

SATTELITE TECHNOLOGY

A CASE FOR DEVELOPING COUNTRIES

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The Traditional educational system has helped to educate half the population of the world. The question now is, can communications satellites help us educate the second half and improve the quality of education for all as well?

Wilbur Schramm

I. Introduction :

“..... Education shall be directed to the full development of the human personality and the sense of dignity, and shall strengthen the respect for human rights and fundamental freedoms”, so says Article 13 of the United Nations International Covenant on Human Rights. Developing countries have been doing all that is possible to reach this ideal and to ensure the right of everyone to education. But what is possible often comes too short of what is desirable.

A big challenge confronting developing countries is to speed up development plans in all fields so as to bridge the gap between them and the rest of the developed world. But the efforts and the financial sacrifices so far have failed to prevent the widening gap between industrial and developing nations. Julius Nyrere, President of Tanzania, has succinctly stated this challenge. “While others try to reach the moon, we are trying to reach the village.” It is by no means an easy challenge ! Ironically the very technology which enabled those “others” to reach the moon may be the only one in the foreseeable future capable of reaching the village; by this we mean satellite technology.

This paper explores the potential of communications satellites for education and social services in the developing nations; their applications and potential problems.

II. The Evolution of the New Technology :

Communications satellites may be viewed as high altitude signal relay devices that can provide coverage for a large geographical area.¹ Viewed as such, satellites can carry any kind of information that is capable of being electronically transmitted.

In tracing the evolution of this new technology, it is interesting to note that in 1945 communication satellites were no more than science fiction or a dream entertained by such imaginative people as the novelist Arthur C. Clarke. Clarke described an artificial satellite which could be launched into a stationary orbit 22,000 miles above the equator to provide communications for the world.² Almost 18 years later, this dream was translated into reality. In 1962, the National Aeronautics and Space Administration (NASA) launched the world's first successful synchronous satellite. This satellite (known as SYNCOM II) was placed in an orbit 22,300 miles above the equator, almost the same position predicted by Clarke. In this position, and nowhere else, a satellite's revolution around the earth takes precisely 24 hours, matching exactly the time required

for the earth to rotate on its axis. In other words, the satellite's period of rotation becomes synchronized to that of the earth's with the result that the satellite becomes "geostationary", apparently remaining motionless at a fixed point in the sky.³

Two years later, in 1965, the Communications Satellite Corporation launched the Early Bird, the first satellite in the INTELSAT family which now provides worldwide communication services.

The technology of communications satellites in recent years has achieved great progress in the technical qualities, design, power and capacity of satellites as well as ground terminals. To illuminate, the first satellite in the INTELSAT family, the Early Bird, had a capacity of 240 telephone channels and a lifetime of one-and-one-half years. The latest INTELSAT satellite has a capacity of 6000 telephone channels in addition to 12 color TV channels. The development of high-power satellites has resulted in a big reduction in power and cost of terrestrial receiving equipment, thus opening the possibility for direct satellite broadcasting.

In the course of the development of communications satellites three basic types could be identified. These are relay satellites, distribution satellites and direct broadcast satellites. The basis for this classification is effective signal radiating power.

a. **Relay satellites**, sometimes called point-to-point satellites, are usually of relatively low-power and transmit signals from powerful ground transmitters to extremely sensitive and expensive ground receivers. INTELSAT systems are of this type.

b. **Distribution satellites** use space segments of higher-power which are able to serve less sophisticated receiving stations. This type can feed video and/or audio signals to local broadcasting stations or other centers, and offer an alternative to microwaves or long lines. NASA's ATS-1, 3 systems are of this type.

c. **Direct broadcast satellites** are characterized by very powerful space segments that are able to broadcast television or facsimile directly to community or even home receivers. ATS-6, designed for the U.S.—India experiments is the first satellite of this type. This satellite was launched in May 1974, to serve the Health-Education and Telecommunications (HET) experiments in the Rocky Mountains, Appalachia and Alaska. It is the most powerful satellite yet

developed by NASA and it is capable of distributing TV signals to many small receive-only dish antennas costing as little as \$ 3000 each. Because the cost of the ground receiving stations are still too high for home reception, signals are usually broadcast to hospitals and community viewing centers.

