Online Journal of Space Communication

Volume 2
Issue 5 *Satellites Address the Digital Divide (Fall 2003)*

Article 2

June 2021

Current Development: Learning without Boundary: Application of Satellite Communication System on Distance Education

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Learning without Boundary: Application of Satellite Communication System on Distance Education

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Nowadays, the concept of global village has been developed over the world due to the development of communication technology. The information boundaries between areas and regions are gradually eliminated. People are able to have long-distance communication and information exchange, such as searching information via the Internet and making long distance calls that include images. The convenience of communication brought by the technology is applied to education as well.

Distance education is an innovation that allows educational content to be transmitted from area to area and provides students in rural areas an opportunity to get education as well. Originally, the format for electronic distance education was to broadcast information through radio or television stations; more recently, microwave radio technology has been applied within a small region. Students received lectures from distant teachers, but were not able to interact with them. The rapid development of the Internet provides another option for the implementation of distance education.

Due to the need for high speed and high quality educational messages, communication satellites are often used more for efficient transmission. This paper discusses how satellites meet the needs of distance education, the satellite systems that are used in distance education, and some concerns about applying satellites to distance education.

Development of Distance Education

The main purpose of distance education is to provide people greater access to education without the limitations of distance and boundaries. The potential benefits of distance education are user driven experience,[1] reduced learning and travel time, on-demand learning, student and instructor flexibility, faster revision, reduced delivery cost, and learner control.[2]

Initially, distance education was a print-based model of correspondence education. In the 1960s and 70s, distance education heavily relied on radio or television broadcasting. With the development of different technologies, distance education developed into interactive systems, which began with audio conferencing but progressed to more sophisticated systems that involved telephone audio, text and visual materials.[3] Nowadays, the new technology has brought distance education into a videoconferencing system. Using the videoconferencing technologies, distance education is able to have two way

communications so that students are able to interact with instructors. Today, the application of satellite communications offers more possibilities for distance education and improves its efficiency and quality of the experience.

Satellite Communications

"A communication satellite is a microwave repeater station that permits two or more users to deliver or exchanging information in various forms."[4] Satellites are capable of providing wide coverage and two-way communications with the same footprint over the same satellite network. In addition, by utilizing satellites for communication, receivers at different locations within the satellite network are able to receive signal without the help of terrestrial networks. The communication satellites can provide point to point communication and point to multipoint communication.

In terms of the operation of satellite networks, the characteristics of satellites are:

1. Wide area coverage: The coverage footprint of satellite breaks the boundary limitation. Countries, states, or areas are able to receive the signal at the very same time.
2. Broadcast: Satellites provide point to multipoint communication. A central control center can deliver messages/programming/video to individual receivers within the signal area.
3. Data distribution: Satellites are able to provide data casting services. The central control center can transmit data (general data, video, and audio) to other individual receivers at different locations one way or two ways.
4. A broadband capability: The wide bandwidth allows satellites to provide high speed transmission and the ability to store and forward data, which is called caching.
5. On demand: Through the satellite transponder, individual users are able to request data from the data center. In general, satellite communication technology at this stage is mature and is highly suitable for distance education.

Satellites are Appropriate for Distance Education

The purpose of distance education is to provide more access to education for people, especially people who live in the remote areas. Thus, distance education needs a network that enables it to have wide coverage and be interactive providing students and instructors opportunities for real-time communication. Distance education also requires a network, which has broadband capability, so that the network is able to carry large amount of video and audio data. "Satellite distribution can facilitate two-way transmission of dense data traffic at speeds equal to or faster than most wire-based systems."[5] In addition to the synchronous model, distance education provides the asynchronous model for learning.

The asynchronous model allows students to ask questions via email or request instructional materials on the website anytime. Thus, distance education needs a network that has a storage and forward capability.

Although there are some terrestrial systems that provide broadband transmission, such as cable modem and DSL, these systems are not available everywhere even within the same city. When the terrestrial communication networks in the remote area are not well-established, then high-speed data could not be delivered to that area. Through satellite, remote areas have a chance to receive distance education, because satellites have the freedom and mobility of wireless.[6]

USPNet Case

A satellite-based computer network called USPNet-2000 deliver education through distance education to students living in the remote Pacific islands.[7] USPNet-2000 is a VSAT System communication network of University of the Southern Pacific (USP), which founded by the government of Japan, New Zealand, and Australia, together with the USP member countries, such as Lautoka (Fiji), Cook Islands, Solomon Islands, Tonga, and Vanuatu.[8]

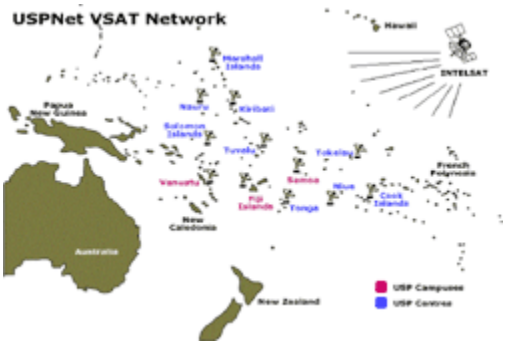

Figure 1: USPNet Networks (Source: USPNet webpage)

The central station is the main campus in Suva, Fiji; it is the hub of this VSAT communication network. The remote campuses are equipped with VAST terminals shown as figure 1,[9] so that they can receive live video lecture from main campus and have synchronous conversation with teachers at the main campus.

