Applications of the INTELSAT System to Remote Health Care

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WHAT IS INTELSAT?

INTELSAT, the International Telecommunications Satellite Organization, is a not-for-profit commercial cooperate of 124 member nations, created on 20 August 1964. It owns and operates a global system of communications satellites that provides international telecommunications services to 180 countries, territories, and dependencies, and domestic telecommunications services to 40 nations.

INTELSAT's services are provided by 18 satellites ringing the globe, far above the equator. Through these satellites, the INTELSAT system links virtually the entire world via full-time/earth station-to-earth station pathways among more than 1,300 antennas.

OVERVIEW

What Are Telemedicine and Disaster Communications? INTELSAT has actively encouraged the use of satellites for both telemedicine and disaster relief: two quite different applications which at time overlap in function.

Telemedicine usually refers to some kind of ongoing, daily program, whereby physicians and health administrators can communicate with patients or other health administrators in remote areas via satellite. Telemedicine requirements might encompass medical file transfers, transmittal of public health information, remote testing and diagnosis, or audio and video conferencing. Earth stations and all related equipment may be either somewhat permanent in nature, or transportable. The use of transportable equipment is increasingly on the rise, as technology improves quality and lowers costs. These transportable earth stations operate with an existing medical care or public health care facility, being mounted on a vehicle that can be driven from site to site and operated for days and sometimes even months at a time.

Disaster telecommunications (which frequently encompass telemedicine applications) are those communications required under special circumstances, for example, in the aftermath of earthquakes, floods, tidal waves, or eruption volcanoes. These conditions create urgent,

immediate needs for communications facilities in unpredictable locations. The disrupted communications system has to be replaced immediately by a new system and the most effective way to do this is via satellite.

Telemedicine and disaster telecommunications are not a specific, separate INTELSAT service, but new communications systems can be set up in a very short time via INTELSAT's existing infrastructure and service offerings. The wide variety of applications available through INTELSAT, provides the flexibility necessary to establish emergency communications on a rapid basis.

INTELSAT Telemedicine and Disaster Telecommunications Applications. INTELSAT has a number of services which are most readily utilized for telemedicine and disaster telecommunications. They are:

- access to domestic/regional networks already in place
- temporary services using transportable earth stations
- INTELNET leases for very small aperture terminals (VSATs)
- Project Access.

INTELSAT DOMESTIC/REGIONAL SERVICES

Satellite communications are a vital tool to foster economic and social development, since they provide a cost-effective method to link a country's urban and remote regions. INTELSAT domestic services let countries have access to satellite capacity on an incremental basis, while avoiding the costs and risks of designing, procuring, launching and operating their own satellite program.

INTELSAT has offered capacity for domestic service since 1973, and currently some 40 countries throughout the world rely on INTELSAT to meet national telecommunications requirements. INTELSAT offers a range of domestic services meeting all types of applications. Each domestic network can be tailored to meet a country's specific communications traffic and geographical requirements.

INTELSAT has introduced regional services as an extension of its domestic services to allow the use of INTELSAT capacity for a mix of domestic and international traffic. Regional services enhance connectivity between neighboring countries with geographic, cultural, and economic ties.

Domestic/regional telephone and television services are available in pre-emptible and non-pre-emptible leases. These services are carried on six INTELSAT satellites in the three ocean regions.

Applications of Domestic/Regional Services. INTELSAT's domestic satellite services are generally used for national terrestrial networks for a wide range of applications, including:

- television and radio broadcasting
- public switched telephony
- public data networks
- private business networks
- remote audio conferencing for health care
- medical data networks/file transfer.

All of these applications can be used for telemedicine as well as disaster communications.

In cases of disaster, an existing lease held by one country can even be used for its own or a neighboring country's emergency communications. These communications can be established using both earth stations that are already in place or through the temporary use of transportable antennas to access disaster sites.

USE OF TRANSPORTABLE ANTENNAS

Transportable satellite uplinking is the fastest growing application in the international television business. Today, 27 INTELSAT member countries have pre-registered 280 C/Ku-band antennas with the INTELSAT system that can be flown to and operated from anywhere in the world.

