APPLICATION OF COMMUNICATION SATELLITES TO EDUCATIONAL PROGRAMS

By Jai P. Singh
Research Engineer, Center for Development Technology
Washington University

In this report, I will discuss what communication satellites could do for education, what the current thinking is, what the experimental plans are, and what the problem areas are.

The communication satellite unfolds attractive, potential benefits for our educational establishments. It can provide wide distance access to a broad variety of information resources, beyond the capability of a single institution. In 1958, the U.S. was the first nation to put up a communication satellite. These potential benefits have not yet been realized in the U.S. Any variety of communication facilities have either been too costly or inappropriate for wide use by educational institutions. The proposed domestic satellite systems, currently under consideration by the Federal Communications Commission (FCC), do not offer any significant cost reduction potentials, as they are multipurpose and locked in the International Telecommunications Satellite Consortium (INTELSAT) III and IV type technology with the sole exception of two filings.

It is in this respect that Washington University has undertaken a NASA-sponsored project to define educational services which telecommunications satellites may help provide, and to provide the decisionmakers in the Federal Government with the design of systems for delivering these services in the U.S. In order to insure that the study takes into account all systems aspects - political, social, organizational, administrative, as well as economical and technical - the work has been undertaken by an interdisciplinary group of research personnel, representing a broad range of disciplines and skills. Most of our group is dominated by economists as well as political and straight types. The program directly relates to the purposes of the nation for focusing upon the potential development and application of space technology to help meet the needs of society in the fields of education. I think that we have taken a systems approach. Some people may say it is the user-oriented approach, and many other people could put it in different ways. The basic thing is to define what the U.S. educational needs and objectives are. I will come back to that, but first I will discuss the "how" that we hope the domestic educational instructional satellite system might develop.

First, you look into the existing situation or into the future and try to define U.S. educational needs and objectives; try to define the constraints and limitations, both political, technological, and administrative. What kind of a system is going to be acceptable; what is the feasibility of a centralized system? How much centralization do you need in the system? Then, you try to build up a requirement for a satellite system. That requirement is going to depend upon other competing terrestrial technologies that may be capable of delivering the same services. It would be a function of the technological environment, the research and development (R&D) in the communication satellite area, and it would be a function of available funding. You try to build up some alternate systems, and present the decisionmakers with a couple of different system designs, all capable of delivering different things. From this, hopefully, some systems would emerge, some decisions for future R&D would be made, and you would have a pilot operational system.

For a pilot operational system we do not have to have a dedicated satellite just for education. As you will see in the later part of this report, there have been a number of experimental systems, and you could use some of the packages on the Advanced Technology Satellite to test out some of the concepts. This, in fact, has been done, and in 1973, people will be looking at testing more advanced concepts. Eventually, we will have gained some experience with the pilot systems. We would then try to redefine our needs and objectives, and eventually our new experience, our new R&D would again enhance the technological involvement, and the cycle would continue, that is the approach that we have taken or the user approach, you might say. The basic question is, how do you define educational needs and objectives? This is not simple; it is not a meteorological satellite, where you could go to people and say, "OK, why do

you need that information?" Everyone has a different philosophy for education. Everybody has a different vision of the role that technology is going to play in education. By technology, I do not mean satellite technology. Satellites are nothing but a delivery mechanism. We have to go to the basic level of technology, such as television, computers, data, and other things; the basic thing that is delivered, and there is no consensus. So what we have done in this area is that we have been trying to create a dialogue with the users, but not just mere dialogue, and not with a layman-type attitude. We have been trying to look into the economics of various services through satellites and trying to provide the users with some decisionmaking, with some groundwork on which he could base his decisions; what he could do with certain types of satellite technology, where satellites are going to be useful and where not, and what the future roles of satellites are in this country.

These needs and objectives could be divided into a couple of categories. As you know, the public television in this country is a part of education, a broad educational segment. Those people know what their needs are today, how many stations that they want to link, but they have not been able to do it because of the cost of the current facilities. They are extremely interested. They could tell you the solution pattern they want, where they wanted to originate their programs from, the states that they wanted to link, how they want to feed the television to the stations — but for instructional purposes, this is a very tough job.

The first thing to do is to conduct studies of the various technologies and media, such as television and computer area instruction and their facsimiles, and automated information retrieval for the libraries. The study should look at the current developments, status problems, and future potentials. It should also look into what the problems have been and try to forecast some demands for the future technology and media utilization in education. It must be defined as to what would be the keys to technology utilization in education. It will not be fair to say, "In this field and time, this is the range of utilization that we are going to have." The particular range will depend on what happened between then and now, on what kinds of major decisions have been made on the federal level and state level, and what kinds of new forcing functions are given there. So there would be certain keys to technology utilization, and you would build up a case; e.g., that range of utilization, that range of delivery that will be needed for that kind of environment. We will try to define conditions for achieving various utilization levels, and the impact of those utilization levels on education.

There will also be background studies on such problems as what people in this domain could accomplish with satellites, satellite-based delivery, and networking system. Estimates for satellite utilization have to be developed, but before we go to estimates, I would like to go back and discuss what some of the basic services are that a satellite could deliver. You could have two different types of satellites for education: one would be a dedicated educational satellite, a satellite completely devoted to education, and the other method would be to lease channels on a commercial satellite. As you know, the FCC has some eight domestic satellite filings under consideration. Various applicants, a number of aerospace companies as well as common carriers, have proposed using communication satellites for various things. The primary use is for point-to-point communication. We have here two options. Fixed satellite service is the service that we have seen in the international domain. It is point-to-point service; that is, service between relatively large, high-cost earth terminals, for point-to-point communication. However, there are two other types of services. One is a Broadcasting Satellite Service which would be capable of delivering television, radio, and other programs; primarily a one-way service to community installations. The cable television head-end that you encounter would be a community installation. Satellites will be able to bring a large number of channels directly to your cable television (CATV) head-end and to your homes. This is something that cannot be done with the broadcasting system, because of the limited frequency availability problem. This is a service people will use in the early eighties or mid-eighties, where satellites would offer an opportunity to bring the signal directly to the home. You have your television set, a special antenna, and a special attachment. All you have to do is to plug in that attachment between the television set and the antenna, and you will be capable of receiving directly from satellites.