This USPNet network provides an efficient communication for the distance education of the University of the South Pacific and its remote campus.

Taiwan Case

Taiwan is another case that successfully delivers education through communication satellite. Unlike USPNet network which utilizes communication satellite to deliver education for remote islands, Application of communication satellite on distance education in Taiwan is mainly to deliver synchronous

education for schools in rural areas. Due to the lack of qualified teachers and teaching resources in some rural areas, Ministry of Education the initiated cooperation with cable TV provider, ERA Digital Media (IDTV), to broadcast English learning through communication satellite for elementary school students in rural areas in July, 2002. ERA Digital Media is the major provider of digital video through communication satellite.[10] In this project, 57 elementary schools in rural areas were equipped with satellite dish as a receiver so that students in different regions can receive a synchronous, interactive distance education at the same time.[11]

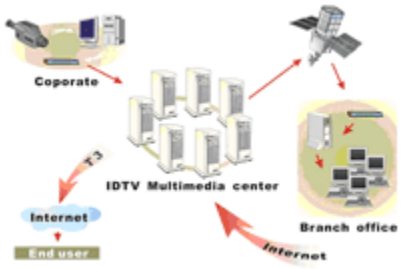

Figure 2: IDTV Digital Media Network (Source: IDTV webpage)

In IDTV's network, the instructional video and audio materials are broadcast through communication satellite to individual schools in different counties. Each school receives the materials by satellite dish and then distributes the materials to the computers in individual classrooms through the on-campus internet.

Students can have interaction with the teacher who is in the instructional center at the same times. Figure 2 shows how IDTV network deliver video and audio data.[12] This helps students who are in any corner of Taiwan have equal learning opportunity.

Distance Learning System and Satellite Network

The application of satellites to distance education provides several different communication configurations such as one-way video, one-way video and two-way audio, two-way audio, narrow-band transmission for graphics, and two-way video.[13] These systems represent ways of meeting the different needs of distance education, for example, ways to improve two-way communication to facilitate interaction between students and teachers. The following satellite communication systems represent two-way communication.

VSAT System

This approach provides for the example of two-way audio, video and data. "VSAT is general assumed to be the remote terminal in a dedicated data network based on the star configuration.

As shown in Figure 3, "VSAT system comprises a hub earth station, with a larger aperture antenna, controlling a cluster of VSATs, with small antennas, typically in the range 0.45to 2 meters (m) diameter."[14]

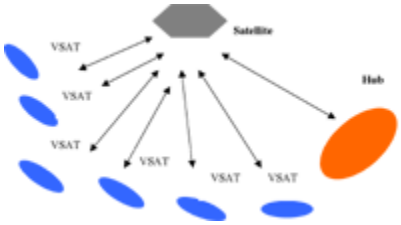

Figure 3: VSAT configuration

By bringing the corporate VSAT business data system into the distance education sector, the VSAT infrastructure will be able to deliver computer files from the teacher-centered station to the individual learning-centered stations. Instructors and students within this system are also able to see and hear each other. In addition, this system can be used for uploading and downloading materials through the same channel. It provides both on-line (real time) and off-line (asynchronous) interaction between instructors and students.[15]

SCS (Space Collaboration System)

SCS is a satellite communication network developed to facilitate the video conferencing in Japan. This system provides for classroom-type distance education in which students receives lectures and demonstrations from a central station and be able to ask questions via satellite. Through the Japanese videoconferencing system, lecturers are able to observe students in the classrooms; it is a two-way video communication. A unique feature of this system is data caching in which students in distant locations may request that CAI (computer-aided instruction) materials be delivered via satellite direct to PCs and workstations.

