SPECIAL REPORT

Development of interactive VSAT/ Software

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1. Introduction

KDDI has provided the KDDI-Skycast Service, which uses VSAT(Very Small Aperture Terminal) with Ku-band frequency to enable high-speed, two-way IP transmission via satellite since October 1999. In the KDDI-Skycast Service, with advantageous features of satellite communications such as its wide service coverage and broadcasting nature, packages of multimedia application software which are well suited to two-way satellite communications are also provided. In this article, the systems and its applications of KDDI-Skycast are introduced..

2. System Description

As depicted in Figure 1, the KDDI-Skycast system has a satellite communication system with a star-type topology, consisting of satellites, hub earth stations (installed at the KDDI's premises) and VSATs (installed at customers' premises). In order to make VSAT terminals smaller and avoid interference from terrestrial microwave circuits, the Ku-band frequency (14GHz for transmission and 12GHz for reception) is utilized.

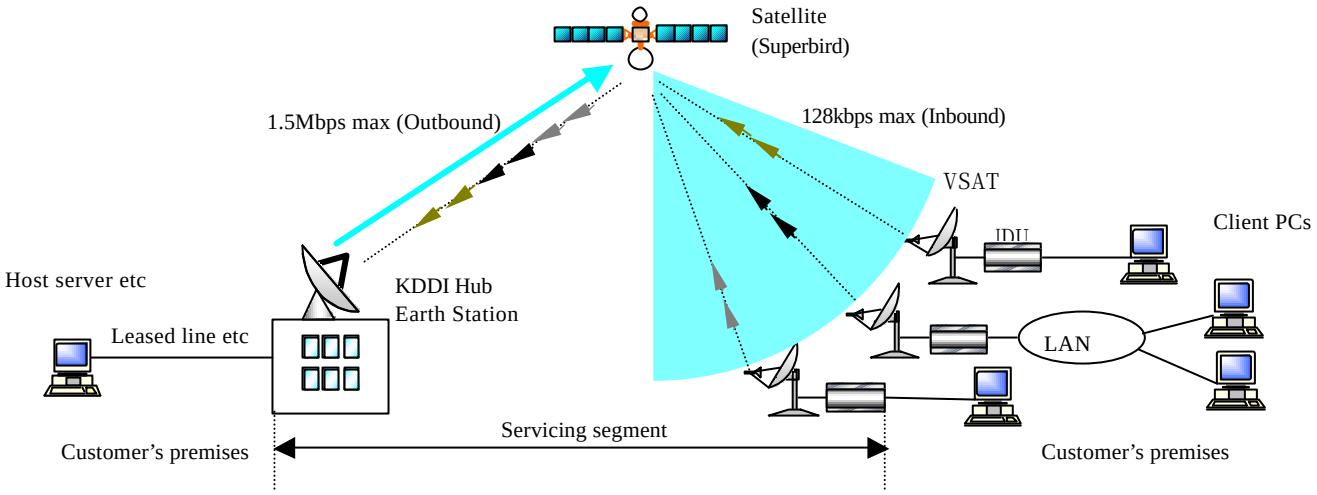

Figure 1 System configuration of KDDI Skycast

2.1 Configuration

(1)Satellites

The Superbird satellites operated by SCC(Space Communications Corp), which cover the whole nation with excellent transmission and receive characteristics, are used.

(2)Hub earth stations

In order to maintain total system availability even in case of heavy rain fall around a hub earth station, the hub site diversity configuration is taken by operating hub earth station both at KDDI Otemachi Building (Tokyo) and KDDI Naha Building (Okinawa). The hub earth station consists of (a)antenna/RF equipment; (b)access control and signaling equipment to provide modulation/demodulation, access control of satellite circuits and protocol conversions; (c)terrestrial interface equipment (such as routers connected to leased lines, FWA and LAN); and (d)monitoring and control equipment.

(3)VSAT

As shown in Figure 2, the VSAT consists of (a)antenna(offset-parabolic antenna with the diameter of 75cm), (b)ODU(Out Door Unit) consisting of SSPA transmitter with the output power of 1W, low noise receiver and frequency converters and (c)IDU(In Door Unit). The ODU and IDU are connected by two coaxial cables, separately for transmission and reception. The VSATs are remotely supervised and controlled from the integrated monitor and control equipment at the hub earth station.