These antennas are used routinely to broadcast live news form locations where major events occur—the crisis in the Persian Gulf region or the excitement of the World Football Cup matches—and of course are invaluable in relaying images, news and information from disaster sites. The antennas are mostly in the range of 1.6 to 1.8 meters in size.

In addition to the video links provided via satellite news gathering teams, INTELSAT also provides a flexible medium for short-term voice and data communications with remote locations under emergency conditions. Very small, readily transportable earth terminals similar to those for news gathering can also be deployed for voice and data communications within what INTELSAT calls the INTELNET service.

For day-to-day and week-to-week remote health care, transportable earth stations are a perfect medium of communication between hard to reach locations where perhaps a single paramedical worker can be linked through a small terminal to specialized doctors at a central hospital facility. Such links could provide voice as well as video conferencing, facsimile, data and other vital services.

INTELNET

INTELNET offers a flexible lease mechanism for voice and data distribution networks. It is most frequently used by banks, insurance companies, news agencies, oil and gas companies, government agencies and other multinational organizations. It permits access close to the customer's location, and can be configured to meet specific communications requirements with minimum technical and operational restrictions.

INTELNET is a digital service designed for use with very small aperture terminals (VSATs) at many remote points operating with a larger central hub earth station. The communications system consists of two parts—a hub station and a remote station to provide one channel of interactive service. A hub station consisting of a transmitter and receiver requires at least a Standard B antenna (10 to 13 meters).

The hub station is not part of the remote station and is usually housed at an existing earth station. These hubs could, for example, be operated on an international gateway antenna of any country, or an antenna used as part of a country's domestic lease. The remote stations can be easily moved and operated from any site from which the satellite to be accessed is "visible." The remote station consists of a 1.2 meter antenna and a transmitter and receiver. While antennas as small as 0.6 meters are used for receive only proposes, the 1.2 meter antenna is currently the smallest antenna for an interactive service. There are systems in development with smaller antennas than 1.2 meters, and INTELSAT is now working to develop a system with a suitcase size terminal of 0.6 meters that operates off of simple battery power. Such a system provides optimum flexibility for both telemedicine and disaster applications.

INTELNET is offered on a global C- and Ku-band, and is offered as a leased transponder service, available in any multiples of 100 KHz (1 MHz, 5 MHz, 9 MHz, 18 MHz, 36 MHz, and 72 MHz). INTELNET can operate with various modulation, coding, and multiple access techniques.

Since INTELNET is offered on a full and fractional transponder basis, the space segment is defined in terms of a resource allocation of bandwidth and power. Users design their own transmission parameters to operate within their leased space segment and this, along with the modulation technique, is assessed as appropriate for use in the INTELSAT system when a transmission plan is submitted. Thus, INTELNET in effect can be used to meet virtually any communications need.

Fourteen INTELNET networks are now in operation, most in the Indian and Pacific Ocean Regions. Each network typically consists of 50 or more VSATs operating with a central hub station which is provided at a gateway earth station. The most common use of INTELNET to date has been for the worldwide distribution of news information, news photos and financial

information. INTELNET is, however, ideally suited to provide thin-route networks for telephony as well as data using very small terminals at low cost, and with considerable flexibility for expansion.

VSATs are an excellent option for telemedicine, with applications that can provide voice, data and fax services. This is particularly true given the low cost of a small microterminal for use within an INTELNET work, something which is going down practically every month.

For both telemedicine and disaster relief efforts, use of these VSAT terminals in either a stand-alone network or in connection with an existing domestic lease can provide rapidly deployed and extensive communication. In addition, data collection networks using INTELNET can also be a valuable tool in disaster prevention. By placing VSAT terminals with seismic or other sensing devices in disaster prone areas, a network can be established with a national or regional hub station to monitor activity and plan for emergency applications. Such networks are effectively used throughout Italy for example, for flood control and seismic sensing.