In July 1975, this satellite was repositioned in an orbital location for transmitting television programs to India, which is the first country in the world to broadcast TV programs directly into small, inexpensive television sets in remote areas. For this experiment, receive-only terminals cost around \$ 600 including a black-and-white TV set.

In 1977, the Canadian Department of Communications with American assistance launched its communications Technology Satellite CTS (now called Hermes). This satellite is equipped with the most powerful transmitter developed to date capable of telecasting video, radio or data signals to very small ground antennas, as small as two feet in diameter.⁵

The development of such high-power satellites and low cost dish antennas offers great promise to developing countries especially those encountering problems in expanding ground broadcast facilities to remote areas.

III. The Potential of Satellites for Education :

The 1970's have seen abundant rhetoric, experiments and plans on how communication satellites could solve the educational and information needs of both developed and developing countries. The potential of this new technology is, unfortunately, exaggerated by some and confused with the potential of other communication technologies by others. Perraton, for example, contends that many of the possibilities offered us by satellites are exactly equivalent to those of other forms of communications technology. In support of his claim, Perraton argues that

if we telephone New York, or set up a joint seminar with a college the other side of the Atlantic, then it is of no educational importance whatsoever whether the signals go by satellite or by sub-marine cable.⁶

Wedemeyer, on the other hand, believes that

Education via satellite is a new ballgame. The purpose and rules have yet to be agreed upon We cannot enter into education via satellite on the naive assumption that it can be more of the same, but with broader dissemination and consumption — that is, merely an extension of what we do now via mass media.⁷

It may be useful for us here to put the matter in proper perspective and single out the features that are unique to satellites.

The first characteristic which distinguishes satellites from any other type of communications vehicle is their scale. One satellite can cover one-third of the earth's surface. This makes it possible to provide all segments of the educational community, irrespective of where they are located, equality of access to programming, materials and resources. It also helps meet the educational and informational needs of isolated population clusters in areas where the extremes in topography and weather coupled with low-level population density and low income inhibit the delivery of information and education by "conventional" means or by alternative technologies. It is no wonder, therefore, that the forerunners in educational satellites — after the wealthy countries — are Brazil and India. According to Perraton, one of the factors which led India to experiment with satellites is that this offered the chance of covering the country for broadcasting twenty years sooner than it would be possible with ground relays of one kind or another.

This feature also makes it possible to spread the cost of programming and broadcasting over very large populations. Ground stations technology becomes therefore, the pacing item, because ground stations can only be amortized over relatively small populations. In this respect satellites may offer education and other social services a unique means to equal opportunity for all people in all regions, regardless of geographical location.

The second unique quality of satellites is that they are distance insensitive. Trans-continental distances are no greater for the satellite than trans-regional distance.⁸ It follows that satellite communications cost is independent of communication distance. For example, it costs the same to transmit from Doha to New York as from Doha to Dubai, provided that these cities have satellite links. This feature has a number of implications for education. Remote, sparsely populated areas can now be reached with no additional cost as to the space

segment of the system. With the development of high-power satellites capable of direct broadcasting and inexpensive receiving terminals for home reception, it is now possible to carry out any expansion of the system without incurring any extra expenses. Satellites then offer a way of distributing the world's educational resources and extending them beyond the privileged few who have always enjoyed these benefits from the time of Socrates on.

The third unique feature stems from the fact that satellites are the only technique of communication which offer the possibility of inter-continental two-way television transmission.⁹ With satellites it is now possible to link centers of excellence across the globe. Teleconferences could be conducted, and advanced courses could be shared by many schools all over the world. The world university might be a reality in the foreseeable future thanks to satellite technology.

IV. Satellite Experimentation :

The history of experimentation with satellites dates back to January 4, 1970, when the Corporation for Public Broadcasting (CPB) initiated an experiment in trans-continental interconnection employing NASA's ATS—1. The objectives of this experiment were technological, the primary one being the evaluation and optimization of a transcontinental satellite link between the east and west coast for video interconnection using medium sized receivers (30—40 foot antenna) in an urban environment.¹⁰ Since then, a number of educational communications demonstrations and experiments using ATS.—1, 3 and 6 have been conducted or planned both in the U.S. and developing countries. A detailed description is beyond the scope of this paper. Rather, we intend to give an overview of some of the experiments which bear relevance to our topic.

