PN-AAX-687
51076

# THE AID RURAL SATELLITE PROGRAM: AN OVERVIEW

Prepared by:
Karen Tietjen

AGENCY FOR INTERNATIONAL DEVELOPMENT
Bureau for Science and Technology
Office of Education

Dr. Clifford Block
Project Manager

A Publication of the AID Rural Satellite Program
Produced by THE ACADEMY FOR EDUCATIONAL DEVELOPMENT under
Contract No. AID/DSPE-C-0081
January 1987

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# PREFACE

This series of reports describes the results of the A.I.D. Rural Satellite Program (RSP), a collaborative activity of nations in three regions of the developing world and of the United States Agency for International Development.

The Rural Satellite Program has been a research effort designed to test two assumptions: first, that the establishment of domestic telecommunications networks is now a practical possibility for many developing countries; and second, that such networks can be successfully utilized by institutions engaged in the work of socio-economic development. If those assumptions are correct, we believe that telecommunications can become a significant new catalyst for rural development.

In the development community, it is widely acknowledged that a lack of communications is a serious deterrent to effective development. How well can rural health systems function when health workers are typically a half-day away from any help or information? How can isolated rural teachers and agricultural workers maintain their skills and morale? Furthermore, how can they extend their scarce expertise to dispersed populations? How can rural services be administered efficiently without two-way communications capability? And how can local economic enterprise flourish without market information and communication with suppliers?

Until recently, little could be done to remove these constraints. Costs were too high and technologies too unreliable. New technological developments, particularly in satellite communications, offer new promise. We now have the ability to place a satellite earth station in almost any location and connect directly into a telephone or data network with reliability that far exceeds terrestrial systems. In addition, the use of satellites has altered the economics of telecommunications expansion, making rural services more economically viable.

AID has been examining the implications of satellite communications almost from its beginnings in the 1960s, as a part of AID's role to help craft, from advancements in science and technology, practical new development options. AID helped formulate the U.S. policy that led to the use of NASA's experimental satellites for educational experiments, such as India's groundbreaking SITE experiment. In 1976, the AIDSAT demonstration linked the rural areas of 27 nations with their capital cities, and with the United States, for teleconference dialogues on the implications of this new technology for development. From the analysis of those experiences, the RSP was born.

These reports summarize the information gained by the Rural Satellite Program on many issues--economics, technology, patterns of use, communications planning, and development applications. The results have been gratifyingly positive. But perhaps the most important aspect of the Program has been the opportunity to move from speculation about the potential of these technologies to actual experience. That experience generated solutions to numerous difficulties, many of which are likely to be applicable as others initiate similar applications.

The systems set up by the Program in all three regions are now functioning as viable national enterprises, with no external funding; indeed, all are expanding, thanks to the continued leadership of Professor Gerald Lalor at the University of the West Indies,

Dr. Pramoetadi in Indonesia, and Dr. Angel Velasquez in Peru. Other nations are increasingly interested, as satellite coverage expands throughout the world and as costs steadily decline.

We hope the results of the Rural Satellite Program have some value for three groups. First, for development ministries and aid agencies, the results show that telecommunications can work reliably even under difficult conditions. They can be readily used by the professionals working in the rural world, and they can make a difference in the work of development. Investments in both the expansion of networks into rural areas and in greater utilization of existing networks are, in many cases, likely to be worthwhile.

Second, to telecommunications providers the data collected by the RSP have shown the substantial revenue flows that can result from rural telephone service. The data have also shown that special services to rural development agencies, such as audioconferencing facilities, can provide major development gains at minimal additional cost. By combining the revenue from community telephone service with the direct development benefits of audioconferencing, an economically and politically attractive rationale for rural telecommunications results.

Third, to the users themselves, the RSP experience has demonstrated how they can readily, and economically, utilize telecommunications in their day-to-day work, expanding remarkably their information resources and outreach. The costs of tying institutions into rural networks through audioconferencing have proved to be modest--in the range of a few thousand dollars for each installation. The costs for transmission are steadily declining and can typically more than pay for themselves in savings in travel. Furthermore, they sometimes represent the only practical way to expand outreach for training, improved administration, and education.

These are but small portents of what is becoming possible. Since the RSP began, satellites have begun to serve domestic communications needs throughout India, Brazil, Mexico, 22 Arab nations, and 6 nations of Southeast Asia, with rural populations of well over a billion people. Others are being planned for Latin America and Africa. INTELSAT has developed a wealth of new services for "thin-route," rural communications. New earth station technologies can now provide electronic mail and data for as little as $10,000 per station. And international interest in rural telecommunications has expanded remarkably.

Although technological growth makes many new applications possible, this potential will be realized only through the hard work of those engaged in day-to-day development activities, people willing to explore the new uses of communications in their work. Those from around the world who have participated in the Rural Satellite Program have been such people. These reports are a first effort to share their experience, the difficulties as well as the successes. On that base of experience we hope that new applications will be soundly built. If so, the Program will have achieved its objective.

Clifford H. Block
Office of Education
Bureau for Science and Technology
U.S. Agency for International Development

# EXECUTIVE SUMMARY

## SATELLITE COMMUNICATIONS FOR DEVELOPMENT

Satellite technology has truly made the world a "global village" for those nations and people who have access to its networks. Satellites have made possible worldwide transmission of telephone and telex, radio and television broadcasting, business information, and delivery of education and health services to rural areas. In contrast to terrestrial transmission systems, satellite transmission ignores rough terrain and vast distances. Transmissions can reach the most remote regions and bring them information vital for economic and social development. But most of the world's villages, especially in the Third World, are still cut off from domestic and international communications systems.

Telecommunications services have been slow to reach rural areas for several reasons: high costs, technical problems, and the lack of a guaranteed return on investment. It is less expensive and more profitable to develop telecommunications infrastructures for urban rather than rural areas. Increasingly, however, development experts and government planners are realizing the role that telecommunications can play in spurring economic development. **A reliable telecommunications system stimulates economic growth and facilitates national cohesion.** Governments are beginning to perceive communications services as a social good to provide to the entire citizenry, rather than solely as enterprises to earn profits.

## A.I.D. RURAL SATELLITE PROGRAM

In 1980, the U.S. Agency for International Development established the Rural Satellite Program (RSP) to investigate the potential uses of satellite-based telecommunications in supporting rural development. **The challenges of the RSP were (1) to identify and transfer appropriate telecommunications technologies to rural or remote areas of the Third World and (2) to develop applications that would support and strengthen the public institutions engaged in development efforts.** The combination of reliable satellite-based communications systems, new telephone-based technologies, and imaginative applications programming held great promise for Third World development. Two-way communications could support the crucial linkages between rural communities and commercial, political, and scientific centers to overcome poverty, isolation, and lack of educational resources.

The Rural Satellite Program established three pilot projects that use teleconferencing networks to link universities, development agencies, and the national centers. The networks utilize commercially available satellite channels, local earth stations, and a combination of land lines, microwave, and radio links to connect sites using telephone-based technologies for voice and graphics communications.

Presented below are the questions addressed by the Rural Satellite Program and its results after four years of field experimentation.

**Are modern two-way telecommunications technologies technically feasible within the severe operating constraints of developing nations, especially rural areas? How can these technologies be made more appropriate in terms of cost and operations? What are required procedures for technical management and operations?**

Each of the RSP telecommunications networks achieved a high level of technical reliability, performing effectively between 90 and 98 percent of the time. This high rate of reliability was accomplished by selecting simple and sturdy equipment, making certain equipment adaptations, and developing many innovative solutions to overcome equipment shortcomings, line noise, erratic power supply, and tropical heat and humidity.

**Can these technologies be used effectively to address major development problems? How can programs supporting agriculture, health, and education be developed?**

The RSP pilot projects focused more on applications development than on technical experimentation in order to ensure the delivery of programs that meet the needs of universities and development agencies in remote locations. All the RSP programs have attracted large audiences. Users have generated demand for training and skills upgrading programs. And rural field workers, who have never before had access to professional support, have been reached via teleconferencing.

**Do telecommunication technologies provide an affordable and cost-effective solution?**

The RSP networks facilitate the delivery of programs and services to sites previously impossible to reach efficiently by other means. The use of the teleconferencing networks greatly reduces the cost of delivering education and training programs by eliminating costly travel and associated opportunity costs and by extending scarce professional resources.

**Can these technologies be effectively exploited by rural institutions and indigenous personnel? What are their management requirements?**

In each project, the RSP collaborated with the national telecommunications authority in the design, development, and management of the network. The projects trained managerial and technical personnel and worked with field workers, faculty, and administrators to develop important and effective ways of using the telecommunications capability. The networks are fully managed by local personnel and, indeed, are expanding under their direction.

Finally, the RSP identified major issues of importance to policymakers in developing countries. In each pilot project, the RSP had to address these issues and devise solutions.

- **Cost:** Government leaders, telecommunications authorities, and ministry personnel must agree on whether and how communications services will be financed.
- **Infrastructure:** The existing telecommunications infrastructure in many areas of the developing world may not be able to support the desired applications. Modifications and additions to existing infrastructure and equipment may be needed.
- **Management:** Effective use of telephone and audioconferencing services demands efficient management systems. Routine procedures must be developed for operation and maintenance of the system and must be carried out by managers, operators, and users of the system.

## RSP TECHNOLOGY CHOICE: TELECONFERENCING

Central to the RSP effort has been the identification and adaptation of telecommunications technologies appropriate to specific applications and environments. The

RSP required a technology with relatively widespread availability, simple technical and management requirements, limited resource inputs, and low transmission costs.

The technology the Rural Satellite Program used was the telephone. The communications support service it developed was teleconferencing. The telephone offers two-way communication; the interaction it provides is crucial for coordination, information exchange, and instructional and training efforts. With the addition of special equipment, the telephone can be transformed into a teleconferencing network which links many groups of people at one time for multi-site, multi-participant meetings, conferences, and seminars. It facilitates dialogue, questions and answers, and immediate response. Like an ordinary telephone call, teleconferencing allows for spontaneity, immediacy, and a certain "intimacy." The end equipment--simple microphones and speakers--is easily operated by users. Like the telephone, a teleconferencing network is relatively restrictive. Participants must come to predetermined conference locations; active participation and interaction, its key assets, necessitate that the audience remain limited. Where there is a need for immediate, interactive communication between specialized groups at multiple widespread locations, a telephone-based network can be invaluable. It may be the only efficient and cost-effective means of carrying out certain activities.

## RSP PILOT PROJECTS: AN OVERVIEW

In collaboration with host government agencies, the Rural Satellite Program established pilot projects in Indonesia, six countries of the West Indies, and Peru. These countries had many similarities: lack of skilled manpower, inadequate or overburdened public service institutions, and remote regions separated by mountains or isolated by water. Each project site also had existing telephone infrastructure to some degree. Indonesia had an extensive satellite-based communications system; Peru was using satellite technology for inter-city domestic communications; and the various nations of the West Indies were connected with satellite, microwave, and troposcatter linkages.

The primary goal of all three pilot projects was the same: to extend educational opportunities and support basic services using the telephone or, more specifically, teleconferencing. The pilot projects, however, did not replicate each other. Each project differed in its orientation, activities, institutional placement, and technical system. Each represented a national development priority. The three RSP projects delivered information, multiplied scarce human resources, and extended institutional outreach in response to different development problems. In Indonesia, teleconferencing was used to meet the growing demand for higher education; in the West Indies, it proved the most effective means of reaching small numbers of people in isolated locations with quality instruction; and in Peru, it provided basic telephone services to rural communities and in-service training to field workers in health, education, and agriculture.

Each pilot project uses the same teleconferencing technology with some variation necessitated by available transmission systems and user requirements. At the heart of each project is a fully interactive, two-way communications network linking several sites. Each site can initiate conferences and communicate with all other sites. The systems use one or two telephone channels depending on the equipment which comprises the "electronic classroom" at each project's sites. Located in a classroom or conference room, the electronic classroom consists of teleconferencing equipment for voice communications--loudspeakers, microphones, and a network control terminal. To supplement voice communication, the Indonesia and West Indies Projects include equipment to provide graphics capability--telewriters, slow-scan video, microcomputers, and facsimile.

## SISDIKSAT: THE INDONESIAN DISTANCE EDUCATION SATELLITE SYSTEM

### Development Need

Indonesia's system of higher education faces a set of challenging demands: to increase the capacities of existing institutions, to increase the quantity and quality of education, and to increase access to the nation's universities. Years of heavy investment in primary and secondary education have greatly increased the number of high school graduates. Each year over one-half million graduates compete for fewer than 110,000 openings at the 48 government-supported institutions of higher learning. These demographic imperatives and Indonesia's rapid economic growth and expanding need for trained manpower have placed great pressure on the higher education system. Established universities lack the capacity and personnel to meet the demand for quality instruction. Recently created universities--located primarily in the outer islands--have even fewer resources to fulfill the nation's needs.

### Communications Response

In 1976, Indonesia became the first country in the developing world to create its own satellite-based communications network. Launched in 1976, the Palapa A-1 was soon followed by two other satellites in the system which links many of the islands comprising the 3,000-mile-long archipelago. But Indonesia did little to use its extensive satellite network for other than commercial services. In 1982, with the initiation of the Indonesian Distance Education Satellite System (SISDIKSAT), the resources of the Palapa telecommunications system were employed to meet the challenges of increasing the opportunities for and quality of university education in Indonesia.

SISDIKSAT was designed to maximize the scarce professional and teaching resources of the Eastern Islands Association, a group of fairly new universities and teacher training colleges in eastern Indonesia. Isolated by vast distances of ocean, each university depended on its own limited resources to achieve the growth required of Indonesia's higher education system. Alone, these institutions could not offer the quality of instruction and full curricula expected of universities or serve the overwhelming number of students requesting admission. Multi-site communications were critical to their development.

SISDIKSAT's main activities are course sharing, enrichment seminars, training programs, information exchange, and message service. Through its teleconferencing network, SISDIKSAT provides rarely available academic courses to university students and improves faculty knowledge and teaching skills through in-service training programs and seminars. SISDIKSAT makes the expert resources of one university available to the others, thus multiplying the outreach and impact of these resources.

### SISDIKSAT Technical Network

With 15 sites, SISDIKSAT is the largest teleconferencing network in the developing world, connecting 12 widely separated universities, the Ministry of Education and Open University headquarters in Jakarta, and the Agricultural Institute in Bogor. Since SISDIKSAT began operations at 11 sites, four additional sites have joined the network. The most technically complex and ambitious of the three RSP teleconferencing networks, SISDIKSAT posed a real challenge for demonstrating the specialized use of satellite communications for development.

All SISDIKSAT sites rely on the existing telephone system; access to the satellite is achieved through dedicated lines from the universities to the nearest earth station. The land lines and satellite capacity are leased on a 24-hour basis, bypassing the noisy local telephone switches and controlling circuit quality. Technical management of the SISDIKSAT network is shared by the user, SISDIKSAT, and the telecommunications company, PERUMTEL. The SISDIKSAT electronic classroom consists of an audioconferencing channel for two-way voice communications. A second channel is used for graphics and hard copy transfer, private telephone conversations, and as a back-up. Each site is equipped with auxiliary power supply units.

### SISDIKSAT Programs and Activities

In October 1984, SISDIKSAT initiated a trial semester offering two courses; it is currently completing its sixth semester with a regular schedule of 15 courses. To date it has delivered 75 undergraduate courses, developed 35 new courses, and reaches over 3,500 students each semester. Course materials are developed in the national language and delivered for at least two semesters; junior faculty are assisted so that they will be able to teach the courses themselves in the future. This strategy ensures the greatest impact on the institutional capacity of the member universities.

Network use extends beyond normal course delivery to other activities, including training, faculty seminars, and administrative conferences. The Open University uses SISDIKSAT for regular in-service training for its local tutors in the eastern islands and for administrative communication with its provincial offices. The Directorate General of Primary and Secondary Education is now launching in-service training for its teachers. Other groups use the system for weekly management meetings.

The SISDIKSAT schedule is almost fully booked six days a week from 8:00 a.m. to 5:00 p.m. for courses and conferences. Network use generally starts two hours earlier with administrative conferencing among the three universities in the eastern time zone and continues into the evening with specially requested courses and Open University use.

### Current Status

The volume of students, the number of courses, and the growing user base of SISDIKSAT show that there is a demand for SISDIKSAT and that it effectively answers the needs of remote and isolated universities for information and instruction. Over 13,000 people in the eastern islands have benefited from SISDIKSAT's programs and services. Most classrooms have been expanded to accommodate more participants. And in a time of drastically reduced budgets, the Ministry of Education continues to fund SISDIKSAT without AID assistance. Moreover, it has proposed replication of the network for the western islands of Indonesia in a World Bank loan proposal. SISDIKSAT has provided a blueprint for a realistic means of expanding educational resources, and the member universities have adapted the network to their particular needs and made it theirs.

## UWIDITE: UNIVERSITY OF THE WEST INDIES DISTANCE TEACHING EXPERIMENT

### Development Need

The countries of the English-speaking Caribbean are typical of most island nations--physically isolated with small populations and narrow economies. They share many of the

problems that stem from these characteristics: vulnerability to world market trends, insufficient scale of demand to justify and sustain investments in basic services, and steady loss of trained manpower to more prosperous locations. These countries have often pooled resources to create regional organizations to serve small-scale but urgent needs. The University of the West Indies (UWI) typifies this collaboration.

Supported by 14 Caribbean nations, UWI is a multi-site institution comprising three campuses--Jamaica, Barbados, and Trinidad--and 11 university centers in the other member countries. UWI is characterized by a strong outreach mandate. Of the 4.5 million people in the region served by UWI, less than 1 percent of the labor force are university graduates. **The University feels a strong need to increase its capacity to provide education and training and to support social services in the region.** In addition to its undergraduate and postgraduate courses, UWI offers professional certification, diploma, and enrichment courses for the adult learner. The "extramural" centers in the non-campus territories typify UWI's commitment to its regional and outreach mandates.

## Communications Response

The University of the West Indies Distance Teaching Experiment (UWIDITE) was the first RSP pilot project to begin operations, making it the first telephone-based conferencing system in the developing world. UWIDITE links seven sites in six countries with a teleconferencing network: the UWI campuses on Jamaica, Barbados, and Trinidad; a satellite campus at Montego Bay, Jamaica; and extramural centers on St. Lucia, Dominica, and Antigua.

Similar to SISDIKSAT in Indonesia, UWIDITE strengthens the capabilities and completes the academic programs of the three main campuses through resource and course sharing. UWIDITE's primary focus, however, is not on undergraduate education or faculty upgrading; nor must it meet the staggering demand for higher education that SISDIKSAT faces. Instead, **UWIDITE serves small groups of people in isolated locations who need training and information often quite different from traditional university curricula.**

## UWIDITE Technical Network

The UWIDITE technical system links the sites in a simple, single-channel teleconferencing network using dedicated lines leased for full-time service from eight regional telecommunications carriers. The UWIDITE transmission system uses a combination of satellite, microwave, and troposcatter services. The system currently links Jamaica with Trinidad via the INTELSAT Flight 4 satellite and then by microwave to St. Lucia, the hub of the system where the network bridge is placed. From there the signal is distributed to Dominica and Antigua via microwave and to Barbados via troposcatter. Each site has a classroom furnished with basic audioconferencing equipment--microphones, convener, and loudspeakers--and the network control equipment which provides switching capability and signal level adjustments. Each classroom seats approximately 20 people, reflecting the relatively small size of the UWI constituency as well as its desire to limit class sizes.

## UWIDITE Programs and Activities

Taking full advantage of the "centers of excellence" at Jamaica, Trinidad, and Barbados, UWIDITE makes campus programs available to the extramural centers. It gives them access to extensive academic, continuing education, and extension courses and

upgrades the centers' capabilities through expanded tutorial, cultural, and enrichment programs. UWIDITE "students" range from the aspiring undergraduate seeking admission to a main campus to the high school science teacher, midwife, community worker, and cardiologist desiring additional professional training and certification.

Illustrative of UWIDITE's academic programs is the Challenge Exam program which allows students in non-campus territories to complete the first part of an undergraduate degree at an extramural center. In 1984/85, over 200 students participated in the program; with UWIDITE, the attrition rate was reduced to 15 percent and the pass rate increased to 70 percent. The Certificate of Education program provides further training, skills upgrading, and job advancement opportunities for teachers; through UWIDITE, the number of certificates awarded has doubled. UWIDITE also offers a variety of services that provide direct support to government and public service personnel, enabling them to do their jobs better. The health sector has been particularly active in its use of UWIDITE. Over 500 doctors and nurses are reached each year with in-service training in reproductive health and family planning. In addition to professional training, UWIDITE has facilitated patient care through medical consultation.

Between September 1984 and December 1986, the network served over 2,000 users and presented approximately 5,385 hours of programming. UWIDITE's programs are highly rated by both presenters and students. The use of written course materials and local tutors enhances the effectiveness of teleconferencing as a method of teaching.

### Current Status

Initial enthusiasm on the part of teachers, students, and University administrators has been followed by a significant regional demand for UWIDITE services. UWIDITE has been readily adopted by regional and development organizations, governments, and the UWI faculties and administrators alike. Since its inception, UWIDITE has already added two sites and soon will add two more. UWIDITE continues to adapt, redesign, and add hardware to the original system as the project expands and new needs arise. After four years of operation, the UWIDITE network has gained the credibility, experience, and "critical mass" of demand which makes review and reexamination of the transmission system feasible. With new sites requesting admission to the network and with lease service from U.S. domestic satellites available, a network based on small earth stations may prove reliable and cost-effective in the future. In 1984, UWIDITE received the prestigious Gleaner Honor Award for its ". . . most dramatic impact on the quality and improvement of life not only in Jamaica but the entire Caribbean, enhancing the education of the people of the region."

## RCSP: PERU RURAL COMMUNICATIONS SERVICES PROJECT

### Development Need

Like many developing countries, Peru has experienced a steady decline in economic conditions over the past decade. Faced with economic and social crises, the Peruvian government has emphasized the development of its vast rural areas in an attempt to increase agricultural productivity, create jobs, and stimulate its lagging economy.

The Department of San Martin, in the isolated upper Huallaga Valley, has been the focus of such agricultural expansion and rural development efforts. San Martin is

separated from the commercial, political, and scientific centers of coastal Peru by the Andes Mountains. The absence of essential infrastructure and communication services--such as roads, transportation, postal and telephone systems--has compounded the isolation and retarded the economic and social development of the region.

## Communications Response

In the mid-1970s, the Peruvian telecommunications authority, ENTEL, established a satellite-based communications system for international and inter-city communications using INTELSAT services. At the same time, ENTEL's engineers began to advocate the use of satellite technology to expand the national rural communications network, suggesting that satellite systems compared favorably with traditional ground and microwave systems from both economic and service perspectives.

The Peru Rural Communications Services Project (RCSP) is based on the premise that telephone service is an effective means of overcoming infrastructure and resource limitations and is an essential component in the development process. Under the RCSP, public telephone service was introduced to seven remote communities in the Department of San Martin, ranging in size from 800 to 15,000 inhabitants. These communities are divided into primary and secondary sites. The three primary sites are relatively populous, rapidly growing towns with a diversified mix of businesses, small industries, and some rudimentary professional services--such as hospitals, clinics, and schools. Four villages are the secondary sites; small and agrarian, these communities rely on visiting paraprofessionals for basic services. With the installation of the telephone system in early 1984, these isolated communities were connected for the first time with each other and with the rest of the country.

Building on the basic telephone system, audioconferencing facilities were placed in each town, as well as Lima and the region's commercial center, to serve the national health, agriculture, and education ministries. A wide variety of administrative, training, diffusion, and promotion programs have been developed. By linking field and extension personnel with regional and central ministry headquarters, audioconferencing improves the operations and outreach of these centralized institutions.

## RCSP Technical Network

The three primary sites are equipped with earth stations and power generators. Each site offers public telephone service and, in principle, devotes one channel full time to teleconferencing. The secondary sites are connected to the primary network through VHF radio links. Because electricity is not available in the smaller communities, the radio links are powered by two 12-volt tractor batteries that require frequent recharging.

The teleconferencing facilities are installed at ENTEL offices or municipal buildings at the seven sites, as well as in the regional center and Lima. The electronic classrooms are the simplest of the three RSP pilot projects. Using one telephone channel, the network provides for interactive voice communications--or audioconferences--only.

Four years following installation, the telephone network and audioconferencing system operate with high technical reliability: in 1985 the earth station sites experienced 365 days of service, and only 4 percent of the audioconferences were cancelled because of technical reasons.

## RCSP Programs and Activities

### Telephone Service

In late 1983 telephone service was inaugurated at the three primary sites; a few months later the radio links were established to the secondary sites. At each of the seven sites, ENTEL established public call offices which operate from early morning until late evening. ENTEL also made private subscriber service available to homes and businesses at the primary sites. Telephones have been installed about equally in private residences and businesses. Several health administrators, quick to realize the value of telephone communications in their work, allocated funds from their own budgets to pay for telephone installations in hospitals and clinics. The agriculture and education sectors, lacking discretionary funds, rely on the (free) audioconferencing network.

The telephone service is used by many people with relatively low incomes and generates sufficient revenues to be partially self-financing. In a two-year period, 190,000 calls were completed and over $240,000 collected. Nearly two-thirds of the area's families have used the telephone system, but commercial users are by far the heaviest users.

### Audioconferencing Service and Use

The audioconferencing component was developed to support and strengthen rural service institutions. Targeted users of the audioconferencing network are the field staffs of the health, agriculture, and education ministries Over a two-year period (1984-1985), 658 audioconferences were conducted--266 in 1984 and 392 in 1985. Over 80 percent of the approximately 900 sector personnel in San Martin participated in the audioconferences which were held primarily for in-service training.

The education sector has conducted the greatest number of audioconferences. The network was used to deliver 35 workshops by an innovative Latin American teacher training program. Special education was also a focus; a series of 37 audioconferences was developed on learning disabilities. So successful were the programs that parents asked to attend, and eventually, in a mixed media event, audioconferences were broadcast live over the local radio station and questions entertained through a "call-in" arrangement.

The health sector has been the most innovative in its use of the audioconferencing network. To gain access to specialists in Lima, an ongoing training program was developed with the Peruvian medical association. Over a 10-month period, 31 health conferences were presented and total attendance reached over 1,100. The RCSP network provided vital support to the National Vaccination Campaign--for coordinating logistics, training workers, monitoring progress, and evaluating results.

## Current Status

Based on the RCSP experience, Peruvian development agencies for the first time have made telecommunications a priority investment for rural areas. CORDES, the rural development agency, has agreed to contribute US$ 45 million to extend telecommunications service to 700 rural communities over the next five years. ENTEL itself has developed a plan to expand service to the Andean Trapezoid area and provide audioconferencing service; it recently obtained donor funding. And 34 small earth stations will be added to the ENTEL system to serve rural areas. Rural communications in Peru has achieved recognition as a catalyst for development.

## COSTS

The costs of satellite and telecommunications technologies continue to decrease. The Rural Satellite Program has shown that the costs of rural telephone system infrastructure can be reduced through innovative design of the earth stations and use of hybrid systems. In Peru, small earth stations costing $250,000 each were combined with VHF radio telephones ($30,000 each) to expand telephone service at lower costs to rural areas. With a more powerful satellite being used in Indonesia, the RSP was able to develop a small four-channel earth station which cost less than $100,000.

More significant, the Peru experience has demonstrated that rural telephone systems yield substantial revenues. In 1985, the telephone system generated $134,000 in income, nearly covering annual operating costs. Rural customers valued the service, paying from one to seven dollars above the average call charge in travel and opportunity costs.

For a relatively small investment, the addition of teleconferencing equipment can increase the telephone's effectiveness as a development tool. An audioconferencing classroom can be installed for as little as $5,000 (per site) and recurring management and transmission charges range between $68 and $140 (for the RSP projects) for an hour's teleconference connecting numerous participants at multiple sites. The cost savings gained by teleconferencing are great: in Indonesia, teleconferencing reduces the cost of course presentation by nearly 60 percent (from $1,281 per course to $542); in the West Indies, the cost savings realized by the UWIDITE Certificate of Education program can double the number of teachers trained under current budget allocations (from $8,172/student to $3,836); and in Peru, the costs of a 10-month training program for health workers presented over the teleconferencing system results in a savings of 35 percent.

## CONCLUSIONS

Six years after the start of the Rural Satellite Program, three teleconferencing networks are in place and supporting development applications in Indonesia, the West Indies, and Peru. Personnel have been trained in their use, operation, and repair, and the networks are regularly used by the sponsoring institutions. Thousands of university students, teachers, agricultural extension agents, doctors, nurses, and rural health care workers participate each year in the programs delivered by the teleconferencing networks. With improved skills, greater knowledge, and up-to-date information afforded by the teleconferences, the participants are better prepared to serve the rural community.

**Telephone-based technologies can be made to work reliably in remote or rural areas of the developing world.** In Indonesia, the 15-site audioconferencing network performs at 98 percent technical reliability; in the West Indies, the network successfully delivers all but 10 percent of its programs; in Peru, less than 4 percent of scheduled transmissions were cancelled because of technical problems. And, since 1985, both the Peruvian earth stations and the Indonesian solar-powered earth station have provided uninterrupted service.

The human system is more liable to break down than the technical one. Both training and practice were needed before there was any certainty that participants and presenters would regularly attend the teleconferences, materials would be prepared and presented on schedule, and telecommunications authorities would not inexplicably turn off the

earth station in the middle of a conference. For true technology transfer to occur in the developing world, new and appropriate training and management procedures must be developed for even the most tried and tested technologies.

**Rural telephone service is affordable; teleconferencing is cost effective.** By its second year of operation, the telephone service in the rural and sparsely populated region of San Martin had generated sufficient revenues to defray 90 percent of annual operating costs. Use continues to increase with the promise of increased revenues. In the UWIDITE project, it was found that a one-week face-to-face seminar for 30 people from several islands would cost $19,000; using the teleconferencing network, the same seminar would cost only $6,000. Over the SISDIKSAT network, course delivery costs $10 per course per student versus $64 per course per student for the visiting professor program.

**Telephone-based technology can meet significant development needs.** It can support a variety of distance education programs, facilitate management practices, and fulfill essential information needs. In Peru, 30 percent of telephone usage is for business purposes, supporting commercial development in a rural region. Over the course of the RSP, a clear pattern has emerged: **rural and isolated people place a premium on training and skills upgrading. Training is by far the most demanded service of a teleconferencing network** and will attract the most users, and training probably will have the most profound development impact of any of the teleconferencing programs.

**Teleconferencing is an effective and valued means of instruction.** Each project has added sites and expanded classroom facilities to accommodate high attendance and demand. In the West Indies, over 500 health professionals followed a single course; in Peru, over 80 percent of the field workers in the region participated in the teleconferences, particularly valued by mature learners. Participants from all three projects found the teleconferencing programs relevant to their professional needs.

* * *

The research results of the AID Rural Satellite Program clearly show that telecommunications is both a practical and effective means of meeting important development needs. **The RSP has demonstrated that with marginal investment existing telecommunications systems can become effective development tools and that telecommunications represents not only a sound commercial investment but an important social one as well.** Wherever basic telephone service is available, rural health, agriculture, and education institutions can capitalize on the telephone system to serve fundamental training and administrative needs. It is hoped that the results of the RSP experience will encourage:

- the countries hosting the pilot projects to continue and expand operations;
- other developing nations to integrate telecommunications investment planning with development planning;
- donor agencies and development banks to review their grant and loan policies in light of the benefits of telecommunications investment.

# INTRODUCTION

A major barrier to development is isolation. Much of the developing world today lives isolated in remote and rural locations separated from the mainstream of modern life by vast distances, mountains, oceans, and impassable terrain. The consequences of this isolation are serious: rural populations are cut off from information crucial to their well being and prosperity. They lack access to basic social services, medical care, and education. Isolation prevents doctors from treating patients with new life-saving techniques, teachers from providing students with basic skills, and researchers from reaching farmers with new "miracle" crops vital to increasing agricultural production.

The growth of local commerce and industry is stunted as transactions with buyers and markets are limited by poor roads and inadequate transportation systems. National institutions cannot easily reach these areas to extend required support; rural institutions must grapple with the inefficiencies caused by delays in administrative communication with distant headquarters; agents of change--extension workers, health care personnel, and teachers--remain unaware of innovative techniques and novel solutions to basic development problems.

Communications technologies can help alleviate the problems resulting from isolation by extending information, knowledge, and expertise to remote and rural areas. Simple telephone communications can bridge the distance between isolated communities and centers of commerce, science, and learning. Two-way communications enable the rapid transfer of vital information--students interact with teachers, buyers interact with sellers, doctors with rural health care workers, and families and friends just keep in touch. Yet, the expansion of telephone service to rural areas has been hindered by the same barriers that have served to isolate them--rough terrain, resulting economic constraints, and the political imperatives of urban development. Recent technological advances, however, offer potentially far-reaching solutions to the problems of rural isolation.

The past three decades have seen a revolution in telecommunications--from the first television transmissions via satellite in the early 1960s to the video- and computer-conferencing activities in the 1980s. Today, telecommunications serve as the "nervous system" of many societies; they are multi-purpose in use and pervasive in effect. Telecommunications provide significant social and economic benefits critical to improving and maintaining national economies and, by extension, the quality of life.

In the relatively short time that communications satellites have existed, satellite technology has displayed amazing range and versatility. The technology has demonstrated its value to telephone and telex communications, radio and television broadcasting, business communications, and the delivery of public services to remote communities.

It has also proved a sound financial and, according to many, productive development investment. Indeed, telecommunications' vital contribution to development was noted in The Missing Link, a report by the ITU's Independent Commission for Worldwide Telecommunications Development:

> Henceforward 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. (p. 11)

In the last decade, it has become evident that the developing world also considers telecommunications a worthwhile investment. Indonesia, India, Brazil, Mexico, China, and a coalition of 22 Arab nations have launched their own satellites. Through INTELSAT, 27 other developing nations have established internal satellite-based communications systems.

Satellite communications offer the potential to reach the isolated and rural areas which characterize much of the Third World and which remain outside the vital flow of information. It is this flow of information which is at the heart of economic growth.

With the advent of satellite communications, the bias of traditional terrestrial systems toward heavily populated urban communities can be overcome. The advantages of satellite communications in meeting the needs of the vast rural areas of LDCs are many: satellite systems are not affected by rough terrain, are less vulnerable to failure, and are distance-insensitive.

The combination of reliable satellite-based communications systems, new telephone technologies, and imaginative applications programming holds much promise for Third World development. Two-way communications provided by the telephone and interactive devices such as facsimile, slow-scan video, and telewriters can support the crucial linkages between rural institutions and communities with commercial, political, and scientific centers to overcome the barriers of poverty, scarce resources, and minimal infrastructure.

In 1980 the U.S. Agency for International Development initiated the AID Rural Satellite Program to explore the potential of telecommunications as a means of stimulating development, extending scarce expert resources, and expanding educational opportunities to remote and rural areas. Building on simple interactive and inexpensive telephone-based technologies, the Program developed an innovative rural telephone system and teleconferencing networks for use as development tools. Three pilot projects were implemented to test and demonstrate that basic telephone service and teleconferencing can reliably and affordably support development activities in education, health, and agriculture.

Six years later, a rural telephone system and three teleconferencing networks are in place and supporting development applications in Indonesia, the West Indies, and Peru. High demand has twice required the expansion of the telephone system and the revenues continue to increase. Personnel have been trained in their use, operation, and repair, and the networks are regularly used by their sponsoring institutions. Thousands of university students, teachers, agricultural extension agents, doctors, nurses, and rural health care workers participate each year in the programs delivered by the teleconferencing networks. With improved skills, greater knowledge, and up-to-date information afforded by the teleconferences, they, in turn, are better prepared to serve the rural community.

The experiences of the Rural Satellite Program in Indonesia, the West Indies, and Peru have shown that telecommunications can have a powerful impact on rural and national development, and specifically that:

- Telecommunications can be adapted to provide affordable communications services in rural areas and a cost-effective means of extending social services to these areas.

- Telephone-based technologies can be made to operate reliably in the rural and remote developing world.

- Teleconferencing, specifically audioconferencing, is an effective means of providing quality instruction and essential training to rural and isolated public service personnel.

Of equal significance, it has demonstrated that telecommunications authorities in the developing world are willing to experiment with new technologies to reach rural areas, to work with users to provide innovative services, and to support development applications by waiving transmission charges or reducing tariffs.

Beyond these major conclusions, the Rural Satellite Program's experiences have provided practical lessons in the planning, implementation, and evaluation of telephone-based communications support projects, including network design and equipment selection, applications programming and management, and technology transfer and training.

This report is an overview of the Rural Satellite Program and its projects in Indonesia, the West Indies, and Peru. It describes the Program's activities and results, its problems and innovative solutions, and summarizes some of the many lessons learned over the course of the past six years.

# THE AID RURAL SATELLITE PROGRAM

## BACKGROUND

Telecommunications services have been slow to reach into most rural areas of the world for several reasons: high costs, technical problems, and lack of a guaranteed return on investment. It is both cheaper and more profitable to develop telecommunications infrastructures for urban rather than rural areas. There is also the feeling among some planners that rural areas do not need or cannot really use telecommunications facilities and that the positive effects of providing such facilities do not justify the expense and effort. Some would say that basic telephone service cannot be provided until the users are able to pay for the costs; however, there is now a growing realization among experts that telecommunications is an essential ingredient that hastens development and is not merely a result of it. A reliable telecommunications infrastructure can facilitate economic growth and promote national development aims. Telephone services to rural and remote areas can stimulate economic development and bring the rural resident closer to the mainstream of national life. There is also a feeling that access to communications facilities should be viewed as a social service to be provided by governments as they provide schools and costs weighed against the social benefits gained. As these realizations grow, an increasing number of developing nations are investing in satellite-based telecommunications systems. What was once regarded as the wave of the future is now a present-day reality. How can developing countries benefit from this "telecommunications revolution"?

The concept of using telecommunications to support development activities is not new to the Rural Satellite Program. During the past decade, several experimental projects have shown the capability of satellite communications to offer significant assistance to the development process. Most notable among these are the demonstrations supported by NASA's Applied Technology Satellite (ATS) series and AID's 1976 AIDSAT demonstrations with 27 countries using two-way communications.

These brief experimental programs clearly indicated that telecommunications could be a valuable tool for the development of remote and rural areas. Satellites, operating from geostationary orbits, have access to any point on the ground unhindered by problems of distance, terrain, or climate. This makes them ideal for reaching widely dispersed rural communities that otherwise would have to rely on costly or undependable forms of terrestrial communication. The implication of these experiments was that inexpensive and rugged telecommunications technologies could be developed for rural service.

At the same time, however, it had become apparent that there were serious obstacles to the wide utilization of this potentially powerful development tool. Primarily, models of successful applications were still too few and too little developed to inspire widespread adoption or investment in rural telecommunications systems by financially strapped developing countries or likely funding institutions such as the World Bank. Although satellite technology costs had fallen dramatically as the technology matured, much of the "ground system"--specifically earth stations--was still too costly for many developing countries to routinely place in rural areas. Nor was the technology always compatible with the conditions prevailing in rural settings. Finally, no blueprint existed for the planning and implementation of long-term telecommunications support activities in the Third World.

As the next logical step in the exploration process, the U.S. Agency for International Development established the Rural Satellite Program to clarify issues of technological appropriateness, application, and effectiveness.

## DESCRIPTION

The AID Rural Satellite Program (RSP) is based on the assumption that communications can make a difference in meeting basic human needs, and that telecommunications can facilitate the many development efforts under way to improve the conditions of rural life in the developing world.

**The objective of the RSP is to determine both "if" and "how" telecommunications can be used to support development in the Third World.** It represents the first attempt to use narrow-band, interactive technologies--primarily the telephone--for development purposes in health, agriculture, and education.

The RSP's major research questions, aimed at policy issues and investment decisions, address the appropriateness of these technologies in the rural development process.

- Are modern two-way telecommunications technologies technically feasible within the severe operating constraints of developing nations, especially rural areas?
- Can these technologies be used to address major development problems?
- Is their application effective in overcoming these problems?
- Do they provide an affordable and cost-effective solution? In what circumstances?
- Can they be effectively exploited by indigenous personnel?

A secondary tier of questions, aimed at developing practicable procedures and processes, focuses on how to make two-way telecommunications technologies work for rural development.

From a technical standpoint:

- How can the technologies be modified to make them more appropriate in terms of cost and operations in rural areas?
- How can the costs associated with telecommunications technologies be reduced to make large-scale implementation economically feasible in developing nations?
- What are the requirements and procedures for technical management and operations?

