and radar satellites is yet to be fully established. In addition, no Information other than images be gathered by satellites.	Enhance the information gathering functions by increasing opportunities of image acquisition which are corresponding to the areas of interest. Improving the quality of images and shortening time for information-sharing, as well as reinforcing functions for surveillance and reconnaissance activities in the ocean and aerospace surrounding Japan. In the course of stated improvement, it is aimed to promote new use and R&D of space regarding national security purposes including research of sensors for an early-warning function.

utilization plan of satellites and other assets / goals for the next 10 years (3/8)

＜reference＞

goals which the sensor, satellites etc. should achieve in order to fulfill the 10-year goals	user organization	expected satellites in 10 years
The improvement of those major points mentioned below will contribute to create the environment of delivering land information at any time. ○Improve sensor performance: The performance of stereoscopic optical sensor should be improved from 2.5 meters to 1 meter in spatial resolution in order to monitor detailed land information. ○Increase observation frequency: Achievement of quick delivery of satellite image data (optical & radar), (usually in several days -> more than once per day) ○Advance utilization environment: Preparing a data delivery system that will ensure easier access satellite data for domestic and overseas users, by successive management of past and future satellite data.	MLIT, MAFF, MOE, local governments and private sector (Promotion support for utilization of satellite data in foreign countries) MOFA	"Daichi-2, 3"(optical, radar) ,later that, 2-4 satellites as series of "Daichi" continuously ASNARO(tentative name)certification satellites (optical, radar) and ,later that, 2-4 satellites continuously
【Information Gathering Satellites】 ○Enhance the resolution: resolution of optical and radar satellites which exceeds the level of commercial satellites ○Increase the frequency of image acquisition : more frequent than "image acquisition of a specific location on the earth more than once a day" ○Shorten the processing time: shorten time required from request to the distribution of products as much as possible	CIRO, CSICE and others	IGS(optical, radar)
【Research of sensors for an early-warning system】 Research of sensors and database for an early-warning system ○New objects to detect: flame of ballistic missile or forest fire. ○Necessary technology: technology of elements of high sensitive infrared sensor, technology to identify kind of flame ○Necessary facilities for support: prepare database to identify and secure the data communication capacity	MOD and others	The Japanese government as a whole promotes effective utilization of satellites, including the possibility of utilizing satellites in which defense purpose and other purpose are combined.
【Research of radio information gathering function】 Research of radio property for a validity check of a radio information gathering function in space.	MOD and others	

9 major social needs and current situation of development and

main social needs	current state	goals for the next 10 years correspond to the social needs
【Facilitate food supply】		
Understand growing condition and quality of grain and other agricultural products	Satellite data is now ready to use practically in various fields, such as monitoring domestic cultivated area, paddy acreage and damage of irrigated rice by disasters. Monitoring the growth situation of rice is now beginning to use practically. To apply to monitor the quality and growth of other crops, it is necessary to improve the estimation accuracy thorough the validation process. Further, irrigated rice damages caused by disasters are currently assessed visually, but it is expected to have fewer loss assessors as decreased number of farmers, and it is a challenge to improve the method of loss assessment.	Satellite images can be analyzed to understand the growing condition and estimate of rice quality, such as rice's contents of protein and water, and its actual utilization has already started in some areas. Approach will be made in the future to improve the estimate accuracy and pursue the sophistication for farm management. Further, in the field of assessment for irrigated rice damages caused by disasters, it is expected to have fewer loss assessors as decreased number of farmers. Japan will aim to establish a loss assessment method using high-resolution satellite images to enable overall evaluation of irrigated rice in Japan, and organize a system that can deploy the method in all prefectures, which is still in a validation phase at 14 prefectures. In addition, constant monitoring of conditions related to crop productions in the major area of breadbasket in the world will be realized to use for Japan's food supply strategy as basic information.
Understand fisheries	Oceanic information that is observed data for sea temperature, oceanic current and ocean color by satellites is now being provided, in combination with other data derived from meteorological satellites and direct observations. Use of satellite data has already reached the stage of its practical realization, however, the U. S. and French satellite data is considered as the most usable from the viewpoint of data accessibility. It is insufficient yet to use Japanese satellite except for research purposes.	To update coastal fishing activities, Japan will aim for healthy development of a fishing industry and stable supply of marine products by giving contribution to improve a prediction of occurrence of red tides harmful to coast fishing and aquaculture industry. Specifically, enhancement of resolution on optical sensors will allow not only to schematically determine the occurrence of red tides over the wide area of Tokyo Bay, but also to spot detailed damage condition, for example in the Tokyo Bay estuary. To advance deep-sea fishery, the current situation only allows seeing the comprehensive condition of oceanic current and other information. Therefore, in the future, Japan will aim to prepare a structure for easy data access and to improve the productivity of fishery and realize efficient support of operation, together with having regional fishery information with the increase of spatial resolution by the sensors boarded on Japan ' s satellites.

