Satellite Technology, the Winner for Interactive Distance Learning Applications

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Abstract: Three technologies are applied to interactive distance learning: infrastructure, applications, and content. Satellite technology plays an important role in the data communication field. By using very small aperture terminals, interactive distance learning is a cost-effective method to keep up with the information world. The content of continuing education programs has further proven the value of distance learning. The detailed system block diagrams of typical interactive distance learning systems will be discussed.

Keywords: very small aperture terminal (VSAT), satellite, data communication, interactive distance learning (IDL)

1. Introduction

As technology moves forward and the explosion of the Internet continues, the world has indeed become a much smaller place. While new technology provides the convenience of accessing an increasing amount of information, the need for and value of education have never been more important.

The consumers of IDL can be divided into corporate customers and general consumers. In general, all corporate training is focused on industry-related information, regulatory matters, continuing education, and sometimes academic degree programs. For individuals, there are continuing education, general subject matter training, and product training.

2. Technologies

Technologies today are focusing on providing tools to meet business and consumer needs. And through a combination of powerful existing and emerging technologies, solutions are just a click away.

Three technologies are key in the area of IDL. Infrastructure, applications, and content all play equally important roles in successfully deploying a robust environment for extending the reach of the instructor to the student and the student to other students, whether they are just across the campus or halfway around the world. The network represents the infrastructure, while IDL equipment shows various applications standards.

Hughes Network Systems (HNS) provides network infrastructure solutions, ONE TOUCH System™ (OTS) provides IDL equipment, and Apollo Group, Inc. provides content. The combination of these three industry leaders provides a turnkey solution. The details are listed as follows.

3. Infrastructure

Introduced in the early 1970s, VSATs have become one of the most important communication tools used today. VSATs represent a technological innovation in the field of satellite communications that allows for reliable transmission of data via satellite using comparatively small antennas. The technology has been used worldwide on both broadcast and asymmetric data transmission applications through star and/or mesh architecture networks.

HNS has been a top provider of low-cost, easily installed, reliable satellite products and broadcast services for more than 25 years. HNS shipped more than 200,000 of these small, affordable dishes and currently controls almost 65% of the worldwide VSAT satellite network market.

The Integrated Satellite Business Network™ (ISBN™) and Personal Earth Station™ (PES™) systems based on TDM/TDMA scheme and star topology provide satellite data communication. The ISBN/PES supports a wide variety of interactive data traffic types between remote user equipment and host facilities, or between any two remotes. Supported interfaces are Ethernet, RS-232, RS-449, V.35, etc. The communication protocols are TCP/IP, X.25, etc. Support is also provided for the low-rate digital voice communications and videoconferencing ability.

HNS has three models of indoor units for use in remote sites: PES 5000™, PES 6000™, and PES 8000™. PES 5000 is a low-cost VSAT providing a LAN as well as up to four serial interfaces and an external voice option.

PES 6000 is a one-slot PES chassis, which is capable of supporting any one of these port cards: MPC, TP C, CPC, and VDPC. PES 8000 is a four-slot PES chassis that can support up to four port cards in any combination. Very often the PES 5000 is proposed as the remote station.

DirecPC® Enterprise Edition (EE) (a.k.a. IP-*Advantage* ™) is designed to work with a new or existing HNS VSAT network that has remotes equipped with an Ethernet interface. All PES remotes are compatible with an IP-*Advantage* outroute because the data is carried on the L-band signal.

The primary purpose of the PES remote is to provide access to a PES inroute as the return channel for IP-*Advantage* traffic. The PES remote will also forward any IP-*Advantage* traffic it receives from the PES outroute to the IP-*Advantage* relay and/or remote host(s), as appropriate. The PES remote can be configured to operate as either a bridge or router. The PES remote can be a bridge because, while the IP-*Advantage* relay requires a router between it and the IP gateway, the PES router can be this router.

IP-*Advantage* data is transmitted from the PES terminal to an IP-*Advantage* relay via L-band output on the PES. There are two different kinds of IP-*Advantage* relays: a PCI adapter installed inside a PC, and a low-cost standalone relay. Often the standalone IP-*Advantage* relays will be employed, as well as appropriate IP packets received from the IP-*Advantage* outroute onto the remote site Ethernet LAN, providing support for the same Ethernet interfaces to the hosts on the remote LAN as the Windows NT IP-*Advantage* relay.