From an applications standpoint:

- What are the most appropriate development uses of these technologies?
- How can programs supporting agriculture, health, and education be developed?
- What are the management requirements and procedures to support the communications support programs?
- How can the technology be exploited to maximize its effectiveness as a communications tool?
- What are the processes and most effective methods of technology transfer?

The means of answering these many questions were provided by three pilot projects, designed and implemented under the RSP, and by careful evaluations which analyzed project effects, problems, and costs.

A final goal of the RSP focuses on the potential constituency and users of telecommunications technology. The RSP has sought to prove that with marginal investment existing telecommunications systems can become effective development tools, and that telecommunications is not only a sound commercial investment but a social one as well. Based on positive research conclusions, it is hoped that the results of the RSP experience will encourage:

- the countries hosting the pilot projects to continue and expand operations.
- other developing nations to consider replication of the RSP efforts and integrate telecommunications investment planning with development planning.
- donor agencies and development banks to review their grant and loan policies in light of the benefits of telecommunications investment.

Several principles have guided the RSP and its activities.

Whenever possible, existing commercial satellite services have been utilized. In the absence of a cost-effective means of using a satellite system, alternative transmission forms have been employed.

Narrow-band, interactive technologies have been used, specifically telephony and its associated technologies to support two-way participatory communications projects. Teleconferencing has been emphasized to "bridge the distance" between isolated communities and urban centers.

Applications have been emphasized over hardware. Only commercially available equipment has been used in an effort to reduce both design and production costs and ensure reliable operations. Technical experimentation has been kept to the minimum, limited to telephone-based graphics equipment and the development of a small solar-powered earth station suitable for rural use.

## ACTIVITIES

While the pilot projects and their evaluation (described in a later section) comprise the heart of the RSP, several other related activities have been undertaken as part of the AID effort.

Engineers at the Institute for Telecommunication Sciences (part of the National Telecommunications and Information Agency) worked with AID to develop innovative satellite system designs and earth station technology for low-cost rural communications. The results of the ITS research contributed significantly to the development of INTELSAT's new low-cost VISTA earth station.

NASA's Lewis Laboratories designed a photovoltaic system (solar power) to provide low-cost, reliable electricity for small earth stations in "power-poor" rural areas. (See pages 76-79 for a description.)

Information research and dissemination has been a central activity of the RSP. Its two policy studies, "Satellite Options for Rural Telecommunications" and "Financing Telecommunications for Rural Development" examine the opportunities available to developing countries for obtaining satellite services.

The RSP newsletter "Uplink" has been periodically published to keep program participants and observers informed about the RSP itself and about other telecommunications-related activities.

Other informational materials have been prepared, including a videotape, "The AID Rural Satellite Program: A Link to the Future," which depicts the pilot projects.

The RSP Library is an extensive collection of documents, periodicals, and books dealing with a broad range of telecommunications topics, focusing on the Third World.

Training played a major role in pilot project implementation. A detailed survey assessing existing U.S. institutional capabilities for providing training in both the technical and programming aspects of telecommunications was conducted.

Not all of the RSP's training efforts have been focused on the pilot projects. In addition to training project staff, the RSP is concerned with reaching a wider audience to educate them about the potential uses of telecommunications. Yearly since 1983, the RSP has presented under the auspices of the U.S. Telecommunications Training Institute a week-long training seminar, "Satellite Systems Applications for Rural Communications," examining the innovative uses of satellite technology, their application to national development, and special significance to rural development. Both AID and RSP staff and telecommunications specialists explore with participants the technical, financial, and operational factors affecting satellite adoption. For the most part, the participants represent the management and technical staffs of national telecommunications authorities or communication ministries of a broad spectrum of developing nations.

## TECHNICAL ASSISTANCE

The Rural Satellite Program is funded by the Bureau for Science and Technology's Office of Education together with the Bureau for Latin America and the Caribbean for the Peru pilot project, with support from the Office of Energy for photovoltaic development.

The pilot projects were undertaken in cooperation with the University of the West Indies, the Indonesian Directorate General for Higher Education, and the Peruvian Empresa Nacional de Telecomunicaciones.

Primary technical assistance for pilot project design and implementation and RSP applications management has been provided by the Academy for Educational Development. Engineering aspects were handled through the Academy's subcontractors, notably Teleconsult.

Florida State University has been responsible for evaluation assistance for the pilot project in Peru, Abt Associates in the West Indies, and the Academy in Indonesia.

Both the Institute for Telecommunication Sciences and the NASA-Lewis Research Center provided research and development assistance on rural communication systems, under AID grants.

# THE TECHNOLOGY

## SELECTION

The goal of the Rural Satellite Program is to use telecommunications to support and strengthen established public services, institutions, and organizations. Satellite technology makes possible the broad distribution of a variety of telecommunications services, such as radio, television, and telephone. Central to the RSP effort has been the identification and adaptation of appropriate telecommunications technologies to specific applications and the developing world environment.

The application of telecommunications technology to development problems is not new. The past 20 years have seen much attention given to the potential of broadcast technologies--especially television--for instruction. The successful Sesame Street series in the United States gave impetus to a variety of experiments in the Third World. The 1976 SITE (Satellite Instructional Television Experiment) Project, introducing educational television to the village, is among the most notable. Yet, the results of the various undertakings have been mixed, and questions remain about the efficacy of television as an instructional tool. Not at issue, however, are that the costs of broadcasting are considerable, the infrastructure for broadcast delivery is limited, and effective programming and operation require extensive professional and technical support.

Because its focus is on rural areas, the RSP experiment required a technology with relatively widespread (or imminent) availability, simple technical and management requirements, limited resource inputs, and low transmission costs. It also required a technology which could meet the communications needs of rural people and institutions and support development.

The technology the Rural Satellite Program used was the **telephone.** The communications support service it developed was **audioconferencing** supplemented by other telephone-dependent technologies--facsimile, telewriters, slow-scan video, and microcomputers.

Most development professionals question the appropriateness of new and sophisticated "high" technology in development settings. Yet, the telephone has been in use in the United States for over 75 years and has successfully supported rural development efforts in Appalachia, the Rocky Mountains, and Alaska. Moreover, telephone systems--particularly satellite-based ones--are proliferating throughout the Third World. If they do not yet reach the village, telephones can be found in most provincial centers in rural Latin America and Asia.

Satellite distribution not only makes reaching isolated areas technologically feasible, but economically feasible as well. By decreasing transmission costs, it makes thin-route telephony more affordable to developing countries and puts telephone service within the reach of a growing number of rural communities.

The telephone offers **two-way communications,** unlike the broadcast technologies of radio and television. **Interaction** is central to coordination, information exchange, and training efforts. A simple telephone call can provide emergency medical assistance, advice on pest control and weather forecasts, information on market prices, and orders for farm equipment or school supplies.

With the addition of special equipment, the telephone can be transformed into a **teleconferencing network** linking many groups of people at one time for multi-site, multi-participant meetings, conferences, and seminars. It facilitates dialogue, discussion, questions and answers, and permits immediate response. Interaction forms the basis of most instructional methods. **Teleconferencing can thus potentially provide an effective means of training, institutional outreach, and administration to rural areas.**

Like an ordinary telephone call, teleconferencing allows for spontaneity, immediacy, and a certain "intimacy." The end equipment--simple microphones and speakers--is easily operated by the users. Unlike radio and television, a technician need not serve as an intermediary between the user and the equipment, nor is the presenter separated from his audience by the time between taping and broadcast.

In addition to its versatility, teleconferencing does not require the same level of investment as television and, to some extent, radio. Teleconferencing networks have a proven track record in the United States and Canada of low maintenance requirements and reliability, not unimportant cost considerations in transferring technology to rural and remote areas. In general, teleconferencing equipment is less expensive, as are associated transmission costs. Teleconferencing requires only one circuit; television the equivalent of 600. In Indonesia an hour of television broadcast time costs $10,000; an hour of teleconferencing time is a little over $100, about one one-hundredth of the cost of broadcast television. The development of effective television programming requires significant professional input and studio time, and the production costs can be considerable. A two-way medium, teleconferencing more closely replicates normal face-to-face communication patterns and is easier for the non-professional to use to deliver effective programs. Clarification, after all, can always be requested by the participants.

Yet, like the telephone, a teleconferencing network is a relatively restrictive medium. Participants must come to predetermined conference locations; active participation and interaction, its key assets, necessitate that the audience remain limited. It cannot duplicate the sheer numerical outreach of the mass media, radio and television. **Where there is a need for immediate, interactive communication between specialized groups at multiple widespread locations, however, a telephone-based network can be invaluable.** It may actually be the only efficient and cost-effective means of carrying out some activities.

The same teleconferencing technology was employed by each pilot project with some variation necessitated by available transmission systems and user requirements. Basic to each project is a fully interactive, two-way communications network linking several sites. The teleconferencing networks work on a "closed circuit, party-line" principle. Only those sites connected by the network may communicate with one another. Each site can initiate conferences and communicate with all other sites in the network.

The various networks use one or two telephone channels depending on the "end" equipment comprising the "electronic classroom" at each project's sites. Basic to all the electronic classrooms is the audioconferencing equipment which allows multi-site, multi-participant voice communications. This consists of a pair of loudspeakers, several microphones with push-to-talk buttons, a convener to set the audio receive volume, and a network control terminal to set signal levels and control dialing functions.

But teleconferencing need not be limited to voice communications alone. The last few years have seen the development of graphics equipment which can send images and text over a single telephone circuit. Telewriters transmit pictures and drawings;

slow-scan television transmits freeze-frame video images; microcomputers transmit text; and facsimile machines transmit "digitized" hard copy of text or pictures. This equipment can add a visual dimension to the voice-only teleconferences at a fraction of the cost of broad-band television.

## ADAPTATION

Although both the audio and graphics equipment are available "off the shelf" in the developed world, the RSP considered several factors during network design and hardware selection to ensure reliable operations, such as:

- climate--high humidity, heat, and dust are typical of developing countries, as is lack of air conditioning.
- power--unstable power, a given in most rural areas, can easily damage equipment.
- ease of operation--rural areas lack trained personnel who can operate complex equipment.
- compatibility with local distribution system--local telephone systems in developing countries are often characterized by poor signal quality and line noise.
- reliable, hardy equipment--isolated areas can provide neither skilled technicians nor spare parts for repair.

Several modifications were made and precautions taken to adapt the equipment to the rugged conditions prevailing at the project sites. The most fundamental of these are:

- four-wire design to ensure higher quality of transmissions;
- use of precious metals, military connectors, and hard wiring in the vulnerable microphone contacts to prevent corrosion from high humidity;
- treatment of all components with insecticide and fungicide; and
- adequate supply of spare parts.

(Additional adaptations are detailed in the individual project descriptions contained in this report.)

## USE

Even the most "old hat" technology requires special treatment to make it an effective development tool. Although teleconferencing does not require the high level of resource input for programming that radio and television do, successful use requires more than good telephone manners. Unlike the ordinary telephone, a teleconferencing network links many people at one time to closely approximate face-to-face meetings and seminars. And similar to face-to-face meetings and seminars, teleconferences require careful preparation to be effective. A productive meeting will always require an agenda and direction; a successful training seminar will always include a pedagogically sound, well-planned presentation and support materials. An easily used delivery system such as a teleconferencing network does not obviate the need for advance planning. Users can be easily "seduced" by the spontaneity and ease of operation and thus ignore the preparation these activities normally require.

In addition, users must make special concessions to the lack of face-to-face communication and the distance separating network sites. Although easily bridged by telephone circuits, the intervening miles can complicate support materials distribution,

scheduling, and participant notification. Careful coordination is required, even if these tasks are facilitated by special equipment, such as a telewriter or facsimile machines.

To maximize the effectiveness of the two-way communications medium, RSP programming followed a few basic tenets developed over the years by various distance teaching organizations:

- Appropriate program selection is a basic requirement. Program topics must be relevant to the activities and interests of the participants; they must also respond to a perceived need.

- Unsound program content or a poorly structured program will not improve upon delivery over the teleconferencing network. A qualified subject specialist should prepare a logical and cohesive presentation. If it does not make sense face-to-face, it will not make sense at a distance.

- A key element in all distance programming is the use of supporting print materials. Academic courses should have texts and study guides; training seminars should have handouts; meetings should have agendas.

- Programs delivered over a two-way communications network should provide for two-way communication. Presentations should not take lecture form, but be frequently punctuated by discussion and allow time for questions to provide for meaningful information exchange and reinforce learning.

- A formative evaluation system should be in place to respond to participant comments and requests and to guide program modification and refinement.

The challenge of the Rural Satellite Program was to adapt and transfer these telephone technologies and communication concepts to rural areas and to make them work for development.

## SERVICE DELIVERY

Beyond technology selection, equipment adaptation, and appropriate procedures for use lies a more fundamental issue for the delivery of reliable and effective teleconferencing services. Although the users of the teleconferencing network are diverse development and educational institutions, it is the telecommunications authority which ultimately provides the means of communication through its telephone system. The introduction of teleconferencing service requires the support and cooperation of an entity which is traditionally accustomed to providing commercial telephone service in a "seller's market" at considerable profit.

For the user, a teleconferencing network necessitates careful preparation of presentations; for the telecommunications authority, a teleconferencing network necessitates some basic operational and attitudinal changes.

A teleconferencing network will, by necessity, connect new, non-standard equipment to the end of telephone lines. To achieve the most reliable and cost-effective design, a teleconferencing network may require direct interface with the satellite itself as a bridging device, as well as the integration of special signaling equipment at the telephone

company's ground station (see SISDIKSAT, pages 26-27). The telecommunications authority must be willing to accept new and, in the case of RSP, untried equipment and network configurations.

In addition to the new equipment, teleconferencing service requires that the telephone company enter into partnership with the users, a practice generally outside its experience. Crucial to effective service is the telephone company's cooperation and responsiveness to user needs. For example, transmission service interruptions must be immediately dealt with and preventive maintenance procedures regularly undertaken to provide reliable teleconferencing service. The telecommunications authority must be willing to cope with specialized user requests.

Most Third World telecommunications authorities see themselves as profit-making businesses; their experience is limited to standard commercial transactions. The development applications of telecommunications--either for rural telephone or teleconferencing service--require that the telecommunications authority recognize that although these services may not generate the same profit percentage, they do yield significant public service benefits. For rural telephone service, the telephone company must be willing to invest in thin-route traffic areas. For teleconferencing service, the telephone company may need to establish concessionary tariffs for other national ministries, such as education, which do not generate profits and may be unable to afford commercial charges.

A goal of the Rural Satellite Program was to forge the ties between the telecommunications authority and users to benefit rural development.

## THE PILOT PROJECTS

The premise underlying the Rural Satellite Program is that telecommunications can help to overcome the barriers to development created by the shortage of skilled manpower and lack of effective public service systems. **The key activity of the Program has been the development of three pilot projects, providing "laboratory" settings in which to test, in realistic rural situations, the use and applications of telephone and teleconferencing networks.** The RSP pilot projects have allowed the Program to reach major research conclusions about technological appropriateness, economic affordability, and effectiveness, and have served to demonstrate the various development applications of telephone technology. More importantly, perhaps, they have afforded many valuable lessons in the "how-to's" of mounting telecommunications support projects--from equipment design and installation to program development and delivery.

In collaboration with host-government agencies, the Rural Satellite Program established pilot projects in Indonesia, six countries in the West Indies, and Peru. Typical of most developing nations, these countries share many similarities: insufficient skilled manpower, inadequate or overburdened public service institutions, and fragmented geography separated by mountains or isolated by water. Yet the nature of the RSP experiment required more beyond these characteristics; it required the availability of certain resources.

The RSP was not aimed at major telecommunications infrastructure development, but rather at the development of applications which could be supported by telecommunications systems. Each project site offered existing telephone infrastructure to some degree. Indonesia had an extensive satellite-based communications system; Peru was using satellite technology for inter-city domestic communications; and the various nations of the West Indies were connected with a mix of satellite, microwave, and troposcatter linkages.

Experience with or willingness to experiment with telecommunications was another important selection criteria. The University of the West Indies had been an enthusiastic participant of Project Satellite; government engineers in Peru had long advocated the use of satellite communications in rural areas; and Indonesia had invested in its own satellite.

Finally, each country offered sound, and often distinguished, research and training institutions to serve as "centers of excellence" for social service organizations and development programs.

Many other countries shared these characteristics; many other countries were considered as project sites. Both the Philippines and Senegal were promising sites. But in the end, political or financial factors eliminated these possibilities. **Indonesia, the West Indies, and Peru were selected as project sites.**

The primary goal of all three projects is the same: to extend educational opportunities and support basic services using the telephone or, more specifically, teleconferencing. The pilot projects, however, do not replicate each other. Each project differs in its orientation, activities, institutional placement, and technical system. Each represents a national development priority. The three RSP projects delivered information, multiplied scarce human resources, and extended institutional outreach in response to

| | Indonesian Distance Education Satellite System: SISDIKSAT | University of the West Indies Distance Teaching Experiment: UWIDITE | Peru Rural Communications Services Project: RCSP |
|---|---|---|---|
| **Institutional Placement** | Ministry of Education: Directorate General of Higher Education (DGHE) | University of the West Indies: Office of Pro Vice Chancellor (Jamaica) | Empresa Nacional de Telecomunicaciones (ENTEL): Office of International Affairs |
| **Number of Sites** | 15: 12 universities, 2 administrative headquarters, 1 extension site | 7: 3 university campuses, 4 extramural centers | 10: 9 rural towns, 1 ENTEL headquarters |
| **Transmission System** | • satellite: Palapa B-1 | • satellite: INTELSAT Flight 4<br>• microwave<br>• troposcatter | • satellite: INTELSAT V-A series |
| **Technical Capability** | TELECONFERENCING:<br>• audio<br>• telewriter<br>• facsimile | TELECONFERENCING:<br>• audio<br>• telewriter<br>• slow-scan video<br>• microcomputer | TELEPHONE SERVICE:<br>• public and subscriber telephone<br>AUDIOCONFERENCING:<br>• audio |
| **Technical Reliability** | 98% | 90% | 96% (at earth station sites) |
| **Teleconferencing Programs and Activities** | • course sharing<br>• faculty training<br>• enrichment seminars<br>• administration | • credit courses<br>• in-service training<br>• outreach services<br>• medical consultation<br>• university administration<br>• international conferences | • in-service training<br>• medical consultation and coordination<br>• sector administration<br>• ENTEL administration<br>• international conferences |
| **Program Delivery Rate** | 83% | 90% | 71% |
| **Users** | • university students<br>• faculty<br>• university administrators<br>• Open University tutors<br>• local education, health, and agriculture officials | • university students<br>• faculty<br>• health care professionals<br>• community workers<br>• agricultural agents<br>• university faculty<br>• local community | • sector field personnel<br>• doctors and nurses<br>• rural health care workers<br>• medical students<br>• primary and secondary school teachers<br>• special education teachers<br>• agricultural extension agents<br>• ENTEL personnel and technicians |
| **Number of Users** | • 3,500 students per semester<br>• 2,000 seminar participants per semester | • 2,000 users in 3 years<br>• 500 users per quarter | • 10,000 person hours per year<br>• 700 sector personnel reached (80%) |
| **Staff** | Part-time<br>• Project Administrator 1<br>and Assistant 1<br>• Chief Technician 1<br>and Assistant 1<br>• Program Development Specialist 1<br>• Local Coordinators 15<br>• Local Technicians 15<br>• Local Operators 45<br>• Support Staff 18 | Full-time<br>• Chief Project Officer 1<br>• Project Officer 1<br>• Administrative Assistant 1<br>• Technical Director 0/1<br>• Support Staff 3<br>Part-time<br>• Local Coordinator 6<br>• Local Technician 6<br>• Clerical 1/2 | Part-time<br>• Project Director 1<br>• Program Coordinator 2<br>• Evaluation Coordinator 2<br>• Technician 2<br>• Field Program Coordinator 1<br>• Sector Coordinator 3<br>• Local Coordinator 21 |
| **Hours of Operation Per Week; Allocation of Activities** | • 68 hours per week<br>• 53% teaching<br>• 27% administration and official messages<br>• 19% SISDIKSAT coordination | • 40-45 hours per week<br>• 60% teaching<br>• 15% administration<br>• 25% UWIDITE coordination | • 15 hours per week<br>• 64% in-service training<br>• 12% administration<br>• 24% RCSP coordination |
| **Current Status** | • operational - August 1984<br>• 3 sites added<br>• existing classroom capacity expanded<br>• guest users: Open University, Directorate General of Primary and Secondary Education, Summer Institute of Linguistics<br>• **continued DGHE funding and operation** | • operational - March 1983<br>• 2 sites added; 1 imminent<br>• classroom equipment capabilities expanded<br>• guest users: ILO, Project Hope, PAHO, AID, CARIMAC, Caribbean Food and Nutrition Institute<br>• exclusive delivery of Challenge Exam Program<br>• 1984 Gleaner Award<br>• **continued UWI funding and operation** | • operational - March 1984<br>• 110,000 calls completed per year<br>• 2 sites added<br>• commercial teleconferencing developed<br>• CORDES pledges $45 million for rural telephone infrastructure<br>• plan to expand to 53 sites in Andean Trapezoid<br>• ministries request continued service<br>• **continued ENTEL funding and operation of teleconferencing** |

different development problems. In Indonesia, teleconferencing was used to meet the growing demand for higher education; in the West Indies, it proved the most effective means of reaching small numbers of people in isolated locations with quality instruction; and in Peru, it provided in-service training to field workers in health, education, and agriculture as well as basic telephone service to link an isolated area with the commercial and political centers.

The development of the projects in Indonesia, the West Indies, and Peru progressed in three stages. Following initial feasibility determinations and project design, the first phase of implementation was the "experimental" stage--the major activity being equipment installation and operations testing, and the prime question "Will it work?". Next came the "demonstration" stage in which the teleconferencing network was used for selected applications, such as course delivery or extension training. At issue: Can it support development programs effectively and what are its most appropriate uses?

The final phase was the "operational" stage. Having demonstrated the technical feasibility and its applications, this stage represented the true test of the technology's effectiveness. Can it be used to support ongoing programs? Has the Project developed the local capabilities to maintain the network and its programs? Will it become a relied on and regular feature of institutional operations? Will the host agencies continue financial support? As will be seen, the pilot projects enjoy substantial success on all counts.

The formula for project support was bi-national. Both AID and host-country resources were required for project implementation. In general, AID provided basic equipment and technical assistance for system design and applications programming. The host agencies or institution provided project staff and covered operational (i.e., recurring) expenses. An RSP field advisor was placed with each project (ranging from eight months to three years); however, beyond initial guidance and collaboration, project operations were fully managed by the host-country nationals.

The following presents a detailed description of the pilot projects in Indonesia, the West Indies, and Peru and their results.

## SISDIKSAT: THE INDONESIAN DISTANCE EDUCATION SATELLITE SYSTEM

### BACKGROUND

Higher education in Indonesia is facing a number of challenges that require innovative responses. Years of heavy investment in primary and secondary education have greatly increased the number of high school graduates. Each year over one-half million graduates compete for fewer than 110,000 openings at the 48 government-supported institutions of higher learning. The 450,000 "losers" must look for places at inferior private universities, wait for next year's exam to try again, or give up their goal of a college degree.

Combined with these demographic imperatives, Indonesia's rapid economic growth and expanding need for trained manpower have placed great pressure on the higher education system. Established universities lack the capacity and personnel to meet the demand for higher education. Recently created universities--located primarily in the outer islands--have even fewer resources, professional staff, and facilities to fulfill the nation's needs. Widely scattered across Indonesia's 5,000 inhabited islands, these newer universities face limitations of growth based on self-reliance.

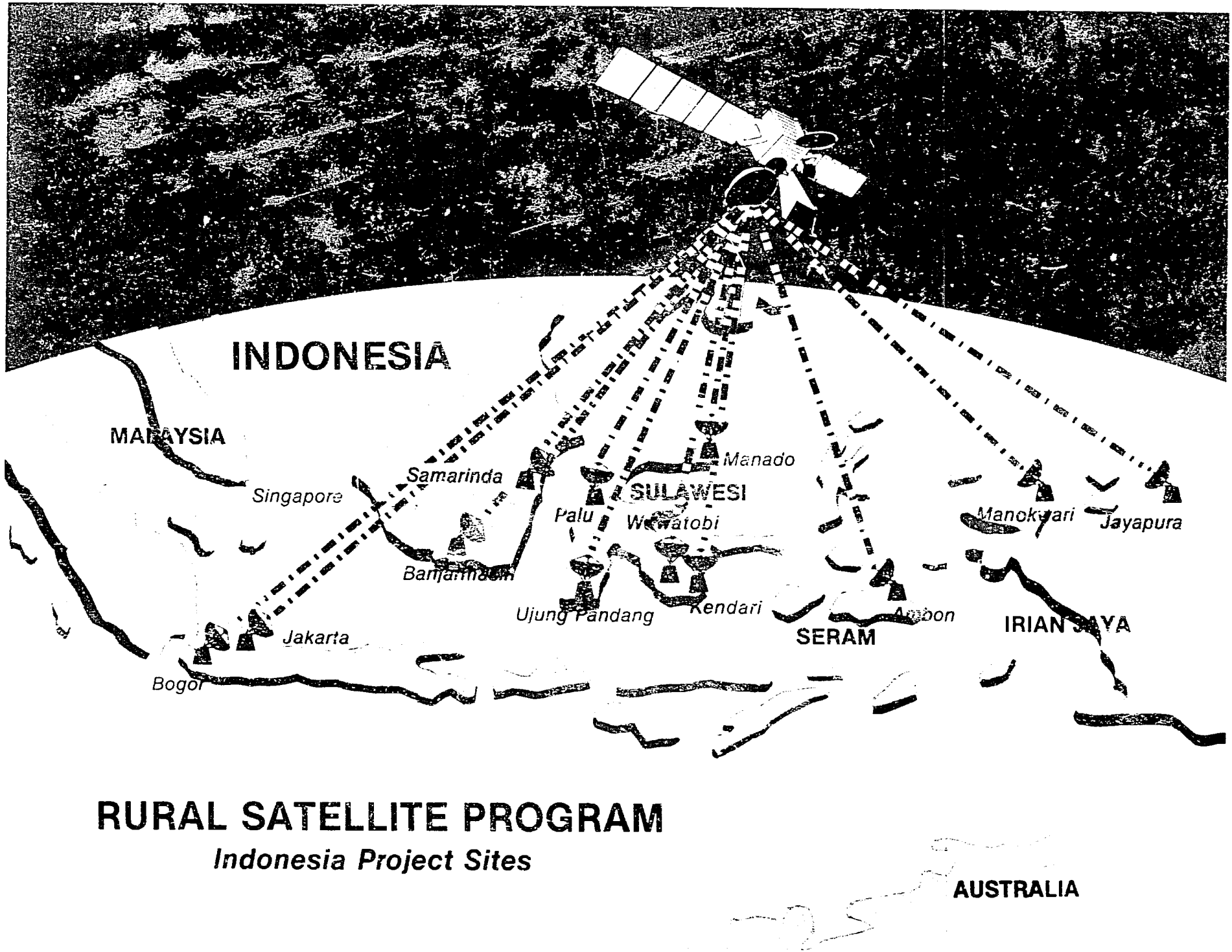
Indonesia's higher education needs are many: to increase the capacities of existing institutions, to increase the quantity and quality of education, and to increase the access to the nation's universities.

To accommodate the national need for skilled manpower, Indonesia's Ministry of Education estimates that it must double university enrollment by the turn of the century. This ambitious goal requires a massive staff development effort to train new teachers and upgrade the skills of the present faculty. Distance education strategies appear to provide a viable solution to meeting many of the problems. In the early 1980s, the Directorate General for Higher Education (DGHE) began planning a print-based Open University and exploring other distance education options.

As the Ministry of Education and Culture grappled with the need to expand its tertiary education system, Indonesia became the first country in the developing world to create its own satellite-based communications network. Launched in 1976, the Palapa A-1 was soon followed by two other satellites in the expanding system which has been crucial in linking the thousands of islands in the 3,000-mile-long Indonesia archipelago.

Although Indonesia was a pioneer in adopting satellite technology, it had done little to use its extensive satellite network for other than commercial services. Equipped with expensive satellites, an expanding ground system, and a cadre of organized and well-trained technicians, Indonesia had not yet systematically exploited this major resource to achieve its development objectives.

Indonesia had long been aware of the potential educational applications of satellite systems. Even before its launch, discussions of Palapa's use for educational purposes were taking place. AID actively participated in policy workshops and, in the years following Palapa's launch, AID provided extensive funding to develop Indonesia's capability in educational technology and media.




# RURAL SATELLITE PROGRAM

*Indonesia Project Sites*

In 1982, with the initiation of the SISDIKSAT Distance Education Project, the ideas and initiatives of the past decade were realized as the resources of the Palapa telecommunications system were employed to meet the challenges of increasing the quality of university education in Indonesia and strengthening the capabilities of its higher education institutions to deal with the need for trained manpower.

## DESCRIPTION

The SISDIKSAT Distance Education Project is designed to maximize the scarce professional and teaching resources of the Eastern Islands Universities Association (BKS).

A group of fairly new universities and teacher training colleges--some founded as recently as 1981--on the islands of Kalimantan, Sulawesi, Maluku, and Irian Jaya, the institutions of the BKS are confronted with numerous problems. Isolated by vast distances of ocean, each university must depend on its own limited resources to achieve the rapid development and growth required of Indonesia's higher education system. Alone, many can neither offer the quality of instruction and full curricula expected of universities nor are they able to serve the overwhelming number of students requesting admission. Multi-site communications are critical to their development.

Linking 12 remote universities spread over 900,000 square miles with a telephone-based communications network, SISDIKSAT provides a mechanism for:

- sharing staff skills and specialized expertise to reach students with quality instruction;
- upgrading faculty knowledge and teaching skills to ensure that more trained instructors are available to the university system;
- redressing the imbalances among the universities by making available the resources of older, well-staffed institutions; and
- overcoming low productivity and inefficiency resulting from poor management and a lack of self-directed student learning.

**SISDIKSAT MEMBERS**

| Institution | Acronym | Location |
|---|---|---|
| Hasanuddin University | UNHAS | Ujung Pandang |
| Tadu Lako University | UNTAD | Palu |
| Sam Ratulangi University | UNSRAT | Manado |
| Halu Oleo University | UNHALU | Kendari |
| Lambung Mangkurat University | UNLAM | Banjarmasin. |
| Mulawarman University | UNMUL | Samarinda |
| Pattimura University | UNPATTI | Ambon |
| Cenderawasih University | UNCEN/J | Jayapura |
| Cenderawasih University | UNCEN/M | Manokwari |
| Institut Keguruan dan Ilmiah Pendidikan | IKIP/UP | Ujung Pandang |
| Institut Keguruan dan Iimiah Pendidikan | IKIP/M | Manado |
| Institut Pertanian Bogor | IPB | Bogor |
| Directorate General of Higher Education | DGHE | Jakarta |
| Universitas Terbuka (Open University) | UT | Jakarta |
| Small Earth Station Remote Extension Site | SBK | Wawatobi |

Through its teleconferencing network, SISDIKSAT provides rarely available academic courses to university students and improves faculty knowledge and teaching skills through in-service training programs and seminars. Its makes the expert resources of one university available to the others, thus multiplying each professional's outreach and impact. Within the 11 BKS universities participating in SISDIKSAT, each generally surpasses the others in an area of expertise. For example, UNMUL in Samarinda emphasizes forestry; UNPATTI in Ambon is developing its capacity in fisheries and ship-building; and UNHAS in Ujung Pandang, the oldest and largest university, serves as a regional resource center.

With agriculture as the major economic activity in the region, the universities have a strong agricultural orientation. Included in the SISDIKSAT network is the Java-based Bogor Agricultural Institute (IPB)--Indonesia's premier agricultural university--which serves as a "center of excellence."

Far removed from the policy- and decision-making headquarters in Jakarta and from each other, the BKS universities have depended on infrequent and costly travel for management meetings. Linking the universities with DGHE headquarters in Jakarta, SISDIKSAT facilitates administrative and institutional communications, allowing university and DGHE administrators to "meet" in teleconferences for discussion and coordination.

Focusing on university students, faculty, and administrators, SISDIKSAT's main activities are course-sharing, professional seminars, training programs, information exchange, and message service. Every year SISDIKSAT delivers 30 high-quality courses to thousands of university students and presents seminar series on topics of interest and importance to professionals in the region. It allows university administrators to meet with Ministry of Education officials and each other without traveling.

In short, SISDIKSAT has two primary objectives:

- in the short range, to provide higher quality education so better qualified students are available to fill national manpower requirements;
- in the long range, to develop faculty capabilities so more trained teachers are available to meet the growing demand for higher education.

## INSTITUTIONAL PLACEMENT, SUPPORT, AND MANAGEMENT

### Institutional Placement

Direction and administrative responsibility of SISDIKSAT range over three levels: national, regional, and local. At the national level, overall direction for the SISDIKSAT Project was placed with the Ministry of Education's Directorate General of Higher Education. Classified as a "national project" which receives its funding from its national development budget, oversight for the Project was lodged with the Office of Academic Affairs, the planning and development arm of the DGHE. The initial aim was to experiment with the communications network in the eastern part of the nation; if successful, it would be expanded to cover other parts of the country and be given permanent support in the DGHE's routine budget.

The DGHE was responsible for funding and negotiations with other national agencies--such as PERUMTEL, the telecommunications authority, and the Cabinet Secretariat, supervising customs clearance. Beyond financial and administrative support, the DGHE did not play a large role in SISDIKSAT direction and management, leaving that to the Universities Association.

Essentially a regional project serving the eastern islands, SISDIKSAT falls under the umbrella of the BKS. Project headquarters were placed at Hasanuddin University in Ujung Pandang, the designated "hub" or resource center of the Association. Yet the BKS is in reality a loose coalition of the region's universities whose goal is to promote resource sharing. Within the hierarchy of the higher education system, the BKS has no administrative power and only as much authority as delegated by its member institutions at the local level.

The individual universities are the true locus of power. Reporting directly to the DGHE (and not to the BKS), each university enjoys a high degree of autonomy and independence. In essence, SISDIKSAT must respond to both the needs and management imperatives of 11 different universities and rely on their ability to make timely decisions and reach consensus.

## Support

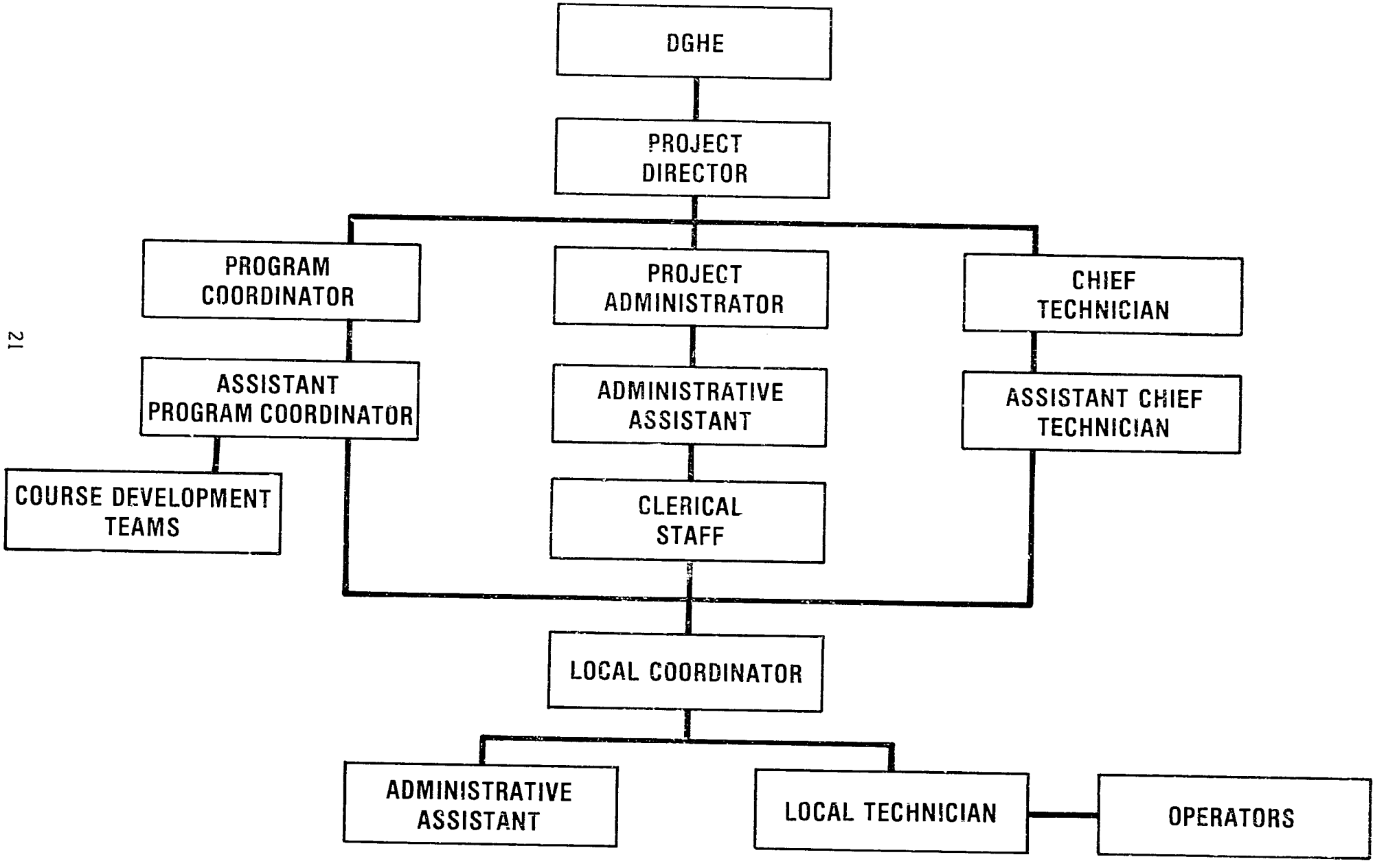
A bi-national effort, SISDIKSAT received support from both USAID and the Government of Indonesia. While AID funds covered equipment, installation, and technical assistance costs, significant support was provided by the DGHE from its development budget. The overall budget for SISDIKSAT was allocated by the DGHE and then broken up into 15 different pieces: a DGHE budget to pay for telecommunications charges and Jakarta expenses; a project office budget to pay for program development, technical maintenance, and daily operations; and 13 site budgets to help pay for local staff and the daily operation of the classrooms. In addition, each site used local funds to pay for the furnishing of the classrooms and for staff and other costs. The SISDIKSAT central office had no direct control over any of the money spent at the local level. Guidelines for its use were established, but although it was earmarked for SISDIKSAT activities, it fell completely under the control of the local university administration. With the conclusion of the Project Agreement in 1986, SISDIKSAT support is provided exclusively from the funds of the DGHE and its university allocations.

## SISDIKSAT Management

SISDIKSAT is managed by a core staff at the central project office in Ujung Pandang with locally appointed staff at each site, the equivalent of 30 full-time staff for 15 sites. With institutional leadership fragmented among the DGHE and universities, Project headquarters has become the heart of SISDIKSAT operations. The highly active SISDIKSAT staff has established a strong administrative, technical, and program management structure for coordinating central office and site activities.

Central project staff consists of three key members--the Project Administrator, Chief Technician, and Program Coordinator, their assistants, and a few support staff; local staff includes a Local Coordinator, Local Technician, and Local Operators. Appointed from local university faculty and staff, virtually all SISDIKSAT personnel work on a part-time basis. Although the management demands of the extensive SISDIKSAT network are many, it is impossible to assign full-time staff, given the existing shortage of university personnel in the region. Thus, in addition to their other duties, SISDIKSAT staff has assumed the heavy burden of managing a 13-site network spanning 2,500 miles and delivering over 15 courses each semester.

# SISDIKSAT MANAGEMENT STRUCTURE



Staff responsibilities are divided along three lines: administration, technical operations, and program development.

The Project Administrator manages the scheduling of the activities on the SISDIKSAT network and the operation of the Project Office. The Administrator maintains close contact with the Local Coordinators. Usually senior faculty members, the Local Coordinators oversee all local SISDIKSAT activities, including supervision of the Local Technician and Operators and management of the budget allotted to the site from the DGHE through the university. The Local Coordinators are critical in conducting program needs assessments, creating local interest and support, and serving as a pivotal liaison between SISDIKSAT headquarters, local university staff, and the outside community.

The technical area is headed by a Chief Technician and Assistant Chief Technician stationed at the project office. Members of the engineering faculty and specialists in electronics, they supervise the overall operation and maintenance of the system, provide technical support and training to the local sites, and coordinate all work with PERUMTEL, the national telecommunications carrier.