utilization plan of satellites and other assets / goals for the next 10 years (4/8)

＜reference＞

goals which the sensor, satellites etc. should achieve in order to fulfill the 10-year goals	user organization	expected satellites in 10 years
The improvement of those major points mentioned below will contribute to the advancement and sustainable development for agriculture. ○Improve sensor performance ①(Monitoring cultivated land) Improve spatial resolution of optical sensor (2.5meters -> 1 meter) and of L band radar sensor (10 meters –> 1-3 meters) ②(Monitoring growing condition and quality of grain) Improve an detective ability using by much more frequency (hyperspectrum, 14 bands -> 185 bands) ③(Second-generation global imager) Improve observation resolution from 1 kilometer to 0.25 kilometer, for monitoring broad and detailed condition of cultivated land. ○Request for observation: Assure users ' request for observation in harvest period ○Advancement of analyzing method: Establish data-analyzing method	MAFF, local governments and private sector	"Daichi-2, 3"(optical, radar) ,later that, 2-4 satellites as series of "Daichi" continuously ASNARO(tentative name)certification satellites (optical, radar) and ,later that, 2-4 satellites continuously GCOM-C(global imager sensor), later that, 1 satellite Continuously
The improvement of those major points mentioned below will contribute to the advancement and sustainable development for fisheries. ○Prepare appropriate number of satellite: Besides using foreign satellites, domestic satellites that will realize more accurate observation should be utilized successively. ○Improve sensor performance: ① Improve optical sensor for the spatial resolution (color, 10 meters -> several meters) ②Improve other necessary sensors (thermal infrared imager, microwave radiometer, microwave scatterometer, ocean color scanner, satellite altimeter) for spatial resolution (several kilometers –> about 1 kilometer) ○Prepare for data delivery system: Certain delivery to local governments	MAFF, Fisheries Research Agency and local governments	Global Change Observation Mission (GCOM-W(microwave radiometer)), later that, 1 satellite continuously GCOM-C(global imager sensor), later that, 1 satellite continuously "Daichi-3"(optical) and, later that, 1-2 satellites continuously Foreign satellites (thermal infrared imager, microwave scatterometer, satellite altimeter)

