Satellite Communications (SATCOM)

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INTRODUCTION

The benefits of space technology, both direct and indirect, have introduced new dimensions into the study and understanding of Earth's processes and in improving the quality of life for the people living on it. All countries should have access to space technology and must share the benefits. An essential pre-requisite to partaking in these opportunities is the building of various indigenous capacities for the development and utilisation of space science and technology. In recognition of such a pre-requisite, a consensus has emerged with in the international community that if effective assimilation and appropriate application of space technology are to succeed in the developing countries, devoted efforts must be made at the local level, for the development of necessary high-level knowledge and expertise in space technology. Towards this end, the United Nations General Assembly has called for the establishment of Centres of Space Science and Technology Education at the regional level in the developing countries.

CSSTEAP is an education and research institution, capable of high attainments in the development and transmission of knowledge in the fields of space science and technology. The Centre offers best possible education, research and applications experience to its participants in all its programmes. The principal goal of the Centre is development of skills and knowledge of university educators and research and applications scientists, through rigorous theory, research, applications, field exercises and pilot-projects in those aspects of space science and technology that can enhance social and economic development in each country. The programmes aim at development of indigenous capability of participating countries, in designing and implementing space-based research and applications programmes. The Centre will also foster continuing education programmes for its graduates, and awareness programmes for policy and decision-makers and the general public.

Bopal campus, SAC, Ahmedabad - SATCOM host institute

The Centre has successfully conducted Four (4) Post Graduate Courses in Satellite Communication at Space Applications Centre, Ahmedabad, one of prime research institute.

Space Applications Centre (SAC), one of the major Centres of the Indian Space Research Organisation (ISRO), is responsible for the applications programmes of ISRO. It extensively interfaces with the actual users of Satellite systems. SAC is actively

engaged in R & D activities in the fields of Satellite Communications and Remote Sensing.

SAC has the entire infrastructure to design, develop and fabricate the Satellite Payloads and Earth Station hardware. SAC also has the capability for installation and commissioning of Earth Stations on turn-key basis and provides consultancy services to various agencies in building the Earth Stations in the country.

In the past, SAC has conducted various experiments in the field of Satellite Communication with different satellites like ATS-6 (US), Sympbonie-2 (Franco-German) and APPLE (ISRO, INDIA). System configurations and the sub systems needed for different applications in the field of Communications and Broadcasting were designed and developed in-house. These experiments laid the necessary foundation and provided useful inputs and very strong base for the conceptualization and overall planning of Telecommunications (Fixed & Mobile) services, Television transmission, Audio-Broadcast etc., requirements of Indian National Satellite (INSAT) systems.

Based on the valuable inputs, during last two decades SAC has designed and developed several payloads for experimental and operational spacecrafts both in the fields of Remote Sensing and Communication e.g. Bhaskara-I & II, APPLE, IRS Series, INSAT (2, 3 & 4) series, GSAT (1, 2, 3 & 4).

Presently SAC is engaged in number of projects involving design and development of VSAT, S-band Digital Audio Broadcasting Receivers, Mobile Satellite System Reporting-terminal, Satellite based countrywide Education, Satellite based interactive Direct Reception TV system (for Developmental Education and Training) etc. A number of indigenous technologies developed by SAC for INSAT ground segment like Radio Networking (RN) Terminal, Disaster Warning System (DWS), Meteorological Data Collection Platform (DCP) Meteorological Data and News Dissemination Systems are manufactured and marketed by Indian industries. Data Reception and Processing System for INSAT and NOAA, processor for local user terminal of INSAT Sear and Rescue System, Satellite News Gathering Terminals etc., developed by SAC are now fully operational.

ISRO also has an important program in Meteorology & Oceanography and SAC has been involved in the design and development of various payloads of IRS (Low orbit Satellites) and INSAT (Geo-synchronous) series of satellites. The Very High Resolution Radiometer (VHRR), designed and developed by SAC, provides cloud images, wind parameters for cyclone tracking and weather forecasting. The INSAT-3D satellite to be launched towards the middle of this decade will also have sounders besides imagers.

IRS-P3, launched by the Indian PSLV rocket in 1996 and currently in orbit has a German MOS payload providing very useful information on aerosol and ocean colour. IRS-P4 (Oceansat-1) is

equipped with a Multi-channel Scanning Microwave Radiometer (MSMR) along with Ocean Colour Monitor (OCM). Data from these and non-Indian satellites like NOAA, ERS, SSM/I, TRMM etc. are being utilized by the scientists at SAC in the application of forecasting the Monsoons, Tropical Cyclones and other important weather phenomena besides many oceanographic applications, such as gyres, sea mounts, bathymetery, ocean circulation etc. The payloads for CARTOSAT-1, & -2 have been developed recently and provide streo-scopic view of earth images.

Sensors for future generation of Remote Sensing satellites, including the high resolution SAR, Scattero-meter in Remote Sensing and transponders for future generation of INSAT-4 series of communication satellite are also being developed at SAC

ISRO also has an ambitious Launch Vehicles Programme. The Polar Satellite Launch Vehicle (PSLV), now operational, has put a number of Remote Sensing Satellites in polar orbit. ISRO has also launched three satellites simultaneously (Indian, Korean & German) through a single launch of PSLV. Three test-flights of the Geostationary Satellite Launch Vehicle (GSLV) have been carried out successfully.

AIM AND OBJECTIVES

Diploma being awarded during the Valedictory function of SATCOM - III

The educational programme of the Centre is oriented towards the dissemination of knowledge in relevant aspects of space science & technology. The initial emphasis of the Centre is to concentrate on in-depth education, research & applications programmes, linkages to the global programmes/databases, execution of pilot projects, continuing education and awareness & appraisal programmes. Scholars & professionals, who contribute to the educational programme, are renowned experts in their respective fields from both within and outside the region.