IP-*Advantage* main features are an outroute rate from 2.21 Mbps to 23.5 Mbps, traffic dynamically split between the two outroutes by software, TCP spoofing, support for multicast, multilogical audio-video channels carried in one DPC EE outroute simultaneously, and support SNMP.

4. Applications

In this information era, distance learning has become one of the most cost-effective methods of keeping up with the complex, constantly changing information-based world. While sharing information is key, real-time interactivity through voice, video, and data not only extends the classroom's reach, but also provides an excellent diagnostic tool in improving retention of the information received.

This level of interactivity among all members of the classroom (instructor to students, or student to student) takes on a greater level of importance with the powerful technology from OTS, Inc., which even exceeds that found in conventional face-to-face learning.

OTS makes interactive keypads and Front Row™ devices (PC-Internet access) used in two distance learning environments: the classroom and the desktop. The OTS remote classroom expands the reach of live, collaborative training from single classrooms to a network of dispersed sites, making it possible to distribute enterprise knowledge.

OTS Front Row speeds and simplifies corporate learning, delivering live, interactive content online, directly to employees at their PCs. A fully integrated IP multicast application, OTS Front Row combines broadcast video, two-way voice, and data exchange to create a robust desktop solution for corporate intranet-based training.

Hosting each OTS class session, the Presentation Server collects responses from all participants – online and classroom – compiling test results and generating class performance reports. Student results are tabulated and immediately available for the instructor to display to all participants. Post-class result analysis allows the presenter to gauge the efficacy of his or her instruction and evaluate each student's participation and learning.

The results are measurable and certifiable, and class records can be logged into the enterprise's database. By fostering a high level of live student-instructor interaction, collaboration, and accountability, OTS IDL rivals the effectiveness of conventional classroom learning.

5. Content

While content abounds throughout the world, a growing need for additional business and science content will propel the value of distance learning even further. Apollo Group, Inc. was founded in 1973 in response to a gradual shift in higher education demographics from a student population dominated by youth to one in which approximately half the students are adults, over 80 percent of whom work full-time.

Apollo Group Inc., has capitalized on that need by providing continuing education programs for adults. Their international organization serves educational programs at 122 campuses and learning centers in 32 states in the United States, Puerto Rico, and Europe.

6. Examples

OTS, maker of the interactive keypads and Front Row system that are used in distance learning, has proven its success with a number of large clients including Ford Motor Company, Hewlett Packard, J.C. Penney, Oracle, the U.S. Social Security Administration, Prudential Insurance, and 3M.

Three example cases will be discussed here. Case I and Case II are keypad/classroom environments with different return paths: Case I is the return voice/data path via LAN-WAN, and Case II is via public telephone. Case III is the Front Row desktop with Internet solution. Please refer to Table 1 for details.

Table 1: Comparison table of three example cases

Case	Environment	Studio	Classroom
I	Keypad/classroom return voice and data via LAN-WAN (Figure 1)	OTS host, TV production, and terrestrial transmission to satellite uplink, as well as the WAN connectivity	HNS VSAT antenna, outdoor unit, PES 5000, standalone relay, etc., indoor units. OTS site controller, keypad, TV, VCR (option), and WAN connection
II	Keypad/Classroom return voice and data via telephone (Figure 2)	OTS host, OTS phone controller, three 1-800 numbers, TV production and terrestrial transmission to satellite uplink, Internet PPP router (Cisco 4000).	HNS VSAT antenna, outdoor unit, PES 5000, and standalone relay, etc., indoor units. OTS site controller, ke ypad, TV, VCR (option), and two analog telephone lines.
III	Front Row desktop with eLearning resolution (Figure 3)	Front Row host, Front Row encoder, Front Row shared application server, TV production, and multicast-enabled T1 connection to the uplink	HNS VSAT antenna, outdoor unit, PES 5000, standalone relay, etc., indoor units. OTS site controller, keypad, TV, VCR (option), and two analog telephone lines.

