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<td><strong>Author(s)</strong></td>
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Development In Telecommunication Technology
For Distance Education:
With Particular Reference To Developing Countries

By

Anna Stahmer
Development in Telecommunication Technology for Distance Education - With particular reference to developing countries.

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1. SYNOPSIS

Telecommunications services offer a number of features which can effectively support distance education systems in their teaching, learning, administrative and research functions. The limited telecommunication infrastructures available in most developing countries, however, will limit the role of telecommunication support in the foreseeable future. In many countries the introduction of basic telephone services will represent a major step forward in terms of technology. Very advanced services, such as compressed video can only represent a second phase after the introduction of the basic services. In the near term telecommunications will most usefully assist a distance education system in improving training end support for regional tutors, resulting in improving quality of the service students will receive. In certain instances, direct student teaching will be appropriate. The link will help the learner to better identify with the institution, i.e. offer some form of personal contact.

Telecommunication can be particularly useful in supporting the administrative efficiency of distance education systems. It can significantly improve student administration related to registration, examinations and often cumbersome logistics, eg. of getting workbooks to the students in a reasonable time frame. Telecommunications can support effective management of distance education systems. The larger the system or country in which
the distance education program is based, the more need exists for effective flow of information between different units. Any well-run business with active branch offices will review requirements of telecommunication services to operate effectively. A distance education system needs to do the same.

Benefits from the use of existing services, domestically as well as internationally will in particular be derived in urban countries and towns. Most distance education systems can use this infrastructure to achieve the efficiencies and benefits outlined above. Experience has shown that learning centres can serve many of these needs. These learning centres, combining administrative, teaching and training functions can be equipped with a number of types of "end equipment". These may include audio-conferencing, slow-scan TV, facsimile, computers or electro writers. The choice of appropriate end equipment, based on an assessment of the total information flow between head office and centre will differ across systems. With the rapid growth of digital technologies, the diverse functions of the present day technologies are being integrated into multi-purpose technologies. The use of telecommunication support for distance learners in rural areas or at the learners home will not happen in the foreseeable future because telecommunication infrastructures are not available at present. As telecommunication services expand, the educators need to be there to make their requirements known.
2. DEFINITIONS

In the paper we are concerned with the distance education process per se, not with broader institutional concepts of which the process may be part. Distance education can be part of an open Learning system which offers open access to courses or it can be part of a strict and formal degree program. We are concerned with the educational process in which a significant proportion of learning and teaching happens while learners and teachers are removed from each other in space or time by television, telephone or other media. The learner can study at home, at the place of work, at a "host university" campus, in learning centres or through a combination of such arrangements. Distance education can take place at any level of education.

Telecommunication is one of the methods available to overcome distance between learners, teachers and administrators. In its technical definition, telecommunications includes Radio and Television broadcasting as well as telephone and data communications. Broadcasting is covered in other sessions of this seminar. While concentrating on what we may call interactive services, we cannot help but make the occasional reference to broadcasting services to bring out the complimentarity of both in the distance education process. As well, the explosion of digital technology makes a clear delineation between different methods increasingly difficult.
3. COMPONENTS OF THE TELEPHONE SYSTEM

Basically, interactive telecommunications systems means; the "telephone" system. Even for computer services, where the user works with a keyboard, rather than a telephone apparatus, it is the telephone system which will carry the information over distances. A short description of the system's key components is therefore in order. They consist of:

1. trunk or interexchange circuits (long distance)
2. exchange or switching systems
3. subscriber lines (local distribution)
4. public call office
5. subscriber terminal

3.1 Trunk of interexchange circuits carrying calls over long distances between exchanges may be cable, fibre optics, terrestrial or satellite radio waves. Each of these technologies has its particular features which makes them more suitable for different types of services. Optical fibre is likely best suited for high capacity routes. Microwave systems are suited for medium to high capacity routings in developing countries. Satellite circuits are suitable for the above, but have a particular advantage in servicing areas separated by difficult terrain as well as for low volume use.

It is evident that a country will need to look at its total telecommunications requirements in order to choose the appropriate trunking system. Where a significant requirement
exists to provide services to remote and rural settlement, or for low volume institutional users, such as universities, a country is likely to also employ satellite circuits to satisfy some of its intercity circuit requirements, because substantial economies of scale are involved by fully utilising the spacecraft capacity. Treating rural or specialized educational and business service requirements as an after-thought will drive up the service costs.

Most developing countries lease their domestic satellite capacity from INTELSAT or from other countries or regional entities which operate their own satellite systems. Among the newly industrialized or developing countries, only Indonesia, India, Brazil, Mexico, China and the Arab States operate domestic or regional satellite systems. Presently over thirty developing countries lease satellite services for domestic trunk or interexchange services through the above options.

A key difference between the INTELSAT system and the domestic systems at this time is the difference in power radiated from the spacecraft, which effects significantly the costs and power requirements of the earth stations receiving the satellite signal. Typically, INTELSAT satellites radiate less power than domestic satellites and therefore require more power on the ground. In the past, INTELSAT has leased a full satellite transponder, which is roughly the equivalent of one TV channel or a thousand telephone channels, for US$800,000 per annum. More recently, INTELSAT has also leased individual voice channels for just over US$3,000 annually. In order to close the equation, the costs of earth stations must also be considered.
Assuming the power level of a domestic satellite, a station providing two to four telephone channels will cost between US$50,000 to US$90,000. Installation and related equipment are not included. Power supply for these facilities can be a significant cost factor. Technologies are being tested to operate the stations with a photo-voltaic power supply.

Television reception can be added to the basic earth station at a cost margin of about US$3,000. In areas with higher power level satellite capacity, a television-receive-only antenna will cost somewhat less. Where lower power levels are available, the TVRO costs will be around US$10,000.

3.2 Exchange or switching systems. The interexchange or trunk circuit is received in a community at an exchange, which in turn, routes the calls into individual homes or into public call offices. Switching technologies have undergone significant changes, with the manual systems operator increasingly becoming a phenomenon of the past. Digital exchanges are cheaper to install and maintain than earlier analog systems, they, however, also are more susceptible to noise in the distribution system from the exchange to the individual subscriber.