Figure 2 VSAT Apperance

2.2 System characteristics

(1) Satellite access scheme

The satellite circuit is configured by combination of the outbound channels (hub to VSAT direction) and the inbound channels (VSAT to hub direction). In the outbound channel, IP packets destined to different VSATs are multiplexed by means of TDM scheme with its maximum transmission speed of 1.5Mbps. In the inbound channel, IP

packets from a number of VSATs are multiplexed by means of on-demand TDMA access scheme with its maximum transmission speed of 128kbps where a set of channels are used under control of the hub earth station and transmission from a VSAT is activated only when it has packets to transmit in order to achieve high efficiency in the use of satellite channels. Furthermore, the outbound channel can be enhanced to its speed of 30Mbps adopting IP over DVB technology which requires addition of a high speed reception unit at the VSAT side.

(2) Protocol, throughput

While proprietary protocols are adopted in the satellite data link layer that implements the reliable data transmission over the satellite link thorough data retransmission and collision/congestion control and in the satellite network layer that implements the IP packet processing over the satellite link through IP packet fragmentation control and TCP connection control, it is guaranteed that standard IP packets (unicast and multicast) are transparently transmitted on end-to-end basis.

In order to avoid performance degradation in TCP throughput due to limitation of TCP transmit sliding window size in presence of satellite transmission delay, the compensation scheme (so called TCP spoofing) is adopted as a part of the satellite network layer functionalities which shows the throughput of 500kbps to 1Mbps per TCP connection. In the TCP spoofing, the gateway equipment at the hub earth station, instead of the receive TCP client, returns acknowledgements to the transmit TCP client to solicit continuous packet data flow.

(3) Network functions

The following network functions are facilitated : (a)grouping function to provide exclusive communication between VSAT groups when sharing a single set of outbound and inbound channels; (b)dial backup function to automatically establish ISDN/PSTN connection by detecting degradation in the received outbound satellite channel; and (c)bandwidth control function to specify minimum guaranteed, maximum limit and priority for streaming applications.

3. Applications

As supplementary, the KDDI-Skycast provides the multimedia applications which are well suited to two-way satellite communications such as (a)reliable multicast file delivery application (Skycast-FTP) and (b)multipoint interactive distant presentation/conference application (Skycast-Lesson).

3.1 Skycast-FTP

The Skycast-FTP is a reliable multicast file delivery application with the structure of server/client model. A originating client uploads contents (files or folders) to the contents delivery server called “Skycast-FTP server” installed at KDDI's premises and specifies delivery parameters such as receiving clients (individual or group) and delivery schedule (instantaneous or specified time), the server automatically conducts reliable IP multicast delivery to the specified recipients.

As compared to the conventional file delivery application by using one-way satellite communication service where terrestrial dialup lines are employed in the return direction, the Skycast-FTP brings customers' benefits in terms of reduction of the communication charges and the time needed for data acknowledgement thanks to the use of satellite channel in the return direction.

Also, it provides a simple Graphical User Interface(GUI) to easily register/update delivery group, group members and contents to be delivered and refer to the delivery log file that shows delivery status of each receiving member as shown in Figure 3. In addition, it provides the automatic upload function where files and folders at a specific directory are automatically uploaded to the Skycast-FTP server so as to enable easy data transfer from external application software.