9 major social needs and current situation of development and

main social needs	current state	goals for the next 10 years correspond to the social needs
【Facilitate natural resources and energy supply 】		
Explore oil and mineral resources in land and seabed areas	Satellite data has been used for natural resources exploration in continental areas, but its analysis ability has not reached its full potential. Furthermore, there are various resources and energy existed over the Japan's territorial seas, said to be the world's 6th largest size, and exclusive economic zone, as well as possibly two hundred nautical mile of the continental shelf. There is an expectation to secure these resources, but the utilization is still limited that "Daichi" is used to observe the oil slick phenomenon (a release of crude oil from the sea floor and becoming an oil slick on the water surface) in a validation phase.	An ability to detect minerals that make up geological layers that contain oil, and minerals such as rare metals, is improved by three times from the current ability of 10 types to 30 types. Also, it is aimed for continuous and wide area observation using a highly sensitive sensor to precisely and efficiently detect the possible areas of oil and minerals and upgrade the exploration method of resources contained in continental areas. Further, Japan is to aim for improving the detection ability of oil slick by enhancing the sensor resolution and contributing to natural resources exploration of seabed in the water territories in Japan. The collected information will be utilized as basic information for the Japan's strategy to secure resources and energy.
【Resolve the global-level environmental issues (realize low carbon society)】		
Gather information of global distribution and the amount of absorption and emission related to greenhouse gases such as CO_2 and methane gas	Distribution of greenhouse gases concentration had been measured at limited locations (approximately 280 locations) on ground. However, Japan's Greenhouse gases observing satellite "Ibuki" launched in January 2009 enabled observation at 56,000 points globally and it was in a phase to observe and analyze the globe cyclopaedically. Further, "Daichi" has been used for the development of evaluation methods of greenhouse gasses emissions from forest degradation.	"Ibuki" would be used for continuously detecting more detailed greenhouse gasses absorption and emissions in each region and absorption by forest ecosystem while continuous observation of the global distribution of greenhouse gases concentration and improvement of sensor ability by twice as much as the present ability to increase the measurement point and its accuracy. It would enable precise understanding of the change in absorption and emission of greenhouse gases caused by the change of climate condition and logging and providing scientific evidences for the emission reduction of greenhouse gases in the future which the entire world must tackle with. Also, by improving the resolution performance of "Daichi" and then detecting more detailed changes in forests and vegetation as sinks of greenhouse gases, “Daichi” would be utilized for gathering information and verifying the Reducing Emissions from Deforestation and Forest Degradation (REDD) in developing countries. Through these activities, Japan will aim to contribute to the global warming countermeasures effective under the post-2012 framework.

utilization plan of satellites and other assets / goals for the next 10 years (5/8)

＜reference＞

goals which the sensor, satellites etc. should achieve in order to fulfill the 10-year goals	user organization	expected satellites in 10 years
The improvement of those major points mentioned below will contribute to the advancement for the exploration of natural resources. ○Improve sensor performance ① (Monitoring geology and minerals) Improve detective ability by using much more frequency (hyperspectrum, 14 bands -> 185 bands) ②(Monitoring natural resources in land and seabed areas) Successive operation of L band radar sensors and improvement for the spatial resolution of L band radar sensor (10 meters -> 1-3 meters) ③Develop thermal infrared sensors (5 bands, 30 meters) ○Advance analyzing method: Establish data-analyzing method such as detecting natural minerals	METI	"Daichi-2, 3"(optical, radar, hyperspectrum sensor)and, later that, 2-4 satellites as series of "Daichi" continuously ASNARO(tentative name)certification satellites（optical, radar）and, later that, 2-4 satellites Continuously
Make it possible to monitor global warming effectively, by improving carbon cycle model and others as bellow. ○Improve the ability of sensors; ①(Greenhouse gases observing sensor) Novel research and development including the study for new sensors based on the detailed analysis of the observation data from "Ibuki." (Improvement of the accuracy of observation and the spatial resolution for CO2, methane gas, etc. Current accuracy of observation is 4 ppm for CO2 and 0.04 ppm for methane gas.) ②(L band radar, Optical sensor(color)) Improve the spatial resolution from 10 m to 1～3 m (radar), and from 10 m to 3 m (optical sensor), to detect more detailed changes in forests and vegetation as sinks of greenhouse gase Research and development of new sensors ③(Global imager sensor) Improve the spatial resolution from 1 km to 250 m, to measure the amount of vegetation (terrestrial and oceanic primary production) ○Improve the analysis methods; Improve carbon cycle model and atmospheric transportation model and, etc. for more effective analysis method of the concentration distribution of greenhouse gases, the absorption and emissions, absorption by forest, and so on. ○Improve the international system; Improve the international system to use the analysis method with the observation data from "Daichi."	MOE / National Institute for Environmental Studies MAFF (Forestry Agency)	1 satellite as asuccessor of GOSAT (passive spectrometer or the other observation sensors) "Daichi-2, 3" (optical, radar) and later that, 2-4 satellites as series of "Daichi" continuously GCOM-C (globalimager sensor) and, later that, 1 satellite continuously