7. Conclusion

The combination of VSAT technology, powerful IDL applications, and enriched content has proven to be an invaluable and cost-effective approach to meet the needs of the 21st century. Recognizing that need and value, in 1998, OTS was acquired by HNS and Apollo, becoming a one-stop-shop providing educational material produced by Apollo and broadcast over Hughes' communication satellite network. Satellite technology is clearly the winner for IDL applications.

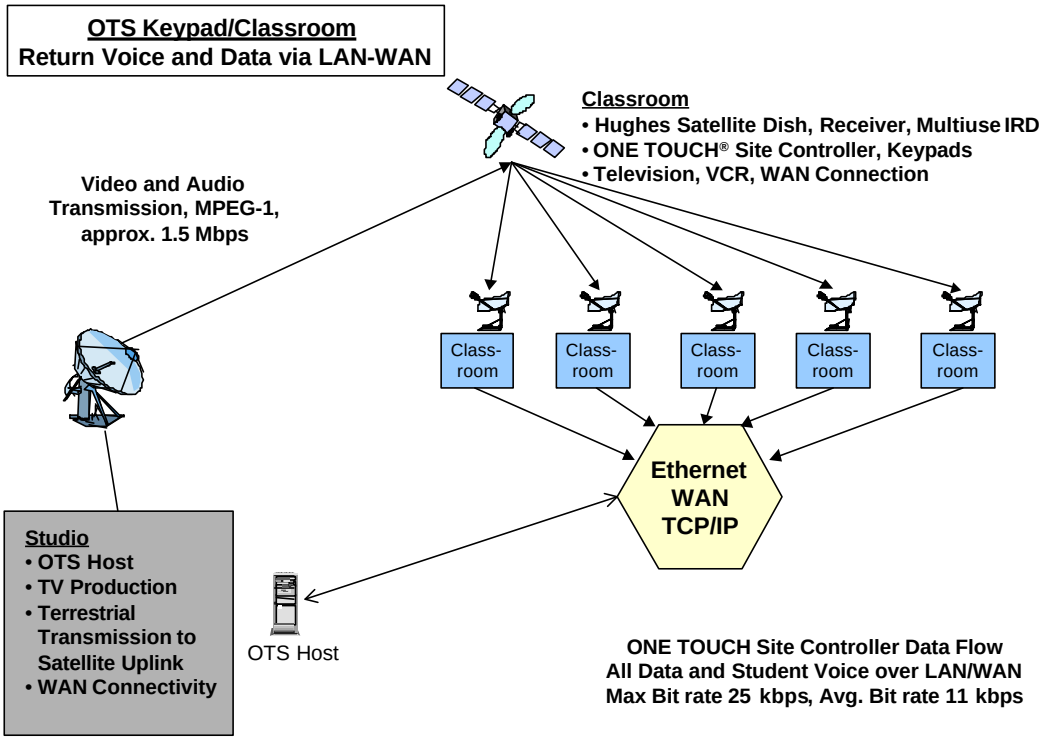

Figure 1.