The State of Hawaii Satellite Experiment :

In April 1971, the state of Hawaii initiated a pilot educational satellite system linking together the Hawaii Community College in Hilo and the Manoa Campus of the University of Hawaii using university-constructed earth terminals. These terminals, costing about \$ 7,000 each, permit two-way voice and Xerox facsimile from all locations.¹¹

In January, 1972, the experiment was expanded to an international network known as Pan Pacific Education and Communication Experiments by Satellite (PEACESAT). Using ATS—1, the experimental project ties together selected educational institutions in the Pacific Basin. In fact, the PEACESAT project

provides an intercontinental "laboratory" to develop improved communication methods for educational, health and community services in the Pacific. The satellite is available 12½ hours a week to relay voice and facsimile signals to and from each site, with slow-scan television and teletype signal transmission reserved for selected locations. Each participating institution provides its own operational staff; furthermore, each institution has its own staff to develop exchange programs.

The Hawaii Project has a number of interesting features. It is supported mostly with state funds, it is the first intra-state satellite network. (This is of special interest to developing countries contemplating regional satellites). It is also the first satellite inter-connection for library networking. According to PEACESAT literature, time zone difference and language and dialect differences have not been a problem. Satellite-using institutions are now making plans for the smooth transition to the operational stage.¹²

The Alaskan and HEW Experiments :

To meet the urgent needs of the Alaskan natives of health, education, and communications, three projects utilizing NASA's ATS-1-3 were initiated in 1971. Since the low-power ATS—1 required very expensive earth stations for TV reception (\$ 200,000 each), NASA restricted the use of the satellite to radio signals, with television relegated to the high-power ATS—6 which requires less expensive earth stations.¹³

The medical project was sponsored by the Lister Hill National Center for Bio-medical Communications to link 21 village health aides with a Public Health services doctor who provides medical counseling and diagnostic services. In addition, health education programs were transmitted to the villagers.

The educational component came about in response to a 1972 NEA-UNESCO study which recommended an in service project using a communications satellite to overcome the isolation and lack of terrestrial communication among teachers in rural Alaska.

Beginning in January 1973, the National Education Association in conjunction with the State Affiliates and the College of Education at the University of Alaska conducted a 16 week satellite radio services with teachers in 17 Alaskan villages. According to Morgan (1973), the reaction to the program was generally favorable.

These experiments have involved interactive communication with voice and digital only. These limitations were imposed by the relatively low-power and small channel capacity of ATS-1 and 3 satellites.

In 1974 the National Aeronautics and Space Administration (NASA) and the Department of Health, Education, and Welfare (HEW) jointly sponsored three community services experiments utilizing the higher-power ATS-6. These experiments took place in three distinct geographic areas — the Appalachian and Rocky mountains regions and the State of Alaska. The experiments provided in-service training for teachers in the Appalachian area, career education for junior high school students in the Rocky mountains, and instructional programs for village schools in Alaska. Health experiments included two-way consultation at a distance with physicians for patients in rural Alaska and instruction for medical students in areas without medical schools.

The success of the projects initiated in Appalachia and Alaska was so encouraging that authorities in the two regions found enough support to lease commercial satellite time to provide the services after the experimental stage. This success also convinced the corporation for Public Broadcasting (CPB) to go ahead with a satellite network for interconnection of all public broadcasting stations. The Satellite network is now operating an effective system.

On the other hand, the Rocky Mountains project failed to sustain interest in and support for continued operation. This failure was attributed to a number of factors; the inability of the project to establish an institutional base of support, poor maintenance of equipment, lack of technical assistance to teachers which resulted in their disappointment, and poor management.¹⁴ These factors should be carefully observed by developing nations contemplating the use of satellites, for these do constitute potential problems.