3.3 Local distribution of the telephone signal to the premises of subscribers is usually handled through a physical pair of wires. The physical connection is often the most problematic part of a telephone system. The cables (subscriber lines) are susceptible to weather, animals, insect damage as well as interference and damage and involve high costs for maintenance and repair.
A means of bypassing the cable problem is presented by radio telephone. These systems have direct line-of-sight radio paths, covering distances up to 50 km. The advantage of these systems include a much shorter installation time for the equipment than for physical plant and the fact that maintenance and administration can be handled from the central location. The cost per subscriber in radio subscriber systems is independent of distances, but directly dependant on the number of subscribers served by a common remote subscriber system.

3.4 PUBLIC CALL OFFICES (PCO)

The PCO is the most basic form of telephone service to the public. PCO's usually are in a central location and consist of a few phone booths from which the public makes calls. PCO's typically cost only a few hundred dollars for the equipment. Operating costs vary according to requirements for power, housing, and staffing. PCO facilities are not very conducive to becoming part of distance education systems because they require major efforts by the learners. Slight adjustments to the service, however, would change the situation significantly. The addition of a small audio conference facility adjacent to the PCO could offer the right climate to support education.

3.5 Subscriber terminal equipment is still predominantly the basic telephone. Technological advances are increasing the intelligence of the apparatus and allow them to interconnect with basic as well as sophisticated devices such as facsimile, speaker phones, audio conferencing equipment, data terminals or computer networks. Ordinary telephone lines can carry most of these services.
To the educator most of these components should be transparent, i.e. not effect the operation of the service. At the same time, however, they effect system planning and costs. For example, the type of long distance service used (satellite, fibre or microwave) will effect how or if small communities can be served. Should existing exchanges and distribution systems exhibit significant technical problems, the educator may be compelled to lease a dedicated and conditioned service, rather than using dial-up service; or she might wish to establish a satellite earth station directly on institutional premises, should traffic warrant this.

The one area which is by far the most visible and critical area for the educator is the subscriber terminal equipment. This equipment and its configuration will define how the educator can structure teaching methodologies and administrative support. At the broader level, however, the utility of the terminal equipment and its attachment will stand and fall with the quality of the distribution system. This factor must always be kept in mind when planning systems in developing countries.

4. TELECOMMUNICATION : SERVICE DISTRIBUTION AND ACCESS

International telecommunication systems have improved and expanded over the past decade at a significate rate, virtually ensuring communication links between the cities and major centres of the world.
Universal telephone access for the majority of the world's population, is however, many decades away. The following statistics show the situation today in a selected number of Asian countries. When looking at these statistics, it must be kept in mind that most of the telephones presently available in developing countries are concentrated in urban centres. The telephone density and therefore access to services in other areas is almost negligible. The situation pretty much describes the types of uses which the system can offer educators.

4.1 Telephones per 100 population (1982, 1983, 1984 data)

<table>
<thead>
<tr>
<th>Country</th>
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<tbody>
<tr>
<td>Bangladesh</td>
<td>0.1</td>
</tr>
<tr>
<td>Bhutan</td>
<td>0.01</td>
</tr>
<tr>
<td>Burma</td>
<td>0.1</td>
</tr>
<tr>
<td>Fiji</td>
<td>7.0</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>35.0</td>
</tr>
<tr>
<td>India</td>
<td>0.5</td>
</tr>
<tr>
<td>Indonesia</td>
<td>0.44</td>
</tr>
<tr>
<td>Malaysia</td>
<td>6.3</td>
</tr>
<tr>
<td>Nepal</td>
<td>0.1</td>
</tr>
<tr>
<td>Pakistan</td>
<td>0.5</td>
</tr>
<tr>
<td>Papua New Guinea</td>
<td>1.6</td>
</tr>
<tr>
<td>Philippines</td>
<td>1.2</td>
</tr>
<tr>
<td>Korea (Rep. of)</td>
<td>13.8</td>
</tr>
<tr>
<td>Vietnam (Soc Rep of)</td>
<td>0.18</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>0.7</td>
</tr>
<tr>
<td>Thailand</td>
<td>1.19</td>
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Expansion of telecommunication services in developing countries has been at the forefront of international debates with the Independant Commission for World Wide Development of Telecommunications, established in 1982 by the ITU. A result of the Commission's deliberations was the implicit acceptance by many countries of the goal to have, by the turn of the century a telephone within 5 km or one hours' walk of each individual in the developing world. It is estimated that this goal can be achieved with an annual additional expenditure of US$12 billion.

These facts establish the parameters within which
- telecommunications can be useful for distance learning in the developing world over many decades to come:
- telecommunications will link learning centres or groups of learners and administrative hubs.
- telecommunications will rarely link individual home-based learners to a central computer or to a tutor.
- telecommunications will offer links between institutions to share resources, eg. to facilitate access to library information, data banks or advanced and specialised teaching.
- telecommunication will facilitate sharing of educational materials and resources at the international level.
- telecommunications services will not be a reality in many rural areas of the developing world.
It is important for the educator to be concerned with the expansion of telephone services and to make their requirements known to systems planners. For example, distance education for basic education, for in-service training, for rural agricultural workers could benefit in many ways from audioconferencing. Educators therefore, should be prepared to convince the telephone company to include limited audioconferencing services in any rural network expansion plans, as an additional feature to the public call office facility.

5. TECHNICAL SYSTEM CHOICE AND LEARNER CHARACTERISTICS

Choices for technical support systems in the distance education process must be determined by the following learner characteristics. The number of learners, the distribution of the learners, the learning arrangements available and the level of the learning.

5.1 NUMBER OF LEARNERS

The number of students effects or even determines the choice between broadcasting or telephone-supported media. A large number of students distributed throughout the country will lead the system designer to propose the use of broadcasting systems, because very large numbers of students cannot fruitfully participate in interactive sessions, and costs and technical complexities would overshadow educational value. Telephone can be used to train the tutors, co-ordinate administrative matters, but not for direct student contact.
5.2 STUDENT DISTRIBUTION

Students engaged in distance education studies, typically study under a combination of arrangements; they study at home, at a learning centre, at their place of work, or at a university or college. In each case, different learning technologies interfaced with the subscriber terminal will make sense. A larger concentration of students will allow the installation of more expensive or more sophisticated technologies, because the per student costs can be shared. A larger number of courses offered at any one facility will allow the sharing of equipment and operations and maintenance support across courses.

