Request for proposals concerning application experiments using Wideband InterNetworking engineering test and Demonstration Satellite (WINDS)

October 30, 2003
Satellite Application Experiment Promotion Conference
The Ministry of Public Management, Home Affairs, Posts and Telecommunications (MPHPT) has been organizing the Satellite Application Experiment Promotion Conference, chaired by Prof. Yasuhiko Yasuda, Science and Engineering of Waseda University, since FY 1997 as part of a collaboration effort involving industry, academia, and government with the objective of verifying the satellite communications technology utilization and promoting the development of satellite applications.

The Satellite Application Experiment Promotion Conference investigates matters, such as fundamental policies with respect to satellite application experiments and the construction and operation of satellite test beds. The conference recently adopted application requirements for experiments using the Wideband InterNetworking engineering test and Demonstration Satellite (WINDS), which is scheduled to be launched in FY 2005, as described below, and is currently requesting proposals for experiment participants.

1. WINDS

WINDS, which is scheduled to be launched in FY 2005, is part of a research and development project to establish the world’s most advanced information and telecommunications network. The project is part of the e-Japan Priority Program, which was established by the Information Technology (IT) Strategy Headquarters of the Japanese government. By utilizing the advantages of satellite communications, such as wide-area coverage, synchronism, disaster resistance, and flexibility in digital cross-connecting, WINDS is able to perform as a research and development satellite, creating technologies necessary to construct future satellite communications networks that can reciprocally supplement existing ground-based networks. (See Appendix 1 for a system outline of WINDS.)

2. Request for Proposals

Experiments that use the WINDS and aim at contributing to the promotion of satellite communications technology and the development of satellite applications are being requested.

WINDS circuits are made widely available to not only satellite development agencies (Japan Aerospace Exploration Agency and Communications Research Laboratory) that conduct basic satellite experiments but also universities, research institutions, administrative agencies, and private businesses for research and development purposes. Eligible applicants include overseas institutions. Joint participation by multiple entities is also permitted.

Proposed experiments are subject to deliberation in the Satellite Application Experiment Promotion Conference to determine acceptance.

3. Period of Experimentation

From the initial checkout of the WINDS until the termination of operation.

4. Requirements for Participation in Experiments

(1) The experiment will contribute to the advancement of satellite communications technology and the development of satellite application.

(2) The experiment plan and results must be reported at the Satellite Application Experiment Promotion Conference. Experiment results are to be made public.
(3) Prior consultation with the parties involved in the experiments concerning intellectual property rights, methods of making experiment results public, and confidentiality of technical information from satellite development agencies is required. The results of the consultation shall be reflected in subsequent contracts.

(4) When running the ground station and other facilities, participants in the experiment must observe the technical standards and operating procedures stipulated by the Radio Law (or applicable local radio laws when in foreign countries) and other laws. A radio station license is required to conduct experiments.

(5) The experiments shall not be used for commercial purposes.

(6) The experiments shall not interfere with the operation of the WINDS.

5. Precautions for Participants in the Experiment
   (1) Restrictions may be imposed on the experiment implementation time and schedule depending on the status of the basic experiments being conducted by satellite development agencies or other application experiments.
   (2) International coordination concerning radio frequencies is currently being conducted based on Appendix 1, and revisions and restrictions may be necessary as a result of such international coordination.
   (3) Please refer to *WINDS Application Experiment Guide*¹ for further details and restrictions.
   (4) Participants will be asked to enroll as members of the WINDS Application Experiment Implementation Council (tentative name)² to ensure the smooth and efficient implementation of application experiments.

Notes:
1. See paragraph 8 on how to obtain a copy of the guide.
2. The WINDS Application Experiment Implementation Council will be responsible for handling matters concerning WINDS application experiments, such as scheduling, the sharing of information, and compiling experiment results.

6. Equipment Used in the Experiment
   (1) Participants may use the satellite transponder free of charge.
   (2) Equipment for the ground station shall, in principle, be prepared by the participants. Participants may use (borrow) the ground station prepared by the satellite development agencies, however, requests to borrow equipment may not always be granted due to limited availability.
   (3) Any expenses incurred in the implementation of experiments shall be borne by the participants.
   (4) Please refer to *Application Experiment Ground Station Guidelines*³ for specifications on the ground station's communication capabilities with the WINDS.

3. See paragraph 8 on how to obtain a copy of the guidelines.

7. Application Procedure
   (1) People wishing to participate in an experiment shall submit the following documents to the address shown in paragraph 8.
      a. Experiment Plan Overview
         An overview prepared in Japanese or English, in accordance with the
particulars indicated in Appendix 2 (to be submitted by mail)
b. Electronic Data of Experiment Plan Overview
   A data file prepared in whole or in part in MS-Word format (The electronic
   media used is to be submitted by mail or sent as an attachment with an e-mail.)
(2) Documents (1) must arrive between April 1, 2004, and April 30, 2004.
(3) The submitted documents will not be returned.

