1 Introduction

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A wideband internetworking engineering test and demonstration satellite (WINDS) is currently under development as part of the Japanese government's "e-Japan Priority Policy Program" IT Strategy. This satellite will form a part of advanced information and telecommunications networks. The device technologies related to the establishment of high-speed satellite communications in the Ka band will be tested and demonstrated, toward the goal of realizing ultra-high-speed communications within Japan and between nations in the Asia-Pacific region. The satellite technologies to be used in the construction of satellite networks that will supplement ground communications networks with an advantageous robustness against disasters will also be tested and demonstrated.

Major new technologies to be installed in WINDS include a multi-port amplifier, an active phased-array antenna, and an onboard baseband switch. The multi-port amplifier technology is designed to compensate for attenuation due to rain, a persistent problem in the Ka band. As this multi-port amplifier can provide flexible power-distribution management of transmitted beams, it can, for example, increase the power of the transmitted beam as required in rainy weather or increase the power of the radio waves directed toward regions with high communication demands. The active phased-array antenna makes it possible to change the direction of the transmitted and received radio waves freely at high speed. This antenna enables communications over large areas in the Asia-Pacific region. The onboard baseband switch allows high-speed communication with three channels of 155 Mbps lines within the satellite. These technologies enable data communication of up to 155 Mbps from the satellite to a residence and 1.5 Mbps to 6 Mbps from a residence to the satellite, using an ultra-small aperture terminal featuring a diameter of 45 cm, which can be installed in the balcony of an ordinary home. In addition, the technologies enable ultra-high-speed data communication of 1.2 Gbps, the fastest in the world, to and from an earth station equipped with an antenna featuring a diameter of approximately 5 m, a type assumed to be generally applicable for use among communication carriers. Further, as WINDS covers major cities in Japan and in the Asia-Pacific region with fixed spot beams, it also provides ultra-high-speed satellite communications to these areas. The active phased-array antenna makes it possible to transmit and receive radio waves to and from anywhere over approximately one-half of the earth's surface. Thus, WINDS provides broadband communications in areas with insufficient telecommunications infrastructures, including Pacific islands, and is expected to help bridge the digital divide throughout the Asia-Pacific region.

The satellite has been jointly developed by the Japan Aerospace Exploration Agency (JAXA) and the National Institute of Information and Communications Technology (NICT). NICT is in charge of developing the on-board baseband switch.

In terms of ground facilities, NICT is in charge of developing a 1.2-Gbps/622-Mbps fast modem, the large earth terminal (featuring a 5-m antenna) and a super-high data-rate very small aperture terminal (i.e., a land-based

mobile station) equipped with a 2.4-m antenna. These facilities are all used as earth stations for the world's fastest 1.2-Gbps or 622-Gbps data transmission with the satellite transmission in "non-degenerative mode" (also referred to as "bent-pipe mode"). JAXA is in charge of developing the ultra-small aperture terminal, with a diameter of 45 cm, which enables 155-Mbps data transmission in degenerative mode using the satellite baseband switch.

Planned satellite communications experiments include fundamental experiments (for 1.2-Gbps transmission, onboard baseband switch congestion, and network and multicast operations) by NICT and JAXA and application experiments by potential users in the Asia-Pacific region. WINDS application experiments were solicited and selected by the Satellite Application Experiment Promotion Conference of the Ministry of Internal Affairs and Communications. Fifty-three projects (26 from Japan and 27 from overseas) have been adopted to date. Future participants in experiments will include not only development organizations but also a wide range of interested parties hoping to employ satellite communications in the future.

This special issue reports on the current status of the WINDS project, with the cooperation of JAXA, NICT's partner in this joint project. The issue provides an overview of the WINDS project, the onboard and ground experimental facilities, and the results of development. We hope that these results will in turn be used in WINDS satellite application experiments and that they will ultimately help realize a range of advanced ultra-high-speed satellite communications systems in Japan. With the approach of a launch planned for the winter of fiscal 2007, satellite development is progressing smoothly. During this preparation period, many parties collaborated in development and joined in the experiment planning studies. We would like to take this opportunity to express our sincere respect and gratitude to all of these people for their valuable contributions.

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