5.3 LEARNING AND STUDENT SUPPORT ARRANGEMENTS

Learning support arrangements for distance education programs are very diverse. They include arrangements where students study from print materials exclusively and directly (through correspondence or personal visits) interact with the educational institution; to arrangements whereby tutors or administrators are locally available for tutorial support as well as for administrative matters; to arrangements whereby learning centres are established at which the student also has access to libraries, discussions with fellow students or even limited laboratory equipment.
Arrangements which bring together the students at learning centres allow for more diverse technical support services. Audioconference services can be used for tutorial support, with or without local tutors present. Computer networks can be used to support student registration and administration of student credit etc. Where available, students can use the telephone system to call tutors or administrators.

5.4 LEVEL OF LEARNING

At the less specialised level, where the number of learners is likely to be larger and where access to tutorial resources is easily available locally, broadcasting might be effective. This would apply in primary and secondary education or introductory college-level courses. In the case where a small campus does not have a specialised statistics professor, for example, a local faculty member may be familiar enough with the subject matter to assist the students in their studies and assignments resulting from a broadcast cause.

At the more advanced or specialised level of studies and research such local support is not likely easily available. Here, interactive systems appear to be preferable, in that they help the learner to overcome problems by asking questions — more limited numbers of students at this level will permit meaningful participation in the interaction. Students at this level likely live and work in centres with reasonable access to
telecommunications services. Interactive systems in these instances may also be affordable because of the higher costs of alternative methods of getting access to education at the advanced or specialised levels, i.e. through travel and study abroad. The difficulty of professionals to free themselves from existing work and family obligations also represents a significant obstacle for professionals worldwide to pursuing advanced and specialised education. Telecommunication systems can help bring the opportunities to the learner.

5.5 LEARNING CENTRES

Large distance education systems tend to decentralise their activities to regional administrative as well as learning support centres. It is at these centres that telecommunication support can make eminent sense. First, many of the centres will be located in towns and are likely to have telephone services. Second, they bring together a number of learners for a variety of courses, so that basic exhibition equipment can be affordable. Third, administrative functions can be carried out more efficiently and speedily where access to telecommunication services exists.
A telecommunication system merely represents the electronic highways over which the educator and the learner exchange information and knowledge. To the teacher, learner as well as administrator, the technologies and processes required to produce and exhibit the information is much more immediate than the distribution technologies of the electronic highways.

Many different technologies have been tried and tested, ranging from full-motion video to asynchronous computer conferencing. These technologies have their strengths and weaknesses in the education process. Each distance learning system will have to determine its own requirements. One fact seems to be clear, however from the previous discussions as well as from actual project experiences - the fact that distance learning systems will use telecommunications services to connect learning centres or administrative nodes, not individual homes. This fact, in turn, has direct implications for the choice of production and exhibition technologies. Larger number of students, courses, or administrative functions will allow for more diversity of equipment.
Over the years, distance education systems have interconnected and tested via their subscriber terminals a large number of types of end equipment. Audioconferencing, electronic blackboard, facsimile, microcomputers, telex, slow-scan television, videotex, and compressed video are among these. Distance education systems will have to make choices as to which mix of equipment makes the most sense, given that it will be used for direct teaching as well as for administration.

This choice cannot be made without an assessment of the production technologies required to prepare the educational or administrative software (content). Some equipment such as audioconferencing, facsimile and slow scan television are very simple in that ordinary voice, a photograph or page of text can be picked up and transmitted for exhibition without further preparation. Electronic blackboards can be activated by a pen, a computer keyboard or tapes which are prepared in the studio. Microcomputers can originate and exchange messages, data and instructional support materials amongst all connected points. This technology is used increasingly, in particular as educators and administrators are beginning to work with computers as a matter of course, i.e. text is less and less transcribed from handwriting to computer, but originates directly on the computer. Videotex has been tested in various settings, but has not found a strong footing in education to date. Here, production costs are relatively high and only larger numbers of learners warrant the costs. The critical mass of scale has not been reached for this technology.
Audioconferencing and increasingly computer conferencing have found a strong base in education. Audioconferencing is a relatively inexpensive and flexible device, often used to extend classroom lectures and discussions "life" from a classroom to remote students. Computer conferencing today is not used much in the teaching process, but finds its use primarily for messaging as well as administrative support and documentation.

Ongoing technology development, in particular based on digital technologies will give the educators more choices. At present, each of these devices require a full telephone channel for transmission. Meaning, that an instructor who wishes to verbally explain a computer graph, needs to have at her disposal two telephone channels. Alternatively, she will have to switch between the two functions. Technology development has reached the stage where simultaneous transmission of both signals will soon be a reality - saving costs for the lease of a second channel. In addition, where today, when an educator needs to send facsimile messages to a number of sites, he most likely sends it individually to each. Signalling methods have to be perfected which allow simultaneous reception of the messages. For distance education, it ultimately will also make sense to transfer data, text, graphics, total learning packages and examinations from the head office to learning centres via computer-to-computer links. The learning centres would be responsible for printing and copying. More technology development is required to make such features more reliable in most developing countries.
7. RELEVANT EXPERIENCES AROUND THE WORLD

7.1 Canadian Survey (for detail see attachment one)

Telecommunications systems are used by about 70 institutions on a more or less regular basis for distance education. In addition, a large number of institutions and companies lease facilities on an occasional basis.

The organisations using such systems fall into the following categories:

![Figure 1. Canadian Organizations Involved in Distance Learning](image)

Audioconferencing support linking teaching and tutorial staff to learning centres is by far the leading technology used:
Continuing and professional education is the level at which most activities take place, followed by undergraduate education:

Courses most frequently available are in the health sciences, education and in the arts.
Attachment two summaries world-wide uses of telecommunications technologies, some of which are highlighted here (Please note that the activities described use satellite services. Additional non-satellite applications can be found in Australia's University of the Air and Guyana's SSB links with remote health care workers). The Indonesian uses of the communications are described by my colleague, Dr. N. Idris, in the second paper of this panel.