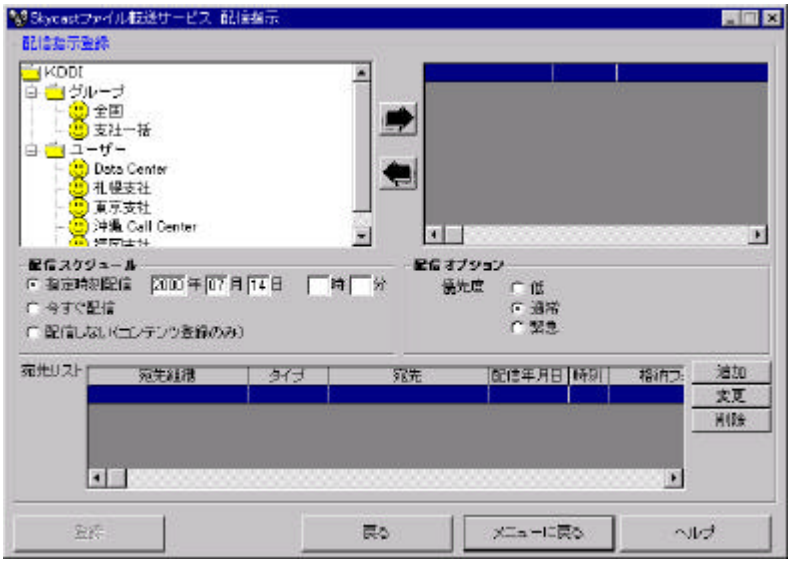

Figure 3 Example of GUI of Skycast-FTP

As depicted in Figure 4, the Skycast-FTP is employed as a high-speed communication infrastructure in the ASP services provided by Linkworld Corporation targeting printing and design industry. The use of satellite communication service is suited to the industry because of the fact that printing factories are located in suburban areas

where terrestrial high-speed communication services are not available, and each delivery of printing contents, though it requires high-speed delivery, does not hold the communication link too long, which allows efficient time sharing of the high speed satellite channel by many users.

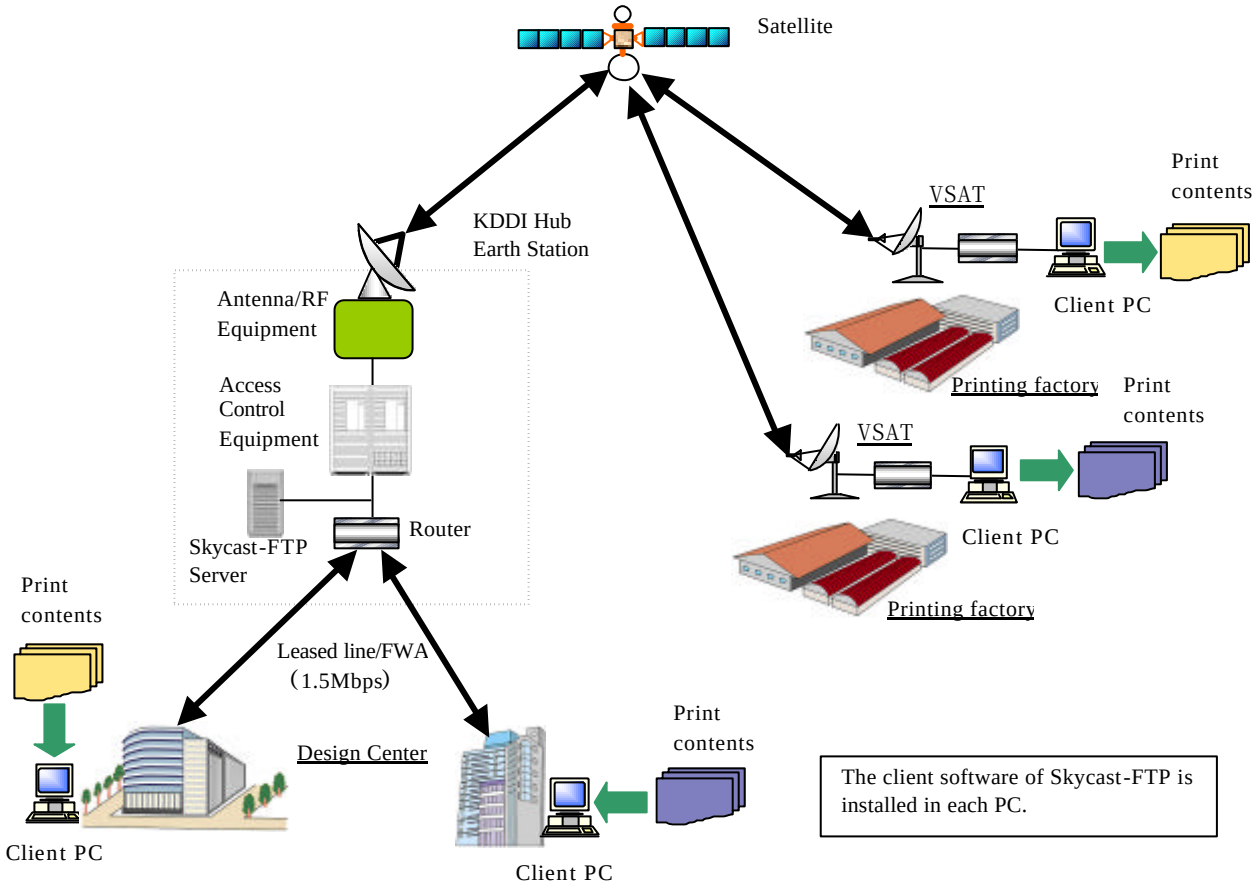

Figure 4 Configuration of the system for Linkworld Corp.

