SatCom Based Telemedicine Network – Technology Evolution

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Introduction

Indian Space Research Organisation (ISRO) from inception is oriented towards the specific goal of utilisation of Space Technology for National development. In this endeavour, the SatCom based application for Education and Health is a major step in harnessing Satellite Technology for benefiting the grass root level population of the country.

This journey started with the Satellite Instructional Television Experiment (SITE) using NASA's Application Technology Satellite (ATS-F) during 1976-1978, wherein more than 2000 villages were linked for providing education to the village community in the areas of Rural Development, Health, Hygiene and Adult Education. While this was hailed as one of the biggest sociological experiment in the world, the experience gained from this experiment lead to full scale development of a "Training & Developmental Communication Channel (TDCC)" using the power of SatCom. Several experiments and demonstrations were successfully conducted using the system. The TDCC network consists of the Teaching End, the Satellite and the Class Room. The system uses the Extended C-Band transponder of INSAT satellite earmarked for the Training and Developmental Communication Channel. While the educational content was beamed from ISRO's Studio at Space Applications Centre (SAC), Ahmedabad, the receive terminals had various facilities like Receive only, Interactive Audio Talkback and Video Talkback.

The success of TDCC experiments culminated in yet another application project by ISRO, the "Jhabua Development Communication Project (JDCP)" which is the forerunner for Telemedicine programme of ISRO. The JDCP provided a system test bed for SatCom based developmental direct broadcast for district level development in the Jhabua District of the State of Madhya Pradesh. The experience gained in the utilization of communication hardware in the rural areas combined with innovative software approach covering the areas of education, health, hygiene and community development, provided the impetus to start the Telemedicine Pilot Projects in the year 2001.

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The Telemedicine initiative, developed and implemented in selected parts of the country, on pilot basis, during the past two years, has been one such effort to reach the speciality healthcare to the rural population living in geographically distant, remote, and interior parts of the country.

Telemedicine System

The Telemedicine facility caters to the transmission of patient's medical images, records, output from medical devices, besides live two-way audio and videoconferencing. With the help of these, a specialist doctor advises the non-specialist doctor or a paramedic at the patient's end, on line, about the medical care. In the context of distant and rural areas, the Telemedicine-based medical care is also highly cost effective.

Telemedicine system consists of customized medical software integrated with computer hardware alongwith medical diagnostic instruments connected through the satellite based communications means (like VSAT), at each location. Generally, the medical record/history of the patient is sent to the specialist doctors, either in advance (offline) or on real-time basis (online); who will in-turn study and provide diagnosis and treatment during videoconference with the patient's end.

Telemedicine System Topology

Telemedicine software consists essentially of 'store and forward' modules for Tele-Cardiology, Tele-Radiology and Tele-Pathology modalities, alongwith the video-conferencing facility. The connectivity is provided through DAMA based VSAT system with 3.8m antenna with 2W transmitter for the mainland states and 5W transmitter for the off-shore islands and North Eastern Region. The satellite connectivity is in Extended C-band Mesh configuration controlled by the ISRO Hub Station providing Network monitoring and Control serviced through the bandwidth from INSAT satellite.

The standards adopted for transfer of medical images confirm to the Digital Imaging and Communication in Medicine (DICOM); and for the patient record information, part of Health Level-7 (HL-7). The Telemedicine Centres, both at the district/rural hospitals and at the specialist hospitals were set up under standard room conditions and lighting suited to videoconferencing standard – H.325. Further, the mode of Telemedicine consultations were based on 'store & forward' of patient's medical data and images, followed by video conferencing. The bandwidth used during video conferencing is 384 Kbps whereas during the data transfer the bandwidth used is less than 128 Kbps. The minimal medical diagnostic instruments provided at the remote end are

the 12 lead ECG, X-Ray digitizer/scanner and a pathology microscope with digital camera. However with the experience of utilization of the facility it is observed that the pathology microscope and camera are not essential for many of the remote district hospitals and they are not being provided on a case by case basis.

Point-to-Point System

Based on the need, utility, operation and maintenance and the acceptability considerations of this newer application; the initial pilot Telemedicine efforts had adopted the 'Point-to-Point' Telemedicine System- wherein, at a given time one rural end could have tele-interaction/Telemedicine consultation with one specialist end.