7.2 THE WEST INDIES

The West Indies

- primarily a terrestrial network linking campuses and centres of the University of the West Indies in Barbados, St. Lucia, Antigua, Dominica, and Trinidad; the link from Trinidad to Jamaica uses Intelsat satellite
- a single dedicated audio channel is leased from the regional carriers
- peripheral equipment includes teleconferencing, slow-scan TV, electrographics and microcomputers, all of which are housed in an electronic classroom at each site; seats around 20 participants
- over a thousand hours of use annually for distance teaching, administration and intra-institutional management
- main applications include teacher diplomas in specialty areas such as mathematics, hearing impaired; continuing medical education seminars for nurses and physicians; in-service training programs for nutritionists, extension agents and other occupations
- the number of participants in the sessions is typically limited because of the small populations on the different islands
- tariff for the network was developed on the basis of distance, but underwent subsequent modification. The telecommunication costs so far have discouraged the expansion of the service to all fourteen member countries of the university.
University of the South Pacific

- original programs carried out on experimental ATS satellites; more recently under INTELSAT project SHARE one circuit obtained linking six countries: Fiji, Cook Island, Kiribati, Solomon Island, Tonga and Vanuatu

- audio teleconferencing for a few hours per day; trials with facsimile, slow scan TV and computer networking have been carried out

- administrative support and conferencing represent major use categories of the system; special tutorials and teaching sessions are conducted

- relies heavily on print materials for teaching because many of the students live too far from the satellite sites to participate

- the administrative support offered by the system allows the university to enroll close to twice the number of students in extension courses as would otherwise be possible

- the regional carriers and the university have not been able to work out satisfactory tariffs. To date the service has been free of charge because it used experimental satellite services as well as project Share. Negotiations have been ongoing for several years to come to an arrangement for the special needs of the university
7.4 PERU

Peru

- Audio conferencing for educational purposes shared with commercial use via the public telephone network

- INTELSAT based program in C band

- Three remote earth station locations and four VHF sites

- Each participating community has a public audio conferencing centre at the municipal building or the telephone office

- Over 400 hours of audio conferences are conducted on an annual basis

- Remote health care staff are eager participants; the education sector brings together primary and secondary school teachers or community workers for special programs, such as literacy; agriculture extension agents gather once a week for in-service training in matters ranging from rice irrigation to pest control

- Very little print materials are provided for the sessions

- The number of participants in the sessions is rarely over 20

- The use of the audioconferencing network has been free-of-charge for the development ministries, but tariffs are under review, as the telephone company is intending to extend this service to other areas.
8. COSTS AND BENEFITS

8.1 Costs

The listing of costs for telecommunications systems for distance education is not very useful and often misleading, unless this listing is linked to specific regions of the world and unless it represents a total system, rather than the component parts themselves. For example, TVROs, using domestic satellite capacity can be quoted at under a three thousand dollars. The costs of the satellite segment necessary to distribute TV signals are generally under $1 million per annum and the earth station required to send the signal to the satellite will cost several hundred thousand dollars. Telephone-supported systems have a different distribution of costs across components. The space segment costs could be as low as a few thousand dollars per month, but the earth stations probably will cost around $50,000. None of these include operating costs, and do not include import duties, power sources and other required infrastructures.

The above represents for most distance educators a distribution system which is far too powerful to be cost effective. Unless the student base and course volume envisioned is of a scope beyond any presently existing institution, the facilities will need to be shared with other interests, in particular those which have the technical expertise to operate and maintain such systems, the carriers and broadcasters. Ideally, educators...
will lease capacity on an as required basis on existing networks. This will keep down the lease costs, but most importantly will keep responsibility for operations and maintenances with the carrier. Educator's do not have the skills and resources to operate a telecommunication system and should not attempt to do so, unless their operation has grown to a significant activity where in-house service makes sense.

Closely related to distribution cost is program production cost. TV production typically is more costly than radio production, which is typically more costly than interactive programming, just looking at the costs of facilities required to do production as well as the pre-testing required to insure that program learning objectives are met. These program production costs represent, however, only a small component of the total distance learning package. Before deciding on any one technology, technical network and distance learning model, the educator must establish a comprehensive model for the total system and must engage in an interactive process of discussions, not only with other educators and learners, but with telephone companies and broadcasters to understand technical systems resources available and to formulate realistic network requirements.
At the exhibition end broadcast equipment is typically less costly than telecommunication equipment. The planner has to keep in mind that telecommunication services can serve more functions, i.e. also support administrative members from the field to headquarters.

Cost accounting for these systems is a difficult process, as the telecommunications links and associated equipment often are used for multi-purpose functions, i.e. including those that do not relate to distance education. It is interesting to note that many of the institutions included in the Canadian survey (in particular the dual-mode institutions) were not able to break out of their total expense statements those cost that are specific to the distance education/telecommunications components.

8.2 BENEFITS

Benefits of telecommunications systems to education are plenty; both in relation to teaching as well as in relation to administration. Many of the benefits are sequential or secondary and have rarely been quantified.
One main area of benefit is the substitution of telecommunications for transportation. It increases the productive time of specialists, faculty members and administrators. It also offers opportunities for increased outreach of specialists who could not possibly in person travel to and teach as many groups as can be reached by telecommunication.

The use of telecommunications to coordinate student and course administration and the flow of learning materials to students is very valuable. The University of the South Pacific speculates that it can handle a significantly larger number of students because of the satellite network.

Telecommunication support not only saves travel time but also opens up opportunities for advanced training for practicing professionals. These individuals would not be able to leave their work for training, but can study at home supported by learning materials and direct access to remote tutors, experts and faculty, even at overseas locations.

Asynchronous computer messaging increases efficiencies in that messages can be received and responded to in due course, not necessitating all parties to be involved and available at the same time.
Telecommunication support, because of the fact that it offers learners the opportunity to talk back to headquarters can also help shape the thrust and improve relevance of the distance education outreach. Learners of the smaller islands of the Caribbean reported that the courses and seminars offered by the University of the West Indies had with the advent of the distance teaching system become much more relevant to their needs.
DISTANCE LEARNING VIA SATELLITE IN CANADA

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ABSTRACT

This paper reports on a recent study of the institutions, communications technologies, course content and students involved in distance learning in Canada. The organizations range from communications service providers to school boards to non-profit professional networks to degree-granting consortia.