This system has been used to implement a cooperative distance education project between Japan, China, and Thailand. Figure 4 shows that SCS is a VSAT system.[16] Each distant school is VSAT station, which enables students to request and receive synchronous and asynchronous lecture from central school which is the hub station.[17]

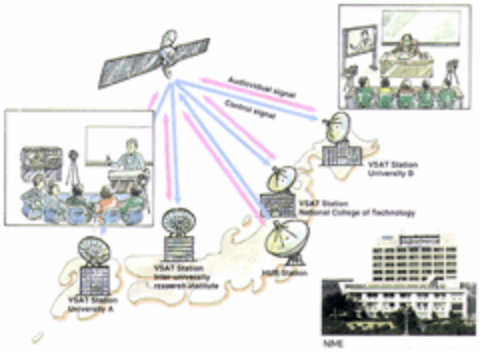

Figure 4: SCS system (Source: SCS webpage)

SkyplexNet System

SkylexNet system represents a synchronous and an asynchronous learning model for distance education. This system is developed from the VSAT system. The user ends are equipped with VSAT and the service centers are equipped with satellite dish as well; so that in the asynchronous model, students have on-demand access to instructional materials through this system shown as Figure 4. Besides, students are able to have real-time interactions with teachers in the synchronous model.[18]

In addition to the above three system, the WorldSpace A.D.V.I.C.E. (Auxiliary Data and Voice Integrated Channel for Education) and the Inteleconference Hughes Network Systems also provide for two-way communication.

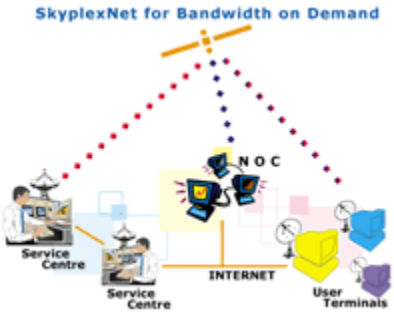

Figure 5: SkyplexNet System. VSAT enables user ends and service centers have synchronous and asynchronous communication.
(Source: SkyplexNet webpage)

A.D.V.I.C.E.

A.D.V.I.C.E. is a system that can provide more than one mode of delivery, such as data casting, webcasting, audiographics, and pr-recorded CDs.[19] In the data casting model, the contents are delivered to the learning centers before classes begin. Users can download the lesson from the learning center. Then the contents are cached on the users PC and can be viewed via a custom Worldspace viewer anytime. Webcasting is basically similar to datacasting, however; the content is derived from an existing website. In audiographic model, the data relates to

visuals supplemented by an audio commentary. Students can receive live lectures and PowerPoint presentation at their PCs at a scheduled time. In addition, this system provides a channel in which students and teachers can have synchronous conversation.[20]

Inteleconference

Inteleconference system is based on VSAT system; it provides point to point and point to multipoint video conferencing. Remote schools can share sources from the central control center. This system allows four conferencing models that are broadcast, two-way communication, N-way (broadcast with audio return) communicaiton, and 2+N way (multipoint) communication.[21]

In some cases, the distance education provider adopts one-way communication via satellite for delivering data. For example, the University of Costa Rica is receiving Internet data via a receive-only satellite dish.[22]

Concerns about Utilizing Satellite Communication Networks in Distance Education

In spite of the fact that integrating communication satellites into distance education has improved the quality of delivering data, there are still some factors that need to be considered in utilizing such communication systems, These include cost, installation, infrastructure, and regulatory concerns.

Satellite communication involves several components; thus, users have to evaluate the cost of utilizing satellite systems, and of maintaining the equipment needed to support distance education exchange via satellite networks. Both delivering and receiving learning centers have to consider whether if they are able to afford these system, or to whom they need to look for cooperation and assistance. Installation is another concern since distance education via satellite will often need to be integrated with terrestrial education systems. Installation at the remote site at the classroom is generally a simple matter, much like installing a simple TV receive only dish. Before initiating a distance education project, schools will need to consider the structural requirements, such as the suitable location of the satellite dish and related issues such as clear line and sight to space and the weather.

Infrastructure is one of the major concerns in providing distance education through satellite systems. Establishing satellite communication networks in developed countries and in urban areas would pose few problems integrating with the local infrastructure. However, when establishing satellite communication networks in developing countries and rural areas, the lack of available and reliable electricity will hinder the construction of such communication networks. This factor, accompanied with the financial challenge, becomes a constraint. In addition, the regulation of telecommunication in some regions might affect the

integration of satellite into local education. In Australia, the provincial authorities make their own purchasing arrangements and differing approaches to connectivity; therefore, there can be different sectoral arrangements operating.[23] The regulatory framework relating to satellite communications usually differs from country to country.

Most easily accept receive-only dishes (with some notable exceptions such as China and Singapore); however, obtaining a transmit license can be a complicated manner. Those who wish to develop an distance learning network should emphasize the social value when applying for the necessary licenses and permits.

Conclusion

Satellite communication has improved the implementation of distance education in variety ways. More and more satellite and telecommunication providers offer distance education service. New systems for enhanced communication, such as Worldspace's A.D.V.I.C.E and Hughes' Inteleconference combine data broadcast with audio and with video. Through these technologies, distance education of the future will be able to deliver diverse multimedia materials for students and teacher interaction, Nevertheless, cost and the basic infrastructure are big issues for developing countries and for rural areas. They happen to be the places that need satellite communication the most.

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