9 major social needs and current situation of development and

main social needs	current state	goals for the next 10 years correspond to the social needs
【Resolve the global-level environmental issues (realization of low carbon society)】		
Understand the global water circulation and environmental changes	Japan has been conducting the observation of precipitation distribution related to water cycle and clouds and aerosol distribution related to the global environmental changes in international frameworks using overseas satellites, but it requires continuous observation to see the long-running changes and it is expected for the further improvement of prediction accuracy.	Japan will aim to improve the accuracy by doubling the current ability to measure the global precipitation distribution and improve the ability for higher accuracy by more than twice as high as the current ability for clouds and aerosol distribution in international frameworks for the future. Also, Japan will aim to clarify and establish methods for generating mechanism of abnormal meteorology such as El Nino, desertification and torrential rainfall, and to establish the clarification and forecast methods for global environment changes and water circulation mechanism by understanding them continuously, globally and in more details, as well as to conduct disaster prevention by providing necessary information quickly and properly.
Realize energy to support the low carbon society	Renewable energy power (for example,solar power generation and wind-generated power) has been used on earth, but there are some stability issues, and the utilization of energy to overcome these issues has not been realized in space.	Research and development of the technology necessary to realize the solar power generation system in space for clean and stable energy utilization without any geopolitical influences, Japan will aim to have prospects for practical application within the next 10 years, comparing with the progress of the renewable energy development on earth.
【Enhance the domestic quality of life (realize a healthy and long-lived society, and convenience for the people)】		
Realize a healthy and long-lived Society	The prevention study of osteoporosis and urinary calculus and effective application of high quality protein crystallization for drug development have currently been conducted by applying the research achievement of space medicine for the senior citizen medical care, but they are not for practical use yet.	Japan will aim to achieve practical results through the use of the microgravity environment focusing on the issues for the life of people and the solutions for social issues such as medical care for elders, problems of nursing care and drug development.

utilization plan of satellites and other assets / goals for the next 10 years (6/8)

＜reference＞

goals which the sensor, satellites etc. should achieve in order to fulfill the 10-year goals	user organization	expected satellites in 10 years
Contribute to establish forecast model for global environment changes, clarify generating mechanism of abnormal meteorology and prevent disaster by improving points as bellow. ○ Develop observation satellites; Continuous observation of the distribution of clouds and aerosol by domestically-developed satellites (possible to high-precision measurement), instead of overseas ones novel development and utilization of sensors to observe vertical distribution of clouds and aerosol ○ Improve the ability of sensors; It will be aimed to improve the ability of sensors for high-precision measurement as follows, ①(Microwave radiometer) Reduce the measurement error by half to detect the amount of rainfall and moisture in detail (Current error of observation is ± 70%) ②(Global imager sensor) Improve the spatial resolution from 1 km to 250 m, to measure the amount of clouds, aerosol, and etc. ③(Dual-frequency precipitation Radar sensor) Improve the measurement sensitivity of vertical distribution of rainfall in precipitation area with dual-frequency observation, from 0.7mm/h to 0.2mm/h ④(Clouds profiling radar) Improve the minimum measurement sensitivity by ten times to understand vertical distribution or movement of clouds and aerosol, from 26dBZ to 35dBZ (possible to understand 90% of the clouds) ⑤(L band radar, Optical sensor(color)) Improve the spatial resolution from 10 m to 1～3 m (radar), and from 10 m to 3 m (optical sensor), to detect more detailed changes in forests and vegetation as sinks of greenhouse gases ○ Improve the analysis methods; Improvement of the global environment changes analysis (atmosphere-ocean coupled model and etc.)	MLIT (JMA) MOE / National Institute for Environmental Studies MEXT / JAMSTEC	Global Change Observation Mission (GCOM-W (microwave radiometer) and, later that, 1 satellite continuously GCOM-C (global imager sensor) and, later that, 1 satellite continuously Global Precipitation Measurement (GPM (Dual-frequency precipitation Radar sensor) cooperated with NASA Earth Clouds, Aerosols and Radiation Explorer (EarthCARE (clouds profiling radar), cooperated with ESA) "Daichi-2, 3" (optical, radar) and later that, 2-4 satellites as series of "Daichi" continuously
○ Research and development to have prospects for feasibility of space solar power system ・Technologies to gather energy efficiently in space ・Technologies to send energy efficiently and safely from space to the ground ・Technologies to construct large scale structures in space ○Short-term issue ・To conduct demonstration of technologies for the energy transmission on the ground and to confirm the influence in the atmosphere utilizing "Kibo" or small sized satellites.	(R&D) MEXT / JAXA METI / USEF universities, private sector, etc.	Small sized demonstration satellite for space solar power system
○ The utilization of "Kibo" will be promoted, conducting maintenance and operation of "Kibo" consistently, and transportation of goods necessary for operating the Space Station (laboratory equipment water, food, etc.) to the International Space Station will be conducted every year based on the international agreements. (Government will comprehensively determine the extension of its operation after 2016 in consideration of the utilization results, etc.) ○ To focus on issues to respond to the social demands in drug development and medical fields and food, energy and nano material fields and to promote the space environment utilization close related to people's life such as realizing better life for people and corresponding to issues concerning clothing, food and housing as well as excretion issues in the aging society. In addition, as the only participant in the International Space Station Program in Asia, Government will promote the international cooperation with Asian countries by providing them with the opportunities to use "Kibo" for experiments. Japan will also contribute to the world's environmental observation.	MEXT / JAXA universities, private sector, etc.	H-II Transfer Vehicle (HTV) test flight, operational flight #1-#6)