Of the 60-70 using communications technologies such as television, videoconferencing, electronic blackboards and computer conferencing in distance learning, approximately 25% rely on satellite services for delivery. This decade-end review of tele-education in Canada suggests that future developments will include increased institutional cooperation and a greater focus on learner needs.

Institutional Profile

Generally, those organizations using satellite services to deliver courses to students are less than 20 years old, are either community colleges or extension departments or universities or provincial communications service providers which participated in DOC-initiated pilot projects involving Hermes and Anik B satellites during the late 70's and early 80's (Ref. Figure 1).

Most of the educational institutions are what is known as "dual-mode" institutions - that is, they provide both on-campus classroom instruction and off-campus distance instruction. The obvious exceptions are British Columbia's Open Learning Authority, Alberta's Athabasca University and Quebec's Télé-université, which are "single-mode" post-secondary institutions operating without student campuses. Of these institutions, Télé-université is the heaviest user of communications technologies: the others depend primarily on the more traditional print-based correspondence materials, along with travelling professors, and employ communication technologies to provide support, such as telephone tutoring, or enrichment, often through educational television.

In the case of universities and colleges the actual administration of student enrolment, academic records and course
scheduling is similar to that used for on-campus students taking credit courses. In most dual-mode institutions, course delivery for off-campus students is scheduled at the institution’s convenience at periods when faculty and staff are available. Continuous registration is generally provided only by single-mode institutions or by organizations offering professional development courses.

Typically, a student would have an on-campus faculty advisor or an off-campus tutor for academic counselling and would deal with a separate administration office for tuition, mailed materials, etc. Increasingly, local learner centres are being set up with library services, tutor support and satellite dishes for receiving instructional programming. These learner centres are often community outreach sites located in smaller remote communities served by the nearest community college. It appears that more students go to learning centres, rather than studying exclusively at home, particularly when personally purchasing a satellite dish would be the only alternative.

Increasingly, academic institutions are assigning the responsibility for managing distance learning activities to a central office, often within a continuing education or community extension department. Distance learning staff duties may vary from assisting faculty in course development to providing a “quality control” function to liaising with instructional television and satellite delivery services.

Formal staff training in distance learning and instructional technology is usually minimal at both the sending and the receiving ends. When orientation is provided, it is generally in the form of workshops and/or print materials.

Canadian academic institutions are envied by those in the United States for the relatively high level of financial support which the public sector, particularly the provincial governments, provides for distance learning activities. This support is generally through operating grants, rather than through financing of specific course development (a notable exception being the federally-supported computer technology course at B.C.’s North Island College). On the other hand, while the Canadian private sector does provide some support, it is not as active as its counterpart south of the border either in contracting services from, or providing grants to, academic institutions.

Those Canadian corporations or professional associations which sponsor their own professional courses or corporate training sessions frequently use satellite-based multi-point videoconferencing (one-way video, two-way audio) services contracted from the private sector.

Figure 1. Canadian Organizations Involved in Distance Learning

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<th>TYPE OF ORGANIZATION</th>
<th># OF INSTITUTIONS</th>
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<td>UNIVERSITIES/COLLEGES</td>
<td>20</td>
</tr>
<tr>
<td>COM. COLLEGES/TECH. INSTITUTES</td>
<td>10</td>
</tr>
<tr>
<td>ED DEPTS./SCHOOL BDS</td>
<td>5</td>
</tr>
<tr>
<td>CONSORTIA</td>
<td>6</td>
</tr>
<tr>
<td>NON-PROFIT ORGS</td>
<td>5</td>
</tr>
<tr>
<td>PRIVATE SECTOR</td>
<td>4</td>
</tr>
<tr>
<td>BROADCASTERS</td>
<td>7</td>
</tr>
</tbody>
</table>

Technologies Used

Many institutions use more than one technology, with satellite services rarely being narrowcast among a defined number of sites. Satellite-based services usually involve TV rebroadcasting and/or cable redistribution. In addition, they will often include telephone or audio-conference sessions which follow, or are coordinated with, the satellite-distributed programming. As Figure 2 shows, audio-conferencing is used by well over half of the 66 institutions participating in this survey. Although less prevalent – and not shown in this table –, other technologies such as video- and teleconferencing, slow-scan television and electronic blackboards are also being used. Most educational institutions across the country report being introduced to the technologies through collaborations with their local cable companies and with regional telecommunications service providers, such as the Atlantic Satellite Network.
Figure 2. Communications Technologies Used in Distance Learning in Canada

<table>
<thead>
<tr>
<th>TECHNOLOGY</th>
<th># OF INSTITUTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satellite</td>
<td>18</td>
</tr>
<tr>
<td>Cable</td>
<td>20</td>
</tr>
<tr>
<td>TV Broadcast</td>
<td>31</td>
</tr>
<tr>
<td>Radio</td>
<td>6</td>
</tr>
<tr>
<td>Telephone</td>
<td>23</td>
</tr>
<tr>
<td>Audio-Conference</td>
<td>40</td>
</tr>
<tr>
<td>Computer</td>
<td>23</td>
</tr>
</tbody>
</table>

* Total exceeds 40 because some institutions use more than one medium.

Course Content

The courses most frequently available to distance learners are those in the health sciences, education and the arts, including the social sciences. The current trend is towards providing sequential and complementary courses so that the remote student can complete most, if not all, requirements for a degree or diploma without having to travel to a campus.

Figure 3. Course Content Available to Distance Learners in Canada.

<table>
<thead>
<tr>
<th>PROGRAMME LEVEL</th>
<th># OF INSTITUTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELEM/SEC</td>
<td>6</td>
</tr>
<tr>
<td>VOCAT/TECH</td>
<td>28</td>
</tr>
<tr>
<td>UNDERGRAD</td>
<td>26</td>
</tr>
<tr>
<td>GRADUATE</td>
<td>4</td>
</tr>
<tr>
<td>PROF/CONT</td>
<td>20</td>
</tr>
</tbody>
</table>

* Total exceeds 40 because some institutions offer courses at several levels.