At each site a Local Technician, a faculty member with either a degree or some experience in electronics, serves as main technical supervisor and maintenance expert. At each site are two to five Local Operators responsible for daily equipment operation.

The Program Coordinator is responsible for the development of presentations to be delivered over SISDIKSAT, including courses and seminars, for assistance to users, and for evaluation of the programming. The Program Coordinator works closely with Local Coordinators in assessing and coordinating site needs, with the universities' academic affairs committees in course and instructor selection, and with faculty members in curricula adaptation, materials development, and teleconferencing techniques. Given the volume of courses, an attempt was made to recruit and train a team of course development experts, but funding support was insufficient.

A key position called for in the original Project Plan was that of Project Director. Designated as chief spokesperson and liaison officer for SISDIKSAT, the Project Director was to work closely with the various management levels in overseeing the Project and serve as SISDIKSAT advocate at the national level. Unfortunately, this critical post has remained unfilled since the early days of the Project. Its continued vacancy has in no way diminished the need for such a staff person and has served only to demonstrate how essential a senior-level project leader is in garnering support for an innovative project.

The fragmented nature of project direction has proved problematic throughout SISDIKSAT's history and at times has undermined project operations. Although the course development and delivery structures established by SISDIKSAT's central office are effective and the linkages forged with the local sites remain strong, SISDIKSAT suffers from its ambiguous position in the higher education system. A national project without national leadership, a regional project attached to a weak regional association with little authority and no resources, and a project without a director to bridge the management gaps, SISDIKSAT has fallen into a leadership vacuum.

In the absence of strong leadership at the national or regional levels, the dedicated Project staff has assumed these responsibilities. Yet, SISDIKSAT's mid-level staff lacks official authority to compel full support and participation from the eastern island universities, as well as the professional stature to negotiate with top university officials. The

result is that SISDIKSAT management has had to rely on voluntary cooperation and collaboration. Because most of the universities have been eager participants in the SISDIKSAT experiment, Project operations have moved ahead and kept pace with increasing demands for service. But this success may be tenuous. As more sites join the SISDIKSAT network and as more programs are added, it should become increasingly difficult to manage this multi-site communications network solely on the basis of good will. Management shortfalls will occur in course selection, scheduling, materials production, and in financial support.

SISDIKSAT has developed a sound internal management system which supports multiple programs and thousands of students each semester. It must find the proper "institutional" home to maintain its growing operations.

## SISDIKSAT TECHNICAL NETWORK

With 15 sites, SISDIKSAT is the **largest teleconferencing network** in the developing world, connecting 12 widely separated and remote universities in the eastern islands of Indonesia, the Ministry of Education and Open University headquarters in Jakarta, and the Agricultural Institute in Bogor. Included in the network are the four additional sites that have joined the network since SISDIKSAT began operations.

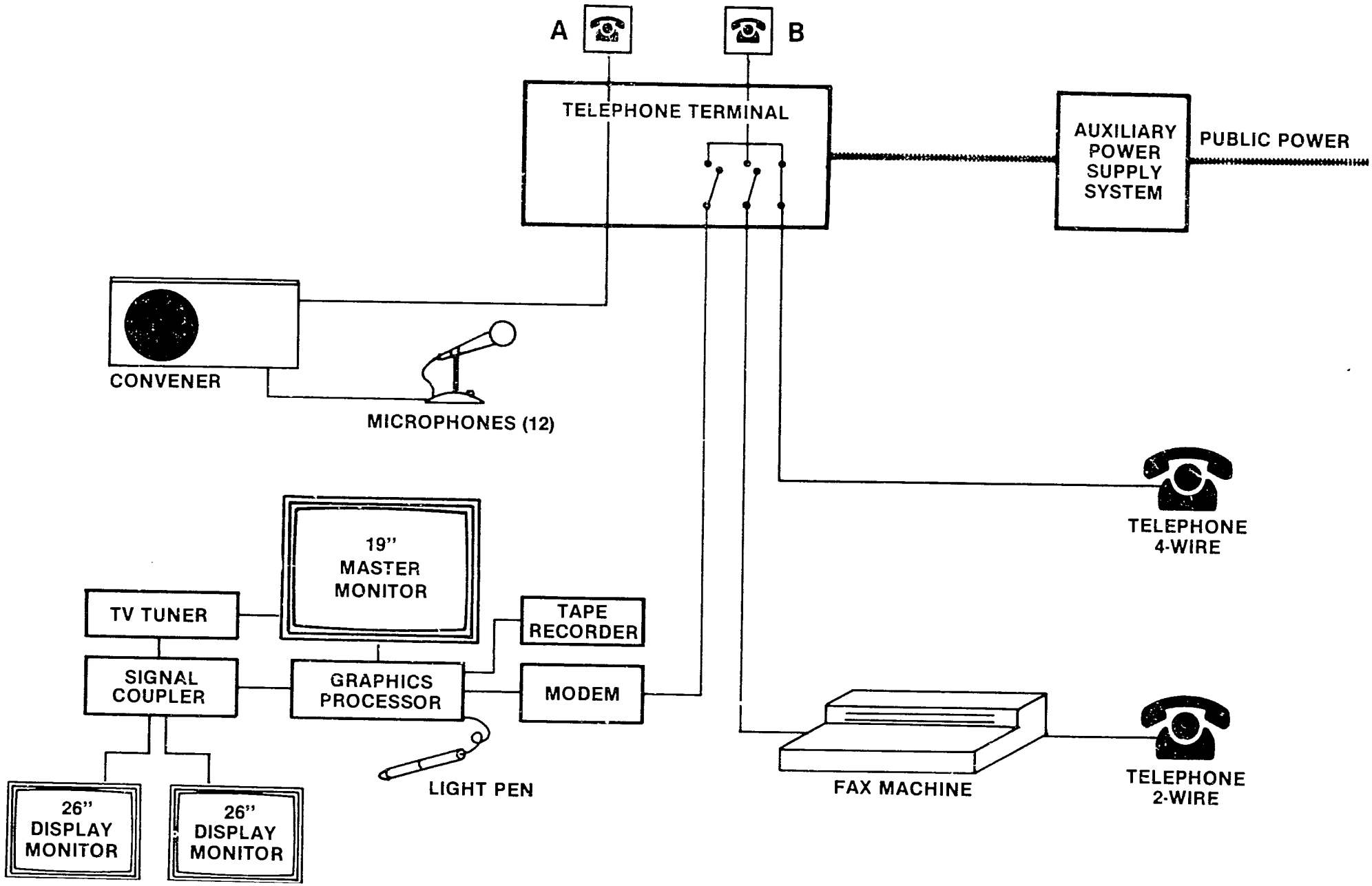
A fully interactive communications system, SISDIKSAT utilizes the dedicated voice channels on the Palapa satellite and a four-wire ground telephone system. The most technically complex and ambitious of the three RSP teleconferencing networks, SISDIKSAT posed a real challenge for demonstrating the specialized use of satellite communications for development.

### Electronic Classroom

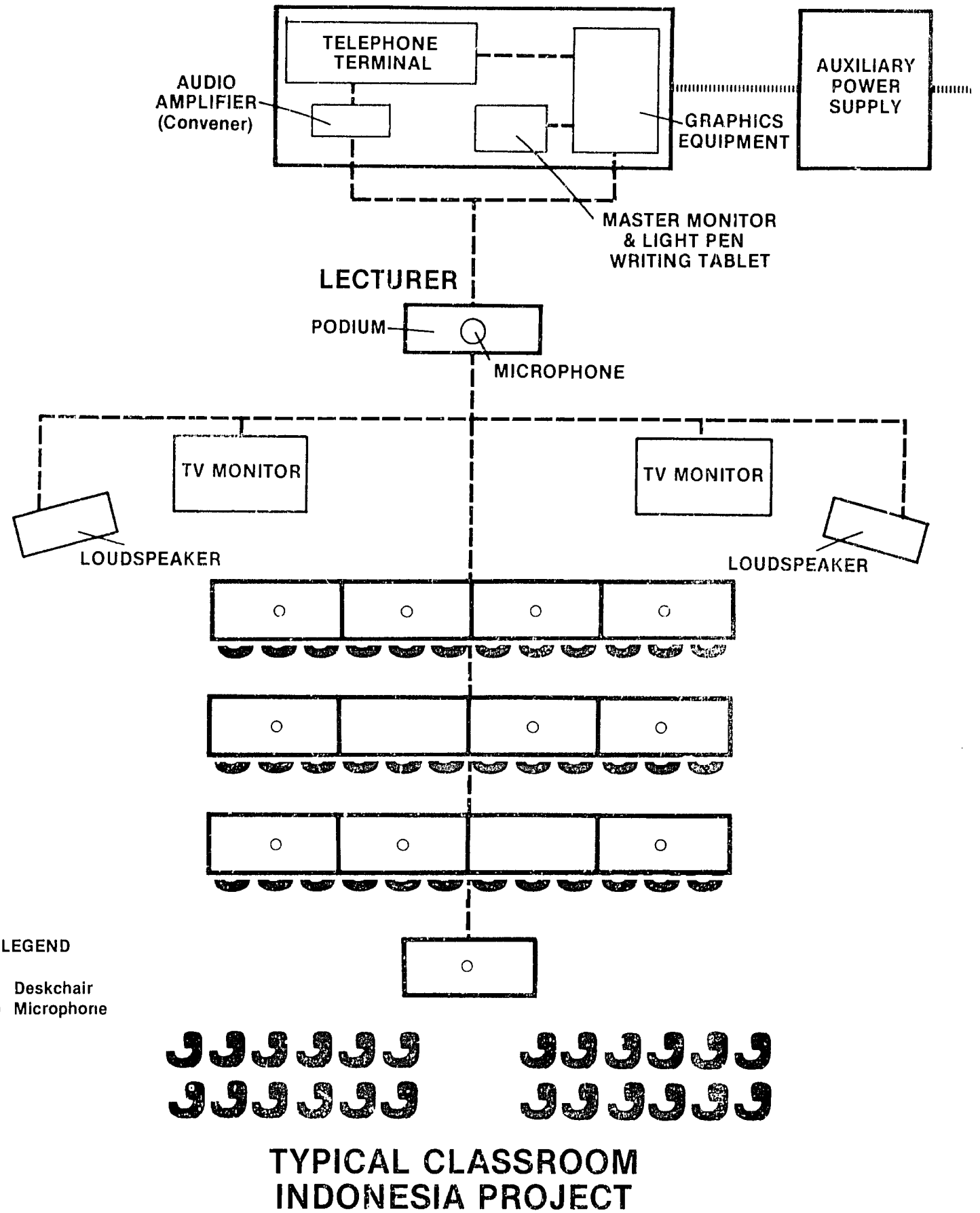
The SISDIKSAT electronic classroom consists of an audioconferencing channel for two-way voice communications. A second channel is used for a number of purposes: graphics and hard copy transfer, private telephone conversations, and as a redundancy or back-up feature. Each site is also equipped with auxiliary power supply units.

The audioconferencing and network control equipment form the core of the electronic classroom, providing and regulating the basic interactive voice communications. Based on the "party line" principle, any site in the network can initiate communications and be heard by all other sites. Unlike a typical telephone conversation, however, only one person can speak at a time. Simultaneous conversation is not possible.

Each SISDIKSAT classroom, accommodating 40 to 80 students, is equipped with 12 microphones--one for every four students. At some sites where SISDIKSAT course attendance exceeds room capacity, technicians have jerry-rigged speakers in adjoining classrooms to broadcast lectures. Whereas the professor--or presenter--is provided with a lavaliere-style microphone to allow free movement, the students are equipped with unidirectional push-to-talk microphones designed to discourage the transmission of background noise and prevent inadvertent jamming of transmissions by leaving the microphones on after speaking.




**LAYOUT OF CLASSROOM EQUIPMENT IN INDONESIA**




# TYPICAL CLASSROOM INDONESIA PROJECT

In the planning stages, the Directorate and BKS members made it clear that graphics support for lectures was very important. A variety of new interactive graphics transmission systems using telephone lines had recently come on the market, although there had been little field experience with their application or use. As an experiment, each classroom was equipped with a facsimile machine and telewriter. And, as described above, a second satellite channel was incorporated into the network to allow for the simultaneous transmission of voice and graphics.

Given the great distances separating the universities, it is clear that physically moving paper to the sites presents a problem. Facsimile machines at each site facilitate the exchange of course notes, research articles, and administrative memoranda quickly and inexpensively. The SISDIKSAT facsimile system offers automatic, unattended reception, operates at slow (3-minute) speeds to overcome line noise, and uses plastic-coated paper to avoid jamming in the high humidity.

In Indonesia, blackboards are considered a major teaching tool. A graphics system--or telewriter--developed by the Open University in Britain and manufactured by Aregon was purchased to provide an "electronic blackboard" capability. Using a special "light pen," a professor can write or draw on a television screen; the image is digitized and sent over the communications network and displayed on a receiving monitor and on auxiliary display monitors strategically located in the classroom. A studio system allows for the creation of more elaborate "canned" graphic cassettes, pre-taped for later use.

Because of frequent power outages and unstable power supply at all of the Project sites, auxiliary power supply systems are located at each classroom to regulate power surges, stabilize incoming voltage, and provide emergency back-up power. The system consists of rechargeable batteries, battery charger, a DC/AC power inverter, and line voltage regulator.

## Transmission System

Because Indonesia already owned a domestic satellite, there was no question of the means of transmission or of selection of a carrier; PERUMTEL had sole charge of the Indonesian telecommunications system. Because interactive graphics transmission was part of the applications design, two transmission channels were required to allow simultaneous transmission. Given this requirement, the satellite architecture was a critical point for controlling costs.

Unlike most conferencing systems which use a terrestrial bridge to link multiple sites, SISDIKSAT uses the Palapa satellite itself as a bridge in a "loopback" or half-duplex design. Transmission at any one site goes up to the satellite and back down to all sites. This loopback design dramatically reduces the number of channels that need to be leased. Using a conventional terrestrial bridge design, the original SISDIKSAT network would have required 40 satellite channels, 2 channels per site; the loopback design option uses only four frequencies for the entire system, two channels in all. At about $119,000 per channel, the cost savings is very significant.

Although economically attractive, the loopback option had two disadvantages. Its use was largely untried and experimental, requiring the introduction of nonstandard procedures and equipment at each earth station which made PERUMTEL understandably hesitant to try the design. The use of the satellite as a bridge also makes the network more susceptible to noise. The satellite bridging plan allows only one site to transmit at a time; once in the transmission mode, no site can be interrupted.

All SISDIKSAT sites rely on the existing telephone system; access to the satellite is achieved through dedicated lines from the universities to the nearest earth station. The land lines and satellite capacity are leased on a 24-hour basis to ensure full-time circuit access, bypassing the noisy local telephone switches and controlling circuit quality.

As a government agency, the Ministry of Education received a concessionary rate from PERUMTEL, also a national agency. Circuit charges, however, remain high--possibly because SISDIKSAT's dedicated multi-site configuration was without precedent, and PERUMTEL calculated the charges on a traditional distance basis, resulting in the same high tariffs for long distance service prevailing throughout Indonesia. It appears, however, that the Ministry of Education will soon request and receive a payment waiver.

Typical of the Rural Satellite Program projects, technical management of the SISDIKSAT network is shared by the user, SISDIKSAT, and the telecommunications company, PERUMTEL. The high level of cooperation and collaboration achieved between the two parties is a model for future projects. Viewing the Project as an opportunity to experiment with possible commercial service options, PERUMTEL has proved a supportive partner in this innovative effort. In charge of all "outside plant" operations, i.e., local and long distance transmission service, PERUMTEL nevertheless has been willing to accommodate the new equipment at its earth stations and follow new procedures required by the network design. It has assigned a management team to the Project, laid new cable as required, and tracked and minimized noise through corrective maintenance.

Although considerable, due to the extent and complexity of equipment, SISDIKSAT's technical responsibilities are limited to the operation and maintenance of the electronic classrooms. Central maintenance and repair facilities are located at SISDIKSAT headquarters under the direction of the Chief Technician and his assistant. Mainly managing technical operations over the network itself, the two technicians direct Local Technicians in routine maintenance tasks, such as level setting, conducting initial diagnostic testing, and advising repair procedures. Regular refresher training for the Local Technicians is also presented over the network.

Much of the first-line repair strategy is based on component swap-out, with the damaged parts returned to the central office for repair or shipment to specialized commercial repair shops. The preventive maintenance plan calls for a semester visit to all sites, but this is often prevented by budget shortfalls and travel is predicated on emergency trouble-shooting.

## Network Performance

| | |
|---|---|
| PERFORMANCE: | 98% technical reliability |
| PROBLEMS: | line noise<br>telewriter failures<br>instability of PERUMTEL communications system |
| INNOVATIONS: | satellite "loopback" bridging<br>gating system |

Not surprising for an innovative undertaking, the SISDIKSAT network experienced many initial technical difficulties.

First were the frustrations arising from the unrealistic expectation that technical design, procurement, and installation could be expeditiously accomplished over a nine-month period. In actuality, putting the technical network in place took almost twice as long, with final burn-in completed in August 1984, nearly a year and a half after start-up.

Second, and of more critical importance, noise on the network increased to an alarming degree as installation progressed. When all 11 original sites were linked into the network, periods of high-quality transmission would be interrupted by loud bursts of noise which would last for seconds, minutes, and sometimes even hours. The cause of the noise was traced to either poorly grounded or damaged local (i.e., terrestrial) lines or to storm interference with improperly shielded lines. Because of the party-line design and satellite bridging, line noise originating at one site can be automatically passed to all other sites. Whatever or wherever the source, the effect was often deafening and certainly inhibited teleconferencing.

To prevent cumulative line noise, a "gating" system was designed and placed at the classrooms and central telephone exchanges at each site. A signal from the transmitting classroom opens the transmit circuits at the other end of the local telephone line thus preventing the transmission of line noise and other localized disturbances to the entire network. In areas where electrical storms are frequent and local lines are normally poor, this device has improved greatly the audio quality throughout the system.

With the installation of the "gates" and regularizing of operations, the technical system has achieved near-perfect performance, far surpassing commercial telephone service. **Only 2.3 percent of SISDIKSAT program activities have been cancelled because of technical problems since mid-1985; only 2.7 percent of network time experienced any technical difficulties.** However, this 98 percent technical reliability record of the audio capacity does not extend to the graphics transmissions.

Although the facsimile component works well for point-to-point transmissions, the Aregon telewriting system has been a major disappointment. To date, it has never operated on a multi-site basis with any regularity or frequency. Malfunctions have ranged from the light pens to the modems to the focus potentiometers in the monitors. Its poor performance results from several factors: overly complex design, susceptibility to climatic conditions, demanding technical oversight, and extreme sensitivity to line noise--a virtual given of the Indonesian telephone system. Because of its unreliability and inability to operate on a multi-site basis, its function has never been incorporated into regular SISDIKSAT activities, with apparently no ill-effect on the network's instructional effectiveness--contrary to earlier claims that blackboards were indispensable.

A final "technical" problem remains unresolved: the issue of technical management.

Although technical training and extensive spare parts have been provided, logistics and manpower continue to be a problem. Getting a failed piece of equipment to SISDIKSAT headquarters takes coordination and money, and after reaching Project headquarters, repair takes time and skills that are at a premium. The SISDIKSAT technical staff has proved very able in assimilating new knowledge and has developed many innovations and technical adaptations to suit local conditions, but more than sophisticated technical skill and knowledge are needed. The technical system requires vigilant management and a small, but full-time cadre of technicians to ensure that all equipment at each of the sites is in good operating order.

At present, SISDiKSAT continues to operate with part-time staff and limited funds.

## SISDIKSAT PROGRAMS AND ACTIVITIES

In October 1984 SISDIKSAT initiated a trial semester offering two courses; it is currently completing its sixth semester with a regular schedule of 15 courses. **To date it has delivered 75 undergraduate courses, developed 35 new courses, and reaches over 3,000 students each semester.** Use extends beyond normal course delivery to other activities, including training, faculty seminars, and administrative conferences and to other user groups. The Open University uses SISDIKSAT for regular in-service training for its local tutors in the eastern islands and for administrative communication with its provincial offices. The Directorate General of Primary and Secondary Education is now launching in-service training for its teachers. Other groups such as the Summer Institute of Linguistics and the Bogor Graduate Agriculture Program use the system for weekly management meetings.

### Program Development and Delivery

Creation of the SISDIKSAT teleconferencing network required the development of a programming system congruent with existing university policies, practices, and procedures which would provide for:

- identification and selection of courses/programs most needed by the universities;
- development and adaptation of these courses; and
- delivery of classes according to scheduling, attendance, and grading parameters.

SISDIKSAT emphasizes primarily a three-pronged course exchange program. SISDIKSAT develops course materials in the national language, delivers courses for at least two semesters to meet the short-term needs of its members, and works with junior faculty so that they can teach the courses in the future without SISDIKSAT. This strategy ensures the greatest impact on the institutional capacity of the universities. SISDIKSAT's goal is to deliver a course once, revise it, teach it again, and then move on to other courses with the confidence that the local tutors can teach the course themselves--using the system only for occasional support from the master teachers.

In developing programs, SISDIKSAT's objective is to serve the largest number of common needs of the universities and to make the most of available resources. The program development process is a straightforward procedure based on negotiation and collaboration. How is it done?

First, a needs assessment is conducted via a written survey and discussions with the sites. Questionnaires are sent to the university rector and his staff asking that they identify the courses needed and the courses the institution is willing to offer. SISDIKSAT collates the responses, identifies the 25 most requested courses, and prepares a list of those courses the universities have offered to teach.

Second, meeting over the network, the academic deans select 10-15 courses for the semester based on need and resource availability. The general guideline calls for a minimum of 2-3 sites following a course. No site has yet participated in all courses; no course has yet been taken by all sites. At the same time, course development teams are identified, with emphasis being placed on seniority and educational level.

Finally, SISDIKSAT staff works with the three-person course team to prepare the course for distance teaching. Initially, course development guides are sent to the team with information on adapting existing course materials and developing new materials, such as study guides and visual aids. This is followed by training sessions in teleconferencing techniques held over the network. SISDIKSAT reproduces the materials and distributes them to the participating sites, including reference texts, slide series, practicum exercises, student workbooks, and, occasionally, textbooks.

SISDIKSAT's original intention was to focus on materials adaptation for the distance medium; however, it was discovered that few appropriate materials existed or were in the language of Bahasa Indonesia. Plans for study guides often give way to the need for basic textbooks. SISDIKSAT course materials have been very well received and are often used in non-SISDIKSAT courses. In fact, materials are so important in the resource-scarce region that 63 percent of SISDIKSAT's faculty seminar participants have indicated that their attendance is predicated on the distribution of handouts.

In general, the course development process has worked well. Occasionally, the most qualified professor identified to teach a course is not the best teacher, despite his seniority. More often, materials do not always follow the prescribed SISDIKSAT format and are prepared late. Finally, without direct access to a central budget, SISDIKSAT often experiences difficulties in paying course presenters.

The SISDIKSAT schedule is almost fully booked from 8:00 a.m. to 5:00 p.m. for courses and conferences. In actuality, network use starts two hours earlier with administrative conferencing among the three universities in the eastern time zone and continues into the evening with specially requested courses and Open University use.

Each site has appointed 2-5 Local Operators to staff the electronic classroom throughout the day. At those sites participating in additional programming, the Operator works into the evening.

The course team (master teachers) shares the instructional responsibilities over the system (generally 100 minutes per week), while local tutors (often junior lecturers in the course subject) at each receiving site supervise students, lead local discussions, administer and correct tests, and generally serve as the arms and eyes of the distant master teachers.

Each course consists of a two-and-one-half hour session on the SISDIKSAT network once a week plus any additional activities assigned by the local tutor. Of this time, approximately 100 minutes are reserved for instruction, 20 minutes for start-up and breaks, and 30 minutes for a tutors' meeting.

Course delivery is highly interactive, with 10-20 minutes of lecture punctuated by questions and discussion. In addition, students are asked at least once in the semester to evaluate the course. Based on their comments, the master teachers revise the course and materials for subsequent semesters.

The use of SISDIKSAT courses is highly individualized by each university. Although often the only means of receiving a course, SISDIKSAT courses are sometimes used as supplements to existing courses. For example, an instructor who teaches the same course on his own campus may require his students to attend portions of the SISDIKSAT course as well; in some cases, students voluntarily audit courses to augment their learning. Use of SISDIKSAT courses is generally left to the discretion of the local tutor,

including additional assignments and preparing and administering of exams. The majority of tutors (63%) held at least seven meetings outside SISDIKSAT time, and only 17 percent used the master teacher's exam unchanged. Course credit and grades are not assigned by SISDIKSAT, but are determined by the local universities.

## Programs

The main SISDIKSAT activity is the **course-sharing** among the sites: nine universities and two teacher training colleges in eastern Indonesia and the Agriculture Institute at Bogor, Java.

After the technical problems decreased in late 1984, SISDIKSAT decided to test the quality and reliability of the system by offering two courses (statistics and food science) in an experimental semester to determine if the system was ready to be used intensively for programming. When both of these courses ran without any major technical problems, a full semester of 12 courses was begun in February 1985. The number of courses was increased to 15 for the second semester of 1985. This was believed to be the optimum number of courses that could be offered during regular class times, given the need to have system time available for other uses. In fact, 17 courses were actually delivered because Cenderawasih University of Irian Jaya, in great need of law courses, paid for the development and delivery of two courses on criminal and agrarian law during the evening hours when the system was not otherwise in use.

In principle, SISDIKSAT courses are taught for two semesters, then temporarily "retired" from the roster on the theory that local lecturers would be able to teach the course, the network could be used for new programs, and the process repeated with a multiplier effect. In practice, however, certain basic undergraduate courses--such as statistics--are so popular that they have been continuously repeated, attracting such large audiences that now even universities with adequate teaching capabilities use SISDIKSAT and no longer offer the course locally.

**Teacher training and faculty development** are important goals of the SISDIKSAT project. The original implementation plan called for the system to be used in support of an ongoing national faculty development program called Akte Lima. This program sought to improve the skills of junior faculty members through a mandatory program that utilized print materials on different content areas and pedagogical topics and local classes arranged at the discretion of each institution. Unfortunately, SISDIKSAT investigations found that the Akte Lima program itself was weak and therefore would be inappropriate to present in a distance teaching format.

In conjunction with its course-sharing program, however, SISDIKSAT was able to develop a **staff upgrading program.** Aimed at the local tutors designated to monitor the courses, SISDIKSAT has incorporated a teacher-training component into each course session. At the beginning of the semester, a series of meetings between the master teachers and local tutors takes place to discuss materials development, course content, and organization. During the semester an extra 30 minutes are added to each course's time slot to allow the master teachers and local tutors to review the material, address any tutor or student problems, and preview the coming week's lesson. This gives the local tutors due opportunity to ask questions that improve their own knowledge.

To a great extent the courses themselves serve a major training function. In addition to the mandatory presence of the tutor, many local lecturers and junior faculty audit the courses voluntarily.

**Seminars** are also used to provide isolated faculty members with new information in their fields and opportunities for scholarly discussions with their peers. Originally, SISDIKSAT began its seminar program by broadcasting face-to-face seminars that were held in Ujung Pandang. Subsequent seminars were arranged at faculty requests, and today SISDIKSAT presents a seminar series based on recently completed doctoral and master's research. The seminars are organized around a variety of topics: science and pharmacy, agriculture, development studies, statistics, animal husbandry, medicine, nutrition, and education. A series of two to eight teleconferences is arranged under each topic, ranging from subjects of narrow scientific interest ("Industrial Use of Seaweed") to those of more general appeal ("Indonesia and the New Economic Order"). In 1986, over 30 seminars were presented.

These seminars have proved tremendously successful; **the 1986 series, arranged for the semester break, attracted over 1,800 (voluntary) participants with 99 percent asking for additional programs.** SISDIKSAT has definitely identified a strongly felt need of the faculty in the region and, based on attendance records, also of personnel from the agriculture and health sectors.

Indonesia's Open University uses SISDIKSAT to deliver a **training program** for its local tutors in the eastern islands. Beginning with four hours per week and progressing to 10 hours per week in 1986, tutors for specific courses meet for two-hour sessions with the Open University's course writers to discuss materials and content.

A third major activity of SISDIKSAT is **administrative conferencing.** Faculty members at IPB and UNHAS use the system for the coordination of a joint graduate program where students study at both campuses. The Summer Institute of Linguistics uses the system for weekly staff meetings between team members at five of the SISDIKSAT locations. SISDIKSAT takes advantage of the fact that it spans three time zones to allocate early morning time to Cenderawasih University for communication between its main campus at Jayapura and its agricultural campus at Manokwari over 500 miles away. They are able to use SISDIKSAT for inter-campus communications from 7:00 a.m. until 8:30 a.m.

A crucial use of the system is for the operation of SISDIKSAT itself. The administrative staff uses the system for communications with the Local Coordinators, Jakarta officials, and course development teams and to track the shipment of materials to all of the sites. The programming staff used the system for meetings with academic rectors and deans for setting up the course-sharing program and for orientation programs for materials developers, teachers, tutors, and students. The technical staff used the system for training programs for Local Technicians and Operators and for conducting system tests and maintenance functions.

Although many SISDIKSAT uses and applications have not turned out as originally envisaged, the member universities and SISDIKSAT have adapted the network to their particular needs and made it theirs.

## COURSES DEVELOPED FOR SISDIKSAT

(August 1984 - June 1986)

1. Adult Education
2. Statistics I
3. Animal Physiology
4. Nutrition
5. Social Science Research I
6. Resource Economics
7. Basic Natural Sciences
8. Soil Science
9. Animal Husbandry
10. Industrial Law
11. Indonesian Social System
12. Fish Diseases
13. Fishing Methods
14. Basic Ecology
15. Macro Economics
16. Human Ecology
17. Organizational Behavior
18. Social Science Research II
19. Criminal Law
20. Agrarian Law
21. Poultry Production I
22. Poultry Production II
23. Management
24. Micro Economics
25. Educational Evaluation
26. Soil-Borne Pathogens
27. Food Enzymes
28. Fishing Equipment
29. Statistics II
30. Basic Forestry
31. Cattle Breeding
32. Fisheries Management
33. Population & the Environment
34. Educational Technology
35. Food Science

## SELECTED SISDIKSAT SEMINARS

Effects of Alcohol & Zinc on Pregnancy
Nutrition & Primary School Performance
Protein Quality of Popular Indonesian Foods
Nutrition Education
Education & Work Opportunities
Bureaucracy & National Development
Models & Simulations for Development Planning
Transmigration & Agriculture in Eastern Indonesia
Side Effects & Consequences of Pesticide
Pig Breeding & Management
Mixture of Tropical Woods for Pulp & Paper
Agriculture Developments in Indonesia
Medicines from Natural Plants
Coffee Growing
Sea Weed as Material for Industry
Transformation of Pesticides Via Microorganisms
Chemical Analysis of Oral KB Medicine
Regression Analysis for Population Data
Cardiopulmonary Resusitation
Indonesia & the New World Economic Order
Macroeconomic Theory & Economic Development
Diagnosis & Treatment of Peptic Ulcers
Immunology for Hepatitis B
Population & the Environment

## ATTENDANCE, USAGE, PARTICIPATION, AND EFFECTIVENESS*

Between October 1984 and December 1986, sixty undergraduate courses were presented over the SISDIKSAT network. **SISDIKSAT was able to deliver about 83 percent of the scheduled class sessions, a record slightly above the average for face-to-face courses.** Less than 3 percent of the cancellations resulted from technical failures; the remainder were caused by failures in the "human system." Teacher absence accounted for the majority (71%) of class cancellations. Many Indonesian faculty members do not place a high priority on holding the mandatory 12-16 classes per semester, although SISDIKSAT teachers appear more faithful in attending their distance courses.

Student absence was mainly confined to the first weeks of the semester, primarily as a result of the slightly different academic calendars in effect at the universities.

Student attendance fluctuated from week to week because of the general lack of emphasis on attendance in the university system and the irregular attendance of some local classes that used the SISDIKSAT courses as a supplemental activity. The average weekly attendance for a single course ran from 470 for a mandatory freshman course to only 20 for a more specialized course. The average weekly attendance for all courses during the first three regular semesters ran from 1,200 to 2,500 students. **The most recent figures show average attendance approaching the all-time high of 3,500 students,** at about 3,200-3,300 a semester.

By 1986 the average operational SISDIKSAT week was 68 hours; 52.5 hours (77%) were programmed in advance. Primary usage of the network is for course delivery: about 36 percent of network time is devoted to this activity. Optimum use, based on a scheduled 100 minute/class, calls for 45 percent of network prime time. Cancellation of classes and failure of teachers to fully utilize the allotted time account for the lower figure. There is also a shortfall in the utilization of the half-hour per class designated for tutor meetings. In 1986, 21 percent of the classes used this additional time. Even though there is usually more than one tutor per course per site, 65 percent of the local tutors indicated they attended every class.

Official university business, meetings, and official messages constitute 27 percent of network use, while SISDIKSAT internal administration, technical management, and training sessions use 19 percent of network time. Finally, 7 percent of network time is used for private message transfer, with "silence" or unscheduled transmissions accounting for the remaining 17 percent.

Most universities send a substantial number of students to SISDIKSAT courses, but highest attendance is credited to the most isolated, the most distant, and the youngest institutions. The two eastern-most campuses account for nearly one-third of the SISDIKSAT students. These two campuses also regularly use off-hour system time for administration and "purchase" special courses for evening presentation, basically using SISDIKSAT over a 12-13 hour period per day.

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* Based on data from 1984/85 and 1985/86 collected by the Academy.

SISDIKSAT SCHEDULE

August-December 1985

| HOUR | MONDAY | TUESDAY | WEDNESDAY | THURSDAY | FRIDAY | SATURDAY |
|---|---|---|---|---|---|---|
| 6:00 | Administrative Conferencing and Fax Time for Eastern Time Zone Sites: UNCEN-Jayapura, UNCEN-Manokwari, UNPATTI-Ambon | | | | | |
| 7:30 | SYSTEM CHECK-OUT FOR ALL SITES OUTSIDE JAVA | | | | | |
| 8:00 | Basic Natural Science P=UNHAS | Methods of Social Research P=UNCEN-J | Macro Economics P=UNHAS | Resource Economics P=UNLAM | Industrial Law P=UNSRAT | Technology of Cattle Production P=IPB |
| 10:30 | ROLL-CALL OF SITES / NEWS AND FAX TIME | | | | | |
| 11:00 | Basic Ecology P=UNMUL | Audioconfer-encing & Seminar & SISDIKSAT Time | Theory of Adult Education P=IKIP-Ujg.Pdg. | Social System of Indonesia P=UNHAS | Summer Institute of Linguistics IPB-UNHAS Grad. Ag. Program | Statistics I P=IKIP-Ujg.Pdg. |
| 1:30 | ROLL-CALL OF SITES / NEWS AND FAX TIME | | | | | |
| 2:00 | Methods of Fishing P=IPB | Food Science P=UNSRAT | Animal Physiology P=IPB | Open University P=O.U./Jakarta | Soil Science P=UNHAS/UNPATTI | Fish Diseases P=UNHAS |
| 4:30 | ROLL-CALL OF SITES / NEWS AND FAX TIME | | | | | |
| 5:00 | Agrarian Law P=UNHAS | Open University P=O.U./Jakarta | Criminal Law P=UNHAS | | | |
| 7:30 | | | | | | |

Central Indonesian Time

P=Presenting Site

In general, the lowest and weakest attendance occurs at the largest and best-staffed institutions in the SISDIKSAT network. Not surprisingly, they view themselves as sources of expertise and course presenters, rather than needful recipients. Indeed, the other universities are eager to receive courses originating from these sources, and they are well attended. Evidence indicates, therefore, that SISDIKSAT is useful and convenient for the larger universities; it is very important to the smaller and remote campuses.

- **User acceptance, attitudes, and assessment of the effectiveness of the SISDIKSAT network are overwhelmingly positive.** Over a period of two semesters, over 3,000 students, local tutors, master teachers, and seminar participants were surveyed about their experience with SISDIKSAT. Because course use differs from university to university, exams are not standardized, and grades are issued locally, SISDIKSAT effectiveness can be judged only by participant assessment.

- **Eighty-five percent of SISDIKSAT's undergraduates found the distance courses to be well organized and presented, with sufficient time for participation, and over 81 percent thought that SISDIKSAT teachers were as good as or better than their local instructor.** Both the teachers and tutors seem to agree: 83 percent of the tutors felt the courses met the needs of the universities, while nearly 80 percent of the master teachers indicated the content of the SISDIKSAT courses was more complete than their regular classes, although preparation was more demanding. A few of the master teachers expressed concern that they could not cover as much material as they were accustomed to because the SISDIKSAT courses attracted a wider range of students from a variety of academic orientations.

- Study and print materials played a large role in successful course delivery. **Both students (80%) and local tutors (97%) found the materials as good as or better than regular materials.** Local tutors indicated they would use the materials in their face-to-face courses as resource references for students (75%), a guide for their own courses (51%), or as main reading for their own course (21%). Ninety-six percent of the seminar participants responded that handouts made presentations more effective; without handouts only 37 percent were certain they would attend.

**Interaction was a central premise of the teleconferencing experiment. What role did it play in the SISDIKSAT courses?** The interactive nature of the SISDIKSAT network introduced a feature rarely employed in face-to-face university classes in Indonesia, namely two-way communication and discussion. In training sessions, SISDIKSAT teachers were encouraged to break lectures with time for question and answer periods. Surveys of SISDIKSAT classes show a striking difference:

- **SISDIKSAT classes were more interactive;** 97 percent of distance classes allowed time for students to speak, compared with 55 percent of regular classes.

- **SISDIKSAT classes devoted a larger percentage of class time to student discussion;** 12 percent of distance class time was spent in student discussion, compared with 6 percent in regular classes.

- **SISDIKSAT classes used more class time for student-teacher discussions;** distance classes averaged 31.6 minutes, compared with 4 minutes in regular classes.

Such interaction, therefore, involved a significant change in teacher behavior. Yet, 95 percent of the master teachers were comfortable teaching over the network. Students, too, were comfortable with the interactive format: 56 percent indicated they had

used a microphone and almost 7 percent said they used it every class. In fact, some students indicated that, protected by the network's anonymity, they were more likely to ask questions than in the professor's presence.

The interaction was meaningful. Eighty-five percent of student interaction took the form of substantive questions. For every 8 minutes of questions, there were 23 minutes of teacher response.

And the interaction was valuable. **Seventy-four percent of the students said they learned from the questions and discussion; an equal number said they would not reduce the interaction.**

- **Sixty-seven percent of SISDIKSAT students said they learned as much or more from the distance courses as from their regular courses. More telling, 95 percent of their local tutors felt the students learned as much (35%) or more (60%).** Because the local tutor was generally the course instructor in the absence of SISDIKSAT, this response is all the more striking in view of its self-judgment implications.

Yet despite these highly positive responses--that SISDIKSAT teachers and materials were as good or better, that courses were well run, that greater interaction was beneficial--students expressed a continued preference for locally taught courses. Only 19 percent of students preferred taking a course via satellite.

This ambiguity results from several factors. First, there is the natural human preference for face-to-face interaction--particularly strong among Indonesians. Also, occasional technical problems and poor soundproofing in some classrooms may have annoyed some students. There are probably also some students who are not very interested in high quality instructors and materials. They may prefer a locally produced 50-page text to a SISDIKSAT-produced 300-page text. Objectively, the students are saying that the satellite courses are very good; emotionally, they are saying that they still feel more comfortable with their regular system.

This response is one indication that audioconferencing programs may be more appreciated by more mature learners who have clearly identified learning needs and recognize the value of outside expertise. Such people are more likely to look beyond the delivery system and base their opinions on the value of the information they receive. Upperclassmen, graduate students, and, especially, professional people may be a more responsive audience for this type of system.

The overwhelmingly positive evaluation, derived from data collected from 846 of the seminar participants, seems to support this idea. **Ninety-nine percent of those participants found the seminars "very useful" and requested more. Over 92 percent found them "very interesting."** Similar high percentages were positive about the supporting materials, degree of interaction, and format of the programs. Additional positive feedback has come from the Open University tutors getting in-service training over the system and from SISDIKSAT tutors. **From a skills upgrading standpoint, the local tutors have indicated SISDIKSAT courses have increased their understanding of the subject matter (81%), their ability to design and teach similar courses (86%), and their teaching skills (51%).**

**Is there a demand for SISDIKSAT?** The volume of students, the number of courses, and the growing user base of SISDIKSAT show that there is, and that it effectively answers needs of remote and isolated universities for information and instruction.