3.2 Skycast-Lesson

The Skycast-Lesson is a multipoint interactive distant presentation/ conference application with the structure of server/client model taking use of the nature of two-way satellite communication in KDDI-Skycast. The application consists of "chairman/presenter" client which is normally at the site connected to the hub earth station by a leased line (headquarters, center studios, etc.) and "participant" client which is normally at the site connected to the hub earth station by VSAT (branch offices, local studios, etc.). The real-time software CODEC based on the MPEG-4 standard, developed by KDDI Laboratory, is employed to encode and decode the video and audio signals in this application. Full motion picture with approximately 500kbps data rate is transmitted in the outbound direction (chairman/presenter to participants),

while highly compressed motion picture with less than 100kbps data rate is transmitted in the inbound direction (participants to chairman/presenter). While the video in the outbound direction (switchable to high-resolution still picture or external video source such as VTR) is multicasted to all participants, the video transmitted in the inbound direction is selected by the chairman/presenter client out of the participants based on their requests. This implements the efficient use of satellite channels on a time sharing basis.

The Skycast-Lesson provides various functions needed for distant presentation and conference such as remote control of electric document by chairman/presenter (e.g. scroll and page change of a Powerpoint file which has been delivered in advance of the conference), participation status management of participants, text-base chat between all participants, help-desk function and so on. The GUI of Skycast-Lesson is shown in Figure 5.

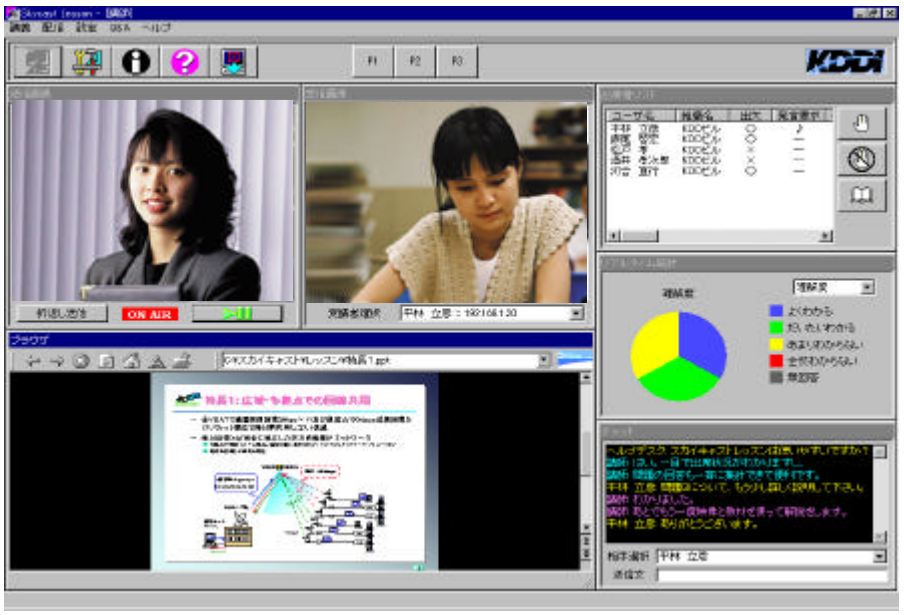

Figure 5 Example of GUI of Skycast-Lesson

4. Summary

In this article, the systems and applications of KDDI-Skycast are briefly described. Although it is felt that the use of satellite communication systems or VSATs in Japan is left behind in Europe and North America, we would expect the wide use of applications like Skycast-FTP and Skycast-Lesson which take advantage of satellite communication such as its broadcasting nature (or its topology where the multicast is easily implemented) and its wide coverage (or its nature where packets can reach “end users”

by single hop). Furthermore, for expansion of the use of satellite communications as infrastructures for future broad band networks, it is necessary to exploit the networking technologies such as efficient delivery (by combination with cache servers), high-speed session (enhancement of existing TCP spoofing technologies) and bandwidth control as well as development of a satellite communication platforms in next generation to dramatically enhance the communication speed and miniaturize VSAT terminals.