8. Contact Address
   Inquiries, application documents, and requests for the WINDS Application Experiment
   Guide mentioned in note 1 and Application Experiment Ground Station Guidelines
   mentioned in note 3 are to be directed to the following address:

   Space Communications Research Office
   Space Communications Policy Division Information and Communications Policy Bureau
   MPHPT
   Attn: Mr. Ishizaki or Mr. Nemoto
   Central Common Government Office, No. 2 Bldg., 11th floor
   2-1-2 Kasumigaseki
   Chiyoda-ku, Tokyo 100-8926
   Japan
   Tel.: +81-3-5253-5771   Fax: +81-3-5253-5772
   E-mail: winds@soumu.go.jp
   (Contact should be made by E-mail or fax in either Japanese or English.)
Overview of Wideband Internetworking Engineering Test and Demonstration Satellite (WINDS)

Key technologies of the communications payload of WINDS are

1. Ka-band multi-beam antenna (MBA) / High power multi-port amplifier (MPA)
2. Ka-band active phased array antenna (APAA)
3. On-board, high-speed switching router (ABS : ATM Baseband Switch)
4. Ultra high speed fixed satellite communication network

Table 1. Characteristics of WINDS (Target)

<table>
<thead>
<tr>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orbit</td>
<td>Geostationary Earth Orbit (GEO)</td>
</tr>
<tr>
<td></td>
<td>143 degrees East Longitude (tentative)</td>
</tr>
<tr>
<td>Mass</td>
<td>Approximately 2,700kg</td>
</tr>
<tr>
<td></td>
<td>(In Orbit, Beginning of Life)</td>
</tr>
<tr>
<td>Size</td>
<td>2m x 3m x 8m</td>
</tr>
<tr>
<td></td>
<td>(Solar Array Paddles deployed: 21.5m)</td>
</tr>
<tr>
<td>Design Life</td>
<td>5 years (targeted life)</td>
</tr>
<tr>
<td>Power</td>
<td>More than 5,200W</td>
</tr>
<tr>
<td>Attitude Control</td>
<td>3-axis stabilized</td>
</tr>
<tr>
<td>Accuracy of Attitude Control</td>
<td>pitch and roll : +/- 0.05 degrees</td>
</tr>
<tr>
<td></td>
<td>yaw : +/- 0.15 degrees</td>
</tr>
<tr>
<td>Launch Vehicle</td>
<td>H-IIA</td>
</tr>
<tr>
<td>Launch Site</td>
<td>Tanegashima Space Center</td>
</tr>
<tr>
<td>Launch Date</td>
<td>FY 2005</td>
</tr>
</tbody>
</table>

Figure 1. Overviews of WINDS in orbit
Table 2. Outline of communication system (Target)

<table>
<thead>
<tr>
<th>Mode</th>
<th>Frequency</th>
<th>Antenna Beams and Coverage Area</th>
<th>Aperture of Ground Terminal and Data Rate (Up/Down: MBA link)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data relay mode</td>
<td>Uplink: 27GHz band, Downlink: 18GHz band</td>
<td>MBA (Fixed Beam) : Japan (9 beams) and Asian region (10 beams)</td>
<td>45cm class: 1.5, 6 / 155Mbps 1-2m class: 1.5, 6, 24, 51X3 (155Mbps) / 155Mbps</td>
</tr>
<tr>
<td>On-board switching mode</td>
<td></td>
<td>APAA (Scanning Spot Beam) : Asia Pacific Region (see figure 2)</td>
<td>2-3m class: 622/622Mbps 5m+: 622Mbps, 1.2Gbps</td>
</tr>
<tr>
<td>Bent-pipe mode</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ATM switching)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(IF-switch matrix)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3. Mission equipment overview and development organization

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Development Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ka-band multi-beam antenna (MBA) / High power multi-port amplifier (MPA)</td>
<td>JAXA</td>
</tr>
<tr>
<td>Multi-beam antenna for fixed satellite communications throughout Japan and major Asian cities. Multi-port amplifier for flexible power distribution of those beams.</td>
<td></td>
</tr>
<tr>
<td>Ka-band active phased array antenna (APAA)</td>
<td>JAXA</td>
</tr>
<tr>
<td>APAA can form 2 communication beams, which can hop from area to area rapidly and electronically in the Asia Pacific region.</td>
<td></td>
</tr>
<tr>
<td>On-board high-speed switching router (ABS : ATM Baseband Switch)</td>
<td>CRL</td>
</tr>
<tr>
<td>ATM base-band Switch can conduct ATM cell based switching up to 155Mbps × 3 channels.</td>
<td></td>
</tr>
</tbody>
</table>