9 major social needs and current situation of development and

main social needs	current state	goals for the next 10 years correspond to the social needs
【Enhance the domestic quality of life (realize a healthy and long-lived society, and convenience for the people)】		
Realize highly accurate positioning	Currently services using a positioning satellite system such as car navigation systems are widely spread and the utilization of a positioning satellite has been expanding, but It has not been able to pinpoint a location of people.	Japan will aim to achieve highly accurate positioning using a Quasi-Zenith Satellite System and improve its convenience by creating new applications such as a seamless personal navigation that works with satellite and ground systems, and to realize safety of the country and people to response to the needs of "ensuring the public safety" in the future. Further, by establishing a structure using 3 satellites after validation of technology and ability of a Quasi-Zenith Satellite System, supplementation and backup of systems for GPS become possible. Also, by using 7 satellites, a self-contained Satellite positioning system can be established that covers the East Asia and Oceania region.
【Create scientific achievement to lead the world (accumulate intellectual assets and expand activity area of humans)】		
Create world-leading achievement in science research continuously	Japan has made world-leading achievements in space science such as space astronomy and solar system exploration, and also been undertaking various efforts to expand the activity domain of humans through the solar system exploration and activities in the International Space Station.	Japan will take a close collaboration with other fields beyond space science and aim to promote the study based on a reinforcement of the structure to promote participation of excellent scientists of universities, as well as to continuously create world-leading achievements. Further, by promoting the space activities of humans and robots, Japan will aim to expand the activity domain of humans and realize the moon exploration using robotics by around 2020, with a view of cooperation of robots and humans.

utilization plan of satellites and other assets / goals for the next 10 years (7/8)

＜reference＞

goals which the sensor, satellites etc. should achieve in order to fulfill the 10-year goals	user organization	expected satellites in 10 years
For a Quasi-Zenith Satellite System that is a core of a positioning satellite system, Government will conduct technical and utilization verification and promote measures for system verification, as well as to promote a new usage with help of both public and private sectors. ○Positioning accuracy: Realize the accuracy of 1-meter from that of 10-meter by GPS, and put to practical use for supplementation and backup of systems for GPS, especially in the survey fields ○Orbit: Realize more than 60 degrees in elevation angle in all over Japan ○Create demands: Promote a new usage that links with ground systems (note) Ready to use QZSs in the same condition in the East Asia region such as Korea	(Technical and utilization verification) MEXT / JAXA METI / AIST MLIT（GSI） MIC / NIC Private sector and others	Quasi-zenith Satellite-1 and additionally 2-6 satellites
It will be aimed to continuously create world-leading scientific achievements, and scientific research and engineering research will be conducted in an integrated manner. It will be also aimed to expand the activity domain of humans. ○ Space astronomy (X-ray, infrared ray, and electric wave observation) ○ Solar system exploration (Mercury, Venus, and asteroids) ○ Robotic exploration on the moon for the future exploration in collaboration with humans and robots ○ Advanced missions with Small Scientific Satellites, demonstration of new sensors and technologies (Themes will be selected in science community) ○ Space biology and microgravity science such as biological science, material science, fluid science, and etc., using the space environment such as microgravity in "Kibo" And so on.	MEXT / JAXA universities	ASTRO-G (Electric wave) and the other space astronomy missions, (ASTRO-H (X-ray), SPICA (infrared ray), Planet-C (Venus), BepiColombo (Mercury) or the other solar system exploration mission (SCOPE (magnetosphere), asteroids exploration (the follow-on mission after "Hayabusa") etc.), Moon landing and exploration mission, Small Scientific Satellites such as Ikaros etc. (3 satellites every 5 years)