Student Profile

The typical distance learner is a working female in her mid-twenties or older, living in a rural or remote area, who cannot attend on-campus classes and may be taking courses at home or at work. While most home-based rural students look to distance learning programs as a way of overcoming geographical distances between themselves and the course-giving institution, many urban students are attracted because it allows them to control their own scheduling — for instance, a B.C. cable subscriber could play back a course which had been video-recorded during the daytime off of the Knowledge Network of the West.

Ranging from a handful to a few hundred, the numbers of students in Canada who are studying at home are relatively small, when compared with those of developing countries such as China (where less than 1% of high school graduates can enter traditional universities, yet projections are that two million students will have graduated from the Central Radio and Television University by 1990). However, the reasons for enrolling in distance learning courses are the same for Canadian students as for their colleagues in other countries: off-campus study is usually the only option available, whether for reasons of geography or limited classroom seats or health problems or child-rearing responsibilities, etc.

In the case of professional and continuing education, employees often receive short courses or seminars at their place of work through professional associations, university extension departments or community colleges. Frequently, discrete networks join forces to provide upgrading for their members, who may be health care professionals, teachers, lawyers or engineers. Unlike the situation in the United States, Canadian employers provide relatively little training from a distance, apparently preferring to move employees to training sites. Even so, more institutions offer courses at the professional and continuing education level than at any other level (Ref. Figure 4).
Figure 4. Academic Level of Distance Learning Courses Offered to Canadians

<table>
<thead>
<tr>
<th>PROGRAMME LEVEL</th>
<th># OF INSTITUTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELEM/SEC</td>
<td>6</td>
</tr>
<tr>
<td>VOCAT/TECH</td>
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<td>UNDERGRAD</td>
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<tr>
<td>GRADUATE</td>
<td>4</td>
</tr>
<tr>
<td>PROF/CONT</td>
<td>30</td>
</tr>
</tbody>
</table>

* TOTAL EXCEEDS 44 BECAUSE SOME INSTITUTIONS OFFER COURSES AT SEVERAL LEVELS

Conclusions and Observations

At this stage there appear to be some voids - notably, 1) lack of in-depth evaluation of the learning- and cost-effectiveness of distance education activities, 2) shortages of original Canadian content (for example, Canadians are taking satellite-based courses from U.S. professional organisations such as the IEEE and could potentially acquire four-year degrees via satellite from foreign academic institutions without ever leaving home) and 3) relatively little collaboration between Canadian post-secondary Institutions and the private sector for on-site employee professional up-grading (when compared, for instance, with the amount of satellite-based delivery to industrial premises being undertaken by California’s Chico State University, or the National Technological University.

Needless to say, over the past decade, both the carriage and content providers have learned a great deal about the advantages and constraints of delivering distance learning through communications technologies. First, setting in place the infrastructure - both human and technical - requires time, senior management support and strong project leadership. Secondly, as costs are high for reaching a relatively few students, sharing technical facilities is essential for long-term viability. The more successful ventures have been based on a mutual awareness of each other's needs and capabilities on the part of both communications carriers and the educational clientele whom they serve. Finally, now that the potential of the technologies are fairly well understood, largely as a result of the pioneer field trials of the past decade, future initiatives should begin - not from the perspective of how to apply the technologies - but rather from the perspective of how to meet learner needs.
SATELLITE SERVICES AND EDUCATION: WHERE DO HOPES AND REALITY MEET?

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N. Mark Lopianowski, Teleconsult Ltd. / Téléconseil Littée

ABSTRACT

Satellite services have not yet fulfilled the expectations placed in them to become key instruments in education and development. Even where suitable satellite technologies are available, relatively little use is happening. Continuing and professional education and training are emerging as the prime users. Many user institutions employ narrow band and interactive technologies to limit transmission and program production costs. In order to promote more significant educational uses, educational planning needs to be understood by spacecraft designers. Educators need to be part of the planning and marketing staff of the service providers.

INTRODUCTION

With the advent of the first communication satellite services in the sixties, many planners speculated and hoped that satellite services would make a significant difference to education and development. The dreams of technological solutions to pressing education demands can be distilled into the following images: a group of third graders and their teachers trying to replicate a simple science experiment which they had seen the television teacher conduct just a few minutes ago on their classroom television set; the mathematics teacher arriving on her bicycle a little early in the morning because she wanted to review the new mathematics assignments which had been downloaded the previous night via the school rooftop antenna; farmers and herdsmen gathering around a communal television set hooked to a small earthstation, intently following a story of a fellow farmer who followed the advice of a friend and used a multi-cropping system.

In the 70's a commonly held belief was that once suitable satellite systems were available, such services would blossom. In 1986, even in regions where suitable satellite systems are available, the dream images are not reality. One basic fallacy of earlier dreams was that somehow the experiences of terrestrial educational broadcast television, or of computer assisted instruction would be turned around. Satellites as the distribution medium would achieve a significant level of acceptance by the educational communities.

This paper describes the actual uses of satellite services for education and development in different parts of the world. It offers some concrete suggestions for satellite service planners and operators. The focus is on developing or newly industrialized countries.

THE SITUATION TODAY

Review Of Satellite Services:

International satellite services are provided on a global scale through the INTELSAT system. INTELSAT also offers leases for countries wishing to use satellite services for domestic purposes. Twenty or so countries make use of this lease. INTERSPUTNIK offers satellite services on a global scale as well. A mix of regional and domestic satellite systems is available in Europe. The Arab states operate a regional satellite system. India, Indonesia, Brazil, Australia, Japan, Canada and the United States operate their own domestic satellite systems. Indonesia leases capacity on its system to several countries in the region for their own domestic services. Many other domestic and regional satellite systems are on the drawing board.

On the ground, TVROs receive television signals for redistribution by cable or rebroadcasting facilities as well as for direct home reception of community reception. For telephony, the satellite earth stations are typically part of the national public telecommunications network. Private telephone and data satellite networks are increasing for...
business use, connecting offices and branch plants. This development is not limited to the industrialized countries, India, for example, has announced that it is looking into offering similar services.