The Indian Experiment :

In late July of 1975, NASA's latest and most powerful satellite, ATS-6 — which was transmitting to Alaska, Appalachia and the Rocky Mountains area — was repositioned over India for a one-year experiment. India transmitted on the UHF band which permitted the use of very cheap receiving sets costing as little as \$ 600 each. This really marks the beginning of direct satellite broadcasting.

Instructional television was beamed directly to individual battery-operated TV sets in 2,330 Indian villages in six states. In addition, larger Indian cities

received the signals through large receivers then transmitted them to their surrounding population. To facilitate the administration of such a large experiment, the villages involved were divided into 6 clusters, groups of approximately 400 villages each. The major objectives of the experiment were :

1. To develop the rural areas and improve agricultural practices;
2. To aid in population control and family planning;
3. To help promote national integration.¹⁵

The Indian experiment, known as Satellite Instructional Television Experiment—SITE, started Television transmission August 1, 1975 for four hours a day (one and a half hours in the morning and two and a half hours in the evening) in four different languages. The morning transmission was directed to school children and offered programs in science education, health education, Indian history and current affairs. The evening transmission was intended for the rural adult public and dealt with news, instructional programs on agricultural improvement, health education and family planning.¹⁶

The Indian experiment was carefully watched by developing countries because in this one single country most of the problems facing the Third World are clearly manifested; diversity in cultural patterns, huge geographical area still not covered by any form of mass media, very high illitracy rate, backward living conditions especially in rural areas, overpopulation, diversity in languages and dialects, to name just a few. Therefore, SITE was considered the first real test of how the new technologies might alter the development of third world nations in a relatively short time span.

Evaluations of the experiment tend to indicate that SITE had limited social impact. One reason might be that the objectives set for the experiment were rather long range goals that would require much longer time to achieve, therefore the impact was not impressive. Raghavan (1980) adds some other reasons. Centralized programing neglected local needs and circumstances, use of other dialects decreased enthusiasm, lip synchronization in some programs affected the credibility of the TV medium, the state of emergency declared by the government one month before the experiment affected the responses of villagers who are usually suspicious of strangers asking them for information about their lives or their attitudes toward government sponsored programs.¹⁷

SITE evaluations on the other hand reported some interesting cases of the adopting of improved agricultural and health practices — but not family planning — as a result of television viewing in the six SITE clusters.

India is moving now into the operational stage with the launch of its own satellite "INSAT-1" which is now being used for conventional communication services such as telephony and radio. Plans are also being made to continue the educational services offered by SITE taking into consideration the shortcomings which appeared during the experiment.

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As we have seen, the passing generation of experimentation aimed at testing the application of communication satellites in health-care delivery, education, rural development, and other public service applications. The results do indicate that satellites passed the test and that most of the shortcomings encountered could be overcome if careful planning is undertaken.

Now, the experimental era is drawing to an end. Some countries have already begun using leased INTELSAT capacity for domestic operations and many plan to share regional satellite systems, among these the Arab countries which will launch the first Arab Satellite ARABSAT-1 in 1983.^{18*}

V. A Case for Satellites in Developing Nations :

The basic argument of this paper is that the educational needs and problems in most developing countries do present a case for which communication satellites might be the most attractive medium. However, the question we should be asking here is not how developing countries can use satellites, but rather how satellites can help these countries solve their problems. The underlying assumption behind this is that if developing nations put their emphasis on their needs and problems, then they free themselves from bondage to satellite technology if other alternatives offer reasonable and practical solutions.

In the following pages some of the problems and needs which are common to most developing regions will be briefly discussed. Emphasis will be on their educational needs and problems although it is realized that satellites are often used for other purposes, and that multi-purpose satellites are more feasible and cost-effective especially in the case of poor countries.

* ARABSAT was originally scheduled to be launched in 1982, but for technical reasons the date was delayed to December 1983.

Education is readily accepted throughout the world as a fundamental human right. Unfortunately, more than 70 per cent of the population of the developing countries are deprived of this basic right. Illiteracy paralyzes every effort for development and accounts for a myriad of other problems in these countries. Most of the literacy programs have been ineffective because of lack of continuity and because they are directed toward only a small segment of the population. The massive literacy campaigns launched by Iraq, Brazil and Tanzania have produced significant results, though the process is still slow.¹⁹ Satellites now have caused some countries like India, Brazil and Algeria to use satellite-based programs to educate their people on a large-scale and on a regular basis.

