Satellite Communications and I

Looking back on my career so far, the title "Intersatellite Communications and I" fits better than "Satellite Communications and I".

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▲ Operation room for intersatellite communications experiments

Intersatellite communication is the communication between a spacecraft in low earth orbit and a ground station via a geostationary data relay satellite. In February 2003, after long nine years from the first launching of a Japanese data relay satellite, we finally realized Japanese intersatellite communications. This is the ninth year since I joined NASDA, or National Space Development Agency of Japan. When I think back, it seems to me that there was a fateful link between intersatellite communications and me. For 8 years until February 2003, I had been working toward a great goal of realizing a Japanese intersatellite communication. In this essay, I would like to write about the process to the success of Japan's first intersatellite communication, seen through the prism of my own experience.

In 1994, I took the entrance examination of NASDA, which is the predecessor of Japan Aerospace Exploration Agency (JAXA). The year 1994 was a year in which the NASDA's satellite "ETS-VI" was launched. ETS-VI was the Japan's first satellite equipped with intersatellite communications device, a satellite which formed the basis of JAXA's data relay satellite. I am ashamed to say, but I had no idea of what kind of satellite ETS-VI was, a satellite which had started a countdown of days before launch while I was taking the recruitment exam. Then, I got an official job offer from NASDA only a day after I heard the news the satellite failed to enter its geostationary orbit. In part for this reason, ETS-VI left an impression on me.

In April of the next year, my first job at NASDA was to monitor and control the satellite, or ETS-VI. This was my first involvement in intersatellite communications. Finding out what ETS-VI's missions are, I learned the world of intersatellite communications for the first time. My major was communication engineering and I learned a little about satellite communications, but still I had never heard of the word "intersatellite communications". While I was interested in the world of intersatellite communications, I thought it was a world out of my reach. I could never imagine that I would be a chief engineer for development of a intersatellite communications system just a few years later, and go through a long, long path to the realization of the system.

Six months after joining NASDA, preparation for launching COMETS - a successor satellite to ETS-VI - started and I was involved in development of a satellite control system for COMETS. But as early as next April, just six months later, I was transferred to the network control section from the satellite monitoring section due to organizational change.
To be honest, I was disappointed to hear about that transfer and thought, "Do I have to transfer to another section in only one year ? Did I waste a whole year ?" I convinced myself that this transfer to network section was a chance to make use of my expertise and radio operator qualification. But, my new job at the new section was to develop an experimental ground system for mission equipment of COMETS. Instead of being away from COMETS, I was unexpectedly assigned to a position in charge of COMETS experimental missions and more deeply involved in the field of intersatellite communications. And later I found that what I

learned in my first year experience at the satellite control section, which seemed a “detour” at the time, was an necessary part to realize intersatellite communications.

Primary job of a conventional satellite network is to monitor and control ground stations. Although it is important to send and receive signals between a ground station and a satellite, a ground station can communicate with a satellite without knowing what kind of operation is being performed. However, in an intersatellite communication network, in order to establish a satellite communication link, we need precise information about what status a data relay satellite is in. A data relay satellite with intersatellite communication equipment is sort of like an antenna placed in space. To send data to and receive data from a low earth orbit spacecraft via a intersatellite link, it is necessary to understand satellite status such as attitude of data relay satellite, direction of antenna, behavior of on-board equipment (transponder). So, what I learned at the satellite control section was never a “detour”, but an essential experience for intersatellite communications, which needs knowledge of satellite operation.

Two years after the transfer, when I felt a little more confident, the launching day of COMETS came. But unfortunately, COMETS could not acquire its geostationary orbit. This was just the second launching that I experienced and I had the day with hope and tension as a COMETS ground system staff. People told me that a moment of launching gave you goose bumps. But, what I had the night was a quite different kind of goose bumps. If only it were a dream. If only it weren’t true. I still remember I was afraid to wake up and go to work next morning. For several months after the day, I felt painful and depressed everyday. Although I had a lot of difficulties during the development, I was strongly motivated by the goal to realize intersatellite communications by COMETS. With this goal in mind, I could carry it through to the end, no matter how much overtime work I had to do, or no matter how many times I had to redo. But, I could not stand the fact that COMETS would never entered into a geostationary orbit and the system we had built up with long time efforts would not be used. Losing the goal, having a terrible sense of loss, I felt as if I got lost in the darkness.