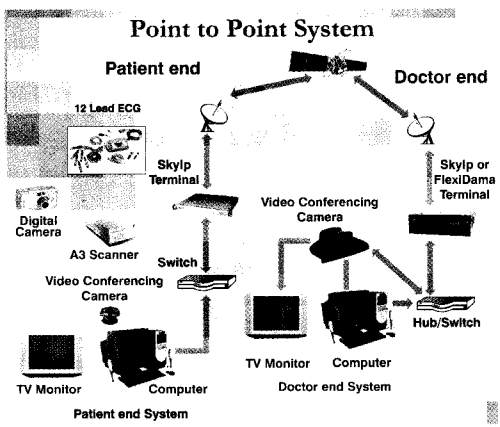

Fig.1 Point-to-point system

Point-to-Multipoint System

With the growing demands for Telemedicine facilities across the country; and several district/rural hospitals desiring to have connectivity and also with more than one specialist hospital; further compounded by the willingness expressed by a number of specialist hospitals to provide Telemedicine service to more rural hospitals; the importance of introducing the 'Multi-Point' connectivity at the speciality hospitals was realized. Accordingly, at one of the super speciality hospitals, multi-point speciality consultation nodes were set up across selected departments connected through Local Area Network (LAN) for distributed consultation.

Point-to-Multipoint System Configuration

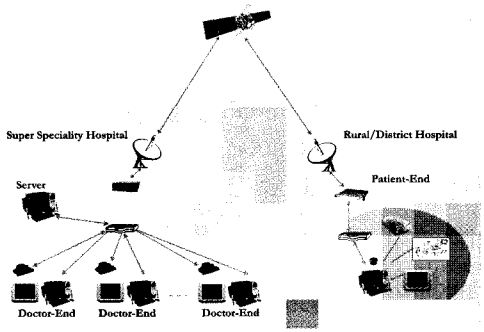

Fig. 2 : Point-to-Multipoint system

Multipoint-to-Multipoint System

Towards reaching speciality healthcare to larger sections of the society, across the country, and in various faculties of medical specialities; the need for demonstrating further 'technology packaging' and implementation efforts – by 'Multipoint-to-Multipoint' type of connectivity has been realized. These efforts also facilitate imparting training to general physicians and

paramedics working in rural areas, besides supporting Continuing Medical Education (CME) efforts.

Server/Browser based System

Presently ISRO has configured server/ browser system in the client/server configuration which is being adopted widely in various nodes.

Depending on the size of the network the server can be sized like Type 1, Type 2 and Type 3 which indicates the number of doctor terminals to patient end. It is observed that the cost of the remote terminal gets reduced drastically with number of client nodes. In the present Karnataka State operational network, with the communication router the server is configured to connect five different Speciality hospitals in different cities.

Mobile Telemedicine

Mobile Telemedicine Unit consisting of Medical equipment along with Telemedicine hardware, software and VSAT system mounted in a Bus/Van can establish a Mobile Telemedicine centre at any place. The technology involved in Mobile VSAT system with 1.8 meter Motor Controlled Antenna which can be pointed to the satellite within the specified accuracies and connectivity established. The Telemedicine system consists of different diagnostic modalities like ophthalmology, slit lamp camera, mobile X-ray machine or a scanner, 12 lead ECG etc., as required.

Since the Mobile Tele-Opthalmology Unit is very essential for Eye Screening during rural eye camps, the unit can also have the facility for grinding and assembling of lenses for providing Spectacles to the needy.

Continuing Medical Education

Continuing Medical Education is another area where the Telemedicine network is extended for Tele-Education. The focus is on video conferencing and classroom presentation. The technology of digital video broadcasting with return channel video for talkback with multicasting feature in a closed user group environment is evolved.

Conclusion

ISRO's Telemedicine Network Topology has progressively graduated from a simple pointpto-point system to multipoint-to-multipoint system covering Telemedicine, Continuing Medical Education and Mobile system which is scalable and reliable. The benefits of the advancements in ICT (Info & Communication Technology) & reduction in cost of hardware & software should reflect in the Telemedicine systems becoming simpler and affordable.