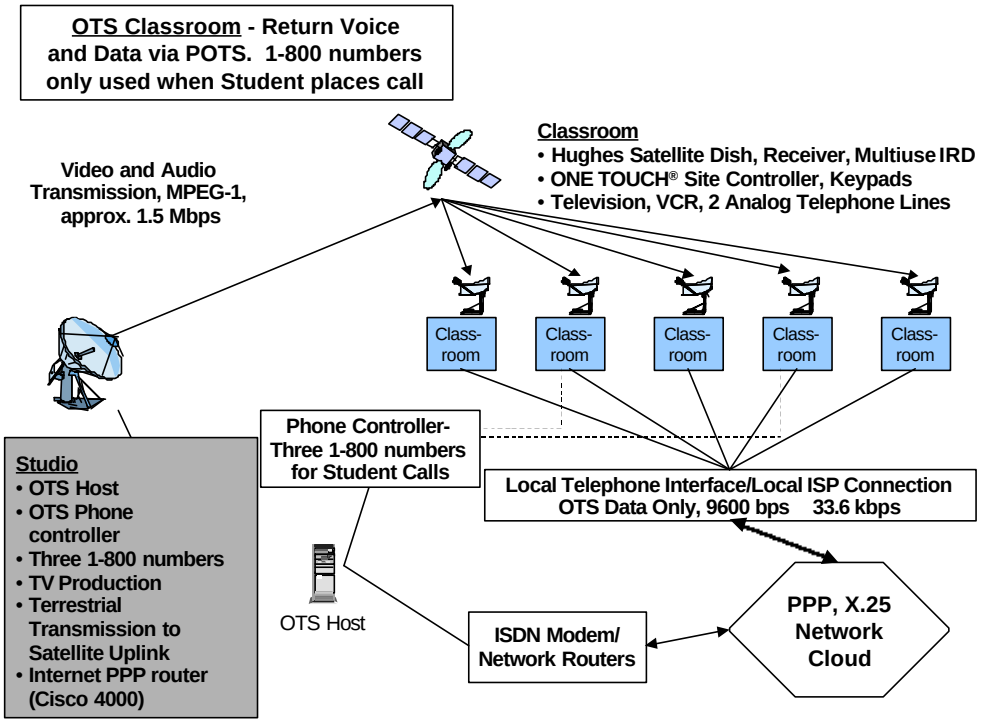

Figure 2.

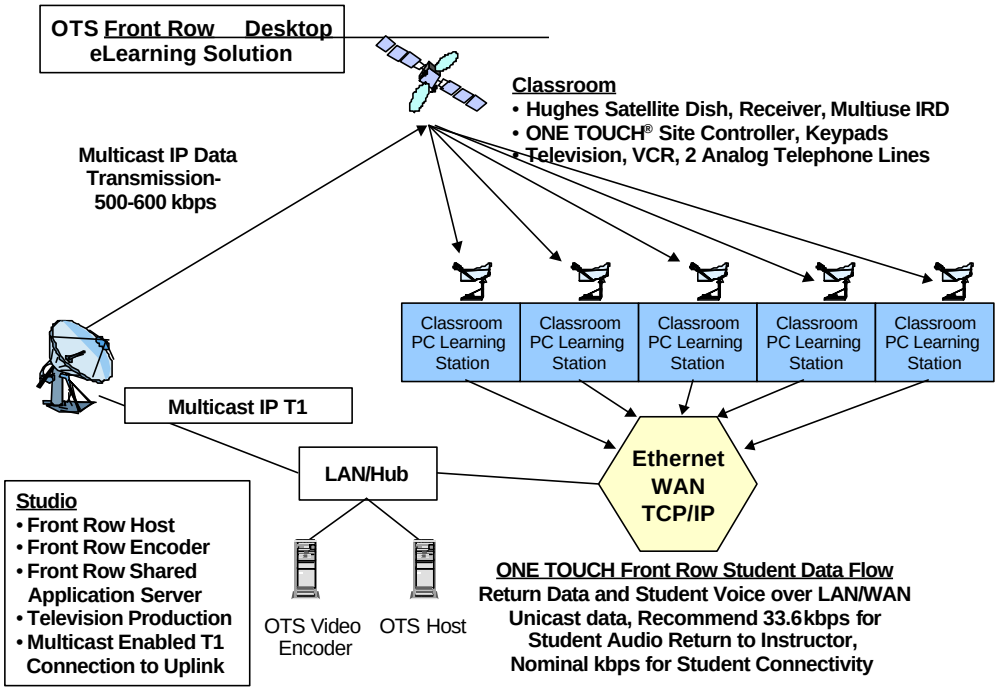
OTS Front Row Desktop
eLearning Solution
Classroom
• Hughes Satellite Dish, Receiver, Multiuse IRD
• ONE TOUCH® Site Controller, Keypads
• Television, VCR, 2 Analog Telephone Lines
Multicast IP Data
Transmission-
500-600 kbps
Classroom PC Learning Station
Classroom PC Learning Station
Classroom PC Learning Station
Classroom PC Learning Station
Classroom PC Learning Station
Multicast IP T1
LAN/Hub
Ethernet
WAN
TCP/IP
Studio
• Front Row Host
• Front Row Encoder
• Front Row Shared Application Server
• Television Production
• Multicast Enabled T1 Connection to Uplink
OTS Video Encoder
OTS Host
ONE TOUCH Front Row Student Data Flow
Return Data and Student Voice over LAN/WAN
Unicast data, Recommend 33.6kbps for
Student Audio Return to Instructor,
Nominal kbps for Student Connectivity

Figure 3