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# 4 Development of Earth Stations System

## 4-1 Overview of Earth Stations for WINDS Experiments

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WINDS has been developed assuming the four types of user earth stations. Those earth stations have been developed by JAXA and NICT. WINDS satellite communication system is very complex, then it needs the satellite network control station, WINDS network management station, which developed by JAXA. The overviews of those earth stations for WINDS experiments are described.

### *Keywords*

WINDS, Regenerative link, Bent-pipe link, Earth station

### 1 Introduction

Before we began development of the Wideband InterNetworking engineering test and Demonstration Satellite (WINDS), we considered how the satellite network would be used, and subsequently directed development of the WINDS system based on this assumed use of the satellite network. We have also classified experimental user earth stations into four types according to their various capabilities. Development of the stations has been based on a division of tasks between the National Institute of Information and Communications Technology (NICT) and the Japan Aerospace Exploration Agency (JAXA). The WINDS satellite network is an extremely complicated system and requires a station capable of controlling this network. In addition to the experimental user earth stations, JAXA is developing a Network Management Center to enable control of the WINDS communication network.

### 2 WINDS Network Management Center<sup>[1]</sup>

WINDS employs a TDMA system, an extremely complicated configuration that provides up to 10 beams and in which the user can simultaneously use three frequency bands in the regenerative link. In addition, the regenerative link uses the demand assign system and requires assignment of traffic slots according to users' requests.

The Network Management Center is responsible for providing these controls for the communication network. JAXA is in charge of development of the Center. Article 4-5 provides details of the Center's development.

### 3 Experimental user earth stations<sup>[2][3]</sup>

As shown in Table 1, the experimental user earth stations are classified into four types according to their capabilities, a function

**Table 1** Types of earth stations

Type	Link type	Antenna	Data rate	Development
Large Earth Terminal (LET)	Fixed Regenerative Link	5 m $\phi$ class	uplink: 1.5, 6, 24, 51, 155 ( = 51 $\times$ 3 ) Mbps downlink: 155 Mbps	NICT
	Scanning Regenerative Link		uplink: 1.5, 6, 24, 51, 155 ( = 51 $\times$ 3 ) Mbps downlink: 155 Mbps	
	Fixed Bent-pipe Link		uplink/downlink: 622 Mbps, 1.2 Gbps ( = 622 Mbps $\times$ 2 )	
	Scanning Bent-pipe Link		uplink/downlink: 622 Mbps, 1.2 Gbps ( = 622 Mbps $\times$ 2 )	
Super high Data Rate Very Small Aperture Terminal (SDR-VSAT)	Fixed Regenerative Link	2 - 3 m $\phi$ class	uplink: 1.5, 6, 24, 51, 155 ( = 51 $\times$ 3 ) Mbps downlink: 155 Mbps	NICT
	Scanning Regenerative Link		uplink: 1.5, 6, 24, 51, 155 ( = 51 $\times$ 3 ) Mbps downlink: 155 Mbps	
	Fixed Bent-pipe Link		uplink/downlink: 622 Mbps	
High Data Rate Very Small Aperture Terminal (HDR-VSAT)	Fixed Regenerative Link	1 - 2 m $\phi$ class	uplink: 1.5, 6, 24, 51, 155 ( = 51 $\times$ 3 ) Mbps downlink: 155 Mbps	JAXA
Ultra Small Aperture Terminal (USAT)	Fixed Regenerative Link	0.45 m $\phi$ class	uplink: 1.5, 6 Mbps downlink: 155 Mbps	JAXA

of the respective antenna diameters. NICT and JAXA divided the various development tasks between them. Here we will provide a brief introduction to these four types of earth stations in the order of decreasing antenna diameter. Please refer to other articles for further reference; for example, Article 4-2 discusses the details of the earth stations developed by NICT, and Article 4-6 discusses the details of the earth stations developed by JAXA.

- Large Earth Terminal (LET) (Antenna diameter of 5 m or larger: developed by NICT)  
A station that can conduct experiments in ultra-high-speed satellite communications (622 Mbps  $\times$  2), assuming complementary use of the backbone network
- Super-High Data-Rate Very Small Aperture Terminal (SDR-VSAT) (Antenna diameter of 2 m to 3 m: developed by NICT)  
A station that can conduct experiments in high-speed satellite communications (622 Mbps) assuming installation in ISPs (Internet service providers)
- High-Data-Rate Very Small Aperture Ter-

terminal (HDR-VSAT) (Antenna diameter of 1 m to 2 m: developed by JAXA)

A station that can provide high-speed satellite communications [1.5 Mbps, 6 Mbps, 24 Mbps, 51 Mbps, and 155 (=51  $\times$  3) Mbps for transmission and 155 Mbps for reception] assuming installation in facilities such as schools and hospitals

- Ultra-Small Aperture Terminal (USAT) (Antenna diameter of 0.45 m or less)  
A station that can provide satellite communications (1.5 Mbps and 6 Mbps for transmission and 155 Mbps for reception) assuming installation in homes

## 4 Conclusions

This article provides an overview of the experimental user earth stations and the WINDS Network Management Center established to control a satellite communication network, a Center whose functions were assumed in developing the WINDS satellite communication network. NICT and JAXA divided the various tasks in the development of these earth stations.

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## **References**

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