In primary education to which all efforts in formal education are directed, the situation is far from being satisfactory. A recent report of the UNESCO about developing nations shows that :

In 1960, 118 million children aged 6-11 years were deprived of schooling; if they had linked hands, they would have circled the globe three times. A decade later, the situation had only slightly improved : 113 million children in the same age group were without schools. However, if educational trends and practices of the last decade continue, by 1985 population growth will be such that 165 million children in the developing regions in the primary school age group will not be enrolled in school. If they were to join hands, these children would be able to circle the globe four times.²⁰

This points to a serious problem with which the existing educational practices have failed to cope. What makes things worse is the fact that due to failure, drop out and the screening process in the system few children complete the primary stage and fewer have the chance for a secondary education. It should also be noted that significant portions of those who do complete their secondary schooling are functionally illiterate in the sense that they cannot engage in all those activities for which literacy is a prerequisite.

If developing countries have a commitment to reach all the children of all the people, and they all claim they do, then much more efficient ways should be sought. New approaches to open learning and distance education utilizing communication technologies as major elements of instruction should be used side by side with formal education. In this respect there is reason to hope that satellite technology can invigorate the educational system as nothing else in the horizon can.

The quality of instruction available to the children who are fortunate enough

to find a place in school leaves much to be desired. Most schools suffer from severe shortage of qualified and trained teachers. As an example of this, it is reported that 70% of teachers in India are classified as "unqualified and untrained."²¹ This may also be the case in most developing countries. What is needed is nationwide TV training programs that provide training and retraining; such programs are already in operation in many countries. One limitation in the use of television so far has been the high cost of reaching remote sparsely populated areas and the villages, and this is where satellites offer the greatest promise.

The quality of instruction in the schools of developing countries is also inhibited by severe lack of instructional materials. The teacher's voice is still the only medium of instruction in most schools. This restricted learning environment may have a devastating effect on the children's growth and development. A more varied, enriched learning environment is urgently needed, especially in the rural areas where children suffer most from cultural deprivation. Television has been known to be a good remedy for cultural deprivation. What is needed is a means of distribution that can guarantee that the "new medicine" goes to the "sick" and not just to the healthy.

One of the urgent needs of developing countries is acquiring the trained personnel who could carry out their development plans. But so far, education in these countries has been very slow in responding to this pressing need. The great mass of youngsters start their work lives or start seeking work without the required vocational skills and with little or no knowledge of the employment needs and opportunities of their communities. Vocational education, therefore, is badly needed, but to the traditional educational system, it is too expensive and too demanding. It requires large numbers of qualified and well-trained teachers and facilities, and these are scarce in developing nations. Satellite networks could effectively undertake the task of providing high quality vocational training and retraining programs, making more efficient utilization of the limited resources that are available to the educational sector in a given country or allowing these resources to be shared with other countries.

The keystone of development plans in most Third World nations is undoubtedly rural development. More than 70% of the population of these countries work in agriculture and live in villages. Life in these villages is still primitive, unhealthy, and far from being satisfactory for human living. Farmers still use primitive methods of farming. Land output is decreasing while population is increasing at a frightful rate. Hunger has recently emerged as the number one problem threatening the very existence of man in some of these countries. Urgent measures are therefore required to develop rural areas and to correct

the imbalance between the city and the village.

Farmers ought to know and be trained to use modern methods of farming. They should be convinced that it is practically possible to double their land output by using fertilizers, new methods of irrigation and pest control. They should be helped to improve their living conditions by exposing them to different life styles and by helping them to take better care of their health. Satellite experiments in Alaska, the Appalachia and India have much bearing to these concerns.

VI. Issues for Consideration !

The needs of developing countries are pressing, and the prospects for the widespread use of satellites by these countries are bright. But it is not by wishful hopes and unwarranted expectations that the new technology can solve our problems. It is important to realise that planning for a large scale educational satellite system will raise a number of important issues which must receive careful attention before any decisions are made as to whether or not to implement such system. Some of these issues are briefly presented here.