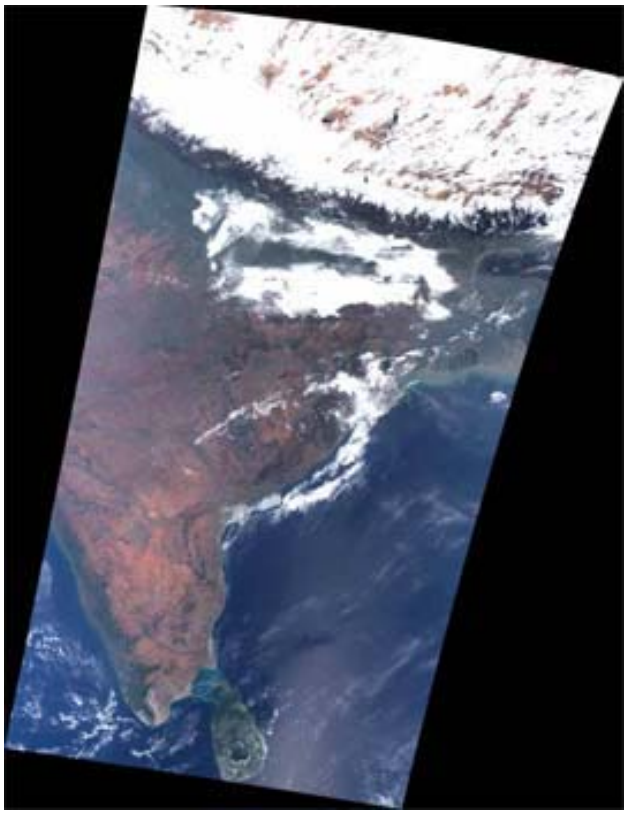
Meanwhile, an emergency task force was set up and started to study the feasibility of entering OICETS into an orbit where communication experiments could be carried out. We, the ground system development team, began to study a modification of ground system which allowed to support COMETS in an elliptical orbit. But I couldn’t change my emotional gear so rapidly. I was overcome with a sense of loss and failure, and felt like quitting my job at times.
One day when COMETS was acquiring its elliptical orbit by the last maneuver, one of my colleagues, who was in charge of orbit control, said to me, “Once we placed COMETS in its orbit, we’ll leave the matter to you.” The word suddenly snapped me out of my stupor. I was not the only one who was thrown into this deep depression. Everyone involved in the development of COMETS had already taken a step forward and was thinking about what to do to achieve the mission goals. When I found that, I felt ashamed of my weakness.
But the word got me on my feet again. I think I wouldn’t be what I am today without that word at that time. And also, this experience of frustration and recovery made me strong, not surrender to any difficulty in the development of DRTS, the next intersatellite communications experiment.

▲ Earth station for intersatellite communications experiments

Four years passed from the failure of COMETS launching. My senior colleagues, who advised and guided me kindly and seriously, had left the department one by one. Then, I found that I had became the longest-serving active involved in intersatellite communications.

As the day of launching DRTS approached, I came to think that I must make a success of DRTS intersatellite communications for my old colleagues who couldn't have seen the realization of intersatellite communications. This might have been overconfidence, though.

In September 2002, DRTS was successfully lunched. And December in that year, NASDA launched an earth observing satellite "ADEOS-II", which would establish an intersatellite communication link with DRTS. In February 2003, after another two months passed, finally came the day when our long-cherished dream, "the success of intersatellite communication" would come true.
I thought " I did everything I could. Now all I can do is pray for success." All ground systems for DRTS and ADEOS-II were set and all staff were waiting with bated breath for the moment when the link was established. The receiving level of DRTS went up, and the moment when the acquisition indicator of the demodulator lighted up, "We made it !" Shouts of joy and applause erupted from everyone in the operation room.
I might have unconsciously felt anxious about the success of the experiment. At the moment of success, I felt an indescribable feeling of relief, then felt deep gratitude toward those who guided, supported and encouraged me. We owed this success much to the effort of people who had overcome a lot of difficulties in developing and launching the three generations of satellite; ETS-VI, COMETS, DRTS.



▲ First image obtained in DRTS/ADEOS –II intersatellite communications experiments

Space development, from concept to realization, takes an enormous amount of time. It is very rare to work on the same project until its mission goal is achieved. Such mission might be unusual as its mission goal is finally achieved after three generations of satellites, as was my case. Even now, after more than a year passed, I am thankful that I had a good fortune of being there at the moment when our long-held ambition was realized.
I received a lot of e-mail messages of congratulations and appreciations on the day after the success. I still keep the messages. They are the proofs that if I never give up, I will reach my goal. They will give me a push to meet another challenge, which I am going to face. We have reached a long-haul destination of "realization of intersatellite communications", but we still have a long way to go. I think that my involvement in satellite communications will not end yet. I am going to continue to be in the field of intersatellite communications for a time. I will go ahead and build up my experience, looking forward the day I step into another new world of satellite communications.