9 major social needs and current situation of development and

main social needs	current state	goals for the next 10 years correspond to the social needs
【Develop industry and create employment continuously】		
Develop agriculture and fisheries further	The demand for satellite data has been spreading for collecting information related to agriculture and/or fisheries and for monitoring the situation of land and ocean area.	Satellite data will be more contributed to the advancement and sustainable development for agriculture and fisheries, through the improvement of efficiency from monitoring crop growth and fishing area.
Create new industry, expand space industry and create employment	It is necessary to expand the base for the space utilization industry, not only the space equipment industry but also the service industry. The international competitiveness of Japan's space industry is weak, so it is necessary to strengthen the international competitiveness by developing Japan's space industry into a strategic industry.	Aim to double the sale of industry by promoting to develop new utilization of satellite data and by creating new industry applied the results of advanced technologies of space science. Enhance the international competitiveness of Japan's space industry in order to create employment.

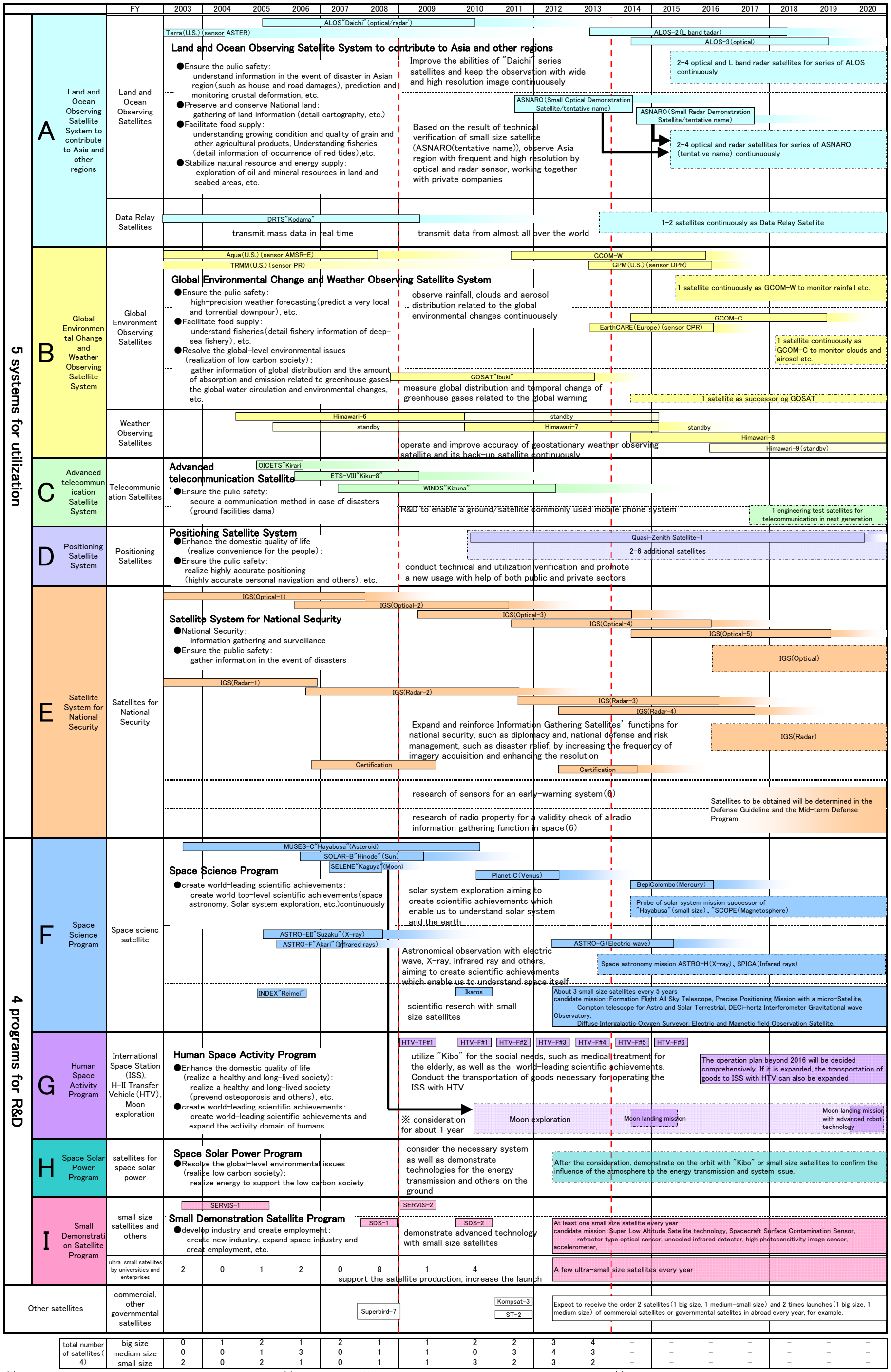
utilization plan of satellites and other assets / goals for the next 10 years (8/8)