The Educational Context

Chu and colleagues showed in their longitudinal study in Indonesia that satellite services contribute to learning even if the programming does not have specific educational or learning goals. They found that people who watched national television increased their knowledge of the national language and of national policy goals. Educational claims of similar nature can be made by most broadcasters. In this paper, however, we are exploring the application of satellites in more narrowly confined educational contexts, i.e. where the programming is designed to bring about changes in knowledge/perceptions/attitudes or action and where it often is accompanied by supporting activities, such as tutorials and group sessions or print materials.

In this paper we divide education by three primary target audiences, the primary and secondary in-school sector, the post-secondary sector, including continuing and professional education and the non-formal or basic education sector. Each of these sectors has needs and characteristics, which effect the choice of media as well the distribution system to support the learning process. These include learner distribution, their numbers and receptivity to learning; they also include arrangements necessary to encourage learning through group support, conversations or print materials.

A LOOK AT EDUCATIONAL USES OF SATELLITE SYSTEMS

North America

The most significant use of satellite services in terms of hours of use and in terms of numbers of educational institutions involved in the delivery and support of satellite-based learning is taking place in North America. Satellite services are used at most levels of education; institutions have developed which are tailored to take advantage of satellite services and go beyond the more traditional approach of merely extending the reach of existing outreach activities.

Canada

Six organizations operate regularly scheduled TV distance education networks by means of satellites: five networks operate in Ku band and one in C band: Twenty five organizations make occasional use of satellite for educational purposes.

The most notable users are:

- DUET (Distance University Education via Satellite), Nova Scotia
  - approximately 130 hours per month, prepared by different institutions.
  - shared use with commercial broadcasters of TV up-link and transponder on Anik C
  - TVROs and cable used for distribution

- RADIO QUEBEC, Quebec
  - programming represents a mix of public and educational broadcasting
  - fulltime use of Anik C3 Ku band transponders
  - TVROs and terrestrial distribution using rebroadcast transmitters and cable
  - carry out their own maintenance on TVROs and the TV transmitters

- CANAL, Quebec
  - occasional use of satellite networking to support educational TV programming originating from several post secondary institutions

- ACCESS NETWORK, Alberta
  - full time use of an Anik C transponder
  - distribution of audio and TV education programming to TVROs
  - terrestrial distribution via 14 FM transmitters and CATV networks
  - reaches in excess of 100 communities
  - programming represents a mix of public and educational broadcasting ranging from children to post secondary audiences

- KNOWLEDGE NETWORK, British Columbia
the domestic satellite system for education. A few of these have use of a full time transponder. Most use occasional, but routine satellite leases. Many operate their own uplink, with participating sites responsible for the reception equipment. Key programming areas are academic, corporate, finance, health and legal. The more significant projects are:

- LEARN ALASKA
  - involves in excess of 200 sites for educational TV; audio conferencing set up to in excess of 100 sites using public switched telephone network
- CALIFORNIA STATE UNIVERSITY, Chico
  - regularly scheduled academic delivery of graduate and post graduate level courses in computer science; occasional use of transponder capacity
- NATIONAL TECHNOLOGICAL UNIVERSITY

medical education seminars for nurses and physicians; in-service training programs for nutritionists, extension agents and other occupations.

- The number of participants in the sessions is typically limited because of the small populations on the different islands.

- Tariff for the network, was developed on the basis of distance, but underwent subsequent modification. The telecommunication costs so far have discouraged the expansion of the service to all fourteen member countries of the university.

**University of the South Pacific**

- Original programs carried out on experimental ATS satellites; more recently under INTELSAT project SHARE one circuit obtained linking six countries: Fiji, Cook Island, Kiribati, Solomon Island, Tonga and Vanuatu.

- Audio teleconferencing for a few hours per day; trials with facsimile, slow scan TV and computer networking have been carried out.

- Administrative support and conferencing represent major use categories of the system; special tutorials and teaching sessions are conducted.

- Relies heavily on print materials for teaching because many of the students live too far from the satellite sites to participate.

- The administrative support offered by the system allows the university to enroll close to twice the number of students in extension courses as would otherwise be possible.

- The regional carriers and the university have not been able to work out satisfactory tariffs. Todate the service has been free of charge because it used experimental satellite services as well as project Share. Negotiations have been ongoing for several years to come to an arrangement for the special needs of the university.

**Indonesia**

- Use of Palapa satellite in C band.

- A mix of 10m and 5m stations, which are part of the common carriers infrastructure.

- 15 sites participate.

- Two fulltime circuits leased from Perumtel using satellite as bridge; use of transmit gating circuits to minimize unwanted noise contribution.

- One circuit for audio conference and the other for electrographics, facsimile and point-to-point voice.

- Electronic classrooms located in a dedicated facility at each participating campus, seating approximately 60 students.

- Since October 1984, 60 undergraduate courses have been delivered in areas such as statistics, research methods, poultry production and forestry; faculty training, and administrative uses are common; seminars targeted to faculty have become popular; the Open University is using the system regularly on a weekly basis to train its tutors.

- The network is in operation for almost twelve hours per day.

- Across the network, student attendance has ranged from 1,500 to 2,600 per week; faculty seminars are well attended and have drawn as many as 1,200 participants.

- The development of the network was partially supported from external sources; the network costs have been a significant source of concern for the long-term viability of the network.

**Peru**

- Audio conferencing for educational purposes shared with commercial use via the public telephone network.
THE CANADIAN SATELLITE USER CONFERENCE, 1987

NAME: Anna Stahmer & N. Mark Lapinnejoki
AFFILIATION: Ryerson/Teleconsult
TELEPHONE NUMBER: (613) 29-5076 or (604) 88-1144

The satellite system has many features which could support educational applications.

Europe

In Europe, conferences, publications and concept papers attest to the interest in the use of satellite for educational purposes. So far relatively little activity is evident. Most notable among these, however, is the networking of large research data banks. The pending Olympus program of the European Space Agency, has an expressed educational objective.

Australia

Australia has been an early user of telecommunications for different levels of education. In the advent of the domestic satellite system, Australia initiated a small seed funding program and issued a discussion paper regarding the educational uses of the satellite system. Since the launch of the satellite, no news of actual educational uses of the system emerge through the perusal of international literature. The technical system has many features which could support educational applications.

Brazil

No educational use of the system have emerged to-date, although the Public Educational TV Network reportedly is switching from microwave to satellite for TV distribution to twelve cities. Several companies with distributed

India

the different ministries are charged with the development of their own broadcast materials; the ministry of education is developing programming for the formal school levels.
offices are considering occasional TV conferences for training and promotion.

Arabsat

The Arabsat system includes an S-band transponder to facilitate the reception of television signals in the more remote parts of the region, at relatively small costs and requiring minimal power.

Arabsat capacity in general is under-utilized and its educational potential is not explored beyond an initial trial period, offered free-of-charge by the operating organization. Some television-based science courses are under development at one of the Arab League organizations and the Association of Arab Universities has held discussions about the use of the network.

Project SHARE

In 1984, Intelsat initiated project SHARE, which has as its objective to demonstrate educational and developmental uses of satellite services in developing countries. Under the project, scheduled to last until the end of 1987, public service agencies have access, free-of-charge to the Intelsat space segment. None of the international carriers which have participated in the program, except for the Canadian carrier, have charged for access to their international gateway service. The projects often consist of a series of specialized seminars. Several, however, offer satellite services over an extended period of time. Most of the projects which have come to fruition to date have linked North American with Third World institutions. From Europe, only Ireland has participated. Only the Chinese TV University and the University of the South Pacific have undertaken educational projects which did not connect to an industrialized countries.

WHAT DOES THE REVIEW MEAN FOR.......

....the satellite systems planner?

Over the first few years of the operation of a satellite system, educational television will be a very minor user of the spacecraft capacity and will rarely require dedicated TV transponders. If a user at all, support to primary or secondary school instruction will likely not exceed a small number of hours per week.

Educational users will share production, uplink and transponder capacity with other educational institutions as well as with broadcaster or the public carrier network on an occasional use basis.
The costs of international telecommunications and in particular of video transmission will keep international satellite education to a minimum, unless the course content is specialized or has a multiplier effect, e.g. the training of trainers, where the ultimate per student cost will be affordable. Direct student teaching on a global scale is an issue for the future.

...for service marketing?

The carrier needs to add new socio-economic planning skills to the staff, who understand educational and developmental needs and translate them into technical network parameters and can develop suitable cost schedules.

The post-secondary and continuing education sector will be the first user of the system.

Special tariffs or service arrangements, such as pre-emptible or off-peak-hour services for the educational users will increase the network use by this sector.

Intra- or inter-institutional networks, if traffic allows, as private networks, or else as special service provided by the overall network, will be desired by customers.

Learning facilities equipped with teleconferencing features and some peripheral equipment will increasingly be required at the community or institutional level and will have to interface with the public switched network. The carrier should be prepared to offer the whole package.

...for the national planning agencies?

The philosophy of a major ITU report "The Missing Link" states that "henceforth no development program of any country should be regarded as balanced, properly integrated or likely to be effective unless it includes a full and appropriate role for telecommunications, and accords a corresponding priority to the improvement and expansion of telecommunications". This statement prepared by telecommunications specialists, should continue to say that no telecommunications program shall be considered balanced and properly integrated unless it specifically aims to satisfy the service requirements of the educational and developmental community in the country. Educational users should be treated similar to business users, as part of the network concept development, not as an afterthought.
Educational programming will be part of a learning package received at nodes or learning centres and not at individual homes, often calling for some form of specialized viewing facilities. Direct broadcasting service does not appear to be a major urgency therefore.

Narrow-band transmission systems will gain significantly over high capacity transmission systems as users are looking for more efficient ways of utilizing capacity.

Use of audio teleconferencing systems will increase with the expansion of telephone services in developing countries.

Dedicated telephone or teleconferencing channels will only be required for links between major institutional users, e.g. university campuses; other users will be satisfied with occasional use of the public switched network.

...... for the educator?

Educational television programming is not typically the main carrier of the instructional content, and often represents only about 10 or 20% of the subject matter, with the reminder offered through print materials, tutorials, learner interaction. Production and satellite distribution require significant financial resources, which are only justified if a large number of learners are reached.

Primary and secondary education is supported in North America by satellite programming. In the remainder of the world this appears to be true only for some activities in India. This reflects the deep-rooted obstacles repeated in different parts of the world when countries tried to introduce ETV in the 60's. Obstacles range from poor planning/policy making, to inadequate interaction between broadcasters and user institutions to scarcity of trained manpower and costs.

In the post-secondary sector audio and video teleconferencing are gaining increasing acceptance as they can be conducted with more limited resources and allow for seminar-style sessions which appear to be suitable to the learning processes of adult learners. Training and continuing education, offered in interactive sessions and distributed via satellite to remote areas as well as among major centres are in significant demand.

Through satellite distribution, courses and programmes can be received in any area of the satellite footprint. This places particular challenges on institutions in smaller countries which might loose their students to the post-secondary satellite institution. The institution can, however, take advantage of the situation by combining its own services with those of the other institution and offer the learner suitable learning packages and local support.
A PLACE FOR CANADA

Canadian institutions have gained significant experience in the use of satellite services for education and development, but have not been able to transfer this expertise to any significant degree overseas. Part of the problem lies in the fact that the satellite operator and educational or developmental users overseas often are so far apart philosophically that they would not be interested in purchasing this type of expertise.

Closer to home, it does not appear that we have developed a marketing approach which combines the technical systems, services and expertise, such as tariff development and marketing with specific educational analysis and goals of the partner country. The inclusion of educational or developmental planners in the preparation of bid documents, for example, would be a good step into this direction.

WILL THE DREAM COME TRUE?

If progress over the past two decades is an indication, it will be many decades before the dream may come true in which satellites will help children and farmers or herdsmen in the developing world to grow, learn and enrich their lives. Satellite services are forging their place, however. They are becoming a vehicle to support the trainers, teachers community workers and various professionals to better carry out their work, which is to be the stimulus for learning, for improved living conditions and for the well-being of children and adults alike. Over the two decades we have changed our dream. We have not changed the goal to be achieved, but the means of getting there.

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