Summary of Existing Interactive INTELSAT VSAT Applications

1) INTELNET leases:

Hub antenna sizes	: from 7.2 m to 30 m
Remote antenna sizes	: from 1.2 m to 4.5 m

2) Domestic leases or transponder purchases: These networks can be tailored to each country's specific needs. Thus there is a broader spectrum of network topologies, modulation techniques, and applications. The characteristics of these networks can be summarized as follows:

C-band hub antenna sizes	: from 7.3 m to 11.0 m
C-band remote antenna sizes	: from 1.8 m to 4.6 m
Ku-band hub antenna sizes	: from 4.6 m to 13.0 m
Ku-band remote antenna sizes	: from 1.8 m to 4.6 m

VSAT-to-VSAT. Telecommunications links between VSATs can be very effective for telemedicine or disaster communications. For example, doctors can compare diagnoses and rescue teams could communicate with each other directly from remote locations. Further, communications networks can be established for continued relief operations spanning the weeks and months after the initial emergency. The technical features of such networks can vary depending on the circumstances of each case. Variables that would need to be considered include:

- The satellite accessed
- The frequency band (C-or Ku-band)
- The modulation technique
- The bandwidth used.

USING THE EXISTING TELECOMMUNICATIONS INFRASTRUCTURE FOR REMOTE HEALTH CARE APPLICATIONS: PROJECT ACCESS

During the mid to late 1980s, INTELSAT sponsored a special program to promote satellite use for health and educational purposes. For 3 years Project SHARE, as it was called, demonstrated diverse and often exciting examples of telemedicine. Today, Project Access has superseded Project SHARE, streamlining the program while at the same time continuing to show users how INTELSAT can bring health care to some of the loneliest points on the globe.

Project Access can provide free use of the INTELSAT space segment for education, health or other closely related social services. Like its predecessor, Project Access was designed to stimulate service to rural and remote areas, while at the same time emphasizing the potential for follow-on commercial service. As such, preference is given to applicants that require only audio or data services who have operational and financial plans to implement a regular commercial service. A high priority is also awarded to projects that are developing or testing new technologies/ applications in remote areas and then apt to be converted to commercial service. Project Access will also provide up to 4 hours of free space segment for special global television events that are sponsored by any of the principal organs of the United Nations, and which are clearly for humanitarian purposes.

Under Project SHARE, some of the most interesting activities were those of Dr. Max House, who used INTELSAT to provide a dedicated narrowband audioconferencing link between the Kenyatta Medical School in Nairobi, Kenya; the Makarere Medical School in Kampala, Uganda; and the Health Sciences Centre in St. John's, Newfoundland Canada. This link allowed EEGs and EKGs to be sent from African cities to Canada, where sophisticated computers and experts could undertake diagnoses and recommend treatments. Weekly audio conferences permitted medical students in Uganda to participate in lectures, rounds and other educational sessions at the hospital in Kenya. Dr. House also established a similar telemedicine link over the INTELSAT system to Jamaica.

Under Project Access, in March of this year INTELSAT provided capacity for a special videoconference to over 30 Latin American countries, for the Third Pan American Teleconference on AIDS. Sponsored by the Pan American Health Organization and the World Health Organization, this videoconference lasted 3 days, bringing together hundreds of health experts from around the world to discuss one of the most pressing issues of our time.

INTELSAT'S ROLE IN DISASTER TELECOMMUNICATION EFFORTS

Is it possible to provide telecommunication links in sudden disaster situations? Yes! There are many examples that demonstrate INTELSAT's flexibility for providing telecommunications in a disaster; these have included requirements for emergency communications in Iran, the Philippines, Bangladesh, Colombia, Mexico, the U.S.S.R., and the U.S.

Iranian Earthquake. In June 1990 Iran suffered a devastating earthquake, severely disrupting communications between the stricken regions and the rest of the country. INTELSAT loaned Iran a portable communication systems to link the earthquake-affected villages with the public switched telephone network. It took 2 days to set up the communication link and 2 days more to teach the Iranian technicians. INTELSAT's emergency relief network continued to provide valuable communications for several months between the stricken area and the rest of the world.

Medical Assistance to the Armenian Earthquake Victims. For several months in 1989, INTELSAT and its U.S. signatory COMSAT joined NASA in a U.S.-U.S.S.R. satellite medical assistance demonstration project, designed to make U.S. medical expertise available to victims of the December 1988 Armenian earthquake. The space segment was provided 4 hours per day, 5 days per week.

INTELSAT provided free space segment for this "Telemedicine Spacebridge" project, which connected specialized medical facilities around the U.S.A. with the Diagnostic Center in Yerevan, Armenia. This made possible live consultation between medical experts in the two countries on the treatment of earthquake victims with long term physical and psychological trauma.

The INTELSAT system also has been used successfully for emergency communications during such international disasters as Hurricane Gilbert and the Mexico City earthquake, demonstrating INTELSAT's flexibility in providing disaster telecommunications needs.

Natural Disaster in Bangladesh. As an aftermath of the recent natural disaster in Bangladesh, one of the two INTELSAT earth stations was incapacitated. INTELSAT immediately made 13 circuits available to Bangladesh on a temporary basis, and also offered a portable earth station until the regular communications links were restored. In addition, an INTELSAT staff member went to Bangladesh to assess the damage done to the earth station.

HOW INTELSAT'S EXISTING INFRASTRUCTURE CAN BE USED FOR DISASTER TELECOMMUNICATIONS

Time is of the essence in establishing a disaster telecommunications network. Use of INTELSAT's existing earth stations to establish disaster telecommunications links is the speediest

alternative. These systems can serve as the hub for VSAT networks configured to respond to the communications requirements of the particular disaster. Naturally, it will take longer to establish a disaster relief network if no hub earth station or VSAT is available.

If there is no transportable earth station available within the affected country, it could seek assistance from other countries. With 17 satellites in orbit and more than 1300 antenna stations in operation worldwide, INTELSAT can facilitate the implementation of the required telecommunication links in a short time.

INTELSAT's INTELNET service is a highly flexible tool for disaster relief, and could also be successfully applied to telemedicine. A special application for INTELNET is the use of data collection networks using VSATs. Data collection with seismic or other sensing devices in prone areas is very important for disaster prevention and the planning of disaster relief operations. Similar data collection networks could be adapted for use by health officials monitoring outbreaks of certain diseases, or for audioconferencing between doctors and nurses in the field and at base hospitals.

It is also important to have emergency contingency plans which can provide disaster communications for different kinds of emergencies. Such plans could shorten the time required for implementation of a disaster communications network.

These plans should show how to set up the telecommunications links in different cases, where the best positions are for transportable terminals, and which earth stations and satellite capacity could be used. For such plans it is important to have agreements with neighbor countries or other nations, including possible support of their infrastructure.

INTELSAT is prepared to work together with administrations or organizations to develop preventive disaster relief plans. An adequate infrastructure using preventive data collection (INTELNET service) and disaster telecommunication planning is the way for optimal disaster telecommunications relief.

The UN and INTELSAT. INTELSAT has provided lease capacity for telecommunications service to the United Nations since 1983. The capacity is used for telecommunications between UN Headquarters and UN personnel engaged in peacekeeping and emergency relief missions. The emergency relief activities include natural disasters, epidemics, famines and environmental emergencies, all of which typically cause extensive loss of life and/or property and require prompt international response.

There are currently three such INTELSAT leases, two of 9 MHz each in the AOR, and one 9 MHz lease in the IOR. The UN earth stations operating with these leases are increasing, and there are now hubs in New York and Lebanon. While to date these UN facilities have only been used by the peacekeeping forces, a review is now underway of expanding their use for disaster situations to provide emergency communications.

THE FUTURE

Global View. Demand for INTELSAT services increases every year. INTELSAT's international and domestic services for voice, data and TV are currently provided over 15 satellites. Eight additional satellites currently on order: the INTELSAT K, which will be deployed in the AOR in 1992; five INTELSAT VII's, the first of which will be deployed in the POR in 1993; and two INTELSAT VII-A's.

The INTELSAT VII series features significantly increased power and coverage capability, enabling provision of service through a new generation of smaller and less expensive ground stations.

Future of Telemedicine and "Disaster Telecommunications." INTELSAT's domestic/regional services, transportable antenna capabilities, and INTELNET service have potential applications for both telemedicine and disaster communications. INTELSAT is a dynamic, user-responsive organization that continually seeks to enhance its global telecommunications abilities. The INTELSAT system, with its wide range of services and global connectivity, is in a unique position to provide doctors and relief workers reliable and easily operable communications, for both planned services and those that are needed at a moment's notice.