Over 13,000 people in the eastern islands have benefited from SISDIKSAT's programs and services. Convinced of SISDIKSAT's value, three additional institutions have joined the network with their own funds. Most classrooms have been expanded to accommodate more participants. And, more importantly, in a time of drastically reduced budgets, the Ministry of Education continues to fund SISDIKSAT without AID assistance. Moreover, it has proposed replication of the network for the western islands in a World Bank loan proposal.

The problems of Indonesia's higher education system are not easy ones. SISDIKSAT has provided a blueprint for a realistic solution to strengthening the educational resource base to meet some of these problems.

The SISDIKSAT model holds promise for what might be done throughout the developing world. Many other nations suffer from limited professional resources, lack of skilled manpower, and overburdened tertiary education systems, and have large rural and isolated populations. Increasingly, these countries--from China to Colombia--are turning to distance education through the creation of open universities to extend educational opportunities to students and professionals far removed from quality institutions. And many have access to satellite or telecommunications service. For example, the open university in Thailand has potential access to the services of Indonesia's Palapa satellite. In China, the newly created open university and other distance education programs are already experimenting with television to reach millions of students. In Colombia, Mexico, and Brazil, distance education efforts can take advantage of existing satellite capacity and telecommunications services.

SISDIKSAT has shown that satellite-delivered teleconferencing is an effective means of addressing many of the challenges facing higher education today.

# UWIDITE: UNIVERSITY OF THE WEST INDIES DISTANCE TEACHING EXPERIMENT

## BACKGROUND

The countries of the English-speaking Caribbean are typical of most island nations--physical isolation, small populations, narrow or single-product economies. Likewise, they share many of the problems that stem from these characteristics--vulnerability to world market trends, insufficient scale of demand to justify and sustain investments in basic services, and steady attrition of trained manpower to more prosperous locations.

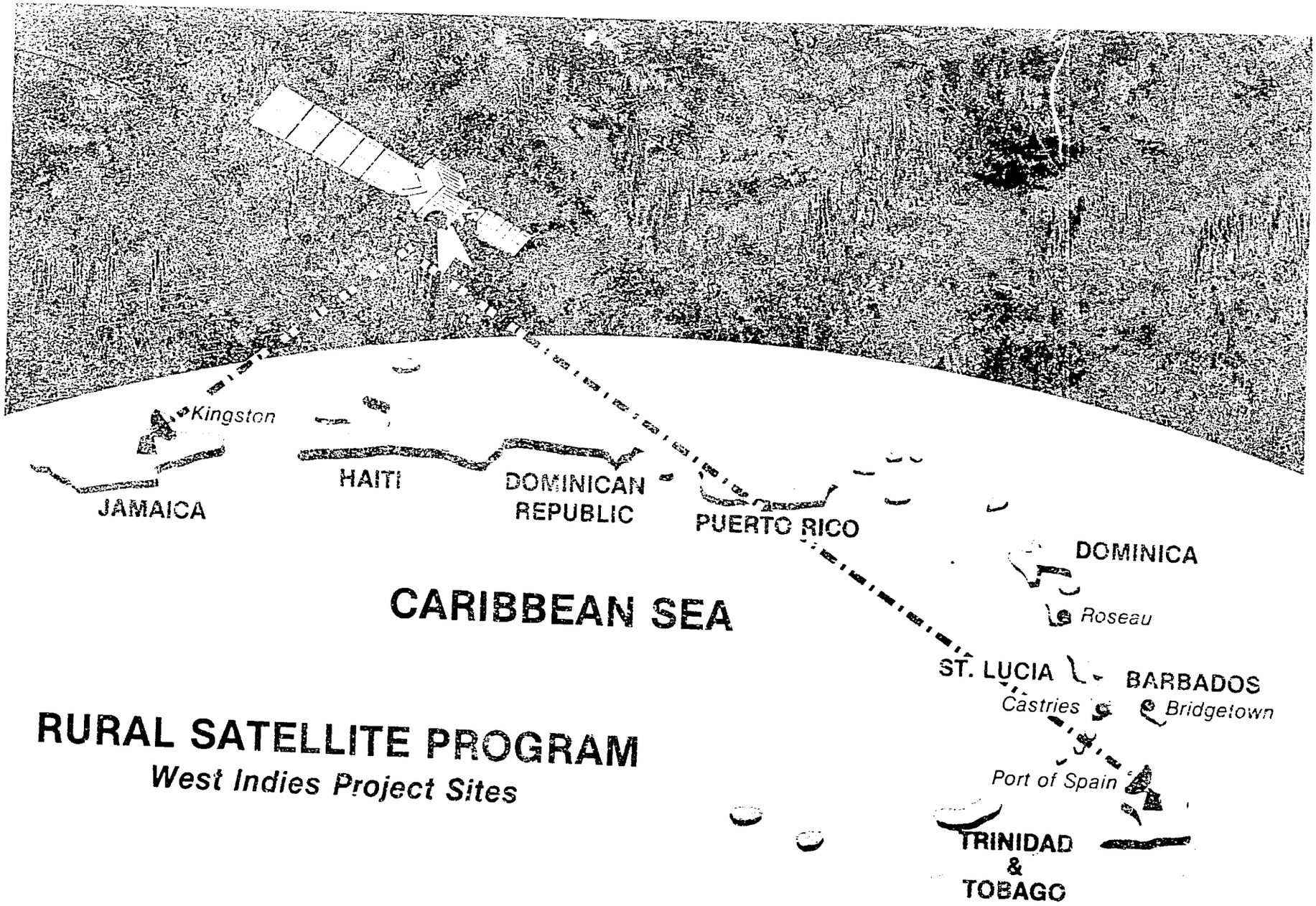
Sharing a common heritage as former British colonies, the 17 countries of the English-speaking Caribbean have often pooled their resources to create regional organizations to serve their small-scale, but urgent needs. The University of the West Indies typifies this collaboration.

Supported by 14 Caribbean nations, the University of the West Indies (UWI) is a multi-site institution comprising three campuses--Jamaica, Barbados, and Trinidad--and 11 university centers in the other member countries. Originally founded in Jamaica as a small elite residential college serving the British West Indies, UWI now serves over 10,000 students, 8 percent at the postgraduate level. UWI not only has expanded geographically but also has increased its program offerings as well. Today it consists of eight faculties with each campus loosely specializing at the graduate level. Trinidad focuses on agriculture and engineering, Barbados on law, and Jamaica on medicine. In addition, various institutes are associated with the University, such as the Caribbean Food and Nutrition Institute and the Caribbean Agricultural Research Institute, as well as the University medical facilities.

UWI is characterized by a strong outreach mandate. Of the 4.5 million people in the region served by UWI, fewer than 1 percent of the labor force are university graduates. The University thus feels a strong need to increase its capacity to provide education, training, and support social services in the region.

In addition to its undergraduate and postgraduate courses, UWI offers professional certification, diploma, and enrichment courses for the adult learner. The various UWI faculties and associated institutes provide "extension" programs for professional groups, industry, and government. For example, UWI at Trinidad provides expertise, training, and management services to the ministries of agriculture throughout the region. By necessity, participants must either reside in or travel to the campus islands.

It is the University or "extramural" centers in the non-campus territories that typify UWI's commitment to its regional and outreach mandate. As centers of culture and learning in the smaller islands, these extramural centers organize educational programs, provide limited classroom and library facilities and academic counseling, and offer tutorial support for students who sit "Challenge Exams" for University credits. They provide liaison and feedback among the University, member governments, and the communities. Each center is generally staffed by a single University tutor, and its limited range of courses and services are occasionally enhanced by visiting lecturers and staff from the main campuses.




**RURAL SATELLITE PROGRAM**

***West Indies Project Sites***

With the worsening economic situation of the Caribbean region, the costs of course delivery and student tuition and maintenance have risen considerably. As more demands are made for faculty and services, UWI has sought ways of improving its services to its constituents in the non-campus territories and maintaining the quality and diversity of instruction of the campuses.

In 1978, UWI looked to telecommunications as a means of meeting the region's pressing demands for education. Project Satellite, a two-month AID-sponsored experiment using NASA's experimental ATS-3 and ATS-6 satellites for video- and audio-conferencing for lectures and seminars, provided a model for the use of telecommunications for extension and outreach activities.

As a strong regional institution, UWI was in a position to address many of the Caribbean development needs identified by AID. The interest and enthusiasm generated by the experiment led to the University of the West Indies Distance Teaching Experiment (UWIDITE) four years later.

## DESCRIPTION

The University of the West Indies Distance Teaching Experiment was the first RSP pilot project to initiate operations--in March 1983--making it **the first full-scale telephone-based conferencing system used for academic course delivery in the developing world.*** UWIDITE links seven sites in six countries with a teleconferencing network: the UWI campuses at Mona (Jamaica), Cave Hill (Barbados), and St. Augustine (Trinidad); a satellite campus at Montego Bay (Jamaica); and extramural centers at St. Lucia, Dominica, and Antigua. UWIDITE provides a means of aggregating and responding to the "small-scale" national demands for training and information--which separately cannot support conventional educational strategies.

Similar to SISDIKSAT in Indonesia, UWIDITE seeks to strengthen the capabilities and complete the academic programs of the three main campuses through resource and course-sharing. For example, the second and third year law courses taught exclusively at Barbados are offered through UWIDITE to the other campuses.

Unlike SISDIKSAT, however, UWIDITE's primary focus is not on undergraduate education or faculty upgrading, nor must it meet the staggering demand for higher education that SISDIKSAT faces. Instead, UWIDITE must serve small groups of people in isolated locations who require information and training often quite different from traditional university curricula. UWIDITE is designed to reflect the University's strong emphasis on outreach and in-service training.

UWIDITE offers a diversity of programs that reach beyond the academic community; many of its programs are aimed at the adult learner. UWIDITE "students" range from the aspiring undergraduate seeking admission to a main campus to the high school science teacher, midwife, community worker, and cardiologist desiring additional professional training and certification.

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* The University of the South Pacific uses teleconferencing for administration, coordination, and occasional tutorials.

Taking full advantage of the "centers of excellence" at Jamaica, Trinidad, and Barbados, UWIDITE makes campus programs available to the non-campus territories. It extends the University's outreach capability by providing the extramural centers access to the extensive academic, continuing education and extension courses, and upgrades the centers' capabilities through expanded tutorial, cultural, and enrichment programs. The UWIDITE user is no longer faced with the dilemma of leaving career and family to obtain additional training.

In summary, UWIDITE serves to:

- strengthen existing academic programs at the main campuses.
- improve the effectiveness of the extramural centers.
- allow students to pursue educational opportunities in their home islands.
- provide a means of communication and interaction to reduce professional isolation and attrition to population centers.
- augment the effectiveness of basic service personnel through improved training.

## INSTITUTIONAL PLACEMENT, SUPPORT, AND MANAGEMENT

### Institutional Placement and Support

UWIDITE direction and management responsibility is lodged with the Office of the Pro Vice Chancellor at the Jamaica campus; the Pro Vice Chancellor serves as Project Director and has general oversight of UWIDITE. In charge of special projects and development programs system-wide, the Pro Vice Chancellor plays a major role in central University planning and administration. On a personal level, the Pro Vice Chancellor brings a high level of interest and actual experience to the project; previously, he had been instrumental in organizing Project Satellite and the subsequent studies which led to the creation of UWIDITE.

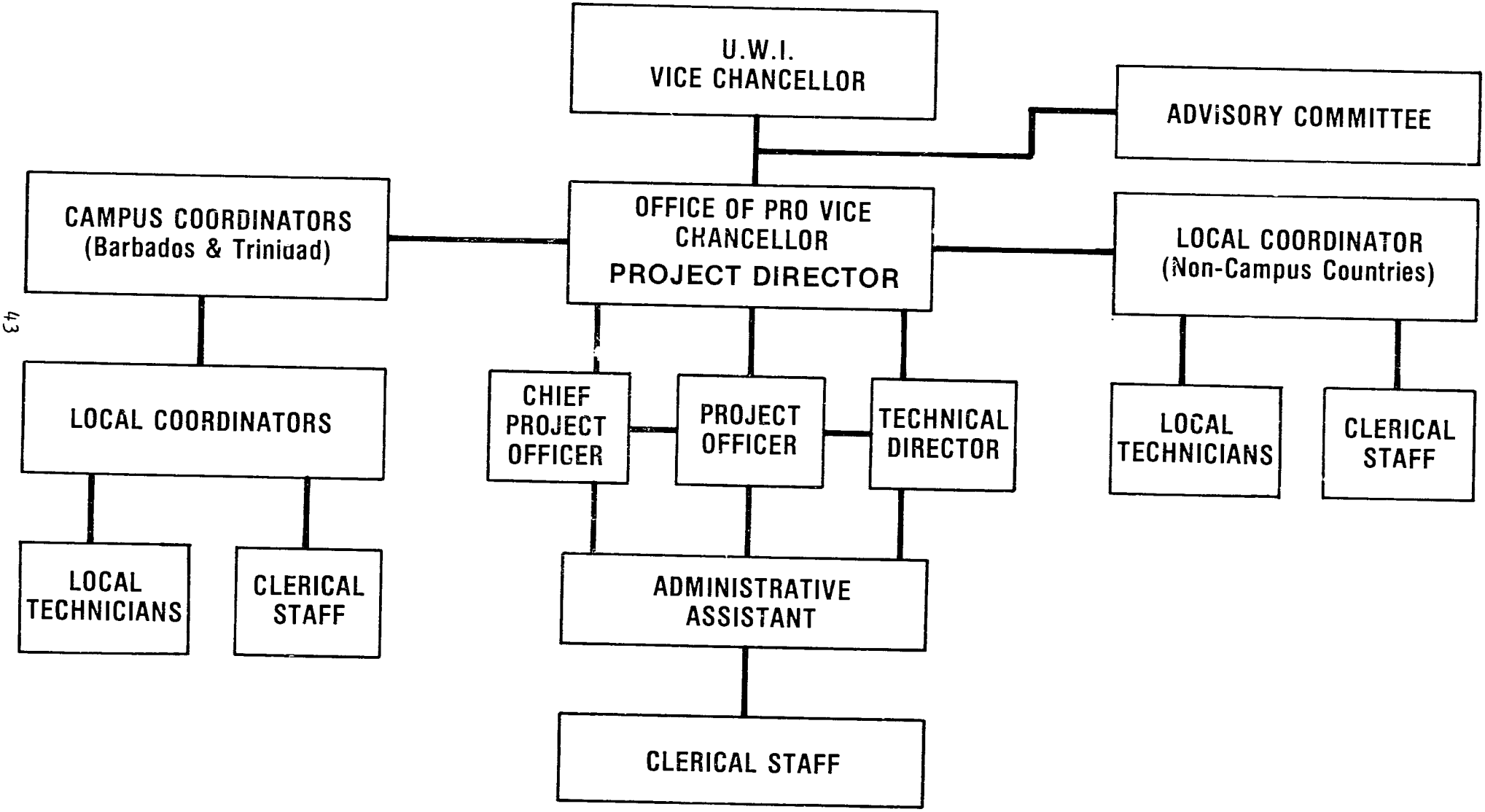
As a "special" or experimental project, UWIDITE's initial operations were supported almost exclusively by USAID through a grant to the University and its technical assistance contract. Under these two mechanisms, the technical network was designed, purchased, and installed; the project structure planned and UWIDITE staff trained; and recurring operational costs--such as leased lines, staff salaries, and faculty honoraria--met. Direct UWI and local government contributions included the classroom facilities. Since the scheduled termination of AID support in early 1986, the University has assumed full financial responsibility for UWIDITE operations.

Since project start-up, however, UWIDITE has attracted further support from other donor agencies (EDF, PAHO, ILO, etc.), corporations (IBM, Colorado Video), and other AID-funded projects in the form of additional equipment and program sponsorship. In addition to central University support, "sponsorship" or charges to organizations using the network may well present a viable financial support base.

### UWIDITE Management

Project headquarters are based at the Mona campus in Jamaica. Management tasks are filled by a full-time core staff with local representatives at each site, similar to SISDIKSAT. While the Project Director is responsible for liaison with the campuses, local governments, telecommunications authorities, and the community, the project

# UWIDITE MANAGEMENT STRUCTURE



officers and staff are in charge of day-to-day operations, program development, and site coordination. Central management responsibilities include:

- operation and maintenance of the electronic classroom.
- program scheduling and registration.
- materials production and distribution.
- software and materials development (in conjunction with course presenters).
- monitoring and formative evaluation.
- user training.

In addition to these routine tasks, at the outset of the project the staff had to devote considerable effort to public relations--in order to introduce UWIDITE's services to the University and community.

Core staff includes a chief project officer, a project officer primarily in charge of science programs, an administrative assistant, and two clerical and one janitorial staff. Although the original staff plan called for a full-time technical director to oversee equipment installation and maintenance, equipment use training, and expanded network planning, UWIDITE has been unable to staff this position permanently. Skilled technicians willing to work for faculty-level salaries have proved hard to attract and difficult to retain. As an interim measure, UWIDITE relies on the part-time assistance of the Jamaica campus electronics department.

At the extramural centers, UWIDITE activities are managed by the appointed local coordinator, usually the resident tutor, and center support staff in addition to their regular duties. At the Trinidad and Barbados campuses, general oversight responsibility rests with the Pro Vice Chancellors, who, in turn, designate from their staffs a local coordinator and support staff (often part-time assistance from campus students). Each site has made provision for part-time technician support, calling on technically trained (or inclined) faculty members or the local telephone company.

In all, UWIDITE activities are carried out by a full-time staff of seven and a part-time staff of approximately eighteen. Augmenting the UWIDITE management staff are, of course, the faculty who prepare courses and teach over the network, the local tutors who monitor student classroom performance, and coordinators of ongoing UWIDITE programs. For example, faculties using the network frequently, such as the Caribbean Food and Nutrition Institute, usually appoint their own UWIDITE program coordinator.

The UWIDITE Advisory Committee is another important component of the management system. Chaired by the Project Director, the Committee provides policy guidance and direction and serves as a bridge between University affairs and project operations. Membership includes the three Pro Vice Chancellors, faculty deans, the director of the extramural department, the University bursar, campus librarians, and representatives from each campus administration. The Committee meets twice a year to review UWIDITE operations and plan subsequent service offerings.

Generally speaking, UWIDITE has enjoyed relatively smooth management and administrative operations from the outset of the project, in large part because of the institutional structure of the University itself. Unlike its Indonesian counterpart, UWIDITE serves and is part of a single institution--albeit an international and multi-site one. It benefits from the standardized procedures and policies governing the University system--from uniform semester schedules, class hours, and grading practices to routine coordination meetings, budgetary guidelines, and faculty terms of service. Furthermore,

UWIDITE operates under the aegis of an established division within the University structure and, through its Advisory Committee, is well integrated into University activities. Its association with and the advocacy of senior administrative personnel with decision-making authority have ensured that UWIDITE receive due consideration in the planning and budgeting processes. Regular presentations to the University Council, whose membership includes ministers of education, on UWIDITE activities give the project high visibility at the governmental level. Finally, the University has been able to appoint and support a full-time staff to the full-time job of running the UWIDITE network.

## UWIDITE TELECONFERENCING NETWORK

Past experience with Project Satellite had demonstrated to the University the benefits of interactive teleconferencing; further studies--primarily the AID-funded Caribbean Regional Communications Study--recommended the use of a two-way communications system rather than a broadcast one, given the need for the relatively isolated populations to communicate directly with one another.

The UWIDITE technical system currently links seven sites in a simple, single-channel teleconferencing network using dedicated lines leased for full-time service from the regional telecommunications carriers. An eighth site--Grenada--will soon be added to the network.

### Electronic Classroom

At each site a classroom has been furnished with basic audioconferencing equipment--microphones, convener, and loudspeakers--and the network control equipment which provides switching capability and signal level adjustments. Each classroom seats approximately 20 people, reflecting the relatively small size of the UWI constituency as well as its desire to limit class sizes.

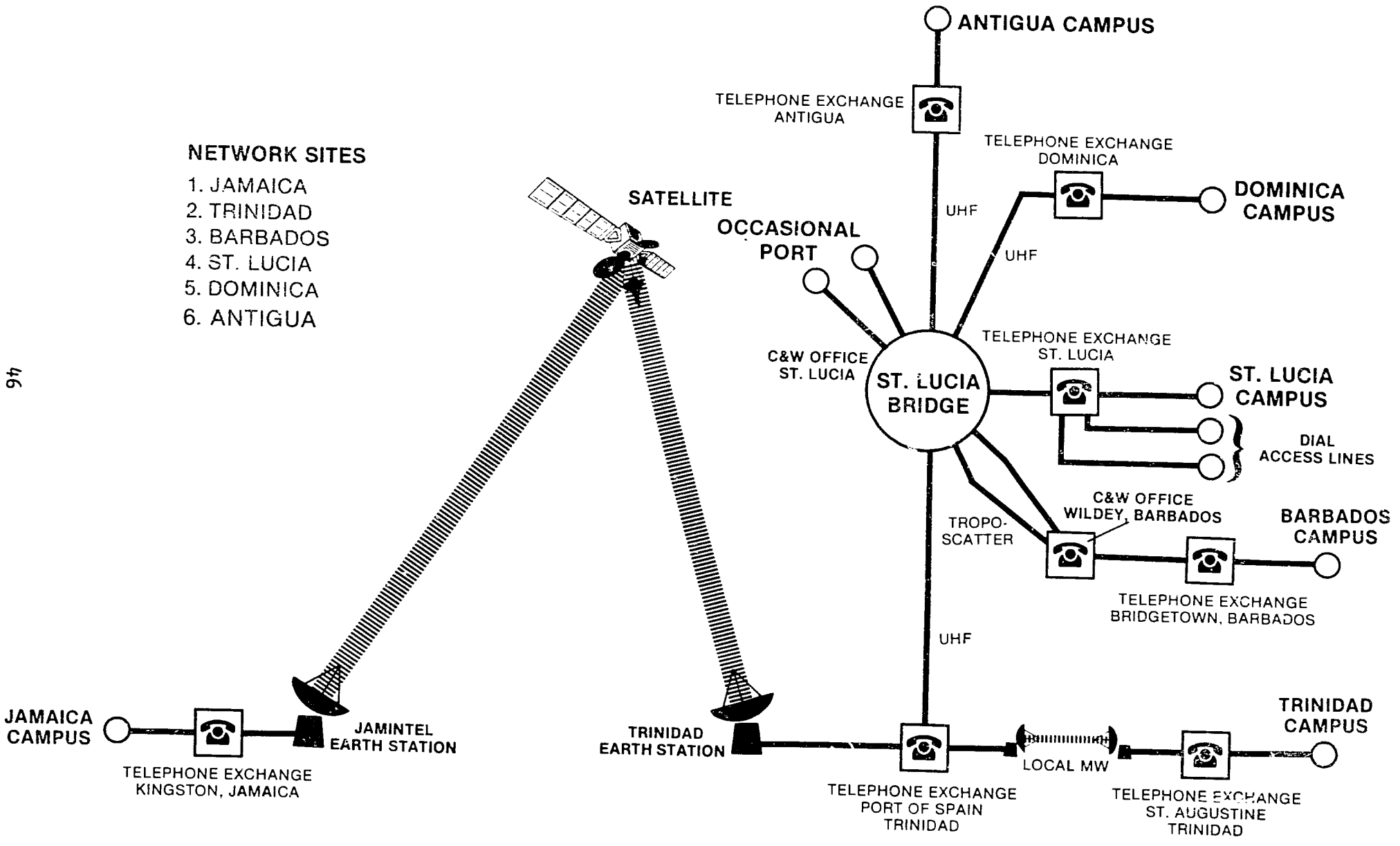
Although initial planning studies did not identify the need for an interactive graphics capability, the University has gradually added graphics equipment to supplement the voice communications system. Through donor and corporate contributions, slow-scan video, telewriting, and microcomputer equipment has been purchased for each site. Because the present network is based on a cost-saving, single-channel design, only one signal can be transmitted at a time. Unlike the two-channel SISDIKSAT network, audio and graphics transmissions cannot be heard and viewed simultaneously. The use of the on-line graphics capability eliminates the voice capability and necessitates that the operator switch between the equipment as required.

In addition to the above on-line equipment, the University has provided stand-alone equipment for off-line use. A video recorder and monitor, cassette player, and x-ray light box (for medical conferencing) augment the electronic classroom.

Finally, each campus has purchased a scrambler to ensure the confidentiality of sensitive discussions, although its effectiveness is limited to two sites at a time.

The UWIDITE network is designed as a large "party line," with each site able to initiate conferences, talk to, and be heard by every other site in the system. This is accomplished by using a telecommunications bridge (i.e., a device for electronically balancing and mixing multiple incoming signals) located in St. Lucia. A dialing system

# U.W.I.D.I.T.E. TELECOMMUNICATIONS NETWORK



with a privacy feature, enabling the selected participation of sites and exclusion of other sites, is incorporated into the design. Although the network is fully interactive, its half-duplex operation requires slight, one-second delays in transmissions to avoid "crashing" noise on the system. Users must pace their transmissions accordingly.

## Transmission System

Three options were considered for the UWIDITE transmission system: leased service on INTELSAT, use of the NASA ATS-3 on an "experimental" basis, and leased private lines on existing terrestrial and satellite systems from the various carriers serving the region. INTELSAT service proved too costly, requiring both the purchase of multiple earth stations and the lease of quarter-transponders (800-1,200 channels), far in excess of the network's one-channel design. Although initially promising, the ATS-3 option was eventually dismissed because of inconsistent transmission quality, uncertain longevity, and competition with national emergency services.

The final option--using the existing telecommunications capacity--proved the most cost-effective and practical approach, given the experimental, albeit promising, project. Thus, the UWIDITE transmission system uses a combination of satellite, microwave, and troposcatter services from several telecommunications authorities.

By eschewing a satellite-based system, UWI knowingly sacrificed the higher transmission quality associated with the technology and became dependent on the technical and operational quality of the regional services. Quality control is provided, however, by the lease of "conditioned" (i.e., improved and repaired) lines dedicated to UWIDITE on a 24-hour basis.

The system currently links Jamaica with Trinidad via the INTELSAT Flight 4 satellite and then by microwave to St. Lucia, the hub of the system where the network bridge is placed. From there the signal is distributed to Dominica and Antigua via microwave and to Barbados via troposcatter. In all, the UWIDITE network relies on the services of eight individual commercial carriers: the local carriers responsible for the ground links between the UWIDITE classrooms and international gateways and the international carriers for the space segments between countries.

**UWIDITE TELECOMMUNICATIONS CARRIERS**

Cable & Wireless (West Indies) Ltd.
Jamaica International Telecommunications Ltd.
Jamaica Telephone Company
Barbados External Telecommunications
Barbados Telephone Company
Trinidad and Tobago Telephone Company
Trinidad External Telecommunications Company
Antigua Public Utilities Authority

Technical management of the network is divided between the University and the commercial carriers, with UWIDITE responsible for the electronic classroom and the telecommunications carriers for the space segment. As discussed above, central technical management activities are based at UWIDITE headquarters in Jamaica. Local technicians at the other sites, however, are instrumental in first-line diagnosis, trouble-

shooting, and repair. If a problem exceeds their capabilities and locally available resources, it is referred to the technical director, and the damaged equipment is sent to Jamaica for replacement or repair.

Operation, maintenance, and quality control of the leased lines fall to the commercial carriers, as well as the interface between local and international transmissions. Although responsibilities are well delineated, resolution of technical problems requires a collaborative effort among UWIDITE, the local telephone companies, and the international carriers in order to isolate the failure. Initially, this complex structure caused confusion and frustration as UWIDITE management had to sift through different telecommunications policies, tariffs, and procedures; but as the carriers grew more familiar with UWIDITE equipment and service requirements, they became more willing to work closely with the UWIDITE network and classroom equipment. In fact, in the non-campus territories it is often the local telephone company technician who doubles as the UWIDITE technician.

Although many of the transmission service providers are private businesses with no national obligations, the University has been successful in obtaining a 20 percent discount in UWIDITE line charges.

## Network Performance

| | |
|---|---|
| PERFORMANCE: | 90% technical reliability |
| PROBLEMS: | line noise<br>inoperability of privacy feature<br>microcomputer errors<br>telewriter failures |
| INNOVATIONS: | multi-carrier teleconferencing network |

Once system architecture was established, design, procurement, and installation were accomplished relatively swiftly between July 1982 and February 1983. Delays were occasioned primarily by non-technical reasons--uncertain shipment schedules, dilatory customs clearance, and difficulty in completing contracts with the several carriers.

Since the opening teleconference in March 1983, UWIDITE has operated successfully with few major problems. Its technical reliability is estimated at 90 percent. The most significant problems are in the transmission system. Although network audio quality compares favorably with the regional telephone service, service disruptions have occasionally eliminated participation of certain sites. The weakest links are the telephone land lines in Jamaica and Trinidad. Along with Barbados, which pairs its telephone cables with other utility cables, these sites are often guilty of "dumping" noise or crosstalk into the network. Although the carriers have instituted regular monthly system-wide checks, it appears that the most likely solution is to add a "gating" system similar to that used in Indonesia at the offending sites.

The basic audioconferencing equipment performs well. Unidirectional microphones were refitted with goosenecks to accommodate UWIDITE users, and some of the push-to-talk switches were replaced. The network control's privacy function, a supplementary feature, unfortunately has never worked, but it is not essential to network performance.

The scrambler equipment added to the network has been effective only for point-to-point, and not multi-point, communications.

UWIDITE's success with the various graphics equipment has been mixed. Its experience with the telewriters (although of different manufacturers) has been similar to that of SISDIKSAT. Problems with the modems, breakage of light pens, and malfunctioning boards have contributed to a highly unreliable, and ultimately unusable, service. The microcomputers have proved promising for non-interactive record and message transfer during experiments, but their utility is undermined by occasional minor signal disturbances and power fluctuation resulting in errors from which the software cannot recover.

The slow-scan equipment has performed most reliably and forms the bulwark of the UWIDITE graphics system. Although its efficacy for text transmission is limited, the slow scan's capability to transmit pictures has become an integral part of UWIDITE's heavy slate of medical programs. Coupled with the x-ray light viewer, the slow scan plays an important role in distance diagnosis and treatment.

The UWIDITE audioconferencing system works reliably and supports a full schedule; UWIDITE continues to experiment with graphics equipment to find the best system suited to its requirements. Most significantly, UWIDITE continues to adapt, redesign, and add hardware to the original system as the project expands and new needs arise.

After four years of operation, the UWIDITE network has gained the credibility, experience, and "critical mass" of demand which makes review and reexamination of the transmission system feasible. With new sites requesting admission to the network and with lease service from U.S. domestic satellites available, a network based on small earth stations may prove both more reliable and cost-effective.

## UWIDITE PROGRAMS AND ACTIVITIES

As the UWIDITE network became operational in mid-term, the period between March and August 1983 served as a trial period, allowing both UWIDITE staff and users to familiarize themselves with teleconferencing operations, uses, and requirements. The UWIDITE staff made good use of this time: over 169 hours of network time were used to orient and train faculty in teleconferencing techniques and materials development, mount a variety of experimental programs and seminars, and to develop procedures for program delivery and system maintenance.

In September 1983, UWIDITE was well prepared to begin its first official academic semester. Since that time,* it has served over 3,300 users and presented approximately 5,385 hours of programming.

### Program Development

The UWIDITE program development process is a collaborative one involving the efforts of UWIDITE's project officers, course presenters, participants, national governments, and the University. Although initially program offerings were more or less

* Through December 1986.

NETWORK SCHEDULE FOR WEEK OF MAY 13, 1984

| | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday |
|---|---|---|---|---|---|---|
| 9:00-9:30 | Administrative Usage | Administrative Usage | Administrative Usage | Administrative Usage | Administrative Usage | TELECONFERENCES |
| 9:30-10:00 | | | Seismic Research | | | |
| 10:00-10:30 | | | | | | |
| 10:30-11:00 | | | | | | |
| 11:00-11:30 | Messages and System Check | Messages and System Check | Messages and System Check | Messages and System Check | Messages and System Check | |
| 11:30-12:00 | Caribbean Lexicography Project | | UWIDITE Technicians | UWIDITE Technicians | | |
| 12:00-12:30 | | | | | | |
| 12:30-1:00 | | | | | | |
| 1:00-1:30 | | | | | | |
| 1:30-2:00 | | Open for Administration | | | | |
| 2:00-2:30 | | | | | | |
| 2:30-3:00 | JHPIEGO Nurses | | | | | |
| 3:00-3:30 | | | | | | |
| 3:30-4:00 | | | | Certificate in Education Teachers of Reading | Certificate in Education Teachers of the Hearing Impaired | |
| 4:00-4:30 | CASTME | JHPIEGO Physicians | CASTME | | | |
| 4:30-5:00 | | | | | | |
| 5:00-5:30 | | | | | | |
| 5:30-6:00 | | | | | Certificate in Education Teachers of Reading | |
| 6:00-6:30 | | | | | | |
| 6:30-7:00 | Accounting | History of The Caribbean | Sociology | Economics | | |
| 7:00-7:30 | | | | | History of The Caribbean (make up session) | |
| 7:30-8:00 | | Law | Law | Law | | |
| 8:00-8:30 | | | | | | |
| 8:30-9:00 | | | | | | |

dictated by the Challenge Exam curricula and the initiatives of UWIDITE staff, today program and course selection is based on request. For example, when a key lecturer at the Caribbean Institute for Mass Communication relocated to Barbados, UWIDITE enabled her to complete her teaching duties. Increasingly, UWIDITE programs provide in-service training and are the result of requests from the member governments or regional service organizations. These applications often involve negotiations with the individual countries to obtain participant release time or even participant selection.

After a potential course or program has been identified, UWIDITE staff must ascertain the specific needs and interest at the participating sites, secure the faculty presenter or expert to teach the course, and assist in content specification with the client and expert. Because staff travel funds are limited, many of these activities are conducted long distance over the network.

In the course of program development, the project officers work with presenters to introduce them to the principles of distance teaching, teleconferencing techniques, and equipment use. If a course selected for UWIDITE is already part of the University curriculum, it is adapted to modules suitable for teleconferencing, with an emphasis on independent reading and assignments. If it is a new program, both a syllabus and support materials are developed. To date, credit courses are taken from existing UWI curricula to avoid the arduous process of academic scrutiny required for certification.

Support materials--study guides, lecture notes, diagrams, and visuals--are an important part of the UWIDITE system. As the UWIDITE student's contact time with the instructor is necessarily limited and much of his study must be pursued independently, support materials are indispensable. After course content is determined, UWIDITE contracts the presenter to prepare course booklets or study guides. UWIDITE provides the authors with graphics and typing assistance and later produces and distributes copies to the sites. At the extramural sites where library facilities are limited and textbooks scarce, UWIDITE materials are often the only resources available. That this process has produced several excellent study guides is attested to by the purchase of UWIDITE materials by non-UWIDITE students taking face-to-face campus courses.

UWIDITE itself has taken the lessons of materials development to heart and prepared a series of teleconferencing guides for distance teachers and students alike, addressing equipment operation, teleconferencing techniques, and materials development. Unfortunately, timely delivery of materials is a problem. Dependent on uncertain and expensive transport services, an estimated 10 percent of the materials arrive at the sites late.

## Course Delivery

UWIDITE operates five days a week, Monday through Friday, between 10:00 a.m. and 8:30 p.m., during the term; evening hours, Saturdays, and term breaks are available for special programs and conferences. About six hours of network time are scheduled daily for academic and in-service programs, with time reserved for UWIDITE coordination and "ad hoc" conferences. Competition for afternoon and evening timeslots has increased with the growth of in-service programs. As part of the University system, UWIDITE adheres to academic schedules and presents its programs according to the University quarter system, although UWIDITE course completion may require two to four terms.

Course delivery generally replicates standard University procedures: registration occurs locally and is logged with UWIDITE and central University administration; local tutors monitor class attendance, distribute materials, clarify assignments, lead "off-line"

discussion groups, and generally serve as a point of contact for the student. Exams are sat locally and transmitted to the instructor for grading. Certificates of Participation are issued by UWIDITE in conjunction with the sponsoring institution or faculty.

The course development and delivery system has worked efficiently and depends heavily on centralized full-time UWIDITE management. Based in Jamaica for organizational and economic reasons (salaries are significantly lower there), it is natural that UWIDITE staff turn to local faculties, institutions, and experts for assistance. This has resulted, not surprisingly, in the bias toward the Jamaica campus as the "center of excellence," thus reducing the substantive input of the other campuses to the outreach effort. As UWIDITE grows and new services and courses are added, however, it is inevitable that the unique resources of the other campuses be brought to bear on UWIDITE programming. Organizationally, the Barbados campus recently assumed greater responsibility for the eastern Caribbean states through the new Office of University Services.

## Programs

The wide diversity of programs in the UWIDITE schedule reflects, in part, the broad spectrum of needs UWIDITE must address and, in part, its mission to experiment with many applications to best ascertain ultimate UWIDITE services. Essentially, UWIDITE supports three types of programs:

- **extension studies** or credit courses leading to formal university certification;
- **extramural studies** or non-credit continuing, professional or in-service training resulting in a Certificate of Participation; and
- **outreach services** or special seminars, consultations, meetings, or conferences supporting basic services in the region.

Extension Studies permit the UWI student to follow University courses for credit toward a degree, as with the Challenge Exams, or a diploma, as with the Certificate of Education program, without matriculating into a campus-based program.

The Challenge Exam Scheme, initiated in 1978, was readily adaptable to the new UWIDITE project. Already a distance education effort, the Challenge Exams allowed qualified students in non-campus territories to pursue the first part of a bachelor of science degree in the social sciences without leaving their home islands. Armed with a syllabus, booklist, and access to the extramural center library, the student followed the course through independent study and sat for the "challenge exam." Students who completed four of the five first-year courses in a maximum of three years were eligible for admission to Part II of the program on campus. Although of benefit to the student and University alike, the Challenge Exam program experienced a high degree of student failure and attrition.

UWIDITE enabled the University to extend tutorials to the students to support them in their studies. UWIDITE presents five first-year courses over the network, four of which comprise the core Challenge program. In principle, it is possible for the UWIDITE student to attend the requisite courses, sit for exams, and matriculate into a campus-based program in two years. In the 1983-84 academic year, 105 students participated in the UWIDITE program; in 1984-85, 222 students enrolled. Attendance has continued to increase in the succeeding terms. In St. Lucia, Antigua, and Dominica, the attrition rate has been reduced to 15 percent and the pass rate increased to 70 percent.

## UWIDITE PROGRAMS

### Challenge Exams

Introduction to Accounting
Personnel Management and Industrial Relations
Elements of Economics
Mathematics and Statistics
Introduction to Sociology
History of the Caribbean
Law and Legal Systems (Tutorial)
Constitutional Law (Tutorial)

### Certificates of Education

Teaching of Reading
Teaching of the Hearing Impaired
Teaching of Mathematics
Teaching of Integrated Science

### Extramural Studies

Training of Pre-School Trainers
Training of Caribbean Labour Administrators
Training of Secondary School Laboratory Technicians
Parasitology
Integrated Pest Management
Cardiology Consultations
Emergency Health Management
Fertility Management Consultations
Obstetrics/Gynaecology Undergraduate Review
Fertility Management Program for Physicians
Fertility Management Program for Nurses
Nutrition for Community Workers
Approaches to Mental Health Problems for Psychiatric Case Workers
Energy Management

### Outreach Programs

Caribbean Art Forms
Creative Writing Workshop
Arts Symposium
Science Quizzes
FARMTECH '85
Radiation Protection for Radiologists and X-ray Technicians

Although the Challenge Exam program was originally intended for the non-campus countries, students from campus countries can now participate in the UWIDITE program. Indeed, it appears that the program will be offered only through UWIDITE.

Other programs have been added to the UWIDITE Challenge Exam Scheme: first-year law tutorials and Certificate of Public Administration, both of which use the first-year social sciences courses.

Aimed at the working professional, the Certificate of Education program for primary and secondary school teachers provides further training and skills upgrading for graduates of the region's Teacher Training Colleges. The resulting UWI Faculty of Education certification is generally recognized as a means of job advancement. The UWIDITE program has offered course series in four different specialties: teaching of reading, of the hearing impaired, of mathematics, and of integrated science. Typically, a course series requires one year of study in Jamaica; through UWIDITE the program can be completed in 15 months at the network sites. Between 1983 and 1985, nearly 180 teachers enrolled in the program; in 1986, 77 awards were made. In the short time that UWIDITE has supported the program, it has doubled the University's annual number of certificate awards.

Other credit programs offered through UWIDITE include courses from the Department of Geology, the Caribbean Institute of Mass Communications, and an undergraduate review program in obstetrics and gynecology.