CRL: Communications Research Laboratory
JAXA: Japan Aerospace Exploration Agency

Table 4. Communication antenna and transmitter (Target)

<table>
<thead>
<tr>
<th>Mission payload</th>
<th>Description</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBA</td>
<td>Antenna diameter: MBA1 MBA2</td>
<td>2.4m 2.4m Each antenna operates for both transmitting/receiving</td>
</tr>
<tr>
<td></td>
<td>Number of beams: MBA1 MBA2</td>
<td>12 7</td>
</tr>
<tr>
<td></td>
<td>Simultaneously usable beams</td>
<td>Max. 8</td>
</tr>
<tr>
<td></td>
<td>Polarization</td>
<td>linear See figure 2</td>
</tr>
<tr>
<td>MPA</td>
<td>Number of input / output ports</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Total maximum output power</td>
<td>280W Flexible distribution in each port</td>
</tr>
<tr>
<td>APAA</td>
<td>Number of beams</td>
<td>2 Beam hopping up to 8 areas per beam within the beam hopping range</td>
</tr>
<tr>
<td></td>
<td>Beam hopping range</td>
<td>+/- 8 degrees</td>
</tr>
<tr>
<td></td>
<td>Polarization</td>
<td>linear (north-south)</td>
</tr>
<tr>
<td></td>
<td>Number of radiation elements</td>
<td>128</td>
</tr>
</tbody>
</table>
Figure 2. Coverage of MBA and APAA (Plan)

**MBA1 (12 beams)**
- Japan: 9 beams:
  - Hokkaido East (V), Hokkaido West (H), Tohoku(V), Kanto (H), Chubu(V), Kinki(H), Chugoku / Shikoku(V), Kyushu(H), Okinawa(V)
- Vicinities: 3 beams:
  - [Seoul(H), Beijing(H), Shanghai(H)]
  - (V): Vertical (North-South) polarization,
  - (H): Horizontal (East-West) polarization

**MBA2 (7 beams)**
- [Hong Kong, Kuala Lumpur, Singapore, Manila, Jakarta, Bangkok, Bangalore]
- Polarization: H (except Singapore: V)

**APAA beam**
- (Examples of radiation region)
  - 2 beams, vertical polarization
Antennas
(a) Fixed beam Ka-band multibeam antenna (MBA)
  High power multi-port amplifier
(b) Hopping spot beam Ka-band active phased array antenna (APAA)
  On-board, high-speed ATM base-band switching router
  IF Switch (IF switch matrix etc.)

Figure 3. Block diagram of mission equipment

- MBA1 TX/RX
- MBA2 TX/RX
- RX Switch Matrix
- TX Switch Matrix
- ABS (ATMS, DDEM, MOD)
- ATMS: ATM Switch
- DDEM: Digital Demodulator
- MOD: Modulator
- Down Converter
- Up Converter
- MPA
- Low Noise Amplifier. Down converter
- RX APAA
- TX APAA

1.5Mbps (Max 14 lines), 6Mbps, 24Mbps, 51Mbps
155Mbps
Bent-Pipe
Experiment Plan Overview

To the Satellite Application Experiment Promotion Conference

Name of representative (Signature)

Name and title of representative (Type script):

Company or organization:

Address:

Name of experiment:

(e.g., “Experiment on _________,” “Research and development of _________ technology,” etc.)
1. Experiment items
   Example (multiple items possible):
   1) ________ communications experiment
   2) Development of _______ technology
   3) Verification and validation of _______ technology

2. Objectives of experiment
   * Describe in 10–20 lines per experiment item.

3. Participants
   Example:
   Experiment implementer: ________ University
   Joint implementers: ________ Research Institution
   ________ Corporation

4. Location of experiment
   Example:
   * On the premises of ________ University (_______ City, _________ Prefecture, _________ Country)

5. Overview of experiment
   * Describe in as much detail as possible.
   * Specify, to the greatest extent possible, the data relay type, antenna beams, antenna aperture, and data rate that will be used.
   (See Table 2 in Appendix 1)

6. Diagram of systems to be used in the experiment
   * Illustrate the configuration of the system to be used. Use another sheet if necessary.
7. Timing and length of experiment requested
   • Describe the minimum conditions necessary to obtain experiment results with respect to satellite use.

8. Use of the ground station
   • Indicate whether or not you will be applying to use the ground station prepared by development agencies.
   If you are going to submit an application for the use of the ground station, specify the size of the ground station required as well as the data relay type, antenna beams, antenna aperture, data rate, etc., that will be used.

9. Other matters
   • Please specify, if any.

10. Contact
    Name and title of person to contact:
    Address:
    Tel.:
    Fax:
    E-mail: