# Communications Technologies in Space Applications in the Future

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On October 1, 2003, the National Space Development Agency of Japan (NASDA), the National Aerospace Laboratory of Japan (NAL) and the Institute of Space and Astronautical Science (ISAS) were merged into one independent administrative institution: the Japan Aerospace Exploration Agency (JAXA). However, immediately after the merger, JAXA had to face the successive failures of H-II A and M-V launch vehicles and the operational anomaly with the Advanced Earth Observing Satellite-II (ADEOS-II: Midori-II). Subsequently, during a year and a half after the merger, JAXA was forced to concentrate all our energy on the accident investigation into the causes of these failures.

On February 26, 2005, JAXA successfully launched the Multi-functional Transport Satellite-1 Replacement (MTSAT-1R: Himawari 6) using the H-IIA Launch Vehicle No. 7 (H-IIA F7) and also successfully launched the M-V Launch Vehicle with the X-ray Astronomy Satellite (ASTRO-E: Suzaku) onboard. With those consecutive successful launches, JAXA finally recovered former vitality and regained former confident.

Furthermore, it is still fresh in our memories that the Space Shuttle "Discovery" was successfully launched for the Return to Flight mission on July 26, 2005, with impressive accomplishments by the Mission Specialist NOGUCHI Soichi of JAXA during the flight.

Since then, in November 2005, the Asteroid Explorer "HAYABUSA" (MUSES-C) had successfully touched down on and taken off from Asteroid "Itokawa" (HAYABUSA will return to earth in 2010). On January 24, 2006, the H-IIA Launch Vehicle No. 8 (H-IIA F8) with the Advanced Land Observing Satellite "Daichi" (ALOS) onboard was successfully launched.

In parallel with those flights, JAXA in April 2005 announced the "JAXA Vision –JAXA 2025–," providing the outlook for the aerospace activities over the next 20 years. This Vision consists of five pillars: "Contribute to building a secure and prosperous society through the utilization of aerospace technologies," "Contribute to advancing our knowledge of the universe and broadening the horizon of human activity," "Develop the capability to carry out autonomous space activities through the best technologies in the world," "Facilitate growth of the space industry with self-sustenance and world class capability" and "Facilitate the growth of aviation industry and aim for technological breakthroughs for future air transportation."

There are many space development plans in spacefaring countries, including the announcement of the "Vision for Space Exploration," a plan to return astronauts to the moon, by the National Aeronautics and Space Administration (NASA), the success of manned space flight by China and the "Galileo Project," a global navigation satellite system, an initiative launched by the European Union and the European Space Agency (ESA). Under such circumstances, it is essential challenges for JAXA how to promote space development activities of Japan and how to expand space applications. Henceforth, JAXA is to develop a concrete implementation plan for realizing Japan's long-term vision.

With respect to JAXA's R&D on communications technologies in space applications, JAXA has been implementing two projects; i) Engineering Test Satellite-VIII (ETS-VIII) having two Large Deployable Antenna Reflectors (19 m × 17 m each) to demonstrate mobile satellite communication system technology; and ii) the Wideband InterNetworking engineering test and Demonstration Satellite (WINDS) to carry out satellited base ultrahigh-speed Internet relay experiments. On August 24, 2005, the Optical Inter-orbit Communications Engineering Test Satellite (OICETS: Kirari) was launched by a Dnepr Launch Vehicle of Russia from the Baikonur Cosmodrome in the Republic of Kazakhstan. The experiments on optical inter-orbit communications between the OICETS and a satellite of the Advanced Relay and Technology Mission (ARTEMIS) of ESA were successfully conducted.

I have long believed that JAXA should leave conventional satellite communications entirely to private sectors and should actively challenge highly advanced technology development. Namely, such technologies as communications are indispensable for all space missions, and are to be further advanced in terms of larger capacity, higher speed, higher efficiency and more sophisticated functionality. For instance, an Information Gathering and Warning System for Disaster and Crisis Management and a Global environmental monitoring system integrating observations and predictions, under one of five pillars of the "JAXA Vision –JAXA 2025–," requires such key technologies as an advanced mobile communications method for information transmission to individuals and a high-speed large-capacity information communications method. In addition, for space exploration and manned space activities, it is vital to develop further advanced and highly reliable communications. I believe that optical communications technologies being deployed on the ground should be extended to space for expanding communications capacity, and in the future, quantum communications in compliance with quantum computers should be researched and studied. Our future research should also cover quantum communication corresponding to the quantum computer.