Extramural Studies form the basis of UWIDITE's in-service training and continuing education effort. UWIDITE's broad constituency is reflected in the varied program offerings, ranging from laboratory management and labor administration to reproductive health and pest management. The individual programs themselves differ in length: some for as little as eight hours, others lasting up to six months. Many of the programs are repeated regularly or are ongoing.

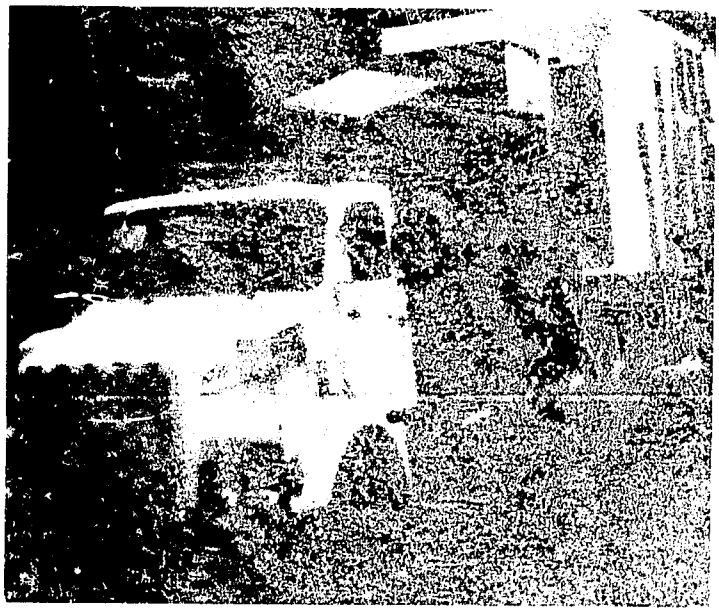
The UWIDITE programs provide direct support to government and public service personnel, enabling them to do their jobs better. Most of the programs are instigated and sponsored by regional institutions, professional organizations, and donor agencies. For example, a 10-week emergency health management course was funded by the Pan American Health Organization (PAHO); a training course for school science lab technicians was supported by the Commonwealth Foundation; and a fertility management course was financed by the Johns Hopkins Program for International Education in Gynecology (JHPIEGO), an AID-funded project.

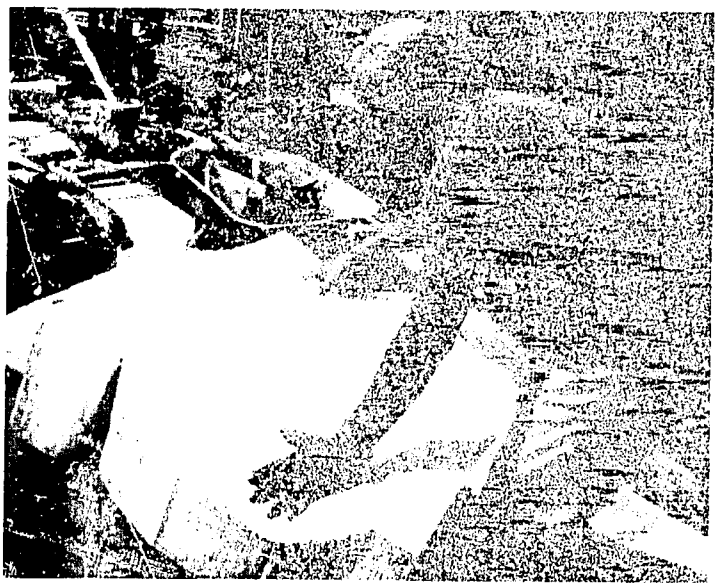
The health sector has been particularly active in its use of the UWIDITE system. The University itself, through its Faculty of Medical Sciences in Jamaica, Queen Elizabeth Hospital in Barbados, and its Mount Hope Medical Complex in Trinidad, plays a major role in the training of medical personnel and health care delivery in the region. UWIDITE supports a number of its programs.

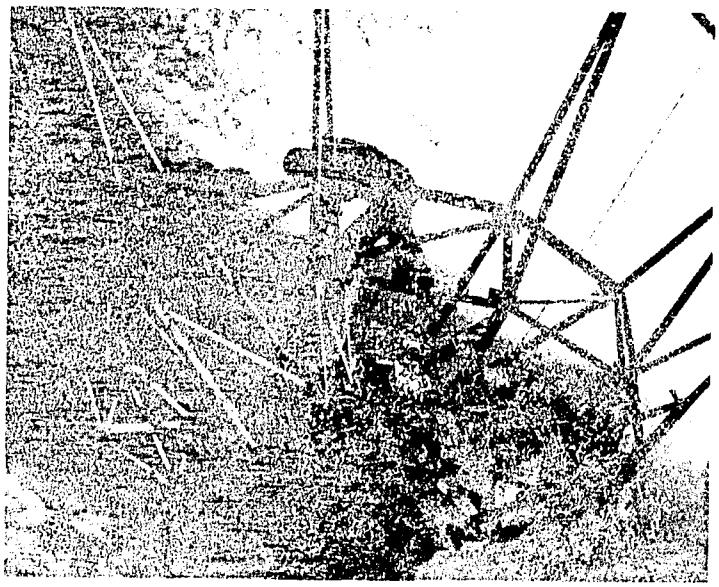
A major activity was the JHPIEGO Fertility Management program to provide post-graduate-level training for doctors and nurses in reproductive health and family planning. Started in February 1984, the 24-hour course has been repeated six times and has attracted between 60 and 70 participants per session. To date, nearly 300 nurses and 200 doctors have been trained over UWIDITE.

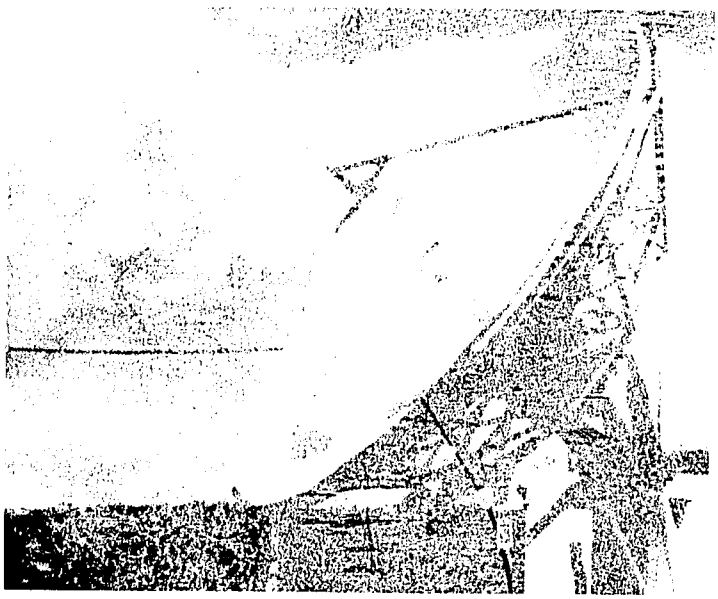
The Caribbean Food and Nutrition Institute developed a 24-hour course for community workers in agriculture, education, health, and development aimed at strengthening

# Images from the AID Rural Satellite Program

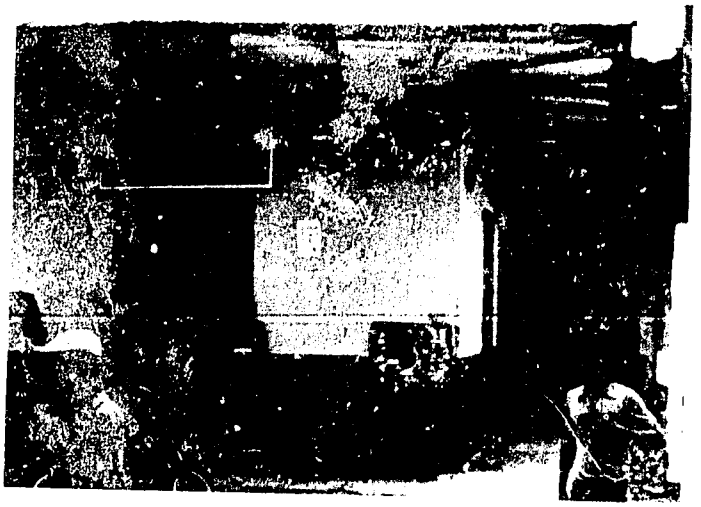








Satellites can provide telecommunications services to remote and rural areas. The smaller the earth stations, the lower the costs. The Peru Rural Satellite Project is the first to successfully use small six-meter stations with the international satellite system for internal communication.



**Basic telephone service is essential to rural development.** For the first time, the rural Peruvians in the remote San Martin region are connected with the nation's commercial and political centers--and with each other. Within months, the new telephone system was used to capacity and has since been expanded twice to accommodate heavy usage. Over 110,000 phone calls were made in 1985, generating over $100,000 in revenues.

b

Push-to-talk microphone

Telephone terminal and private telephone

Facsimile machine

Telewriter/graphics display

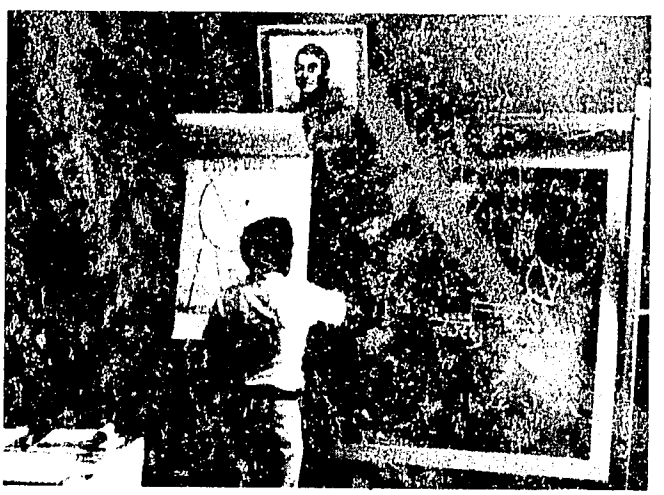
Typical classroom layout

**Special equipment attached to telephone lines can transform ordinary telephones into audioconferencing systems linking many groups over vast distances.** Using a simple telephone circuit, groups of people can talk, view pictures transmitted by telewriters, and receive text via facsimile. The Rural Satellite Program installed 25 "electronic classrooms" for three different projects.

In-service training of primary school teachers

Administration of rural institutions

University teaching to thousands of students

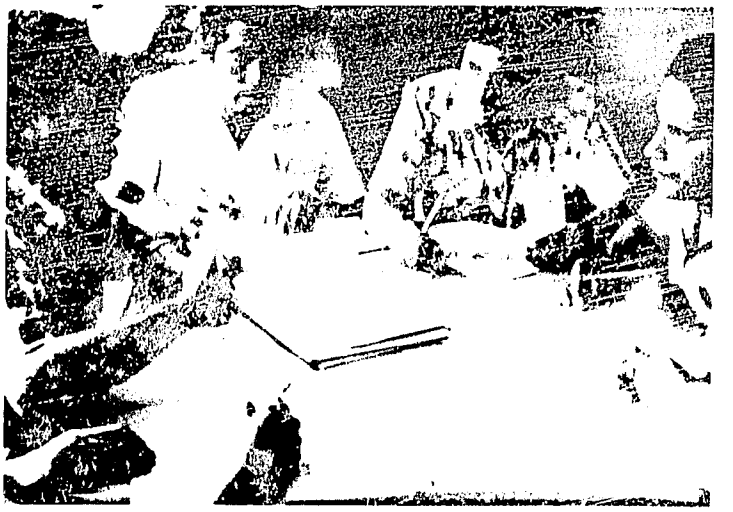


Technical training for telecommunications personnel

**Interactive audioconferencing networks can reliably and affordably support many different development activities.** Audioconferencing provides a means of extending scarce expert resources and educational opportunities to remote and rural areas. The Rural Satellite Program explored its applications for health, education, and agriculture. The Pilot Projects in Indonesia, the West Indies, and Peru used audioconferencing for university teaching, in-service training of health care workers, teachers, and agricultural extension agents, medical consultations, research exchange, and rural administration. Over 92 percent of the participants indicated it helped them do their jobs better.

Animal husbandry training for extension agents

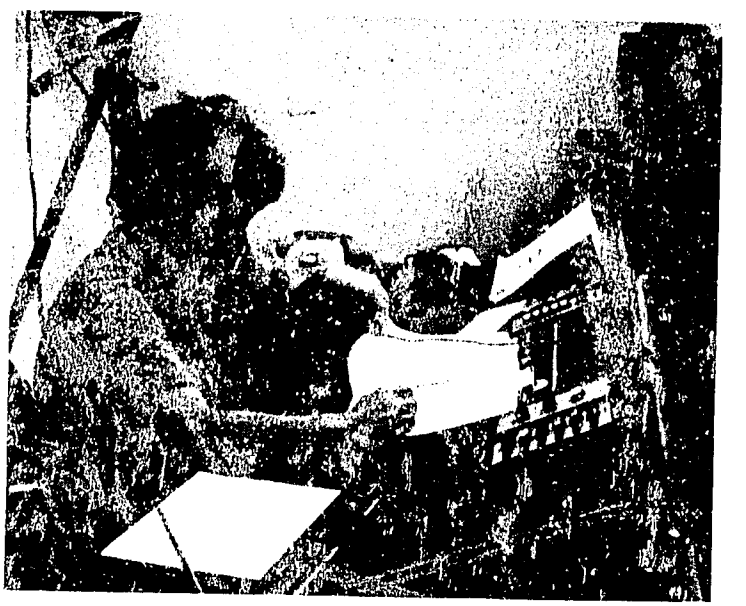
Coordination of Child Health Campaign

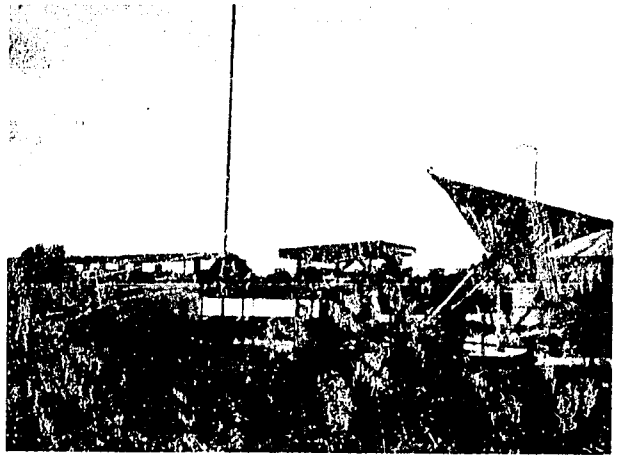


DEPARTEMEN PENDIDIKAN DAN KEBUDAYA
UNIVERSITAS HASANUDDIN
KANTOR PUSAT
PROYEK PENDIDIKAN JARAK JAUH
MELALUI SATELIT
USAID-BKS PTN INTIM

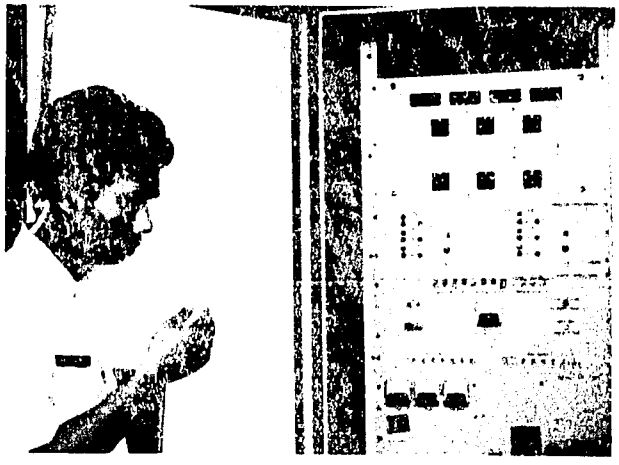
**Effective audioconferencing programs need careful coordination and management of programming, technical, and administrative components.** General requirements for successful communications support projects include:

- a central coordinating office supported by staff at all sites
- accurate identification of user needs and appropriate program development
- thorough training of management and technical staff, as well as program presenter and general users
- development and distribution of educational support materials
- adequate budget for central office and local site operations



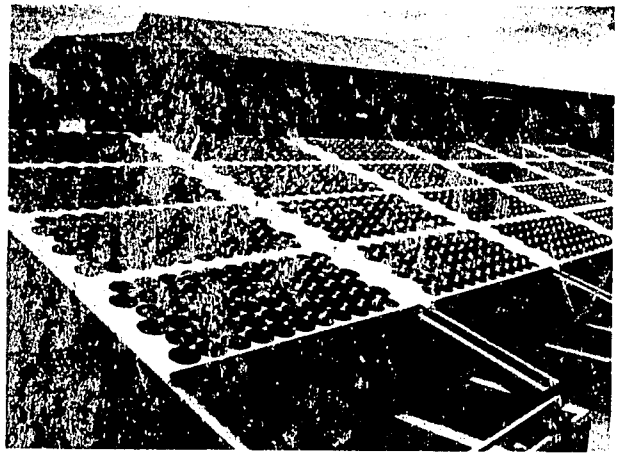


Earth station, photovoltaics, and audioconferencing room

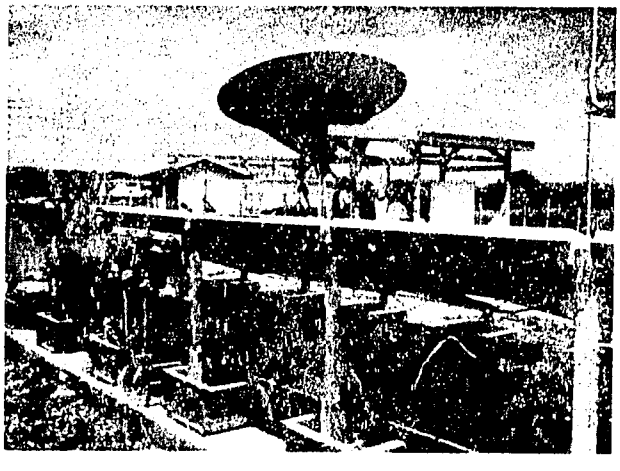


Station requires only quarterly maintenance visits

**Satellite technology can be adapted to withstand the rugged conditions prevailing in rural areas.** In the remote Indonesian village of Wawatobi, the Rural Satellite Program designed and installed a small solar-powered earth station and photovoltaic array. The station provides multi-channel telephone service with low maintenance and power requirements. It operates on less electricity than a home steam iron.



Photovoltaic panels



Panels and storage batteries

their ability to promote good nutrition practices. The program is repeated annually; over 100 community workers have been reached.

In addition to professional training, UWIDITE facilitates patient care. Monthly conferences have been held by interdisciplinary groups in fertility management and cardiology to discuss case presentations, consult on diagnosis and treatment, and determine patient transfer to major hospitals. **In 1985 the first Caribbean Cardiology Conference was organized and conducted entirely by teleconference. Over 100 people in six countries participated.**

That UWIDITE provides an important service to the region is evidenced by the large number of service requests from public organizations and their willingness to assume course expenditure by their reliance on the network itself. The Caribbean Labor Administration Center (CLAC) not only designed and mounted a 36-hour course on labor administration, but it also flew participants from five non-UWIDITE sites to the nearest electronic classroom each week. In three months, the CLAC reached 41 officials--nearly 20 percent of its outreach effort over the previous seven years.

Grenada will soon join the UWIDITE system, largely through the generosity of Project Hope, which is convinced of the value of the UWIDITE medical programs in improving local skills and reducing medical professional attrition from the small island.

**Outreach Programs** are the final component of the UWIDITE education program. Classified as one-time or very short-term programs, UWIDITE's outreach activities encompass social service support, cultural exchange, and enrichment programs. For example, during the past three summer terms, UWIDITE has presented a program on Caribbean art forms--uniting the region's local artists and authors with participants at the seven sites to share their work and explore the creative development process. Through the local Science Teacher's Association, UWIDITE conducted two "science quizzes" for national teams of students under 15 years of age. FARMTECH '85, a seminar/exhibition on agricultural technology held in Jamaica, was extended to the other islands as agricultural scientists presented their papers and led discussions over the network.

UWIDITE is also used for administrative conferences in support of University operations, specifically in:

- examinations and examination schedules
- student admissions
- student affairs
- administration of the library system
- meetings of University boards and committees

The University Registry holds weekly teleconferences to coordinate activities and expedite decisions of the three campus secretariats. Eighty-four members of the University Senate convened a meeting over the UWIDITE network, saving thousands of dollars in travel costs. The libraries, faculties and departments, public relations unit, staff unions, and undergraduate guild have all made substantial use of the UWIDITE communications network.

## USAGE, USERS, PARTICIPATION, AND EFFECTIVENESS

During its first four years, basic patterns of usage have emerged:*

- 60 percent of UWIDITE usage is devoted to teaching, 15 percent to University administration, and 25 percent to internal UWIDITE management and training. Not surprisingly, teaching and administrative usage has increased and internal management decreased over the years of operation.

- Most UWIDITE "students" (82.2%) are between the ages of 26 and 40 years, with the preponderance (38%) falling in the 31-35 year old category--a period when both family and career pressures normally make it difficult to pursue additional training.

- The number of participants in the various UWIDITE courses and programs differs dramatically from the 30 undergraduates in a Challenge Exam course, to the 60 nurses in the fertility management course, to the 100 cardiologists at the annual conference. In general, each program averages about 30 registrants with 6-10 at each site.

- As expected, the extramural centers at Dominica, Antigua, and St. Lucia have proven the most eager users of the UWIDITE network, accounting for 62 percent of network use. Jamaica follows at 16.7 percent, Barbados at 11.8 percent, and Trinidad at 9.2 percent. The high number of Jamaican participants is explained not by the presence of UWIDITE headquarters on campus, but by their enthusiasm for the Certificate of Education program, which originated in Jamaica and is held in high regard there. Continuing problems with the line quality in Trinidad have most likely discouraged some participants on that island.

- Twice as many programs originate from Jamaica as from the other two campuses, again because of its Faculty of Education's role as originator of the Certificate of Education program. The Challenge Exam courses, including the law tutorials and Certificate of Public Administration program, are equally divided--with two courses presented by each campus. The UWIDITE health programs are multi-site in origin; even the extramural sites of St. Lucia and Dominica have served as sources for presentations for the nutrition and undergraduate review programs.

Students (92%), teachers (95%), and administrators (99%) have found the audioconferencing system easy to use. Whereas 75 percent of UWIDITE's teachers find distance teaching more demanding in lesson and materials preparation, their efforts apparently are successful because 89 percent of their students find UWIDITE courses interesting and 98 percent attend regularly. Interaction between student and presenter is high; 60 percent of UWIDITE students have actively participated in discussions over the system, despite some complaints that regional accents--not transmission quality--inhibit understanding. In fact, 87 percent would like to take more UWIDITE courses.

Sixty-eight percent of the students believe they learn as much or more and cover the same amount of material in UWIDITE courses as in traditional, face-to-face classes. Yet, like Indonesia's SISDIKSAT students, the majority (74%) would prefer to have the professor in front of them. This preference apparently has little to do with student-

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* Based on survey data for 1983/84 and 1984/85 collected by Abt Associates.

professor communication as UWIDITE students report an above average level of interactivity, and only 33 percent of the teachers themselves think that face-to-face contact is important to learning.

This preference is significantly reduced by three factors: student "maturity," tutor presence, and materials. Students in the graduate- or professional-level UWIDITE programs are more comfortable with distance learning--only 47 percent of UWIDITE's adult learners express preference for the conventional classroom.

Local tutor presence lowers conventional course preference even more dramatically to 35 percent. Although tutors can contribute little in subject knowledge, their presence in the electronic classroom encourages interaction, discussion, concentration, and attendance. Today, nearly all (98%) of UWIDITE courses use local tutors.

The provision of materials also has a positive impact on learner preference. The majority of students believed that both interaction and class preparation was higher when materials accompanied the lecture.

Although UWIDITE students may not have learned better than their classmates in traditional classrooms (UWIDITE's pass/fail rate is comparable to that of regular courses), more students learn. Enrollment in both the Challenge Exam and the Certificate of Education programs has increased, and UWIDITE has been able to double the annual number of Certificate of Education awards. Since 1985, 112 UWIDITE students have completed the Certificate program.

COMPARISON OF USER ATTITUDES:
SISDIKSAT AND UWIDITE

A. STUDENT RESPONSES

| Survey Question | SISDIKSAT (% agreeing) | UWIDITE (% agreeing) |
|---|---|---|
| 1. Courses are well organized and presented | 85 | 89 |
| 2. I actively participate in distance course | 56 | 60 |
| 3. I learn as much or more in distance course | 67 | 68 |
| 4. I prefer face-to-face classes | 59* | 74 |

B. TEACHER/TUTOR RESPONSES

| Survey Question | SISDIKSAT (% agreeing) | UWIDITE (% agreeing) |
|---|---|---|
| 1. I am comfortable teaching a distance course | 95 | 95 |
| 2. Teaching a distance course is more demanding | 75 | 75 |
| 3. Materials preparation for a distance course takes more time | 55 | 69 |
| 4. Students learn as much or more from a distance course | 95 | 43** |

* plus 22% undecided
** plus 18% undecided

**Can a teleconferencing network provide significant support to a regional institution?** UWIDITE is the first experiment in the developing world to provide education and training via an interactive telecommunications network. Furthermore, it does so across national boundaries.

Initial enthusiasm on the part of students and teachers participating in UWIDITE and on the part of University administration to undertake an innovative experiment has been followed by significant regional demand for UWIDITE services. Already tightly scheduled to accommodate teleconferencing activities, UWIDITE continues to receive new proposals for programs and requests for services. It has been readily adopted by regional and development organizations, governments, and by UWI faculties and administrators alike.

The participating extramural centers ask for expanded services; non-participating member countries are clamoring for admittance to the network. Since its inception, UWIDITE has already added two sites and will soon add two more.

More important, UWIDITE has developed a sound support base. At University Council direction, funds are routinely allocated for UWIDITE operation in the annual University budget. Regional institutions and donor agencies contribute to its operation through user charges and depend on its services. The regional long distance telecommunications carrier has reduced UWIDITE's tariffs and provides additional technical maintenance services. And currently, the University and member governments are exploring options for system expansion.

UWIDITE has enabled the University, affiliated institutes, and governmental associations to reach students and professionals in the non-campus countries with quality instruction, to support development and outreach programs, and to strengthen local social service delivery. It has received recognition for its services throughout the region. In 1984, UWIDITE won the Gleaner Honor Award for its **". . . most dramatic impact on the quality and improvement of life not only in Jamaica but the entire Caribbean, enhancing the education of the people of the region."**

# RCSP: PERU RURAL COMMUNICATIONS SERVICES PROJECT

## BACKGROUND

Like many developing countries, Peru has experienced a steady decline in economic conditions over the past decade. In fact, the last 20 years have seen virtually no growth in the per capita gross domestic product. Faced with economic and social crises, the Peruvian government has emphasized the development of its vast rural areas in an attempt to increase agricultural productivity, create jobs, and stimulate its lagging economy. By opening up new production areas in the promising "high jungle" regions, the government hopes to redress existing food shortages and the unfavorable agricultural export balance.

The Department of San Martin, in the isolated upper Huallaga Valley, has been the focus of agricultural expansion and rural development efforts. Very much a frontier area, San Martin is geographically separated from the commercial, political, and scientific centers of coastal Peru by the Andes Mountains. The absence of essential infrastructure and communication services--such as roads, transportation, postal and telephone systems--has conspired to compound the isolation and retard the social and economic development of the region. In short, San Martin has had little access to information essential to its development--agricultural workers remain ignorant of new cultivation techniques, farmers have little means of acquiring market information and purchasing needed farm inputs, commercial transactions are limited to regional marketing centers, medical care relies solely on limited professional resources, and educational and training opportunities are nearly non-existent.

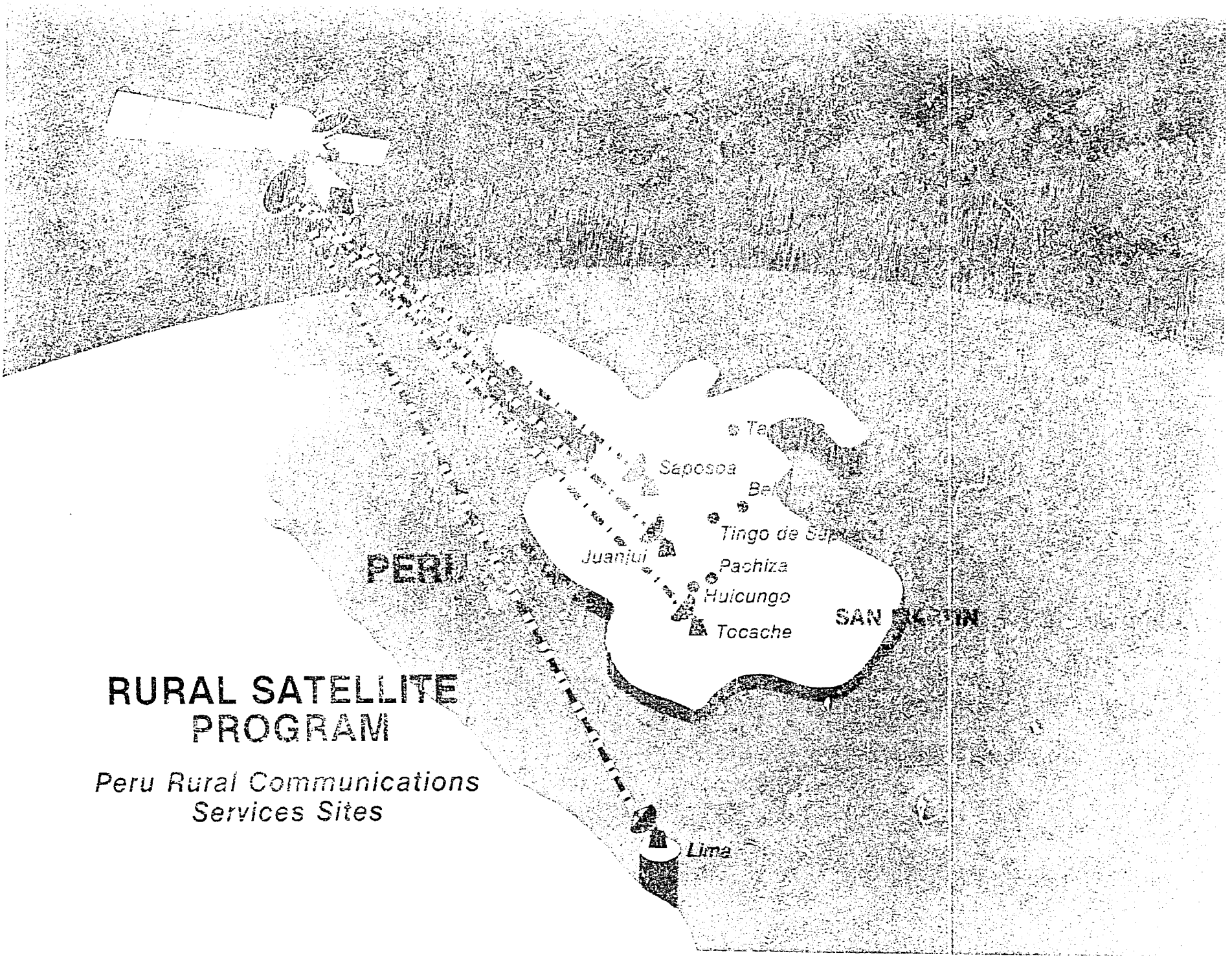
In the mid-1970s, the Peruvian telecommunications authority--Empresa Nacional de Telecomunicaciones (ENTEL)--established a satellite-based communications system for international and inter-city communications using INTELSAT services. At the same time, engineers from ENTEL's Satellite Planning Group and the Instituto Geofisico began to advocate the use of satellite technology to expand the national rural communications network, suggesting that satellite systems compared favorably with traditional ground and microwave systems from both economic and service perspectives.

In 1978 the Instituto Geofisico hosted a seminar for Peruvian and international telecommunications experts to consider the viability of satellite-based rural communication systems. Planning exercises targeted rural San Martin as a likely area for satellite service. These discussions started the process that eventually led to ENTEL's and AID's collaboration on the Rural Communications Services Project (RCSP).

## DESCRIPTION

The Peru Rural Communications Services Project is based on the premise that telephone service is an effective means of overcoming infrastructure and resource limitations and constitutes an essential component in the development process.

Like the other Rural Satellite projects, the RCSP is designed to integrate telecommunications into the process of rural development. Unlike SISDIKSAT and UWIDITE, however, the Peru Project confronts a very basic challenge: providing telephone service




# RURAL SATELLITE PROGRAM

*Peru Rural Communications Services Sites*

to an isolated and rural area. Its primary aim is to demonstrate the flexibility, effectiveness, and economy of a hybrid system of small satellite earth stations and radio links to support basic communications to rural communities.

Under the RCSP, public telephone service was introduced to seven strategically located communities in the Department of San Martin, ranging in size from 800 to 15,000 inhabitants. These communities are divided into primary and secondary sites. The primary sites of Juanjui, Tocache, and Saposoa are relatively populous, rapidly growing commercial towns, sporting a diversified mix of merchants, small industries, and some rudimentary professional services--such as hospitals, clinics, and schools. The villages of Bellavista, Huicungo, Pachiza, and Tingo de Saposoa are designated secondary sites. Small and agrarian, these communities rely on visiting paraprofessionals for basic services. With the installation of the telephone system in early 1984, these isolated communities were connected for the first time with each other and with the rest of the country through the national telephone network.

Building on the basic telephone system, audioconferencing facilities were placed in each town, as well as Tarapoto, the region's commercial center, and Lima, to serve the national health, agriculture, and education ministries. A wide variety of administrative, training, diffusion, and promotion programs have been developed. By linking field and extension personnel with regional and central ministry headquarters, audioconferencing improves the operations and outreach of these centralized institutions. The geographically isolated agricultural extension agents, health care workers, and teachers of the San Martin region benefit from improved access to Lima-based specialists for in-service training and consultation; the ministries now have a means of expediting administrative procedures, coordinating programs, and supervising staff. Overall, enhanced communications supported by the audioconferencing network can make both the field personnel and Lima-based bureaucrats more responsive to each other's needs and consequently more effective in their work.

In summary, the Rural Communications Services Project has three major goals:

- provide a reliable and cost-effective means of extending rural telephone service;
- explore the use of basic telephone service to meet the communications needs of the rural populace; and
- demonstrate the utilization of a telephone-based audioconferencing network to support the region's social services and development programs.

Through the provision of telephone and audioconferencing services, the RCSP responds to a variety of communications needs essential to the region's development.

## INSTITUTIONAL PLACEMENT, SUPPORT, AND MANAGEMENT

### Institutional Placement

Unlike the Indonesia and West Indies projects in which the users take responsibility for the operations and programming of the teleconferencing network, relying on the telecommunications carriers only for transmission services, sole management responsibility for the RCSP rests with ENTEL. As the national telecommunications authority, ENTEL is exclusively in charge of telecommunications and broadcast signal delivery, including telephone, telex, television, etc. The basic telephone service component of the

Project naturally falls within ENTEL's domain, as the only legal telecommunications carrier in Peru.*

In a significant departure from its traditional commercial service orientation, ENTEL has also assumed responsibility for the social service delivery component of the Project, specifically the development and coordination of the audioconferencing service, including programming as well as network operation and maintenance. Although the recipients and beneficiaries of the RCSP audioconferencing component are the managers and field personnel of the Ministries of Health, Education, and Agriculture, it was decided that dividing management responsibilities among three separate user organizations for a totally new venture would result in inefficient operations. What belonged to all would, in actuality, belong to none. ENTEL, as central service provider, presented an ideal locus of management responsibility. Yet, ENTEL was exclusively a technical service provider expected to generate a profit. Its role as a social service provider was unprecedented.

ENTEL, however, was eager to support the national development effort and extend telephone service to rural areas. The RCSP offered this opportunity and became ENTEL's first social service offering.

## Support

Under a cooperative agreement, the RCSP received support from both ENTEL and AID. AID provided the basic equipment required to extend telephone service to San Martin, i.e., the earth stations and power generators, the audioconferencing equipment, and some technical assistance. ENTEL assumed the costs of incorporating this equipment into its telecommunications system: transponder space, radio links, shipment, installation, equipment facilities and telephone offices, and staff to operate and manage both the telephone and audioconferencing services.

Unlike the SISDIKSAT and UWIDITE projects, the RCSP was not burdened with telephone transmission charges. ENTEL provided the transmission services required by the audioconferencing programs free of charge to the participating ministries.

Since the termination of the cooperative agreement in 1985, ENTEL continues to provide free programming and audioconferencing service to the ministries and field sectors. Recently it initiated negotiations with other donor agencies to extend similar service and programs to the Andean region of Peru.

## RCSP Management

To carry out the social service objectives of the Project, ENTEL established an "applications planning" unit charged with promoting, implementing, and evaluating appropriate communications strategies to support the activities of the user groups.

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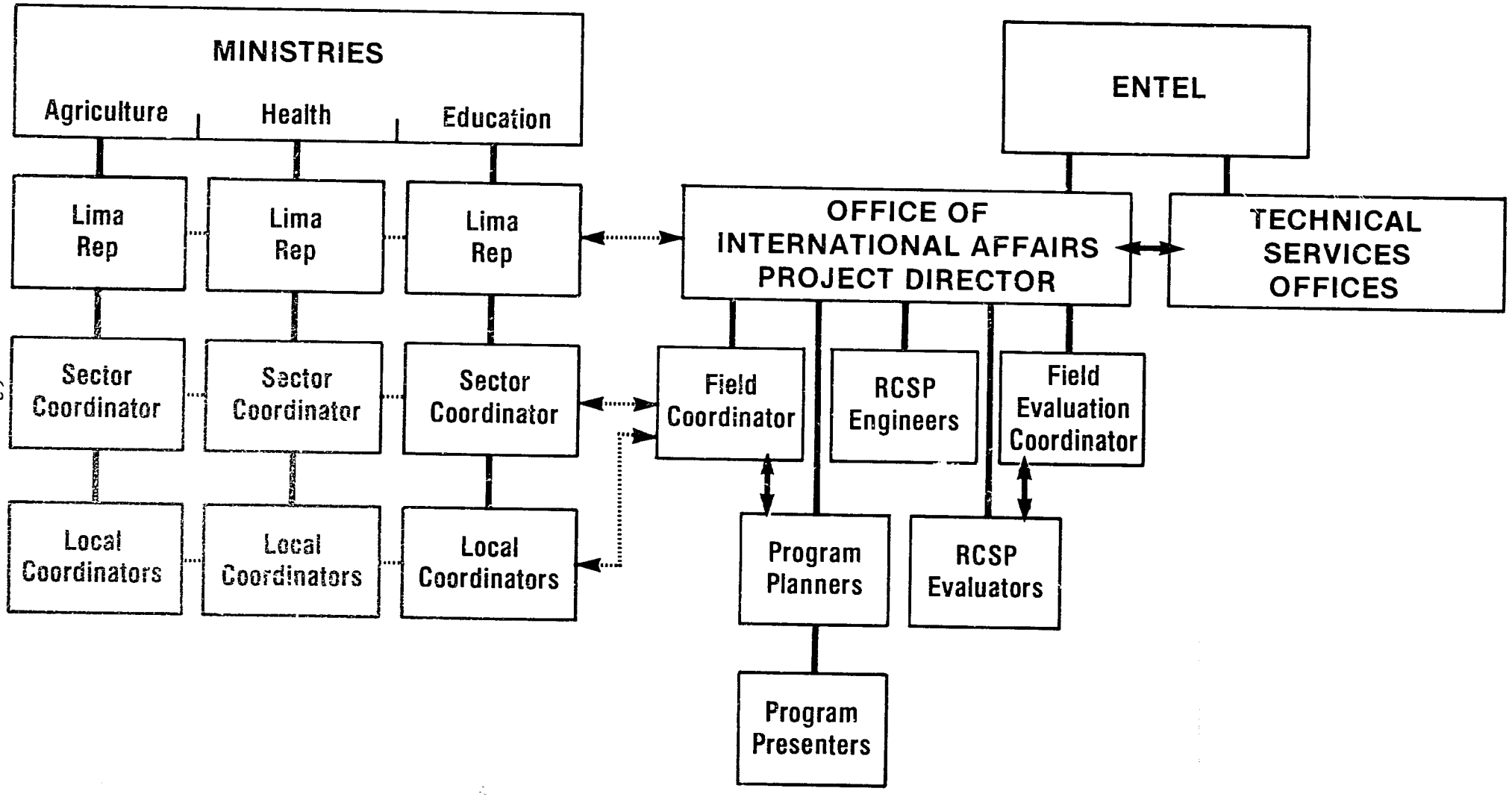
* With the exception of the city of Lima, which is served by a private company.