The current designs for this system have already been demonstrated. If we are going to build some 10 000 receivers per year for a single channel, the unit cost of the attachment between television set and antenna would be $40, and if we made some 100 000, the cost would be something like $25 per unit. All these units have been demonstrated and built by Stanford University, NASA-Lewis, and by General

Electric. You will also need a receiving antenna, a dish-type structure which you can build with chicken mesh very cheap. The cost would depend on how big the dish is.

When the domestic satellite proposals were invited by the FCC, the FCC said that all the applicants should state very clearly what services would be offered to the educational broadcasting people and to the educational community. Of eight applicants, seven have very nicely defined their services as either yes or no for the educational broadcasting community. Only one filing has ventured into the area of instruction. AT&T/ COMSAT is saying, "We will not offer anything specific for educational broadcasters but we are willing to discuss the term, and if the commission thinks that providing free service to broadcasters is a public dividend, we will accept that position; we will provide them free service, but we will put the cost of that service on other users of the system." It is not free; somebody has to pay for that service — other users of the service will have to pay. Also, a major question for the FCC is, what is a public dividend? Is it providing free service to a specific community of users, or is it providing cheaper service to all users of that system? It is one of the burning questions. There are varied opinions. There has been a letter some time ago, by Mr. T. Whitehead of the President's Office of Telecommunications Policy, questioning the whole approach of providing a public dividend based on just for educational broadcasters.

So, there have been a number of offerings, which I will not cover in detail. The only ones who have come forward with something specific are Fairchild-Hiller, who have made substantial offerings, and MCI/Lockheed. There are also filings by Western Telecommunications and Western Union. They do not offer anything at all like AT&T, and Western Union is very much the same case.

We have primarily defined the role of the satellite in the instructional area. For instructional television, the main role will be direct delivery to schools, to broadcaster stations for redistribution, and to Instructional Television Fixed Service (ITFS). Alabama is one of the finest in this service, and they have a number of installations in the state; ITFS head-ends and cable television head-ends for further redistribution. The satellite delivers a large number of channels to various centralized points and from there to cable and other broadcasting stations for redistributing; it is a type of networking.

Delivery of computer area instructions to small remote institutions, particularly those 70 or 80 miles away from a major metropolitan area, is another service. The satellite service, based on a small terminal operation, has shown that we could offer substantial benefits for these purposes if we go to high-powered satellites. Domestic satellites, which are relatively low-powered and multipurpose, are not capable of offering this service economically. Then you go the the computer resources, and one of the best things in this area is that there is a tremendous mismatch between the users and the computer resources. There are some segments of users, such as large institutions that have substantial resources, but some 45 percent of this country's institutions of higher education do not have any computing available to their students, for any purpose. A goal established by the Princeton Science Advisory Committee, in 1967, was that in 1971, they would like to see some 20 min of basic computer processing time available to every undergraduate student in this country. We are nowhere near it; we do not even have 5 min for all students in higher education. The ones who are suffering are the 40 percent of small institutions; some of them are private, and most of them cannot afford to justify a dedicated computer system for their own use. But linked with communication lines, they could justify a remote, centralized computing facility that they could share. So we have a number of users. Multiaccess, interactive computing, and batch processing is nothing but a delivery of our computing power to those schools. Computer interconnection is a new thing. It has been developing, and it is between the computers; that is, between very specialized computers offering very specialized services. It has all ready been implemented using terrestrial networks by the Advanced Research Projects Agency (ARPA) of the Department of Defense. It has been established in 20 institutions; a good many of them are educational institutions. The basic problem is the high cost of communication lines and their inappropriateness of carrying digital data. These communication lines were designed primarily for carrying voice communication. All the subsequent improvements have been on that basic fundamental.

The Corporation of Public Broadcasting, NASA, and the Health, Education, and Welfare Department experiment is new. Educational interest has been excited about this whole opportunity. People got together and decided that they had to do something in this country, too. They have been thinking about it, but they have to do some experiments. The Department of Health, Education, and Welfare and the

Corporation of Public Broadcasting united in the last 6 or 7 months and made the proposal to NASA. As an experiment, NASA put a special package on an Applications Technology Satellite (ATS). They have not decided where the experiment is going to be performed, but the prospective areas are Alaska, the Rocky Mountains, and maybe the Appalachian part of the country. The Rocky Mountains seem to be an especially good site to conduct these experiments. There will be three components of this experiment: (1) there would be satellite educational television (ETV) transmissions of public programs to television stations, (2) there would be delivery of programs to cable-television head-ends, and (3) delivery of programs to schools by rooftop installations. The whole concept will be tested in the summer of 1973.

One of the major opportunities that is awaiting people is that sometime in 1975, they will put up an ATS-G satellite with very high power broadcasting capabilities. They have not decided at this time what the shape of the experiment will be; at this time, users are working to define their experiment, but no decision has been made regarding ATS-G, to date. So far, most of the interest has just been in the delivery of television and radio programs. Stanford University has been a pioneer; they have, for the first time, investigated the feasibility of delivery of computer-aided instruction to remote and isolated institutions. Professor Jamison did this in May 1971, and he is in the process of doing it again in the near future.

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