1] From an economic point of view, most developing countries are neither big enough nor rich enough to make really efficient use of satellite technology on an individual basis. It follows that there will have to be sharing arrangements if unit costs are to be reduced to attractive levels.

If this sharing policy is accepted by a number of neighbouring countries, then, careful planning and co-ordination will have to be employed. Clear and workable agreements on the size of the satellites, design characteristics and other parameters will have to be specified. No less important, agreement about ground station characteristics should be specified so as to assure compatibility among themselves and with the satellite.

2] The use of satellites on a regional or global basis will require international co-operation of a higher degree and of a substantially different nature than the form of co-operative arrangements currently governing terrestrial systems. This is a big challenge because this sharing arrangement would make a country dependent for its domestic communications needs on facilities over which it does not have total control.

3] The existing broadcast system whether it be radio or television is based upon national boundaries. But the regional distribution satellites or the newly developed broadcast satellite systems will eradicate these national boundaries. A satellite broadcast intended for a particular country or region will be receivable

in some other countries as well. This points to the need to consider political sensitivities; for there is a real danger that the potential of satellites may be misused for political purposes and that educational programs be exploited for proganda. It may be useful here to note that UNESCO has issued a "Declaration of Guiding Principles on the Use of Satellite Broadcasting for the Free Flow of Information, the Spread of Education, And Greater Cultural Exchange". The declaration of these guidelines, however, is no guarentee that problems of this nature will not arise. Let us just remember that the Declaration of Human Rights proclaimed 34 years ago has not ended man's suffering!

4] It might be more appropriate for developing countries to adopt a phased approach if they decide to utilize the potential of satellite technology. They can start by making use of available international or regional systems and then expand when they have developed the necessary human and financial resources. It is interesting to know that Algeria was the first country in the world to adopt such policy and to lease satellite capacity from INTELSAT for domestic operations. The Algerian example could be followed by other developing countries.

5] It might also be useful for developing nations planning for satellite broadcasting to experiment first with available television facilities on a small scale. This would provide the personnel concerned an opportunity to gain experience in programming, in identifying potential problems and seeking ways to solve them. Satellite experiments in developing regions do not offer much help in this respect, since they were all conducted with substantial technical and financial assistance from a donor country. It is still uncertain if these countries can run an efficient satellite system without outside aid. Furthermore, experiments are not operational systems and it is always easier to justify an experiment than to commit oneself or one's country to something as costly and as revolutionary as education by satellites.

6] Experience with ETV around the world does indicate that the most serious problems in using television for education and development are not primarily related to the method employed to distribute the television signal whether this be satellite or other alternatives. Rather they involve a myriad of factors that need to be overcome on the ground. If developing nations really want to eradicate illiteracy, provide continuing education, train teachers, promote rural development... etc., new system other than formal education should be sought. It might be a mistake to use new technologies in support of the old impotent system; for this will severely reduce their potential and force them to serve the shortcomings of the old system. Harley reminds us not to think we are using satellite effectively when we have only imposed on them the terrestrial rigidities that are often the source of educational problems or at least a barrier to resolving

them.²² If such changes are contemplated, then they will require new structure, new administrative arrangements, major curriculum revisions, preparation of materials and training of personnel.

7] The biggest challenge in the use of satellites for education will probably be in the area of software. Satellite-based programs are only as effective as the available software and the way in which it is utilized. There is no guarantee, therefore, that the mere adoption of a large-scale dedicated satellite network will, in itself, make things better. The possibility exists that it might make things worse. The success or failure of such a system will depend largely upon the quality and quantity of information which flows over the network, the way such information is used and the effect it will have on its target audience.

These and other issues ought not discourage developing countries or make them refrain from making use of satellite technology in the fields of education and social development. Satellites do have great potential, but they offer no easy solutions. Much has to be done if we are to benefit from the opportunities they open up for us. What is needed is a fresh look and a new start! But the question remains: Are we ready to try something new? Francis Bacon's words are in order here: "He that will not apply new remedies must expect new evils!"

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