# RCSP MANAGEMENT STRUCTURE



Soon after its inception, the RCSP was placed under the direction of ENTEL's Office of International Affairs and supported as an "international project." The office's Director, one of the original team of engineers which spearheaded the move for satellite-based rural systems, and his staff formed the nucleus of the RCSP management team. Again in a departure from the standard ENTEL personnel mix of engineers and economists, the RCSP management team united for the first time engineers and social scientists to jointly develop and support the technical and programmatic aspects of the Project. RCSP support, however, was not limited to the Office of International Affairs staff; throughout the Project, RCSP staff looked to other ENTEL departments for support. For example, the design and installation of the basic infrastructure required the efforts of ENTEL's earth station engineers and its rural services specialists. In the field, the ENTEL office in Tarapoto, the hub of the region's communications system, provides maintenance support and technical supervision of the commercial service operations in the RCSP communities.

Central RCSP operations are headquartered in Lima with a field office located at the ENTEL office in Tarapoto. Until late 1985, a field evaluation office was maintained in Juanjui.

RCSP's Lima and Tarapoto offices work in close collaboration to facilitate the dialogue between the ministries in Lima and the sectors in San Martin, identify user needs, develop programming and schedules, and distribute materials.

The Lima office's prime orientation is toward the ministries' central operations. Approximately six part-time staff members are responsible for:

- liaising with ministry personnel and responding to their programmatic needs;
- developing audioconferencing programs in response to field requests (including expert or "expositor" identification);
- assisting experts in adapting their presentations and material to the distance medium;
- preparing the monthly conference schedule; and
- collating and analyzing evaluation data.

Because most programs originate from Lima, the RCSP personnel in Lima often serve as program moderators.

Ongoing engineering assistance is provided by ENTEL engineers assigned to the Project. They monitor the operation and performance of the audioconferencing network, undertake complicated repairs, and develop designs for network expansion.

The Tarapoto field office's primary "client" is the sector personnel in the region. Because most RCSP programs have a field orientation, i.e., the transfer of information from Lima-based experts to field staff, the RCSP field office is most active in working with sector coordinators to identify user needs. In the experimental stages of the Project, this office was manned by a full-time Program Coordinator and a few support staff and assisted by an Evaluation Coordinator. With procedures now regularized, this position has been reduced to part time. Field office responsibilities are:

- identification of user needs and program requests;
- initial program scheduling;
- monitoring field audioconferencing facilities;
- coordinating program participation (notifying sectors of schedule changes, etc.);

- distributing monthly schedules and support materials; and
- collecting survey data.

Sector Coordinators and Local Coordinators have been appointed by the ministries to serve as points of liaison between the RCSP and the departments of health, agriculture, and education in the San Martin region. The three Sector Coordinators, based in Tarapoto, represent regional sector needs and work with the RCSP Field Coordinator to develop program plans and manage sector audioconferencing activities. The Local Coordinators, one at each site for each sector, represent local user concerns and interests, notify local participants of up-coming programs, and distribute program schedules and materials.

In principle, RCSP sector representatives should total twenty-four, but in actuality the manpower support has been somewhat less. The ministries in Lima have done little to reinforce the responsibilities of the job in their field staff. The RCSP duties became an additional task, and representatives received no compensation for their efforts. All the same, most of the Sector Coordinators and Local Coordinators, particularly in the health and education sectors, support RCSP activities conscientiously in response to the field users.

More disappointing has been the lack of support provided to ENTEL by the ministry representatives in Lima. Although written agreements or "convenios" formalized ENTEL-ministry interaction and coordination, the ministries have never really taken an active part in the RCSP audioconferencing program. The primary reason has been the unsettled political climate prevailing during the life of the Project. As one presidential administration phased out and a new one installed, frequent staff changes left the RCSP positions unfilled. Also, it appears that in reality the Lima-based ministries are not overly concerned about maintaining regular communications or providing support to sector personnel.

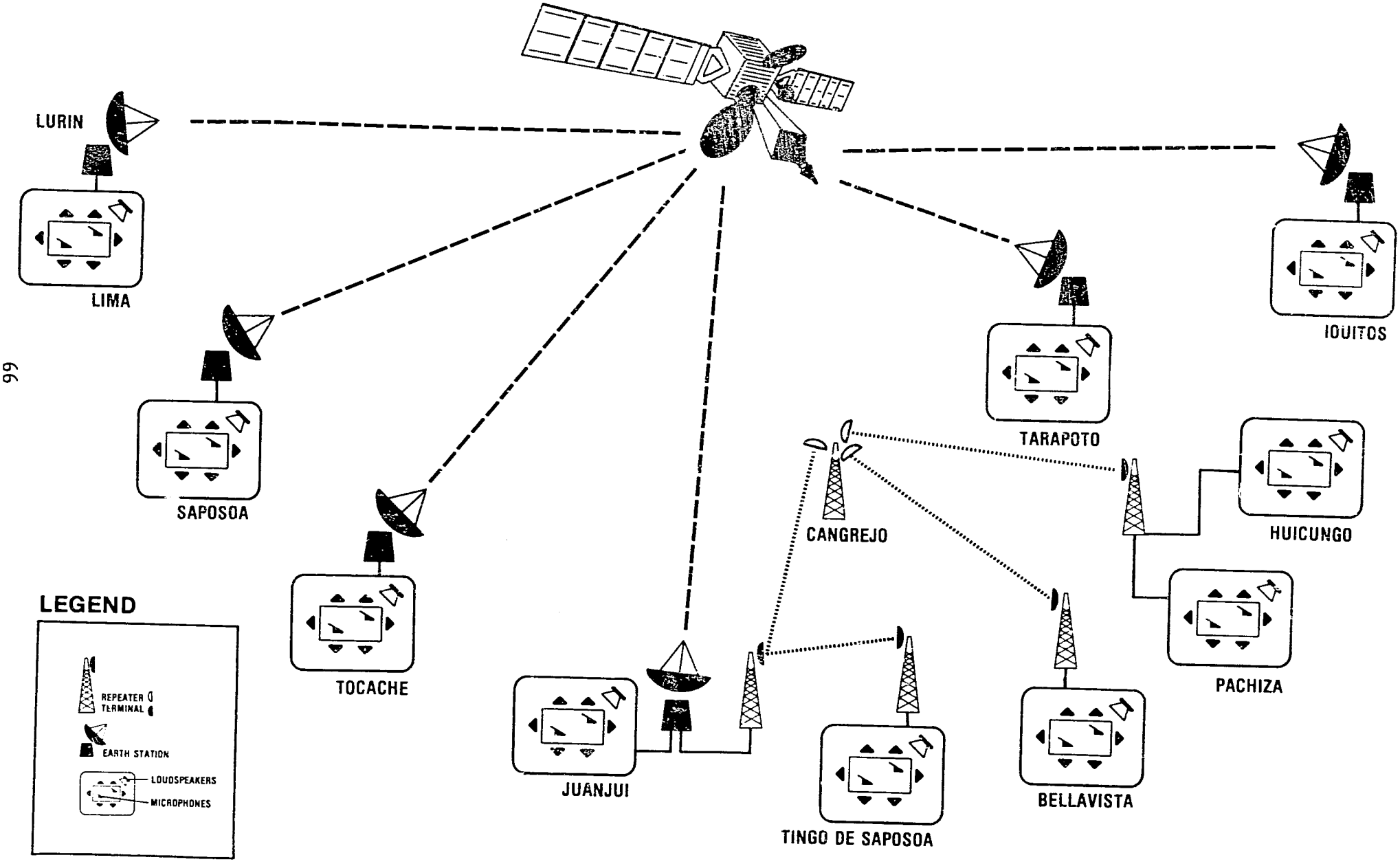
As an "international project," the RCSP benefited from this distinction. Its status entitled it to more resources and staff, allowing the flexibility greatly needed in the early stages of operation. Yet, at the same time, its "special" status, as well as its unprecedented social service orientation, served to isolate the Project from the mainstream ENTEL operation and support structure. From the outset, the RCSP depended on other divisions of ENTEL for support, and this dependence increased as commercial service was established in the region. Uncertainty arose about support responsibilities to a "special" project that had its own management staff. Inevitably, jurisdictional disputes arose when the novel requirements of the RCSP conflicted with standard ENTEL operating procedures. This conflict was particularly apparent in the technical support of the Project and centered on maintenance responsibility for the radio links and the audioconferencing equipment. As both the public telephone and audioconferencing services have become routinized, however, RCSP operations have been integrated into standard ENTEL procedures. The RCSP is no longer regarded as a "special" experiment but rather a blueprint for a new ENTEL service.

## RCSP TELEPHONE SYSTEM AND AUDIOCONFERENCING NETWORK

### Telephone System

The primary technical goal of the RCSP was to develop the most efficient, cost-effective means of extending basic telephone service to the San Martin region, providing

# TELECOMMUNICATIONS NETWORK OF THE PERU RURAL COMMUNICATIONS SERVICES PROJECT



a blueprint for future expansions of ENTEL's rural communications system. Innovative adaptations of equipment and new network configurations characterize the RCSP technical system.

Before arriving at the final system design, the Project went through a series of design phases. The basic design was tied to the expansion of the domestic satellite communications system into the more remote areas of Peru. The initial design recommended the acquisition of two three-channel earth stations which would be tied to surrounding villages by radio UHF/VHF circuits. One channel would be used for the public telephone system, one for government calling, and one for redundancy. This design was rejected when the initial procurement led to bids more than five times the estimated costs for the community radio-telephone installations. After reviewing the overall network design, a greater emphasis was placed on satellite linkages rather than terrestrial ones because satellite links would eliminate the need for costly and maintenance-intensive terrestrial radio links.

The three larger towns of Juanjui, Tocache, and Saposoa are equipped with earth stations and power generators. Two stations, Juanjui and Tocache, were designed to operate with four SCPC channels and Saposoa, a smaller community, with three (although with modification channel capacity could be expanded to 12). The system employs manual (i.e., operator) switching.

As part of the effort to reduce capital costs, the standard earth station design was modified in three ways. First, 6.1-meter earth stations, never before used with INTELSAT domestic service and smaller than standard antennas, were specified as part of a calculated risk to conserve costs. Second, the earth stations were designed to be non-redundant on the premise that rural telecommunications could forego some reliability if system costs could be significantly reduced. Third, system installation was conducted by ENTEL under manufacturer supervision, thus foregoing the "security net" of a turnkey contract and the increased costs associated with such an agreement.

Following installation, ENTEL was able to reduce the number of satellite circuits required by the new telephone system from ten to two by reconfiguring the audioconferencing network. ENTEL has also expanded system capacity by adding two additional channels to each earth station.

The three earth station sites plus Tarapoto, already equipped with an earth station, comprise the primary network. Each site offers public telephone service and, in principle, devotes one channel full time to teleconferencing. This full-time designation is to prevent competition between the teleconferencing activities of the Project and commercial telephone activities, although before expansion of channel capacity, commercial service often encroached on audioconferencing time. At present, the audioconferencing channel is used for commercial purposes as well, but on a scheduled basis.

Soon after installation, ENTEL decided to add subscriber or private service to the public call service in Juanjui, Tocache, and Saposoa. It has been twice expanded.

The four smaller communities--Pachiza, Huicungo, Bellavista, and Tingo de Saposoa--comprise the secondary network. Each site received one VHF channel which is shared by the teleconferencing services; Bellavista, a larger community, received two channels. Because electricity is unavailable in the smaller communities, the radio links are powered by two 12-volt tractor batteries and require frequent recharging. These sites are connected to the primary network through VHF radio links bridged at the

Juanjui earth station, although Bellavista traffic is now routed through the less burdened Saposoa earth station.

## Audioconferencing Network

The teleconferencing facilities are installed at ENTEL offices or municipal buildings at the seven sites, as well as in Tarapoto and Lima. Two other sites with existing telephone service have been added to the network. The electronic classrooms are the simplest of the three pilot projects. Using one telephone channel, the network provides for interactive voice communications--or audioconferences--only. The electronic classroom consists of basic audioconferencing equipment--conveners, loudspeakers, and microphones--and network control equipment for level-setting and switching. Given that the transmission system, i.e., the telephone system, itself was new and untried, it was decided that inclusion of equipment for graphics transmission would be premature. Based on transmission system performance, ENTEL is now interested in experimenting with slow-scan video.

Originally, technical maintenance and repair were performed by Lima-based RCSP engineers. Today, however, their part-time duties are mainly confined to overseeing system expansion plans and dealing with the few problems that cannot be resolved in the field. Operation and maintenance responsibilities for the telephone system belong to the local and regional telephone offices; these offices now perform first-line maintenance and repair of the conferencing equipment.

## Technical Performance

| | |
|---|---|
| **PERFORMANCE:** | 96% technical reliability |
| **PROBLEMS:** | unstable INTELSAT satellite<br>earth station modem and transmitter burn-out<br>poor quality radio equipment<br>inadequate battery capacity |
| **INNOVATIONS:** | use of 6-meter earth stations with INTELSAT<br>hybrid earth station-radio link system |

Three years following initial installation efforts, the telephone network and audioconferencing system operate with high technical reliability: **in 1985 the earth station sites experienced 365 days of service, and only 4 percent of the audioconferences were cancelled because of technical reasons.**

As with most new and sophisticated communications systems, however, it has experienced its share of start-up difficulties. During the first 18 months of operation the number of service interruptions was quite high because of modem and transmitter burn-out, instability of the INTELSAT IV-A satellite and inadequate tracking indicators, and, of course, technician and operator unfamiliarity with the new system.

ENTEL replaced the damaged equipment with solid state technology and placed voltage regulators and surge protectors at each earth station. When the system began using INTELSAT's series V-A satellite, the quality and reliability of the satellite links improved markedly.

A major disappointment has been the performance of the radio links to the secondary sites. Although the hybrid design combining earth station with VHF radio is sound, the Hungarian radio equipment, acquired by Peru in a barter agreement, is not. The radio units are unreliable and need frequent service. Most of these units are located in remote locations which are difficult to service (five are at the top of a mountain and are reached only after a three-mile hike).

More important, the secondary sites' power subsystems are totally inadequate for any kind of reliable service. The batteries must be recharged every 10 days and sometimes more frequently. They must be physically transported to a central location for recharging. The administrative and transport problems have led to frequent outages. Because of the erratic performance and frequent breakdowns of the unreliable and acknowledgedly sub-standard radio equipment, the secondary sites have sporadic telephone service and seldom have been able to participate in the scheduled audioconferences. ENTEL, therefore, decided to discontinue audioconferencing service at the three smallest sites and has placed the equipment in other locations with reliable transmission systems.

The audioconferencing network itself has suffered from relatively few technical problems, primarily in interference and voice quality. Some problems were traced to the interface of the audioconferencing equipment with the earth stations, some to electronic burn-out caused by unstable power and power surges, and some to the poor acoustical conditions of the conferencing facilities. These were easily remedied. In the main, however, the quality and reliability of the audioconferencing network depend on the overall quality and dependability of the telephone system. As telephone service improved at the primary sites, so too did the audioconferencing service.

Many of the telephone system's problems were caused by its popularity. The unexpected heavy demand for rural telephone service overburdened the telephone system, resulting in equipment breakdowns, insufficient spare parts, inadequate power supply, inadequate channel capacity, and long lines of people at the public call offices. ENTEL responded by increasing channel capacity, reconfiguring the system to route radio link traffic through the least-used earth station, and installing automatic switching at the regional ENTEL office. These adaptations and adjustments have resulted in successful provision of quality telephone and audioconferencing service to the remote rural areas.

## DEVELOPMENT APPLICATIONS*

The key objective of the RCSP was to demonstrate the potential of rural telecommunications to serve as a catalyst for development and support sector-specific activities. The RCSP focused on both the role and uses of basic telephone and audioconferencing service in the rural sector.

### Basic Telephone Service and Use

In late 1983 telephone service was inaugurated at the three primary sites; a few months later the radio links were established at the secondary sites. At each of the

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* Based on data from 1984 and 1985 collected by Florida State University.

seven sites, ENTEL established public call offices equipped with phone booths which operate from early morning until late evening. Public call service is provided in two ways--telephone calls sent/received and telephone messages sent/received. Public calls are initiated at the ENTEL offices by placing a request with the operator. These requests are arranged sequentially, awaiting an open channel. The individual must wait at the office until his call is successfully placed or cancelled. A similar procedure is followed to receive a call.

Because most receivers (and initiators) of calls do not have home telephones, ENTEL has developed a telephone message service to prearrange calls between two public booths or between a private phone and a public booth. When a message arrives in a community, ENTEL delivers it to the recipient's home or work place. These messages are quite brief, indicating merely that the recipient should be at the ENTEL office at a specified date and time.

Although it was originally envisaged that telephone service would be limited to public call boxes and possibly made available to local sector offices, not long after system initiation ENTEL made available private subscriber service to homes and businesses, as well as government agencies, at the primary sites. The private subscriber service has tended to alleviate pressure on the public call facilities, and, not surprisingly, the completion rate for "private" calls is less than that for "public" calls. Although private users do not wield the same influence on harried operators as the public call customer, the long wait for completing a telephone call is not as onerous. Telephones have been installed about equally in private residences and businesses. The original plan to install telephones in sector offices was not implemented because of the high cost of running lines to community clinics, schools, and extension facilities and ENTEL's reluctance to provide free telephone service to the individual ministries. However, several health administrators, quick to realize the value of telephone communications in their work, have allocated funds from their own budgets to pay for telephone installations in hospitals and clinics. The agriculture and education sectors, lacking discretionary funds, rely on the audioconferencing network.

**Within months of installation, the telephone service was used to capacity.** In the first six months nearly 5,000 calls were completed per month over the system, ranging from 1,890 calls at the largest community to 39 calls at the smallest. This heavy traffic resulted in congested lines and long waits at the telephone office, with the radio-linked communities often losing precedence to customers at the earth station sites. The following year ENTEL added two additional channels per earth station. By 1985 the average waiting time to complete a call was 50 minutes, 74.3 percent of calls were completed, and traffic had risen to over 11,000 calls per month. **In 1985 the telephone system produced over US$ 134,600 in revenues.**

Contrary to expectations, the addition of the channels has not reduced waiting time or improved completion rates. These two problems, in fact, have worsened. Although more traffic is accommodated with increased channel capacity, the system is still overburdened by the ever-growing demand for telephone service.

Over the past three years of service, certain usage and user patterns have emerged. Initiated telephone calls have dominated the RCSP traffic. More than 93 percent of the calls are made from the network sites to locations outside the network (48 percent were directed to Lima); however, approximately 20 percent of the calls from the remote radio-linked villages are to the larger earth station communities. In general, there is little receiving activity. **The average call lasts about six minutes and costs about**

**US$.75. This amount represents 0.7 percent of monthly family income (US$ 153), a relatively high sum, indicative of the value the rural user places on telephone service.**

The "penetration" of telephone usage is high. **Nearly two-thirds of the area's families have used the telephone system.** The system's utilization rate equaled about 2,561 calls attempted per 1,000 residents. The average number of calls per user is 4.6 per month. Telephone is the preferred means of communication: users indicated that on the average they sent 1.8 letters and 0.6 telegrams per month, and made 1.4 trips to Lima and 4.4 trips to the regional commercial center of Tarapoto per year. Furthermore, in the years following the initiation of telephone service in San Martin, users have indicated heavy reliance on telephone and telegram service, and preference for other communications means, particularly mail, declined dramatically.

Seventy percent of the telephone users use the system for personal reasons, 27 percent for business, and 2.5 percent for both. **However, the "commercial" users are by far the heaviest users: 45 percent of the commercial users placed five or more calls a month, compared with 23 percent of the "personal" users.** In fact, commercial users exceed average use by 24 percent. Clearly, the telephone system is used to facilitate business and commercial activities in the region.

## Audioconferencing Service and Use

The operations and development efforts of the social service sector in San Martin are severely handicapped by:

- inadequate access to information required to develop and provide effective services;
- lengthy delays in handling routine administrative matters;
- lack of staff supervision; and
- absence of in-service training programs for field workers.

The audioconferencing component was developed to support and strengthen these rural institutions. Audioconferencing facilities with push-to-talk microphones were established at each site, either in the ENTEL office itself or a central municipal building. Targeted users are the field staff of the health, agriculture, and education ministries, including administrators and service personnel such as teachers, doctors, nurses, health care workers, and extension agents. At each site a representative from each sector was designated "Local Coordinator" to work with Sector Coordinators and RCSP staff in identifying sector needs and organizing appropriate programs. A monthly schedule was developed detailing sector programs, participating groups, dates and time, and coordination responsibilities. The schedule was distributed at the beginning of each month to enable field workers to prepare for audioconferences.

**Over a two-year period (1984-1985), 658 audioconferences were conducted—266 in 1984 and 392 in 1985. Over 80 percent of the approximately 900 sector personnel in San Martin participated in the audioconferences.**

Initial reaction to the audioconferences was enthusiastic. However, technical problems with the new telephone system, as well as the audioconference management system, resulted in a 37 percent program cancellation rate. The radio-linked sites were rarely able to participate in audioconferences because of technical difficulties. Failure of coordinators or presenters to appear on time or at all discouraged those who had taken

time to attend the conferences. Participant and presenter unfamiliarity with the interactive technology resulted in lengthy (78 minutes) and tedious conferences. And participants complained that regional sector interests subverted topics of local interest and relevance.

In 1985, however, improvements in all aspects of the audioconferencing system, programmatic as well as technical, rekindled user interest and confidence, and network use and management settled into a routine pattern. The cancellation rate fell to 29 percent, a 41 percent improvement over the previous year. Better network coordination and understanding of user needs have lowered last-minute cancellations substantially, although general labor strikes and political unrest periodically have disrupted all sector activity and the erratic services provided by the radio links virtually excluded the secondary sites from participation.

Improved network management also has responded to user schedules. Previously scheduled between 9:00 a.m. and noon to free the telephone channel for commercial use in the afternoon, the 1985 audioconferences were shifted to lunchtime to accommodate health sector personnel, late afternoon for teachers, and Fridays for agricultural workers (the day set aside for office tasks). The management system relies less on rigidly planned monthly schedules to allow for "unscheduled" (less than six weeks in advance) conferences, which have grown to 31 percent of total conferences.

Growing familiarity with the medium has improved the quality and content of the audioconferences. Start-up delays have been reduced to 15 minutes, and the average conference session lasts 54 minutes. Support materials are prepared and distributed more regularly, although late delivery by postal and distribution services continues to be a problem.

The number of audioconferences increased in 1985 in all sectors except health, which was most adversely affected by the elimination of the three radio-linked sites from the audioconferencing network. Average attendance per audioconference grew in every sector except agriculture; attendance of health sector personnel doubled. **Total enrollment, including repeat users, was 10,000 person sessions.** In 1985 ENTEL itself discovered the utility of the audioconferencing network for training and management and consequently added its regional headquarters in Iquitos to the network. In fact, ENTEL use now accounts for 33 percent of network use. Based on sector demands and requests of its own staff, ENTEL has moved the decommissioned audioconferencing equipment from the secondary sites to other communities.

**Network use is predominately for in-service training, which accounts for 64 percent of all sector and ENTEL programs.** Administrative use fell from 30 percent in 1984 to 12 percent in 1985. This shift reflects user preference and need for in-service training, as well as frustration with administrative conferences which consisted mainly of directives communicated from ministry headquarters in Lima. With the emphasis on in-service training, Lima gained increased precedence as the originator of audioconferences. Implying that regional experts are inferior to Lima-based authorities, sector participants have expressed a strong preference for more centralized training programs. RCSP staff in Lima has responded by recruiting the best qualified presenters--both within the central ministries and from other institutions and universities--to meet the growing demand for distance training. Although some programs continue to originate from regional headquarters at Tarapoto, there is generally little reliance on and consultative interaction among local resources.

# SAMPLE OF PORTION OF RCSP MONTHLY SCHEDULE

| Nº | FECHA | HORA | SECTOR | TIPO | CLASE | | TEMA O AGENDA | RESPONSAB. ATC | SALA EMISIÓN | SALAS PART. | TIEMP. | METAS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | S | M | | | | | | TIPO USUA. | #E |
| 01 | Lun.2 | 12md. | Entel Seg. | CAP | X | | Evacuación | Sr.Oscar Cruz | Lima | Todas | 60 | Pers.en gral. | 20 |
| 02 | Lun.2 | 15:00 | Educ. | CAP | X | | Curricular Básico de Alfabetización | Srta.Chauca | Lima | Todas | 60 | Espec.de Alfabet. | 08 |
| 03 | Mar.3 | 08:45 | Entel P.Ext. | DIF | X | | Difusión Normas Técnicas | Ing.R.Carhuayo | Lima | Todas | 60 | Ings.y - Técr.P. Ext. | 15 |
| 04 | Mar.3 | 12:00 | Salud Col.de Enfer. | CAP | X | | Cuidados Internsivos | Srt R.Sán - chez | Lima | Todas | 60 | Enfer.y técn.salud. | 30 |
| 05 | Mar.3 | 14:00 | Agric. Col.Méd. Veterin. | CAP | | X | Enfermedades transmisibles de los animales al hombre : Vigilancia Epidemiológica. | CMV | Lima | Todas | 60 | Médicos Veterin. Comunid. | 30 |
| 06 | Mie.4 | 15:00 | Salud | DIF. | | X | Convulsiones | Dr.Yalán | Lima | Todas | 60 | Médicos enf.técn. padres de fam.comun. | 60 |
| 07 | Jue.5 | 08:45 | Entel P.Ext. | DIF. | X | | Difusión Normas Técnicas | Ing.C.Rojas | Lima | todas | 60 | Ings.y técn de P.Ext. | 60 |
| 08 | Jue.5 | 12md. | Salud CMP | CAP | X | | Paludismo (clínico) (I Parte) | Dr.Carrasco | Lima | todas | 60 | Médicos y personal de salud | 60 |
| 09 | Vie.6 | 08:30 | Agri. | CAP | X | | Insectos y plagas en el Dpto.San Martín | Ing.Cárdenas | Tpto. | 2,3,4, 5 | 60 | Ings.téc. agropec. del CIPA X | 20 |
| 10 | Vie.6 | 12md. | Entel Seg. | CAP | X | | Evacuación | Sr.O.Cruz | Lima | Todas | 60 | Personal en gral. | 20 |
| 11 | Vie.6 | 15:00 | Educ. | CAP | X | | Curricular Básico de Alfabetización | Srta.Chauca | Lima | Todas | 60 | Espec.Superv.prov. y sect. | 08 |
| 12 | Lun.9 | 12:00 | Entel Seg. | CAP | X | | Evacuación | Sr.O.Cruz | Lima | Todas | 60 | Pers. en Gral. | 20 |
| 13 | Mar.10 | 08:45 | Entel P.Ext. | DIF. | X | | Difusión Normas Técnicas | Ing.R.Carhuayo | Lima | Todas | 60 | Ings. y técn.P. Extern. | 15 |
| 14 | Mar.10 | 12:00 | Salud Col.Enf. | CAP | X | | Fiebre Amarilla | | Lima | Todas | 60 | Enf.y téc. salud | 20 |
| 15 | Mar.10 | 14:00 | Agric. CMV | CAP | | X | Brucelosis y tuberculosis. Bovina.Epidemiológica y Control. Repercusión | CMV | Lima | Todas | 60 | Médicos veterin.téc. comunidad | 30 |
| 16 | Mie.11 | 15:00 | Salud | DIF | | X | Niño con fiebre | H.del Niño | Lima | Todas | 60 | Pers.de salud.Comun. | 30 |
| 17 | Jue.12 | 08:45 | Entel P.Ext. | DIF | X | | Difusión Normas Técnicas | Ing.Carhuayo | Lima | Todas | 60 | Ings.y téc. P. Externa | 08 |
| 18 | Jue.12 | 12:00 | Salud CMP | CAP | X | | Paludismo (Tratamiento y Control) (II Parte) | Dr.Ventocilla | Lima | Todas | 60 | Médicos y pers. de salud | 20 |
| 19 | Jue.12 | 15:00 | Entel SS.AA. | CAP | X | | Trámites de Contratos de arrendamiento y renovaciones de los mismos. | Sr.T.Peña | Lima | Todas | 60 | Pers. de ABS | 10 |
| 20 | Vie.13 | 08:30 | Agri. | CAP | X | | Uso de semilla mejorada del maíz | Ing.Cancino | Tpto. | 2,3,4, 5. | 60 | Ings.técn. agropec.del CIPA X | 30 |
| 21 | Vie.13 | 12:00 | Entel Seg. | CAP | X | | Charla sobre Identificación Personal | O. Cruz | Lima | Todas | 60 | Pers. en Gral. | 20 |
| 22 | Vie.13 | 15:00 | Educ. | CAP | X | | JUPCE | JUPCE | Lima | Todas | 60 | Dir.Zonal Espec. | 15 |
| 23 | Lun.16 | 12:00 | Entel Seg. | CAP | X | | Identificación Personal | O.Cruz | Lima | Todas | 60 | Pers. en General | 20 |
| 24 | Lun.16 | 14:00 | ENTEL TEL | CAP | X | | Lectura de la máquina registradora en Intis | Ing.Montes | Lima | Todas | 60 | Personal de Tel. | 10 |
| 25 | Lun.16 | 15:00 | Educ. | CAP | X | | Educación Primaria y Secundaria de Menores | | Lima | Todas | 60 | Dir.Zonal espec.supervis.Prov.y Sect | 10 |
| 26 | Mar.17 | 08:45 | Entel P.Ext. | DIF. | X | | Difusión Normas Técnicas | Ing.Carhuayo | Lima | Todas | 60 | Personal en General | 10 |
| 27 | Mar.17 | 11:00 | Entel RR.HH. | COORD. | X | | Alcances del Dpto. de Promoción Social | | Lima | Todas | 60 | Jef.de área y Jef.de Oficina. | 15 |

This phenomenon at first appears to counter one of the original RCSP goals--the decentralization of communications aimed at regional interdependence and resource sharing. Actual user preference for Lima-originated conferences seems to reinforce the centralized management system prevailing in Peru. On the other hand, however, sector participants made their dissatisfaction known with earlier inapplicable, unresponsive audioconferences organized by the ministries. In fact, the health sector refused to attend ministry programs. In the final analysis, therefore, it seems that there exists a "bottom-up" communication structure for the audioconferencing program even though the local communities do not turn to each other for support.

The health sector has been the most innovative in its use of the audioconferencing network, reflecting perhaps greater congruence of its communication and information needs with the service provided by the RCSP. Unfortunately, because of persistent non-performance of the radio links, the valuable medical consultations to the most remote communities had to be cancelled. Clearly one of the most service-oriented activities, these distance diagnosis and treatment programs are an important rural service and enjoyed great popularity during their short tenure.

Other health programs, however, have flourished. To gain access to Lima-based specialists, an ongoing training program was developed with the Colegio Medico (Peruvian medical association) in four areas: internal medicine, pediatrics, gynecology and obstetrics, and primary health care. These conferences are well received by the participating doctors, nurses, nurses aides, and community health workers. Over a 10-month period, 31 conferences were presented and total attendance reached over 1,100. The RCSP network was also used to support the National Vaccination Campaign--for coordinating logistics, training workers, monitoring progress, and evaluating results.

RCSP Respondents' Ratings of Selected Audioconferencing Attributes as Either "Good" or "Very Good"*
(in percentages)

| Attribute | Agriculture (N=46) | Education (N=74) | Health (N=63) | ENTEL (N=45) |
|---|---|---|---|---|
| Facilities | 86 | 66 | 81 | 76 |
| Audio Quality | 63 | 86 | 84 | 91 |
| Organization | 61 | 72 | 76 | 82 |
| Degree of Interaction | 45 | 54 | 72 | 67 |
| Content | 66 | 91 | 97 | 94 |
| Exposition | 70 | 88 | 97 | 93 |
| Utility | 82 | 93 | 95 | 97 |
| Appropriateness | 77 | 93 | 90 | 86 |
| Contribution | 81 | 88 | 90 | 100 |

* Data and Table prepared by Florida State University.

The education sector has conducted the greatest number of audioconferences. The network became the means of delivery for 35 workshops conducted by PROMULCAD, an innovative Latin American teacher training program. Special education was also a sector focus. A series of 37 audioconferences was developed on learning disabilities. So successful were the programs that local parents asked to attend, and eventually, in an innovative mixed media event, audioconferences were broadcast live over the local radio station and questions entertained through a "call-in" arrangement. Using new diagnostic tools gained through the audioconferences, the teachers were able to document local needs and successfully petition for the establishment of a regional treatment and rehabilitation center.

The agriculture sector has been the least successful in establishing a viable audioconference program in San Martin. Plagued by strikes and a poor leadership and management structure, the sector completed only 88 audioconferences in 1984 and 1985. Furthermore, the farm-visit strategy promoted by the ministry prevents extension workers from regularly attending audioconferences. However, in 1985 the RCSP's new training orientation and revised schedule helped to increase the number of successful audioconferences by 57 percent. In Lima, a new ministry coordinator has been appointed. A well-known agricultural expert himself, he has delivered eight well-received audioconferences.

**What has telephone and audioconferencing service meant to rural San Martin?** Rural communication services have had a powerful impact. The telephone service has been expanded twice; it has sustained a strong and growing demand, used by many people with relatively low incomes; it generates sufficient revenues to be partially self-financing. **In a two-year period, 190,000 calls have been completed; over $240,000 has been collected in charges.**

At a marginal cost, the audioconferencing system supports many innovative applications and enjoys high public sector demand, as well as promising viable commercial use for the private sector. **Over 92 percent of the audioconference participants indicated the programs improved their skills and job performance, and 55 percent responded that without the audioconferencing service they would be unable to obtain essential information and training.** The network's popularity with rural workers is attested to by official letters to ENTEL requesting it to continue service after formal RCSP conclusion, even if they must pay for the service. ENTEL itself is now a significant user of the audioconferencing service and has added audioconferencing equipment in several of its offices in the region.

Based on the RCSP experience, Peruvian development agencies for the first time have made telecommunications a priority investment for rural areas. CORDES, the rural development agency, has agreed to contribute US$ 45 million to extend telecommunications service to 700 rural communities over the next five years. ENTEL itself has developed a plan to expand service to the Andean Trapezoid area and provide audioconferencing service, and has recently obtained donor funding. Fourteen earth stations and 20 UHF/VHF radio links will be installed in this remote area. Two audioconferencing classrooms have been placed in Juliaca and Puno, isolated population centers in the sierra, and ENTEL has approved plans to extend the RCSP audioconferencing service to other communities in the sierra and jungle regions of Peru. INTELSAT's Project Share is interested in transmitting the Peruvian training conferences to other Andean countries. Rural communications in Peru has achieved recognition and credibility as a catalyst for development.

## SMALL EARTH STATION SUBPROJECT

### BACKGROUND

With the exception of the Peru Project, the Rural Satellite Program focused on using existing telecommunications infrastructure to provide rural teleconferencing services. The Program, however, recognized that many rural communities lacked even the most basic telephone service and would continue to do so because of economic constraints faced by Third World nations.

Although satellite technology costs have fallen significantly as the technology has matured, much of the "ground system"--specifically the earth station--is still too costly for national communications carriers to routinely place in rural villages. Furthermore, the earth station technology is not always compatible with the conditions prevailing in rural settings--such as the lack of trained technicians, maintenance depots, adequate electrical power, and so on.

The goal of the Small Earth Station subproject was to develop a prototype earth station appropriate for rural use which could support teleconferencing services as well as a photovoltaic power system to meet operational needs in areas lacking power.

### DESCRIPTION

The Rural Satellite Program chose the remote Indonesian village of Wawatobi in Sulawesi Tenggara, 60 kilometers or a two- to three-hour drive from the small city of Kendari, as the site for the small earth station experiment and demonstration. Site selection was based on its rural location, absence of a telephone or any communications service, lack of a power supply, and the presence of numerous potential user groups. As a district center, Wawatobi conformed to PERUMTEL's goal to supply similar governmental administrative divisions with telephone service. With several large development projects in the area, many development applications were envisaged for the teleconferencing capability.

Within Indonesia, PERUMTEL was the designated principal. As the only legal owner and operator of satellite equipment in Indonesia, PERUMTEL was responsible for the operation, maintenance, and repair of the earth station and power supply. PERUMTEL was consulted in the earth station's design to ensure system compatibility and would play a major role in the system's installation. It agreed to make two channels available for SISDIKSAT use.

### DESIGN

#### Earth Station

The earth station was developed to provide audioconferencing and telephone service. The technical specifications called for:

- transmit/receive capability
- six duplex voice circuits

- 600-watt power budget to operate earth station and two-channel audioconferencing system with end equipment (see discussion of Indonesian Project)
- conformance with PERUMTEL and Palapa standards

The performance specifications called for:

- up to 10-channel capacity
- minimum prime power requirements
- operation in the absence of air conditioning
- easy installation
- simple, unmanned operation
- minimal maintenance requirements
- low cost

The earth station components are:

- 5-meter antenna
- 11-watt solid-state low power amplifier (LPA)
- GaAs FET low noise amplifier (LNA)
- high stability frequency converters
- two FM single channel per carrier (SCPC) modems
- weatherproof fiberglass equipment shelter enclosure on an I-beam skid

Specific equipment items, except the shelter and the modems, were purchased from U.S. manufacturers based on known field performance and cost-effectiveness. The modems and shelter were manufactured in Indonesia.

Total earth station power requirements were 461 watts when equipped with the two SCPC modems. The remainder of the power budget, 139 watts, was designated for end equipment operation. **In all, the earth station and audioconferencing system operate on about the same power as the average home steam iron.** Had air conditioning been required or different equipment used, the power requirements would have more than tripled, far exceeding the capacity of the photovoltaic power supply.

Significant power savings were achieved by two means: First, the 11-watt LPA draws considerably less power than the standard "traveling wave tube" LPA. Second, a day/night switch in the adjacent classroom de-activated the LPA and LNA when not in use, reducing power draw on the photovoltaics by an additional 120 watts.

To avoid the need for air conditioning in the tropical climate, the equipment shelter was insulated and treated with a white, heat-reflecting paint. Three fans were included in the design: two 111 CFM fans were mounted on the equipment rack to cool the LPA which, in turn, was mounted on an aluminum plate with two oversized heat sinks. The 215 CFM was attached to the shelter wall and protected with a weatherhood.

## Photovoltaics

Photovoltaic systems are a tried and tested technology with a history of use in the Third World. Thus, the specifications for the RSP photovoltaic array differed little from what is normally offered by photovoltaic systems: stand-alone power and reliability.

In conjunction with a small earth station, however, there were a few specific requirements:

- sufficient power output to operate the two-channel earth station and audioconferencing system
- easy installation
- low maintenance

Because the design and production contracts were effectuated before the RSP had selected a site and developed detailed earth station criteria, much of the photovoltaic array design was based on generic and incomplete information. To some extent, then, later earth station design was based on photovoltaic design--a somewhat unusual and not recommended procedure.

## INSTALLATION, OPERATION, AND PERFORMANCE

In retrospect, it appears that the most trying task of the installation process was transporting 20,000 pounds of equipment to the remote site. In Indonesia, it took five months. Because poor transportation systems--poor roads and available shipping means--are generally a given in the rural setting, this should be planned for in future projects.

Once at the site, installation proved relatively easy. Civil works were limited to concrete pads for the earth station, the equipment shelter, and a security fence. For the photovoltaic array, a semi-enclosed shelter on a concrete pad was required to house the electronics equipment for controlling the power supply and the small emergency generator. A security fence enclosed the array.

Installation of the photovoltaics was speedily concluded with few mistakes; installation of the earth station experienced a few days delay because of the Indonesia-based installation engineers' unfamiliarity with the system and water inadvertently entering the microwave connectors. After these initial difficulties, however, alignment was completed and the system accepted by PERUMTEL.

Routine operation of the earth station and photovoltaics requires turning on the day/night switch to activate the system; this is done by the local technician/operator at the public call office. Should a problem occur within the system, an alarm located at the adjacent office is activated. In addition, a summary alarm panel is located within the equipment shelter. Routine system monitoring is limited to the equipment front panels which include several monitor ports and test points.

The normal maintenance program is based on three-month intervals, including lubricating the grease fitting in the antenna and cleaning the shelter dust filter. Once a year the crystal oscillators in the frequency converters are adjusted.

**Since the earth station's installation in June 1985, it has not experienced a single failure or any down time.** The design has proved reliable for the rugged environment. Slightly concerned by the heat load, PERUMTEL plans to install additional fans which will add only slightly to overall power drain.