＜reference＞

goals which the sensor, satellites etc. should achieve in order to fulfill the 10-year goals	user organization	expected satellites in 10 years
See the row of “Facilitate food supply“ and “Preserve and manage national land”.		
○ Goal of policy ・Create new industry by promoting to develop new utilization of satellite data ・Spin-off the results of advanced technologies of space science mission into use and R&D of space and industry other than space science ・Increase the entry into international market by enhancing the international competitiveness of satellites and sensors（such as promotion of research and development, consideration of systematic procurement）and by taking measures to develop international market ・Create new industry, expand space related industry and create employment by promoting the demonstration of advanced technology with small size satellites and others and by supporting the micro satellites of small and medium companies, venture companies and universities ・Aim to double the sale of space related industry and create employment by expanding the use and R&D of space	（R&D, promotion of utilization） MEXT / JAXA METI / NEDO, AIST, USEF MIC / NICT MLIT（GSI） university and private sector	SERVIS-2, SDS-2 and others, 1 demonstration satellite every year

5-year development and utilization plan of satellites and other assets corresponding to 9 major social needs (foreseeing next 10 years)

Necessary fund is estimated to be JPY2,500B for the utilization, R&D of all satellites described at this plan, which should be shared by government and private sector.
This was estimated by Secretariat of Headquarters for Space Policy based on a certain assumption, so is not a target committed by government and is very rough one.



		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
total number of satellites(4)	big size	0	1	2	1	2	1	1	2	2	3	4	–	–	–	–	–	–	–
	medium size	0	0	1	3	0	1	1	0	3	4	3	–	–	–	–	–	–	–
	small size	2	0	2	1	0	1	1	3	2	3	2	–	–	–	–	–	–	–

(1) Necessary fund is estimated on the assumption as below.
- big size satellite(development cost:JPY50B, launch cost:JPY12B)
- medium size satellite(development cost:JPY30B, launch cost:JPY9B)
- small size satellite(development cost: JPY6B, launch cost:JPY4.5B)

(2) This plan covers FY2009-FY2013
(3) Development period and procurement period prior to the launch are not described at this chart.
(4) This includes the order of satellites and their launch from abroad, but not the super small satellites.
(5) The number and the time of launch which are described within broken line are to decided later. (It is not counted at " total number of satellites".)
(6) It will be determined in the Defense Guideline and the Mid-term Defense Program after the consideration what the entire defense capability should be