**What is the significance of the RSP small earth station?** Because the Rural Satellite Program's small earth station was designed to work with a high-powered regional satellite, Palapa B-1, the design cannot serve as an exact technical prototype for other developing countries, as each rely on dissimilar satellite capabilities. The RSP earth

station does demonstrate, however, that with design modifications, off-the-shelf components can be assembled to create an earth station responsive to the requirements of remote areas. Coupled with simple photovoltaics, these earth stations can continue to provide service in the absence of local power source.

The availability of small earth stations will encourage the growth of stand-alone telecommunications links in rural communities, as well as at the sites of educational and rural service institutions. Since the installation of the Wawatobi earth station, a local manufacturer has adapted and improved the basic design, and PERUMTEL has tendered bids for the provision of similar stations.

## TECHNOLOGY TRANSFER AND TRAINING

Technology transfer has been an essential element of the Rural Satellite Program. On one hand, as pilot project implementation plans called for host-country nationals to run the projects, trained staff were essential during the experimental and demonstration stages. It was also hoped that a core skill base be developed and institutionalized for continued network operation and expansion after the "project" phase had ended.

On the other hand, in addition to the research questions about technical viability and applicability to development goals, the host-country staff were key to resolving the question of "operability." Are the human resources available in rural areas with the basic technical and managerial skills to support network activities? Is it possible to transfer the skills required for network operation? What is the best method of transferring these skills?

The Rural Satellite Program used a three-pronged strategy to effect skills transfer: collaboration, host-country management, and formalized training.

Collaboration between expatriate and host-country staff was a keynote of the pilot projects. This was not difficult to achieve because the unprecedented nature of the project activities tended to blur the distinction between the expatriate "experts" and the project staff. The projects were viewed as learning experiences for all involved.

While the RSP staff was familiar with telecommunications development and applications planning, the host-country staff was knowledgeable in other essential areas--local communications patterns and needs, indigenous teaching methods, institutional organization, and administrative procedures. Neither knew exactly what to expect of network reliability and use in the remote and rural project areas.

As noted above, management and operation responsibility belonged to host-country staff. The single RSP field advisor assigned to each project provided initial guidance and direction, but did not manage project operations. The field advisor was instrumental, however, in organizing the training needed to develop host-country staff skills.

Training programs formed the major component of the technology transfer strategy. Considerable resources were put into the effort to train the personnel who would be working with the teleconferencing networks. Training goals were:

- to provide project and technical staff members with the skills and knowledge necessary to manage, program, operate, maintain, and repair a telecommunications network;
- to develop an institutional capacity for training within the project itself; and
- to orient users to the procedures and techniques for using the system.

For all three projects, training was conducted in a variety of situations (face-to-face and distant, classroom and on-the-job, group and individual, in-country and out-of-country, etc.) and via a number of different methods, including formal classes, seminars, in-service training, and individual consultations. Initially all of the training was done by expatriate staff. As the host-country personnel were trained in various areas, they took an ever-increasing role in developing and leading project training programs. Expatriate consultants worked closely with counterparts from the project staffs so that, beyond the

immediate benefits of their short-term assignments, these experts would have developed staff capabilities to do the work themselves in the future. Whenever possible, host-country consultants were hired to build national capabilities and develop a resource base.

With a few minor variations, the three pilot projects required similar personnel and had similar training needs. In the planning stage, it was important to provide upper-level leadership with information about the applications of teleconferencing to facilitate participation decisions. Although there was some previous experience with telecommunications projects in the West Indies and Peru, policymakers at the various ministries and university deans within the BKS and UWI systems were unfamiliar with the technology's uses.

With implementation, there arose the immediate need for a core staff who could support technical, administrative, and programming activities, as well as represent the project to prospective users.

As implementation progressed, skills had to be transferred to:

- Local Coordinators, Technicians, and Operators on how to manage and operate the electronic classrooms;
- program developers and presenters on how to prepare appropriate presentations and support materials;
- program participants on how to use the equipment, follow the teleconferencing format, and use materials; and
- telecommunications carriers on the design and operation of the teleconferencing networks and their interface with the telephone and satellite systems.

Most of the projects' initial training took place overseas because of:

- a lack of indigenous expertise in audioconferencing operation, repair, management, and programming;
- the difficulty of finding foreign experts in these fields who were able to travel to the projects for longer than two or three weeks;
- the need to have people see a fully operating teleconferencing system and talk to the people operating and using it;
- the need for factory training for the Chief Technicians; and
- the advantage of getting people out of the country so that they could work exclusively and intensively on project-related activities without the distractions of daily life that were certain to occur in-country.

Overseas training--primarily in the United States--was designed with the job duties of the trainee in mind. For example, training for the SISDIKSAT Project Director, the RCSP Field Evaluation Director, and the UWIDITE Chief Project Officer consisted primarily of observation of a number of projects and technologies in use to introduce them to the concept of distance instruction and the realities of hardware capability. The goal was to equip them with the knowledge to inspire participation in and enthusiasm for network use. Tours varied between two and four weeks in length and sites visited included the Appalachian Community Service Network in Kentucky, the Indiana Higher Education Telecommunications Service in Indiana, the Center for Interactive Programming in Wisconsin, and the Learn Alaska Network in Alaska.

## INSTITUTIONAL TRAINING RESOURCES

| Institution | Location | Training |
|---|---|---|
| Academy for Educational Development<br>• AID Rural Satellite Program<br>• AID Clearinghouse on Development Communications | Washington, D.C. | • development communications, telecommunications applications |
| Appalachian Community Services Network | Washington, D.C. & Lexington, Kentucky | • how to develop requests for teleconferences, program identification |
| Aregon International | London, England | • testing and operation/maintenance of telewriters and graphics studio |
| British Open University | Milton Keynes, England | • orientation to distance education programs |
| Center for Communication Technology | Jakarta, Indonesia | • materials development, classroom design, review and revision of text materials |
| Center for Learning & Telecommunications | Washington, D.C. | • instructional development and program management, educational applications |
| Dantel, Inc. | Fresno, California | • testing and operation/maintenance of network control equipment |
| Florida State University, Learning Systems Institute | Tallahassee, Florida | • program evaluation |
| Indiana Higher Education Telecommunication System | Bloomington, Indiana | • distance education: media and programs |
| Indiana University<br>• Agency for Instructional Television<br>• Department of Telecommunications Radio & Television Center<br>• Independent Study Division of Continuing Studies<br>• Teacher Resources Center | Bloomington, Indiana | • uses of media in education, distance program services development, program development and evaluation, distance training techniques |
| Kellogg Corporation | Boulder, Colorado | • teleconferencing service development, teleconferencing techniques |
| Public Service Satellite Consortium | Washington, D.C. | • telephone technologies, equipment demonstrations, system management |
| Pulsecom/Harvey Hubbell, Inc. | Fairfax, Virginia | • testing and operation/maintenance of network control equipment |
| Purdue University<br>• Agricultural Education and Extension Program<br>• Center for Instructional Service | West Lafayette, Indiana | • telecommunications-based extension programs, program development and management |
| University of Alaska, Learn Alaska Instructional Telecommunications Network | Anchorage, Alaska | • program management: program identification, scheduling, attendance, record-keeping, etc. |
| University of Connecticut, Center for Instructional Media and Technology | Storrs, Connecticut | • instructional media and development |
| University of Hawaii, East-West Center | Honolulu, Hawaii | • development communications |
| University of Iowa, Center for Credit Programs | Iowa City, Iowa | • software development, course writing, materials preparation, curricula adaptation to distance media |
| University of Kentucky, Extension Services | Lexington, Kentucky | • uses of telecommunications for extension services |
| University of Maryland<br>• Center for Instructional Development & Education<br>• International University Consortium<br>• Open University | College Park, Maryland | • distance education models, faculty coordination, system management, course development and evaluation |
| U.S. Department of Agriculture, Extension Service | Washington, D.C. | • uses of technology for extension service, program and system management |
| Virginia Ostendorf, Inc. | Boulder, Colorado | • teleconferencing techniques, network management, materials development |

Substantive and highly specific study programs were arranged for the key management staff to develop the skills they needed to manage project operations. SISDIKSAT's Administrator went to the Learn Alaska Program for a three-week internship on management, while its two programming people went to the University of Iowa's Center for Credit Programs to study distance education and to prepare specific materials for the project. This approach was very beneficial as it resulted in the actual creation of products rather than solely increased knowledge or skills.

UWIDITE's Chief Project Officer and its three main course presenters received training on course adaptation at the University of Connecticut's Center for Instructional Media and Technology.

In addition, a three-week study program was conducted for four strategically placed SISDIKSAT Local Coordinators which took them to the University of Connecticut and the telewriter manufacturer, Aregon, in the United Kingdom, to learn how to use the studio system for "canned" graphics.

One of the problems encountered in arranging this type of training was the paucity of places in the United States where a participant could go for first-hand experience with distance education--particularly via audioconferencing systems. Most institutions in the United States utilize television rather than audio only. All of the active programs are deeply involved in the operation of their own systems and do not regard themselves as training entities. Therefore, special training programs had to be developed.

There was an immediate need for training of the Technical Directors (or Chief Technicians) as equipment installation and operation obviously preceded programming needs. This training was combined with factory testing at selected equipment manufacturers' facilities. A six-week factory training and testing program was conducted for the SISDIKSAT Chief Technician with the telewriter manufacturer in England and telephone terminal producer in California. The RSP Project Engineer accompanied him.

The UWIDITE Technical Director also participated in factory testing with RSP engineers and received training on the terminal equipment. As part of the agreement with the earth station manufacturers, training was provided to the Peruvian RCSP engineers during factory testing as well. Unfortunately, the RCSP project managers decided against additional, and ultimately essential, training at the telephone terminal manufacturer's facility.

In addition to this structured overseas training, many of the projects' staff have participated in international conferences. All three Project Directors, the SISDIKSAT Administrator, and the UWIDITE Chief Project Officer have made presentations on project activities. UWIDITE's Chief Project Officer has been especially conscientious in pursuing additional training opportunities. She has used personal study and travel grants to visit distance teaching institutions in the United States and Canada and did a three-week internship with a private teleconferencing service and consultation firm.

Obviously, overseas training requires significant investment. To maximize the return, the trainees have held key project positions, shared their knowledge through in-country training programs, and have--with one exception--made a commitment to remain with the project for at least two years.

Having completed their overseas training, key project personnel turned their attention toward in-country training aimed at the next level of project staff--the Local Coordinators and Technicians. Initially, a variety of face-to-face training sessions were

conducted; these were later followed by training programs delivered over the more economical teleconferencing system. For the faculty presenters and local coordinators involved in the UWIDITE and SISDIKSAT projects, the training focused on the uses of teleconferencing for higher education, preparation of course materials for distance education, teleconferencing techniques, and the operation and use of the end equipment. Similar training was held for the sector and local coordinators and for key professionals from the health, education, and agriculture sectors, with a major focus on needs identification and program selection.

As much of this training preceded network installation, equipment was wired up locally in two or more adjoining classrooms to simulate teleconferencing conditions. Thus, the participants not only benefited from "hands-on" operation of the equipment, but they were able to experience first-hand the use of the medium and witness why certain protocols and practice are recommended.

After the networks were in place and operating, most subsequent formal training programs were delivered over the teleconferencing systems to avoid the expense of face-to-face programs and associated travel and living expenses. With the basic orientation of key central and local personnel accomplished, specialized distance training sessions were run lasting from a few hours to a day. Presentations were made to course developers and other prospective user groups by central project staff. Programs were organized for course presenters and master teachers on materials development and course delivery. Refresher courses were delivered to local or new project personnel. At the opening of each semester or program series, core staff attended the first session to introduce students and participants to the system, the equipment, and procedures for its use. Participants were encouraged to use the microphones and invited to speak over the network.

Not surprisingly, technical training comprised a significant part of the training effort both at the outset and throughout the life of the project. Technical support systems and personnel structure differed from project to project. Only SISDIKSAT maintains an extensive cadre of technical staff--technicians and operators--to run the teleconferencing network. Both the RCSP and UWIDITE projects have appointed one or two technical personnel, although it must be noted that the RCSP relies on and enjoys the support of the entire ENTEL support system.

In the case of each project, equipment installation and network testing served as a major training ground. "Hands-on" or "on-the-job" training became training bywords. Under manufacturer supervision, ENTEL satellite engineers installed the earth station system, and local telephone office personnel participated in the installation of the radio links and teleconferencing equipment. In the West Indies and Indonesia, the Chief Technicians worked alongside RSP engineers to install the equipment and were assisted by the Local Technicians at each site. Further, local carrier personnel, from the commercial carriers in the West Indies or PERUMTEL in Indonesia, participated in system-wide tests.

Only in Indonesia, however, were formalized training programs developed for all involved technical personnel, both SISDIKSAT and PERUMTEL. In Peru, ENTEL naturally considered itself already expert in system operations and eschewed further training; in the West Indies, difficulties in hiring a full-time Technical Director prevented training beyond the installation activities.

TRAINING MATERIALS

| Target Group | SISDIKSAT | UWIDITE | RCSP | Small Earth Station Subproject |
|---|---|---|---|---|
| Technical Staff | "Technician's Manual" (system overview & equipment specifications)<br>"Operations Manual"<br>"System Overview"<br>"Operator's Guides to Design, Operation, Maintenance and Repair of Equipment" (5 booklets)<br>Videotapes: how to perform maintenance tasks | | | "Overview & Guide to Small Earth Station"<br>"Operation & Maintenance Manuals for Earth Terminal"<br>"Installation Manual for Earth Terminal"<br>"Operation and Maintenance Manuals for System Components" |
| Local Coordinators | "Local Coordinators Manual"<br>"Resource Collection" (selected readings on audioconferencing) | "Managing a Distance Training Session" | "Guida para el Desarollo de Teleconferencia en Areas Rurales" | |
| Course Writers and Program Presenters | "Introduction to SIS-DIKSAT"<br>"Teaching Via Satellite"<br>"Selected Readings on Audioconferencing"<br>"Activities Guide"<br>"Operations Guide" (photo-guide to operation of equipment)<br>"Course Development Guide" | "UWIDITE Course Development Manual"<br>"Use of the Voice"<br>"Distance Teaching with Audio Tapes"<br>"Distance Teaching with Video Productions"<br>"Preparation and Use of Material for Slow Scan Television" | "Modulo de Capacitacion en Teleconferencia" | |
| General Users | "Introduction to SIS-DIKSAT"<br>Wall Poster (how to use microphones)<br>Microphone Labels (user instructions) | "An Orientation to the UWIDITE Network and Teleconferencing" | | |

When the equipment was available after clearance and testing, a seven-day workshop was held for the SISDIKSAT Local Technicians and key PERUMTEL staff. One person from each site came to central headquarters where three sets of equipment had been set up for instructional and practice sessions led by the senior technical staff. This training was followed a month later by a week-long program for the Local Coordinators which focused on the management system, training resources, budgeting, and audioconferencing.

Over the network, major training programs are regularly presented for the Local Operators during the time between semesters. The programs run for three hours in the morning and three hours in the afternoon. Printed materials are sent to all participants, and the Local Technicians serve as tutors with the central office technical staff serving as the main instructors. Refresher training on level setting and equipment maintenance for the Local Technicians is also held over the network once or twice a year. Furthermore, with assistance from the Ministry of Education's Center for Communications Technology, SISDIKSAT has developed an instructional video cassette series for use by Local Technicians and Operators.

SISDIKSAT's Chief Technician worked regularly with PERUMTEL central and local staff and made many informal presentations on network requirements and operating procedures. In an effort to reach all of the far-flung PERUMTEL staff for coordinated training, SISDIKSAT's Chief Technician and the PERUMTEL Project Officer used PERUMTEL's closed circuit TV training system, offering one-way video reception and two-way audio capabilities at PERUMTEL earth stations. Presentations on various aspects of the system and the satellite interface were delivered over the TV channel using specially prepared diagrams. Questions and answers were carried over the audio connection. Print materials were distributed to all participants.

PERUMTEL staff prepared for the installation of the small earth station with a two-week workshop presented at the Indonesian manufacturer's factory which included design review, operation and maintenance techniques, and participation in the series of factory tests. This was followed by a week of on-the-job training conducted during installation and acceptance testing at the earth station site.

The final training tool employed by the projects is the wide variety of support materials prepared by project staff. Their preparation had a dual purpose: to reinforce the knowledge of the project staff by organizing their thoughts and putting them on paper and to "institutionalize" and preserve this knowledge for both users and future staff members by storing it in tangible form. These materials consist of technical and user manuals, program development guides, teleconferencing handbooks, and prototype management logs. For the most part, with the exception of some detailed technical specifications, these materials are written in the relevant native language.

Overall, the RSP approach to technology transfer for the pilot projects has been a sound one, as evidenced by ongoing project operations. With its emphasis on "institutionalization" of management capabilities and development of training modules and materials, the RSP has ensured that these skills can be passed on to others. As the projects pass their fourth year of operation, many original project staff have moved to other positions. In fact, the communication, management, and teaching skills they developed under the Program are much in demand and have led to career advancement. Yet, with their departure, other staff who they have trained can move into their positions. The strategies of collaboration, host-country management, and overseas training developed the initial skills; the ongoing training programs and materials maintain the projects' vigor.

# COSTS

Costs were an important consideration of the Rural Satellite Program in its efforts to explore and promote the developmental uses of telecommunications in the Third World, where the barriers are not only technological, but financial as well. Many developing nations simply have not been able to afford to extend telephone service to rural areas or justify the investment on a solely commercial basis. Satellite technology offered the potential of low-cost transmission for rural telephone service; new telephone-based technologies offered the means of supporting development applications. The RSP pilot projects provided the opportunity to document the actual costs of utilizing these important technological innovations.

From a cost standpoint, the Rural Satellite Program had three goals:

- to reduce basic infrastructure costs by utilizing smaller earth stations and alternative retransmission methods, thus making it more feasible for developing countries to expand telephone service to rural areas;
- to develop low-cost communications capabilities to maximize institutional and developmental use of the basic telephone service; and
- to establish the actual costs of installing and operating rural communications systems in comparison with alternatives.

The costs of the Rural Satellite Program and its pilot projects cannot be totally representative of the investment needed to mount similar telecommunications support projects. As a research and development effort, substantial costs accrued for innovative and first-time planning, design, and implementation activities. Costs are, therefore, much higher than they need be for subsequent undertakings because neither the high-cost U.S. technical assistance nor complex engineering studies will be required. Nor are the hardware and equipment costs of the RSP necessarily reflective of the resources needed for replication. As an AID program, the RSP followed U.S. government procurement regulations requiring purchase of American-made equipment. As an experiment of limited scope, the savings associated with bulk purchases were not realized.

All the same, the capital investment and recurring costs of the pilot projects are a fair indication of the resources needed to support telecommunications projects. The following discussion is not an economic study. It merely intends to present the basic costs associated with rural telephone and teleconferencing networks from a budgeting perspective. Capital and start-up costs are treated as one-time, up-front expenditures; transmission and management costs comprise recurring costs.

## RURAL TELEPHONES

Rural telephony has increasingly gained credibility as a catalyst of development. Yet, the fact remains that the costs of providing service to low-traffic rural regions often proves too high to induce investment in areas which do not promise the same financial returns as urban areas.

To realize the development benefits afforded by rural telephony--either through basic telephone service or teleconferencing--the costs of the telecommunications infrastructure must be reduced to be considered affordable by telecommunications authorities. Encouraged by the proliferation of satellite systems and the steadily falling costs of earth stations, the Rural Satellite Program undertook the Peru Rural Communications Services Project to develop new design configurations and adapt existing hardware in an effort to further reduce costs, as well as to document the actual costs of putting in place and operating a satellite-based rural telephone system.

The following data on the RCSP rural telephone system is based on a detailed economic study prepared by Florida State University as part of the RCSP evaluation. This section presents the basic costs of hardware, civil works, and operations and maintenance of telephone service in the rural San Martin region of Peru. The costs of the RCSP teleconferencing component are explored in a later section.

## RCSP Cost Overview

Throughout the design, installation, and initial operations period of the RCSP, approximately five years, care was taken to track and document expenditures. Yet, despite the accuracy and completeness of the cost figures, the limited applicability of the RCSP model to other rural telephone system development efforts must be acknowledged. There is no generic rural telephone system model which is appropriate for worldwide use. Each country or region will differ in its needs and according to the selected transmission system. In Peru, the RCSP used a satellite-based system; elsewhere, microwave, land lines, or hybrid systems may be the transmission system of choice--or necessity. Moreover, there are tremendous variations among satellite systems which will result in cost differences. In Peru, the RCSP used INTELSAT's domestic service; elsewhere, in Indonesia for example, the project may have benefited from the lower costs associated with a more powerful national satellite, such as Palapa. (A satellite cost axiom is the stronger a satellite's signal the smaller--and less expensive--the ground technology, although per circuit costs are higher.) Further, the rapid technological advances which characterize the telecommunications and satellite industry will most likely quickly outdate existing models.

Nevertheless, the RCSP serves as an example to illustrate the cost elements, or "ingredients," needed to develop a rural telephone system and their relation to each other.

The RCSP rural telephone system consists of three earth stations (primary sites) and four radio links (secondary sites) providing both public call and subscriber service. The total cost of putting in place the RCSP system, including more than two years of operation, was $2,785,900.

This includes equipment (the earth stations and power generators were manufactured in the U.S.), associated shipping and installation expenses, later system improvements and capacity expansion, the civil works necessary for the creation of the telephone offices and to house the equipment, the management and operation costs including start-up efforts, and taxes on the imported equipment. The one-time capital costs for infrastructure development and taxes represent nearly 70 percent of total system costs; the management and operation costs about 30 percent.

Overview of System Start-up and Operations Costs, 1980-1985

| Expenditure | Cost | % of Expenditure |
|---|---|---|
| Equipment | | |
| Earth Stations* | $ 1,001,300 | |
| Telephone Plant | 52,400 | |
| Radio Links | 36,600 | |
| Miscellaneous | 68,000 | |
| Subtotal, Equipment | 1,158,300 | 41% |
| Installation | | |
| Earth Stations | 90,600 | |
| Telephone Plant | 9,800 | |
| Radio Links | 8,500 | |
| Subtotal, Installation | 108,900 | 4% |
| Civil Works | | |
| Land | 8,200 | |
| Buildings | 231,800 | |
| Antenna Base | 51,000 | |
| Power System (Generators, Batteries) | 155,200 | |
| Miscellaneous | 6,700 | |
| Subtotal, Civil Works | 452,900 | 16% |
| Planning, Management, and Operations | | |
| ENTEL Planning | 49,900 | |
| Salaries (Including Teleconferencing) | 463,100 | |
| Operations | 365,400 | |
| Subtotal, Planning, etc. | 878,400 | 32% |
| Taxes (Import Duties) | 187,400 | 7% |
| TOTAL | $ 2,785,900 | 100% |

* Including three four-channel earth stations, spare parts, power generators, and shipping charges.

As ENTEL was a full participant in system planning and design, the $49,900 allotted to "planning" does not fully represent the true three-year planning effort. With three years of routine system operation included in the accounting period costing no more than $600,000 (see below), it appears that planning costs are also included in the salaries and operations line items. Further, the $352,000 contributed by AID in technical assistance must also be considered. Although this component is excluded from the chart because U.S. assistance will most likely not figure in future endeavors, the resource input cannot be completely discounted. Were ENTEL to replicate this design elsewhere in the country, it would not need external technical assistance, but it would need to allocate

resources to manage the procurement activities covered by the AID technical assistance. If the cost for technical assistance is included in the total RCSP costs, planning will account for 14 percent of total expenditures.

Examination of the primary (or earth station) sites and the secondary (or radio link) sites provides a more complete picture of investment components and recurring costs. It will be noted that total system costs cannot be derived from individual site costs as total costs include additional engineering time, consumable spare parts, repairs and replacements, taxes, etc.

## Primary Sites

The telephone office at Juanjui is fairly indicative of the two other earth station sites. As it serves as the gateway for the secondary radio-linked sites, however, its operating costs are slightly higher ($2,000-$3,000) than those at Tocache or Saposoa.

Cost of Earth Station Site Installation (Juanjui)

| Expenditure | Cost | % of Expenditure |
|---|---|---|
| **Equipment** | | |
| Earth Station (4 Channels & Spare Parts)* | $ 258,700 | |
| Telephone Plant | 27,200 | |
| Power Generators | 28,800 | |
| Test Equipment | 2,300 | |
| Emergency Radio | 5,700 | |
| Subtotal, Equipment | 322,700 | 54% |
| **Civil Works** | | |
| Telephone Office | 85,300 | |
| Antenna Base | 6,700 | |
| Power System | 42,500 | |
| Miscellaneous | 1,800 | |
| Subtotal, Civil Works | 136,300 | 23% |
| **Installation** | | |
| Shipping | 20,200 | |
| Manufacturer Supervisory Assistance | 7,200 | |
| Training | 7,500 | |
| ENTEL Salaries, Travel | 98,700 | |
| Subtotal, Installation | 133,600 | 23% |
| TOTAL | $592,600 | 100% |

* This figure includes a channel added by ENTEL and supplemental spare and replacement parts. The original purchase from Harris set the basic three-channel earth station price at $203,000 and spare parts at $7,000.

The above chart indicates the capital investment required to establish telephone system infrastructure at one site, including both public call and subscriber service and the channel used for teleconferencing. Other one-time start-up costs not attributable by site, but included in the total system costs, are the planning costs. Land for a 4,000-square-foot telephone facility was donated by the municipality, as was generally the case at other RCSP sites, indicating the value the communities placed on telephone service. In Juanjui, the estimated real estate value is nearly $32,000.

While capital costs for the earth station site total nearly $600,000, annual operating costs represent less than 10 percent of the original investment.

Cost of Earth Station Site Annual Operation and Maintenance (Juanjui)

| Expenditure | Cost | % of Expenditure |
|---|---|---|
| Personnel | $ 22,800 | 47% |
| Power (Electricity & Fuel) | 12,900 | 27% |
| Maintenance | 11,700 | 24% |
| Miscellaneous | 1,000 | 2% |
| TOTAL | 48,400 | 100% |

Nearly 50 percent of operating expenditures were for personnel: 1 administrator, 1 engineer, 2 technicians, 1 telephone service director, 8 telephone operators (1 full time, 7 part time), 1 commercial service director, 1 secretary, 1 driver, and 1 messenger/janitor. Maintenance expenditures are budgetary rather than actual, representing ENTEL's rule-of-thumb estimate of 2 percent of capital investment per year.

An associated recurring cost of earth station operation is the cost of transponder space. Although the small scale of the RCSP system allowed it to rely on existing excess capacity made available free of charge, these costs must be considered for future systems. ENTEL estimates that annual use of the INTELSAT V satellite costs approximately $3,800 per circuit for a 6.1-meter earth station.

## Secondary Sites

Four sites were connected to the RCSP telephone system through VHF radio links. The BUDAVOX radio equipment used at the secondary sites was not specifically purchased for the project, but had been in stock at ENTEL for some time. Its cost is based on replacement estimates, not on actual value, given its consistently poor performance.

The radio link telephone offices were established in existing facilities, and no significant civil works or construction were required. A vehicle, maintained at the Juanjui earth station, was used exclusively for technician transport to the secondary sites.

Cost of Radio Link Site Installation (4 Sites)

| Expenditure | Cost | % of Expenditure |
|---|---|---|
| Equipment | | |
| Radios | $ 36,800 | |
| Other (Batteries, etc.) | 33,400 | |
| Subtotal, Equipment | 70,200 | 62% |
| Installation | 32,800 | 29% |
| Vehicle | 10,300 | 9% |
| TOTAL | 113,300 | 100% |

The capital costs per site average $28,325. Again, overall system planning costs are not attributable on a per-site basis but must be considered in basic start-up expenditures.

Management and maintenance responsibility for the radio linked sites is centralized within the Juanjui telephone office. The Juanjui office has assigned one technician to oversee the radio links operation; maintenance duties consist of overland travel to the sites to recharge batteries and make repairs; and, because the sites operate off batteries, the electricity expenses are those associated with the radio repeater station.

Cost of Radio Link Sites Annual Operation and Maintenance (4 Sites)

| Expenditure | Cost | % of Expenditure |
|---|---|---|
| Central Operations | | |
| Personnel | $ 2,100 | 15% |
| Maintenance | 1,500 | 11% |
| Electricity | 1,600 | 12% |
| | 5,200 | 38% |
| Site Specific | | |
| Huicungo | 200 | 1% |
| Pachiza | 200 | 1% |
| Tingo de Saposoa | 200 | 1% |
| Bellavista | | |
| Personnel | 6,300 | 45% |
| Other | 2,000 | 14% |
| TOTAL | 14,100 | 100% |

The annual recurring costs per site for operation and maintenance average $3,525. In reality, however, the Bellavista office accounts for over 70 percent of secondary site operations. This is because ENTEL maintains a permanent office at Bellavista, which offers telegraph service as well, while at the other three sites operating concessions were given to local businessmen. The Bellavista office costs $9,600 to operate; the others $1,500 each.

Viewed as a whole, the seven-site system required nearly $1.9 million for hardware purchase and installation and costs about $150,000 a year to operate.

## Revenues and Benefits

In 1985, the recurring costs of operation and maintenance for the seven-site system were $150,000; the total income was nearly $135,000. **Revenues covered 90 percent of recurring costs.**

Comparisons of Revenues and Costs of RCSP System

| Site | Revenues (1985) | Annual Operations | Capital Costs |
|---|---|---|---|
| Juanjui (Earth Station) | $ 49,200 | $ 48,000 | $ 600,000 |
| Bellavista (Radio Link) | 5,700 | 9,600 | 28,000 |
| Other Radio Sites (3) | 1,700 | 4,500 | 85,000 |
| Total RCSP System (All 7 Sites) | 134,600 | 150,000 | 1,900,000 |

Given that rural telephone systems are generally expected to cover less than 50 percent of annual costs during the first five years of operation,* the RCSP figures are indeed impressive. The high rate of cost recovery is probably due to several factors. Most rural systems provide unreliable, erratic service which decreases use and discourages users; however, by its second year, the non-redundant RCSP system operated without failure at its earth station sites. Because of the region's previous exposure to limited radio and telex services, the RCSP system enjoyed immediate usage and steeper saturation curves. That consumers must learn to use the system is borne out by the increased number of calls and revenues in 1985 compared with the previous year. And finally, the existing commercial base in San Martin and its pioneer (i.e., non-native) population, provided the immediate need and desire to communicate outside of the region.

It is not unlikely that the RCSP system will meet all its recurring costs within the next few years. The user base continues to grow, and in 1987 ENTEL plans to double the capacity of the Juanjui and Tocache earth stations (from 7 to 14 channels) to satisfy

* Walter Richter, Economist, International Telecommunication Union (personal communication).

unmet demand and reduce the uncompleted call rate due to system congestion. It appears that the expansion of private subscriber service can significantly contribute to revenues. In 1985 subscriber service at the three earth station sites constituted nearly 30 percent of total traffic and contributed over $40,000 in revenues. That monthly traffic at the public call facilities was not reduced by the addition of at-home service indicates that subscriber service generates additional traffic. System traffic could be increased further by improving service reliability at the secondary radio-linked sites, although this would incur the added expense of replacing the faulty BUDAVOX equipment.

Finally, the level of revenues could be increased by raising tariffs. The current average charge per call to the San Martin customer is about $1.15, averaging 0.7 percent of his monthly income ($153). Based on the estimated opportunity costs associated with the wait for call completion (nearly an hour) and the travel costs incurred to reach the telephone offices (about half of ENTEL's customers traveled over 20 kilometers), the average cost to the consumer was far in excess of the amount paid at the telephone office, ranging from one to seven additional dollars. An additional charge of $.15 per customer would recoup the shortfall between revenues and recurring costs, and given the value placed on telephone service, probably would not inhibit traffic.*

It is always difficult to isolate the economic value of a single public sector investment. Given the illicit drug traffic in the San Martin region, it was impossible to measure the benefits to the commercial sector generated by the RCSP telephone service. Yet, certain general indicators of benefits do exist. Through their investment of time and travel, the ENTEL customers have demonstrated the value they place on telephone service, indicating that the benefits are at least equal to the cost of the call. That nearly 30 percent of the RCSP calls are for business purposes indicates that benefits are accruing to the area's commercial sector. Further, the basic telephone system supports the audioconferencing network which provides valued training to the social sectors.

Throughout the developing world, telephone service has traditionally been one of the few public sector investments that an LDC could make and expect immediate returns. In many ways, telecommunications--which has proved so profitable--has fallen victim to its own success. Anything less than 100 percent cost recovery (including capital costs) is disappointing to the telecommunications authority. Thin-route systems in rural areas have not in the past yielded the same revenues as urban areas. **Yet, as evidenced by the RCSP system, rural systems do generate healthy revenues.** It is possible that they can cover operating costs and, with careful pricing, even defray start-up costs. From a development perspective, rural communications systems are unique. Few other development investments generate revenues and are eagerly paid for by users. Road systems do not; sanitation systems do not.

The 10 percent shortfall between revenues and recurring costs of the RCSP telephone system can be more than offset by the cost savings to the government by the use of teleconferencing services for training programs alone (see Teleconferencing section).

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* Shortfall: $15,400. 111,000 calls (1985 traffic) x $.15 = $16,650.

## INDONESIAN SMALL EARTH STATION

While the 6.1-meter earth stations used for the RCSP Project with INTELSAT satellite service cost approximately $250,000 each, the 5-meter solar-powered earth station developed for use with the Palapa satellite system in Indonesia cost $121,500--about half the RCSP earth station price.

Small Earth Station in Indonesia

| Expenditure | Cost | % of Expenditure |
|---|---|---|
| Equipment | | |
| Earth Station (4 channels) | $ 104,253 | |
| Spare Parts | 17,234 | |
| Subtotal, Equipment | 121,487 | 82% |
| Civil Works | | |
| Antenna Foundation, Shelter, and Fence | 8,000 | |
| Subtotal, Civil Works | 8,000 | 5% |
| Installation | | |
| Shipping (International) | 12,348 | |
| Training | 6,000 | |
| Subtotal, Installation | 18,348 | 13% |
| TOTAL | $ 147,835 | 100% |

In each case, the earth stations were designed to be as cost-efficient as possible and to respond to telecommunications needs of the rural communities they were to serve. Both the Peru and Indonesia stations are non-redundant and provide four telephone channels (although the Peru stations have an expansion capacity of 12 channels in contrast to 6-channel capacity of the Indonesian earth station). The principal reason for the price differential is the comparative strength of the satellites used. The national Palapa satellite, with a more powerful signal, does not require as large antenna or high power as in its ground system as does the INTELSAT satellite.

Satellites are becoming increasingly more powerful, thus reducing earth station size and costs. As this trend continues, the future should yield smaller and less expensive earth stations.

## TELECONFERENCING

The costs of the teleconferencing networks are viewed as marginal, based on the use of existing telecommunications systems. Teleconferencing networks which support development activities can "rationalize" investment in thin-route rural telephone systems where traffic does not always produce sufficient revenues to fully subsidize the system.

In Indonesia and the West Indies, the teleconferencing networks used the commercial systems already in place. Even in Peru, where the actual telephone system was installed under the project, the teleconferencing network was ancillary because the prime objective of the project was to develop and explore the use of rural telephony.

Just as teleconferencing networks build on the existing telecommunications infrastructure, they also rely on the existing institutional structure. Their use need not entail the creation of new institutions but can be integrated into the operations of rural institutions to support their development efforts. As such, the associated costs again are marginal. In Indonesia, the West Indies, and Peru, the networks merely extended what already existed.

There are three cost elements to consider for a teleconferencing network:

- the capital costs--the teleconferencing equipment, associated hardware, facilities, and start-up costs;
- the costs of the transmission system--satellite "air time" and telephone lines; and
- the costs of managing and maintaining the network and developing programs for delivery.

## Hardware, Equipment, and Start-Up Costs

The basic audioconferencing (voice only) component of the pilot projects' electronic classrooms ranges in cost from $4,600 to $10,000, depending on the number of channels needed and the number of microphones required. For example, the SISDIKSAT audio component--the most expensive of the projects--was based on a two-channel design to provide simultaneous voice and graphics transmission, which more than doubles the cost of network control equipment. Moreover, twice the number of microphones were used; at about $100 per microphone, these costs can mount significantly on a multi-site basis.

Cost of One Electronic Classroom (in U.S. dollars)

| Electronic Classroom Equipment | SISDIKSAT | UWIDITE | RCSP |
|---|---|---|---|
| • Audioconferencing (convener, microphones, loudspeakers) | 4,179 | 2,416 | 1,912 |
| • Network control | 5,762 | 2,569 | 2,637 |
| Subtotal - Audio Component | **9,941** | **4,985** | **4,549** |
| • Telewriter | 5,270 | 9,500 | n/a |
| • Auxiliary video display | 3,128 | n/a | n/a |
| • Facsimile | 2,995 | n/a | n/a |
| • Slow-scan video | n/a | 11,000 | n/a |
| • X-ray light box | n/a | 350 | n/a |
| • Microcomputer and modem | n/a | 3,000 | n/a |
| Subtotal - Graphics Component | **11,393** | **23,850** | - 0 - |
| • Gating system | 2,027 | n/a | n/a |
| • Auxiliary power | 3,052 | 500 | n/a |
| Subtotal - Classroom Support | **5,079** | **500** | - 0 - |
| TOTAL - Electronic Classroom | **26,413** | **29,335** | **4,549** |

All the audioconferencing equipment (and most of the graphics equipment) was manufactured and purchased in the United States according to government regulations. This equipment is top-quality, and its U.S. origin has increased cost implications--both for the initial purchase price and subsequent shipping costs. Although the equipment is not currently manufactured in the project countries, classrooms have been added in both Indonesia and Peru using local materials. The project technicians eliminated the sophisticated network control interface and connected telephones (instead of microphones) and speakers directly into the telephone lines. Although a much cheaper solution, it is inevitable that the audio quality will be adversely affected because the signal level control devices have been omitted.

The graphics equipment--telewriters, facsimile, etc.--add considerably to the cost of a basic classroom. For both the SISDIKSAT and UWIDITE classrooms, the graphics component exceeds the cost of the audio component. In Indonesia, it doubles the cost of the electronic classroom, as well as doubles the cost of the network control equipment; in the West Indies, it more than quintuples the costs. In fact, for the price of a single slow-scan video unit, UWIDITE can purchase two basic audioconferencing classrooms. The full complement of graphics equipment used by the Rural Satellite Program was for the purposes of field experimentation. For replication purposes, future investment should be based on close scrutiny of user needs and commitment to fully exploit the graphics capability. **In the final analysis, the audioconferencing classroom, which is the foundation of the interactive teleconferencing network, need not cost more than $5,000 per site and can support approximately 30 persons per class.**

As evidenced by the total hardware expenditure for the projects, the hardware costs are not limited to classroom equipment. Central network hardware, such as "bridges" and the graphics studio in Indonesia, and maintenance items, such as spare parts and test equipment, must be included, as well as installation materials (i.e., flexiduct, plug adapters, etc.).

| Total Hardware Expenditure | SISDIKSAT (12 sites) | UWIDITE (6 sites) | RCSP (10 sites) |
|---|---|---|---|
| Classroom Equipment, Bridges, Spares, Test Equipment, Installation Materials | $458,439 | $37,271* | $61,100 |

* Audio component only

The burden or "loading factor" ranged from 23 percent to 35 percent, in direct correlation to the complexity of the teleconferencing network. The loading factor indicates the amount of investment in addition to basic equipment required to complete network installation, exclusive of manpower. For example, the cost of six audioconferencing classrooms and central bridging equipment for UWIDITE totaled $30,365; an additional 27.5 percent was spent to complete hardware purchase and shipping, for a grand total of $38,715.

| Equipment Loading Factor | SISDIKSAT (%) | UWIDITE (%) | RCSP (%) |
|---|---|---|---|
| • Spare parts | 11.7 | 9.7 | 4.2 |
| • Shipping and insurance (from the United States) | 14.4 | 4.8 | 9.5 |
| • Installation materials | 2.1 | 4.0 | 0 |
| • Test equipment | 2.2 | 2.0* | 9.5 |
| • Miscellaneous | 5.0 | 7.0 | 0 |
| TOTAL | 35.4 | 27.5 | 23.2 |

* Rental

Although shipping costs will vary depending on the point of origin and destination, the other figures in the above chart are the minimum level of investment recommended.

A final capital cost of a teleconferencing network is the conferencing facility itself. For each project, either the universities, telephone company, or municipality provided a room adequate for the number of envisaged participants as well as the necessary classroom furniture. Improvements specific to the electronic classroom included the addition of an optional air-conditioning unit, security bars or locks, rudimentary acoustical conditioning (curtains over cement walls), and locally built cabinets to house the equipment. In general, these improvements cost between $200 to $1,000 per site.

Two other categories of start-up costs were incurred in the pilot projects' development: training and technical assistance.

| Overseas Training Expenditures | SISDIKSAT | | UWIDITE | | RCSP | |
|---|---|---|---|---|---|---|
| | Cost | Person Weeks | Cost | Person Weeks | Cost | Person Weeks |
| Total Training Expenditure | $75,000 | | $10,000 | | $4,000 | |
| Type of Training: | | | | | | |
| • Management | | 22 | | 2.5 | | 1.5 |
| • Program/Course Development | | 10 | | 4.0 | | 1.5 |
| • Technical | | 6 | | 1.5 | | -0- |
| TOTAL | $75,000 | 38 | $10,000 | 8 | $4,000 | 3 |

As discussed in the previous chapter, much of the RSP training was through collaborative effort--technical assistance personnel working in tandem with host-country

project staff to transfer skills. This approach makes it difficult to isolate all the costs of training. In-country special start-up training costs are covered by technical assistance costs; ongoing training routinely conducted by project staff is included in annual management costs (see below).

It is possible, however, to document the costs of specialized training for project staff conducted overseas. This includes tuition, charges by training institutions, travel and subsistence, and supplementary training materials and supplies.

A total of 49 weeks of overseas training was provided for the three projects. SISDIKSAT, the largest and most technically complex of the projects, required the most investment, UWIDITE very little because of the staff's familiarity and experience with teleconferencing, and RCSP the least because required training was primarily conducted in-country.

It should be noted that several project staff, particularly UWIDITE's, have pursued additional specialized training as part of their own professional interests. These costs do not figure in the chart.

Although the dollar amounts for U.S. technical assistance will hold little validity for project replication endeavors, the resources used in pilot project implementation should be noted with some caveats. The RSP was a unique endeavor, and the pilot projects were the first full-fledged attempts to use teleconferencing in an ongoing and systematic way. Therefore, the amount of U.S. technical assistance is much higher than it need be for future such projects. Nevertheless, certain functions covered under technical assistance should be provided for--network design and procurement, for instance. Otherwise, many of the activities were conducted jointly by expatriate and project staff and to some extent represent a duplication of effort.

| Technical Assistance (Person Years) | SISDIKSAT | UWIDITE | RCSP |
|---|---|---|---|
| Project Direction & Support | 4.50 | 2.00 | 2.00 |
| Field Advisor | 4.25 | 0.75 | 3.00 |
| Consultants | 0.50 | 0.10 | 0.20 |
| Engineering | 2.30 | 1.00 | 0.10 |
| TOTAL | 11.50 | 3.85 | 5.30 |

The RSP technical assistance team participated in project planning, design, procurement, installation, training, and management to various degrees. The "Project Direction & Support" category mainly includes early planning and procurement activities; the "Field Advisor" category includes project development, initial management, and training duties; the "Consultants" category includes specialized training support, such as for curricula and materials development; and "Engineering" includes network planning, installation, and burn-in.

Because it was not a part of the project implementation effort, the resources for external, summative evaluation are not considered. Formative evaluation efforts were jointly undertaken by field advisors and project staff.

## Transmission Costs

The projects' electronic classrooms are connected via the existing telephone systems serving the various sites. SISDIKSAT and RCSP rely on the national telephone systems; UWIDITE uses the numerous carriers serving the Caribbean region. Both the UWIDITE and SISDIKSAT networks lease the telephone lines or circuits on a 24-hour basis; the RCSP teleconferencing network is assigned a channel on an as-needed basis.

The "leased line" or transmission charges are essentially the cost of renting the telephone capacity for the "dedicated" SISDIKSAT and UWIDITE networks or of making multi-site long distance calls in the case of RCSP. The transmission charges for each project vary, not only because the number of sites served and channels used differs, but also because the telephone tariffs vary among the telecommunications carriers. Telephone charges are not standardized throughout the world; simply, the cost of a long distance telephone call in Indonesia is not the same as in Peru or Jamaica. Furthermore, the arrangements negotiated between users and carriers will vary. For example, as a public service, ENTEL-Peru provides telephone service free-of-charge to the RCSP teleconferencing network, while UWIDITE has been able to negotiate a 20 percent discount with its major commercial carrier. SISDIKSAT enjoys a preferential or concessionary tariff and is currently negotiating to dispense with payment altogether (per RCSP) based on its status as a national education project.

| Annual Transmission Charges ($US) | SISDIKSAT | | UWIDITE | | RCSP | |
|---|---|---|---|---|---|---|
| | Total | Per Site (13) | Total | Per Site (7) | Total | Per Site (10) |
| Total transmission charge/year | 237,500 | 18,269 | 104,000 | 14,857 | free | free |
| Transmission charge/channel | 118,750 | 9,135 | 104,000 | 14,857 | free | free |
| Transmission charge/hour | 70 | 5 | 60 | 9 | 40* | 4* |
| Transmission charge/ channel/hour | 35 | 3 | 60 | 9 | 40* | 4* |

* Based on ENTEL projections (estimates) for a commercial tariff.

Depending on the tariff agreements, the charges per telephone channel will remain fixed. The addition of new sites to the network will increase the charges, but not always proportionately as the "Per Site" columns in the above chart appear to indicate. Depending on the type and configuration of the transmission system, the charges can vary according to site. For example, in Peru the satellite charges may remain the same, but the ground charges will increase.

The most effective way to "lower" hourly transmission costs is to increase network usage. The above hourly charges are computed on actual usage rates: SISDIKSAT at

3,400 hours per year, UWIDITE at 1,740, and RCSP at about 480. Of course, there are in the end a finite number of hours available, and usage will be constrained by participant availability as defined by business hours, holidays, weekends, term breaks, etc. That SISDIKSAT hours are nearly double that of UWIDITE is partially indicative of the intensive use SISDIKSAT maintains through semester breaks when UWIDITE use decreases by 50 percent.

If use does not warrant a "dedicated" network, transmission costs can be reduced by renting transmission capabilities on a part-time or as-needed basis, as in Peru where teleconference hours do not justify full-time rental. Better still, of course, is the replication of the agreement between ENTEL and the user ministries which entirely eliminates transmission costs to the user.*

## Management, Operations, and Programming

| Annual Management Costs ($US) | SISDIKSAT (12 sites) | UWIDITE (7 sites) | RCSP (10 sites) |
|---|---|---|---|
| Central and Site Staff (Sectors for RCSP) | 22,000 | 79,750 | 28,100 |
| Technical Maintenance (Parts and Travel) | 15,875 | 15,289 | 1,400 |
| Course Delivery (Teachers and Presenters) | 6,750 | 13,232 | n/a |
| Course and Materials Development | 19,688 | 10,606 | n/a |
| Materials Production | 10,125 | 3,223 | 1,000 |
| Materials Distribution | 2,625 | 12,803 | 500 |
| General Travel | 5,250 | 4,799 | 2,300 |
| TOTAL | 82,313 | 139,702 | 33,300 |

As indicated in the above table, there is little uniformity in the management and programming costs of the three projects. These reported costs vary markedly--from a minimum of $33,000 in Peru to a maximum of $140,000 in the West Indies.** Nor are these costs necessarily related to the scope of the activity (except in Peru where the activities are significantly fewer).

The SISDIKSAT project serves twice as many sites and three times as many students as the UWIDITE project, yet SISDIKSAT's management costs are 40 percent less than UWIDITE's. The primary explanation for the variation appears to be the difference in the cost of doing business in each country. For example, the 30.5 man-years needed to

* This does not, of course, eliminate the costs to ENTEL. At the outset of the RCSP, however, ENTEL was donating excess transponder capacity which was not in use for commercial service. As soon as traffic requires transponder space, however, the opportunity costs to ENTEL of providing this service will increase.

** The management and operating budgets were the responsibility of the host countries. These figures are derived from the budgets provided by the managing institutions.

implement a year of SISDIKSAT activities cost $22,000; the 11.5 man-years required for UWIDITE implementation cost $80,000. On an individual basis, the SISDIKSAT administrator's annual salary is $600; her UWIDITE counterpart's is $8,200. Quite simply, salaries and other costs are higher in the West Indies.

Further comparison between the two university-based projects shows that investment in salaries (including teachers) and materials comprise between 74 percent and 85 percent of management costs, as would be expected for any traditional education activity. The amounts spent on technical maintenance and repair are relatively minor--20 percent in Indonesia, 11 percent in the West Indies, and 5 percent in Peru--although these figures do not include technical personnel costs (included in the salary line item). In fact, the bulk of the technical maintenance line item is for site travel rather than component replacement.

Materials development, production, and distribution comprise 40 percent of SISDIKSAT's budget and 20 percent of the UWIDITE budget. Although study guides are a regular part of any distance education program, SISDIKSAT and, to a somewhat lesser extent, UWIDITE, often found it necessary to produce basic course materials due to the unavailability and high cost of standard textbooks. UWIDITE's high cost of materials distribution reflects the university's estimate for commercial distribution via courier services. In reality, traveling faculty and staff are more often enlisted to carry materials, and distribution costs are much lower than budgeted.

| Annual Operating Costs ($US) | SISDIKSAT | | UWIDITE | | RCSP | |
|---|---|---|---|---|---|---|
| | Total | Per Site (12) | Total | Per Site (7) | Total | Per Site (10) |
| Actual Costs (Transmission & Management) | 319,813 | 26,651 | 243,702 | 34,815 | 33,300 | 3,330 |
| Percentage (Transmission) | 74% | -- | 43% | -- | 0% | -- |
| Percentage (Management) | 26% | -- | 57% | -- | 100% | -- |

The RCSP Project in Peru is by far the least expensive project to operate, in large part due to the free transmission service provided by ENTEL and to the limited scope of operations (which require only 9 man-years for annual support). The university-based projects, SISDIKSAT and UWIDITE, cost between 7 and 10 times as much for a number of reasons: each pays for transmission services (74% of the SISDIKSAT budget); each leases full-time transmission capacity; and each delivers a heavy load of high-quality, formalized academic courses and must pay for associated staff, development, and materials costs. The higher per site transmission costs and the high management costs make UWIDITE the more expensive to operate on a per site basis, although as a larger project, SISDIKSAT requires more resources in absolute terms.

By reducing the SISDIKSAT network to a single channel along the lines of the UWIDITE model, however, the operating costs of SISDIKSAT can be reduced by 38 percent for a total of $201,063 per year ($16,755 per site).

## Cost-Effectiveness

Presenting costs in terms of units (e.g., per hour, course, etc.) is generally helpful for comparison with the costs of traditional or alternative methods of education, training, and information exchange which are often comparably measured. Figured on the total operating cost per project (see previous chart), the following chart indicates a variety of different unit measures for the three projects to provide a simple basis for comparison and analysis with alternative delivery means within each country. Due to lack of information, applicability, and uniformity of the descriptions, the various unit measures cannot be determined for all three projects. For example, "per course" figures for both RCSP and UWIDITE are not appropriate because RCSP does not present courses and the many UWIDITE credit and extramural courses vary in length and duration, whereas SISDIKSAT offers a standardized 30 courses consisting of sixteen 130-minute sessions.

Program Delivery Costs

| Annual Unit Costs | SISDIKSAT | | UWIDITE | | RCSP | |
|---|---|---|---|---|---|---|
| | Units | $US | Units | $US | Units | $US |
| Per Hour | 3,400 hrs. | 94 | 1,740 hrs. | 140 | 500 hrs | 67.63 |
| Per Teleconference | n/a | -- | n/a | -- | 392 t.c. | 85 |
| Per Person Session | n/a | -- | n/a | -- | 10,000 p.s. | 3.33 |
| Per Course | 30 courses | 5,958* | n/a | -- | n/a | -- |
| Per Participant | 8,800 part. | 36.34 | n/a | -- | n/a | -- |

* Representing single channel use; with two channels, $9,917/course. In practice, only one channel was used for teaching.

On the other hand, as the RCSP program consists mainly of individual training conferences ranging from 50 to 70 minutes, it is possible to quantify the number of teleconferences and aggregate the number of people attending the sessions (including repeats).

UWIDITE yields the least information. Although attendance and other data are available for the credit programs (i.e., Challenge and Certificate courses), the information is incomplete for the extramural and outreach programs. As previously noted, UWIDITE's offerings vary in length and duration, making it impossible to factor out the undocumented activities in order to obtain unit costs per course or per participant.

It is a relatively straightforward procedure to establish the costs of communication service delivery; it is not as easy to identify and quantify the ultimate social and developmental benefits of teleconferencing activities. From a less far-reaching perspective, however, the cost-effectiveness of teleconferencing programs can be partially assessed by comparison with alternative means of providing similar services or products. In

the case of the RSP projects, these services include university teaching, in-service training, critical information exchange such as medical diagnosis or consultation, and more efficient institutional management and administration.

Teleconferencing networks build on existing institutional structures and are generally used to deliver existing programs or services, as in the case of SISDIKSAT and UWIDITE, or facilitate internal communications, as in RCSP. As such, a program delivered by teleconferencing cannot be expected to cost less than the original course or service itself. Use of teleconferencing networks to extend outreach necessarily adds the expenses of equipment, transmission, management, and program adaptation. However, it is possible to achieve certain economies through teleconference delivery, as evidenced in Indonesia. A single SISDIKSAT course costs $5,958 to prepare and deliver (including basic course design and adaptation, teaching, and materials production and delivery); it is extended to 11 universities for $542 per site. A traditional face-to-face course costs $1,281 to prepare and deliver; it costs the same per site as the course must be replicated at each university. **Through SISDIKSAT, the cost of course presentation is reduced by 58 percent.**

In general, distance instruction is not recommended where quality face-to-face instruction is possible. In Indonesia, lecturers at the local universities are often pressed into teaching a course in which they have minimal or no training. Despite good intentions and expertise in another subject area, they cannot consistently offer quality instruction. **For less than half the cost, SISDIKSAT provides expert teaching, quality materials, and at the same time, serves to upgrade the skills of the local lecturers.**

More often the case in developing countries, recourse to even partly trained local specialists does not exist. To extend the skills and knowledge to the needful audience or to unite participants for discussion, some form of travel must take place--either bringing the trainer to the trainees, the trainees to the trainer, or uniting a group at one central location. These options are usually limited by budget. Governments and institutions cannot afford to support all the travel necessary for meaningful information exchange. Teleconferencing networks can serve as a substitute for specialist or participant travel. For example, **in 1985 a day-long meeting of UWI's University Senate involving 84 people from the Trinidad (59), Barbados (12), and Jamaica campuses (13) held over UWIDITE cost less than $1,000. To hold a similar meeting in Trinidad with travel and subsistence for the Barbadian and Jamaican participants averaging $450, it would cost over $11,000. UWIDITE allows a cost savings of 90 percent.*** Two such meetings or workshops a month would equal the total annual UWIDITE operating budget. With the use of UWIDITE, the cost-savings would provide for all but 2 percent of its operating budget.

A similar example exists for Indonesia. A major instrument for training and idea exchange in Indonesia is the workshop. One or two participants from several institutions are flown to a central location for a five- or six-day meeting that focuses on some issue or field of knowledge. Two of the major expenses are air travel and living expenses. An average Association workshop in Ujung Pandang with two representatives from each of 10 universities would entail an expense of $3,125 for airfare and $4,063 for eight days of living expenses in Ujung Pandang including travel time. Additional expenses for

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* In fact, the UWIDITE estimate is inflated because the hourly rate used includes academic program development costs which do not figure in administrative conferences.

materials and staff would bring the total cost of a six-day workshop for 20 people to over $9,325. If 50 of these workshops were held in a year, the total annual cost would be $468,750. These workshops could be delivered over satellite instead with program coordinators at each location and with the same level of support in terms of materials, honoraria, and even snacks. **By accomplishing this task of running 50 workshops for 20 people per workshop, SISDIKSAT would cover its annual costs of $319,813 and recoup the capital investment in less than four years.** The satellite system would still be available for other activities such as courses, seminars, and meetings because the workshop activities would occupy only six to eight hours of SISDIKSAT time during a 12-hour workday.

In Peru, a series of 31 training conferences for health personnel was delivered over a 10-month period to three earth station sites in San Martin. At $85 per teleconference, the series cost about $2,600. To replicate this activity on a face-to-face basis would require that a number of (at least 10) medical specialists travel to the region for a minimum of four days to visit each site. At a minimum of $400 per specialist (including time and travel expenses), the series would cost $4,000. **A 35 percent savings was realized.**

Associated with travel are opportunity costs. These costs become particularly apparent with in-service training. Participants are professionals with duties and responsibilities which make extended absences from the work place both impractical and often impossible. In developing countries, where the skilled manpower base is already strained, it is indeed a dilemma to excuse a doctor, health care worker, or teacher from the urgent demands of his job to participate in a training seminar which would improve his skills. In economic terms, the cost could be assessed by determining the wage of a suitable replacement. The reality is that a replacement may not be available, and the job would remain undone during the professional's absence. In Peru, the RCSP network was used to reach over 1,100 professionals in the health sector who were unable to leave their jobs to attend a lengthy training program.

Using a UWIDITE example, it is possible to quantify the opportunity costs.

Typically, the education ministries in the region provide support for continued teacher training through a limited number of scholarships to attend the one-year Certificate of Education program at the UWI campus in Jamaica. The cost to the sponsoring government is $8,172 per student, including the economic cost to the university ($3,255), maintenance allowance ($2,190), and replacement and leave expenses ($2,727). In 1985/86, UWIDITE delivered the same program (270 hours of instruction at $140/hour) to 65 students at six sites. Immediately eliminated were the costs of $4,917 for maintenance, replacement, and leave. Assuming that the economic cost to the university remains the same and that the $581 UWIDITE cost per student is additive, the cost per student was $3,836, resulting in a savings of 54 percent to the sponsoring government. **For every one student sent to Jamaica, UWIDITE can train two. Indeed, the cost savings associated with UWIDITE for the Certificate of Education program are so significant that the cost of sending the 65 UWIDITE students to the Jamaica campus for conventional instruction would cover 100 percent of annual UWIDITE recurring costs and allow the purchase and operation of four additional electronic classrooms.**

Teleconferencing also compares favorably with another method of extending expertise--visiting professor programs. In Indonesia, remote universities have often relied on a "flying dosen" (flying teacher) program to augment their teaching staffs. A professor, expert in a particular field, leaves his regular teaching duties to travel to another university for one to three weeks to present an intensive course to both students and faculty. As an alternative, SISDIKSAT enables the professor to stay on his home campus, teach

his regular students, reach students at many universities simultaneously, and teach at a more leisurely (and probably more effective) pace. **Course delivery over the audioconferencing network is estimated at $11/course/student as opposed to the $64/course/student of the "flying dosen" program.***

Cost Effectiveness: Comparison with Face-To-Face Delivery

| Activity | Face-to-Face | SISDIKSAT | UWIDITE | RCSP | Savings |
|---|---|---|---|---|---|
| • Course | $ 1,281/site | $ 542/site | | | 58% |
| • Seminar (1 day, 84 people) | 11,250 | | 1,000 | | 90% |
| • Workshop (6 days, 20 people) | 9,325 | 3,384 | | | 64% |
| • Training (31 sessions) | 4,000 | | | 2,600 | 35% |
| • Teaching Certificate | 8,172/ student | | 3,836/ student | | 54% |
| • Visiting Professor | 64/course/ student | 11/course/ student | | | 83% |

Unfortunately this method of comparative analysis is not readily applied to many of the less easily quantified benefits provided by a teleconferencing system. A teleconferencing network can promote better institutional and personnel management, more efficient operations, increased work output, and better staff performance. Attention also has to be given to the intrinsic value of the activities carried out over the communications network. How does one calculate the value of knowledge gained, health conditions improved, or even lives saved? How does one estimate and compare the value of training a doctor, family planning worker, graduate student, or high school teacher?

The Rural Satellite Program has identified the resources required for rural telephone systems and teleconferencing networks. The three pilot projects have provided dollar figures for hardware, transmission, operation, and management. The value future users place on these telecommunications services ultimately will determine their true cost-effectiveness.

* These figures are based on attendance of 50 students/site/course, i.e., 50 students per "flying dosen" course and 550 students (11 sites) per SISDIKSAT course. Using the current average attendance of 23 students/site, the SISDIKSAT costs are $24/student/course. SISDIKSAT classrooms can accommodate 50 students, and its attendance increases every semester.

## CONCLUSION

In 1980 when the Rural Satellite Program began operations, it was a pioneer in advocating the importance of telecommunications to Third World nations and promoting its application to the problems of rural development. Since that time, AID has been joined by many voices:

- The Maitland Commission in its seminal report, The Missing Link, cites telecommunications as a cause of development, not a consequence of it.

- The Center for Telecommunications Development has been established to assist developing countries to establish and improve their telecommunications facilities.

- The U.S. Telecommunications Training Institute, a joint venture between the U.S. government and private industry, provides nearly 500 training slots to engineers and technicians from the developing world each year.

- INTELSAT, the international satellite service, has introduced its VISTA service in an effort to provide reliable, low-cost satellite communications to developing countries.

The Rural Satellite Program no longer stands alone. Its pilot projects, however, remain the only efforts to systematically explore and support the applications and uses of telecommunications in rural areas.

**After five years of field experimentation, what has been learned?**

Although a proven technology and means of communication in the United States, teleconferencing was untried in the Third World. The RSP Projects introduced teleconferencing to rural and remote environments, where the telephone had arrived only recently. In 1982 the research questions were: Could the technology withstand the rigors of the environment, the deficit of resources, and the paucity of skilled telecommunications technicians? Could the technology be adequately transferred to ensure long-term operation and efficient use of the teleconferencing networks? Would it be an effective development tool? What were the most appropriate applications? Would it offer an affordable, cost-effective solution to development problems?

**Telephone technology can be made to work reliably in the developing world.** In Indonesia, the 15-site audioconferencing network performs at 98 percent technical reliability; in the West Indies, the network successfully delivers all but 10 percent of its programs; in Peru, less than 4 percent of scheduled transmissions were cancelled because of technical problems. And, since 1985, both the Peruvian and Indonesian earth stations have provided 365 days of service. This high rate of reliability was accomplished by selecting simple and sturdy equipment, making certain equipment adaptations, and developing many innovative solutions to overcome the typical LDC problems of line noise, erratic power supply, tropical heat and humidity and equipment shortcomings. These challenges resulted in new network configuration and equipment designs, such as:

- the design of a small, solar-powered earth station for rural use;
- the first-time use of a 6-meter earth station with INTELSAT domestic service;

- satellite bridging to conserve channel use;
- a network "gating" system to reduce line noise; and
- auxiliary power systems to compensate for brown-outs and black-outs.

The RSP experience has proved that users and telecommunications authorities can work together. Teleconferencing service can be integrated into regular telephone service delivery, and telecommunications authorities are willing to work with users to provide service once they understand the technology and its application. Nor are they insensitive to the developmental benefits, as evidenced by their willingness to reduce tariffs.

Yet, not everything was successful. The telewriters used for both the SISDIKSAT and UWIDITE Projects proved disappointing in their performance; the radio links in Peru did not reliably support telephone and teleconferencing service. And the RSP learned that the human system was more liable to break down than the technical one. Both training and practice were needed before there was any certainty that participants and presenters would regularly attend the teleconferences, that materials would be prepared and presented on schedule, and that the telecommunications authorities would not inexplicably turn off the earth station in the middle of a conference.

For true technology transfer to occur in the developing world, new and appropriate training and management procedures must be developed for even the most "old-hat" technologies.

**Telephone technology can answer development needs.** It can support a variety of distance education programs, facilitate management practices, and fulfill essential information needs. In Peru, business use of the telephone system exceeded average use by 24 percent, supporting commercial development in a rural region.

As evidenced by the RSP pilot projects, teleconferencing is versatile: it is equally appropriate for delivering university courses, in-service training, health campaign coordination, medical consultation, and management conferences. It cuts across sector boundaries: university students and field workers, physicians and rural health care workers, teachers and agricultural extension agents can all benefit from teleconferencing. Yet, over the course of the Program, a clear pattern has emerged. Rural and isolated people place a premium on training and skills upgrading. In-service training is by far the most demanded service of a teleconferencing network and will attract the most users. And training probably will have the most profound development impact of any of the teleconferencing programs.

**Teleconferencing is an effective and popular means of instruction.** Each project has added sites and expanded classroom facilities to accommodate high attendance and demand. In Indonesia, it was not unusual for a site to have 100-150 students attend a single class. Special UWIDITE and RCSP programs often attracted large segments of the community, as well as the usual targeted participants.

The teleconferencing programs also achieved high "penetration" within the sectors: in the West Indies, over 500 health professionals followed a single course; in Peru, over 80 percent of the field workers in the region participated in the teleconferences.

Satisfaction with the communications medium--essentially two-way voice communications--was expressed by the users. In Indonesia, for example, 74 percent of the students indicated that they learned especially well from the interactive question-and-

answer sessions, which were a regular feature of the SISDIKSAT courses. While 67 percent of the students thought they learned as much or more from the SISDIKSAT courses as from their face-to-face classes, 95 percent of their local tutors believed the students learned as much or more from the distance courses.

Participants from all three projects found the teleconferencing programs relevant to their professional needs. The SISDIKSAT local tutors believed the distance courses and training sessions improved their ability to teach similar courses themselves.

In Peru, 92 percent of the participants stated the teleconferencing programs helped them do their jobs better. In fact, in 1985 over 300 teleconferences were organized at field workers' requests.

This demand is likewise evidenced by the 99 percent of the SISDIKSAT seminar participants' request that additional seminars be offered. And in the West Indies, the University has decided that the UWIDITE Challenge Exam program is so successful that it will no longer offer face-to-face tutorials on the campuses.

**Rural telephone service is affordable; teleconferencing is cost effective.** In the rural and sparsely populated region of San Martin, Peru, the telephone service generated by its second year of operation sufficient revenues to defray nearly 90 percent of annual operating costs. And use continues to increase with the promise of increased revenues.

The pilot projects have demonstrated that at marginal costs--as little as $6,000 per site and $60 per hour--the telephone can be transformed into a powerful development tool through the addition of simple audioconferencing equipment. The investment returns are great in terms of human resource development and improved institutional effectiveness. A teleconferencing network can eliminate costly travel expenses associated with training and administrative communications. In the UWIDITE Project, it was found that a one-week face-to-face seminar for 30 people from several islands would cost $19,000; using the teleconferencing network, the same seminar would cost only $6,000.

The opportunity costs incurred when an already difficult-to-replace professional is pulled from the urgent demands of his job to pursue training can be largely avoided by delivering the same training to his work place over a teleconferencing network. In Peru, the RCSP network has reached over 1,100 trainees in the health sector with in-service training.

Finally, a teleconferencing network's ability to maximize resources to reach a greater number of people has significant cost ramifications. Over the SISDIKSAT network, course delivery costs $11/course/student versus $64/course/student for the visiting professor program.

The research results of the AID Rural Satellite Program clearly show that telecommunications can be both a practical and effective means of meeting a number of important development needs.

The ultimate outcome of the Rural Satellite Program is that the experience and knowledge now exist to provide a sound foundation for others interested in establishing innovative uses of telecommunications. It signals the beginning of a global effort to bring education, training, and information to more and more people at lower costs. It is hoped that, based on the experience of the Rural Satellite Program, others might benefit

from its triumphs and pitfalls to more effectively design and implement similar projects in the future.

The concluding section presents a few of the "how-to" lessons learned in the course of project implementation.

## LESSONS LEARNED

The Rural Satellite Program promotes an innovative idea; its pilot projects were the first efforts in testing the technology/methodology developed under the Program. Establishing a rural telecommunications network requires tremendous effort; establishing a distance instruction program in the developing world, where the vicissitudes and vagaries of the climate, environment, and infrastructure make daily life a challenge, at times approaches the overwhelming. Over the past five years, a tremendous amount has been learned about the planning and implementation of satellite-based projects, from the minutia of equipment procurement and technical design to the grander theories of distance education and development. The basic tenets of any development project about the need for strong institutional support, sound management, and dynamic leadership are equally important for a telecommunications-based project. The following are some of the lessons from the AID Rural Satellite Program.

### TECHNICAL

- Everything takes more time than anticipated. The planning of a rural system, purchase of equipment, shipping, testing, installation, and initial shake-down period can take several years. The basis of a sound technical plan is an accurate initial baseline survey of the existing resources and, in the case of an audioconferencing network, the telecommunications system itself. Pay particular attention to the quality and stability of the local lines. The 44,600 miles up to the satellite and back probably will be less of a problem than the last mile of cable that links the classroom to the satellite network.

- In planning rural telephone systems, do not underestimate the tremendous pent-up demand for service. After three years of operation in rural Peru, telephone usage still has not leveled off, but continues to grow despite the initial high rate of usage. The design of rural systems should be flexible to allow expansion of channel capacity in response to user demands. Heavy usage will take its toll on the subsystems, such as power; therefore, generators and related equipment should be able to withstand exceptional wear-and-tear.

- Audioconferencing is the true "workhorse" of a teleconferencing network. Two-way voice communication is teleconferencing's most important feature and key to effective instruction and discussion. Although the functions of supplemental equipment--telewriters, facsimile, etc.--are fascinating and seem to border on the magical, they will only enhance the audio component, not replace it.

- Make every effort to field test electronic classroom equipment before committing to a bulk purchase. This is particularly important for the more demanding graphics equipment, such as telewriters, slow-scan video, and microcomputers. Also remember that good performance with a two-site linkage may not extend to multiple sites. Because of project deadlines, the RSP did not field-test the experimental Aregon telewriter equipment in Indonesia. Had it done so, the purchase never would have been made.

- In choosing equipment, start simple and make it more complex only if the staff, time, money, and skills are available to support it. The capabilities of the equipment, of course, should correspond to the needs of the activities and staff who will be using it.

One of the Program's main technical problems has been with the highly complex and delicate graphics system that has been subject to hardware problems, interference from poor quality lines, and lack of proper maintenance and operation procedures. Problems with a secondary but glamorous piece of equipment can create a negative attitude toward the entire system, even if the basic audio system is functioning well. The idea of teaching with a solely audio system worries instructors; initial planning surveys find most teachers stressing the absolute need for graphics equipment. These statements should not be taken at face value. Close observation of regular face-to-face teaching methods should be made. It could reveal that visual and printed materials are not a fixture of regular teaching practices--as in Indonesia--and the need for graphics is not as immediate as perceived.

- Technology-based projects generally start off with the good intention of avoiding concentration on the hardware at the expense of the software. When the inevitable problems occur during testing and installation, all attention becomes riveted on "getting the thing to work" and less priority is given to the actual activities that will be undertaken when the system does work. It is also unfortunate that funding is often more easily found for the purchase of new equipment than for the operation, maintenance, and repair of existing equipment. However, this "actuality" does not lessen the very real need for ongoing support of the technical system. As the foundation of the programming activities, its reliable performance is essential. "Economizing" in this area can cause fundamental problems. The program's technical systems require more manpower than spare parts, a requirement more easily met in the developing world.

## PLANNING

- Include the telecommunications authorities in all technical planning steps and in all technical training efforts. Although PTT personnel may not be familiar with new earth station designs, their participation is integral to later operational success, and they bring valuable experience to the design process. Even if the telecommunications authority is not responsible for operation and maintenance of the teleconferencing equipment, its staff should be included in training programs to ensure that they understand the equipment interface and transmission system requirements.

- Accurately assess the stages of growth and maturity of the user institutions before creating an implementation plan. A major challenge of the Indonesia Project has been to reconcile the actual educational practices of the universities with the requirements of distance education. Do not assume that the basic pedagogical methods of higher education in the developed world are in place in the developing world. In Indonesia, particularly, SISDIKSAT found itself grappling with such basics as getting the instructors to come to class regularly and ascertaining whether textbooks actually existed and if they were in a language the students could understand, before focusing on the more "esoteric" needs of distance education such as course adaptation, study guide development, and interactive teaching techniques.

- Do not assume that an existing institution or association of institutions implies common needs among its members. Nor should need be confused with demand. In the Peru Project, it was originally anticipated that the Lima-based ministries were eager to communicate with field personnel in facilitating administration and management. Although field workers were enthusiastic, central ministries were reluctant to avail themselves of a two-way network whereby field personnel could respond to and question central policy.

- Do not assume standard administration practices or structure are present at all participating institutions. A continuing management problem for SISDIKSAT has been the lack of standardization among the universities which causes conflicts in essentials such as semester start-up, testing, etc. Further, the management needs of the distance teaching program may be incongruent with management practices of the institutions.

## IMPLEMENTATION

- Although telecommunications can provide a reliable link between members of a group, it does not solve any existing problems of the coordination and organization of that group. It is a major task for SISDIKSAT to get 11 universities to agree upon programming. The RCSP could not overcome the shortcomings of sector organization, as evidenced by the agricultural sector. A strong organization is needed at the center of the network to coordinate, mediate, and implement the proper policies and procedures that will ensure a smooth-working, highly efficient telecommunications network. This requires officially mandated authority, strong and competent leadership, and--very important--readily accessible budget.

- A strong management structure is essential to a successful teleconferencing project. The scope of the project must not be underestimated; it links several sites and diverse institutions, and entails both the operation of a technical network and program development. Well-organized reporting procedures and sufficient staff are necessary for such a complex activity. Although core management staff need not be numerous, it is recommended that they be assigned to the project on a full-time basis. Project management is a full-time job.

- Central management staff needs ready access to a discretionary budget. These "liquid" funds will provide for emergency repair visits, component purchase, materials production, etc. Ability to react quickly is central to effective operations of a teleconferencing network. If the permission to purchase a $20 box of fuses must pass through the bureaucratic approval process, it is fairly certain that network operations will be undermined.

- The introduction of an innovative system does not automatically mean that the users will adopt innovative ways of utilizing such a system. A major effort must be made to get users to take advantage of the new capabilities and limitations facing them. You have to work for incremental change. Faculty members who have been lecturing for years will not immediately see that it is more effective if periods of 10-15 minutes of lecture are interspersed with interactive periods that involve the students. Providing users with a telewriting/graphics capability does not automatically ensure that they will use it or use it well. There must be staff members trained in interactive audioconferencing who are available to work with users of the systems and gradually get them to expand and improve the ways in which they use the system's capabilities.

- Preparation of support materials is one of the most important elements in distance instruction. Nearly all pilot project participants cited support materials as an influential factor in their learning, acceptance of distance instruction, and attendance. In itself, this is not surprising because support materials are a standard feature of face-to-face instruction. In a distance teaching milieu, however, they can pace learning, give a visual aspect to an audio presentation, and provide a central focus of attention in the absence of the presenter himself.

- Preparation and distribution of support materials are two of the biggest problems for management staff. Materials preparation takes time and work. Often presenters are resistant to preparing materials for their lectures, assuming that a lecture and discussion are enough. In fact, some UWI professors termed support materials as tantamount to "spoon-feeding." In general, however, those teachers who prepare materials for their face-to-face classes are not reluctant to develop materials for their distance classes.

Timely distribution of materials depends on early receipt from developers to allow time for distribution to the distant sites in areas where postal service is neither quick nor reliable. Because funds are often lacking for reproduction by central management, procedures must be established for local reproduction, possibly charging students a materials fee.

- The presence of a local tutor greatly enhances student acceptance, attendance, interaction, participation, and, by extension, learning. Less mature or less motivated learners, i.e., undergraduate students, appear to benefit from tutor presence. Both UWIDITE and SISDIKSAT now nearly always use local tutors.

- Diplomas and certificates of attendance serve as inexpensive, but effective, incentives and reinforcement to teleconference participation in non-degree distance programs. These documents are means by which professionals can show they have pursued additional in-service training even if formal professional or academic certification is not awarded.

- A picture is not always worth a thousand words. Graphics equipment must be used effectively to justify the investment. Sending meaningless pictures or images over the network will not enhance communication or learning. The use of graphics equipment must be carefully planned. Comprehensible diagrams, etc. are best prepared in advance and then integrated into presentations.

Two-way, telephone-based communications networks can benefit rural institutions and users by providing access to expert resources, quality training, new technologies and methodologies, and scientific research, among other uses. They provide a means of communication with policymakers, a chance to ask questions and discuss problems, and an opportunity to participate in the decision-making process.

Communications support projects that are truly effective, however, must be based on thorough analysis, sound design, and realistic expectations. Technical networks must be integrated into institutional operations and supported with user and operator training. A state-of-the-art technical network alone does not ensure that desired benefits will accrue. It is the usefulness of programming and the suitability of applications which will determine the communications support project's impact on development. A network that fully satisfies important communications needs will prove to be well worth the investment.

## AID RURAL SATELLITE PROGRAM PUBLICATIONS

This report is one of a monograph series, "Telecommunications and Rural Development," prepared for the AID Rural Satellite Program by the Academy for Educational Development, including:

- **An Overview of the AID Rural Satellite Program,** Tietjen, K.
- **The Design and Installation of Rural Telecommunications Networks: Lessons from Three Projects,** Goldschmidt, D., Tietjen, K., and Shaw, W. D.
- **Distance Education via Satellite: A Case Study of the Indonesian Distance Education Satellite System,** Shaw, W. D.
- **An Analysis of the Costs and Revenues of Rural Telecommunications Systems,** Goldschmidt, D.
- **A Handbook for Planning Telecommunications Support Projects,** Tietjen, K.

Also included in the series is a report prepared by Florida State University:

- **An Evaluation of the Peru Rural Communications Services Project,** Mayo, J., Heald, G., Klees, S., and Cruz, M.

Other Rural Satellite Program reports available are:

- **Telecommunications Services for Agriculture and Rural Development: Experiences of the AID Rural Satellite Program,** Stahmer, A.
- **Telecommunications Services for Health Care: Experiences of the AID Rural Satellite Program,** Stahmer, A.
- **Telecommunications for Higher Education,** Tietjen, K.
- **Peru Rural Communications Services Project: Final Field Report,** Medrano, L.
- **The University of the West Indies Distance Teaching Experiment: A Case Study,** Stahmer, A., and Lalor, G.
- **Teaching Via Satellite: An Audioconferencing Guide,** Shaw, W. D.
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Copies may be obtained from:

Dr. Clifford Block
United States Agency for International Development
Bureau for Science and Technology
Office of Education
Washington, D.C. 20523
U.S.A.

(703) 235-9006

Ms. Karen Tietjen
AID Rural Satellite Program
Academy for Educational Development
1255 23rd Street, N.W.
Suite 400
Washington, D.C. 20037
U.S.A.

(202) 862-1900

## Acknowledgements

The following individuals are among the many who have contributed to the success of the AID Rural Satellite Program:

**Agency for International Development**
**Bureau for Science and Technology**
**Office of Education**

Clifford Block, Project Manager
Robert Schenkkan, Former Manager
Lawrence Frymire
Peter Spain
David Sprague

**Office of Energy**

Shirley Toth

**Bureau for Latin America and Caribbean**
**Office of Development Resources**

Richard Martin

**Florida State University**

John Mayo
Gary Heald
Steven Klees
Martha Cruz
Diefla Pramono

**Abt Associates**

Larry Kerpelman
John Hodgdon
Elaine Mason

**Academy for Educational Development**

Karen Tietjen, Director
Anna Stahmer, Former Director
Douglas Goldschmidt, Former Dep. Dir.
Willard Shaw
Hugh Orozco
Luis Medrano
Michael Calvano
John Tatlock
Sandra Lauffer
Heather Hudson
Frank Dall
Jay Miller
Alan Kulakow
Peter Boynton

**NASA--Lewis Research Center**

William Bifano
Richard DeLombard
Anthony Ratajczak

**Institute for Telecommunication Sciences**

Peter McManamon
Ray Jennings

**Others**

Edwin Parker
Dennis Foote

**SISDIKSAT—Indonesia**

A. Amiruddin
Sidharta Pramoetadi
Hasyah Haneng
Tahir Ali
Rajab Johari
Rhiza Sadjad
I. G. N. Agung
Purwadi Harto
Soedarko
Bambang Riady Oemar
Anwar Hafid
Iip A. Arief
Abd. Muis Ba'dulu
Musyi Amal
M. Lawele
Mirhanuddin
Yan Pieter Karafir
K. W. Timboeleng
F. Manuhutu
Zainuddin
Soedarto
Emir A. Siregar
L. A. Sinsuw

**UWIDITE—West Indies**

Gerald Lalor
Christine Marrett
Diana Grant
Keith Hunte
Max Richards
Marilyn Floissac
Roy Braithwaite
Elizabeth Campbell
E. R. Waldron
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