The course is directed towards the following categories of professionals from Government agencies.

- University Educators and Researchers.
- Professionals and Specialists.
- Telecom System Managers, Engineers and Planners.

It is expected that at the end of the programme, participating scholars will be able to

- Serve as catalysts for furthering the skills and knowledge of other professionals in their countries. and they will contribute in policy making, planning, development and management of satellite meteorology and its applications in their countries.
- Enhance the self reliance of their countries so as to lessen dependence on external experts.

TYPES OF COURSES (Duration, Time, Qualification)

Post Graduate Diploma	9 Months	Bachelor's Degree in Electronics/Telecommunications /Electrical Engineering or Master's degree in Science (Physics, Electronics) or equivalent with at least 5 years of experience in teaching/research or professional experience in the field of Communication Engineering and/or related disciplines.
Master of Technology Degree	1 yr. 9 Months	after completing Post Graduate Diploma

COURSE STRUCTURE

Phase-1 of the course consists of nine core modules, in addition to the Pilot Project. Each Module covers specific areas of Satellite Communications. Broad structure of these modules is given below:

Core Modules, where the emphasis is on the development and enhancement of the knowledge and skills of university educators, research and application scientists.

Dr. M. Richaria of INMARSAT (UK) delivering lecture in SATCOM-IV Course

- Communications System- an overview
- Satellite Communication Systems
- Earth Station Technology
- Satellite Broadcasting
- Specialised Applications and Future Trends
- Operational Communications Satellite System
- Network Planning, Management & Operational Issues of Satellite Communication Systems
- Development, Education and Training Applications

Pilot-Project, oriented towards planning and executing project to be carried out in the home country as part of Phase-II.

Phase-II (1 Year, in home country) consists of carrying out the Research Project in their respective countries with a view to transfer the technology to the next level of persons. The topic, normally selected, has relevance to the development and upliftment of their country's satellite communication infrastructure. It also acts as a test of the methodology assimilated during the educational programme.

The performance of the participants in the Centre's programmes is evaluated through oral, written and computer-assisted interactive assessments at periodic intervals both in theory and practicals during each module of the course. On successful completion of the Phase-I (of nine months) of the course, the Centre awards a Post Graduate Diploma and on successful

completion of Phase-II, Andhra University (India) awards M.Tech Degree to Scholars satisfying their requirements.

COURSE METHODS & TEACHING AIDS

Modern methods of teaching and instruction are used for imparting training during the course. Printed course material of the lectures is provided in advance. The course methods include classroom lectures, video lectures, computer based training packages, laboratory experiments, group discussions, demonstrations, seminar presentation and field work/case studies (as applicable). Computer based interactive packages are also used for self learning.

FACULTY

The faculty for the course constitutes scientists in different fields, drawn from Space Applications Centre, other Centres of Indian Space Research Organisation (ISRO) and various other agencies/universities from India and other countries, mainly from Asia and the Pacific region. These experts have long and varied experience in the field of Telecommunication, Satellite Communications and their applications. The core faculty has a strong scientific background with a number of publications, experience of participating in international scientific programs and organizing a number of courses to their credit. A few visiting international experts are also invited to deliver lectures. In past, experts from INMARSAT (United Kingdom) have delivered lectures.

FACILITIES

Space Applications Centre (SAC) has state of the art Earth Stations and various well equipped laboratories where R & D on Satellite Communication and related topics are carried out. The Post Graduate courses are organised in two phases :

EDUCATIONAL TOURS

As a part of the course, the participants also visit different centres of ISRO/Dept. of Space and other organisations concerned with Satellite Communications. During these tours the participants are also a given a glimpse of our historical monuments and other tourist places of importance in India.

SATCOM-IV Participants at Taj Mahal, Agra

ACHIEVEMENTS IN THE PAST 10 YEARS

- Past 10 years, SAC has successfully conducted four courses in SATCOM, and sixty participants from 13 countries of Asia-Pacific region have been awarded diploma. It is also very heartening to note that twelve participants have been awarded the M.Tech Degree, some more are in the process of completion. The major themes covered under PG diploma pilot project work are given in table 1.

Table 1: SATCOM (CSSTEAP) P. G. course student's pilot project work themes

S.No.	Trainees Country (No. of student)	Application Theme
1.	Bangladesh (5)	Development of met. Data processing s/w, study & design of DAMA system for communications, study of antenna tacking system for LEO satellites, digital cyclone warning system, Met. Data reception system
2.	DPR Korea (6)	Design of digital modem, design & development of GPS receiver subsystem, design of HEO based communication system, study of data compression techniques for RS imageries, study of Ku-based VSAT network of satellite communication, satellite based meteorological data reception.
3.	India (10)	design of CDMA based mobile satellite network, satellite system for military applications, study and simulation of multi-carrier demodulator for on board processing communication payload, encryption schemes for satellite based data communication, development of compact C-band 20 W SSPA using hybrid power modules, design of Ka-band electronic beam squint tracking system, study of propagation effects in Ka-band, satellite based communication for Indian Navy, satellite based communication system for ships borne applications using INSAT.
4.	Indonesia (5)	satellite based network for store and forward data collection, communication payload for low earth orbit satellite system, satellite based met. data collection system for land and sea, digital repeater system for LAPAN, ground station for Micro-satellite (TUBESAT Lapan).
5.	Iran (3)	Earth station reliability, analysis of satellite based computer network for Ministry of Agriculture, development of portable communication system for disaster application in Iran
6.	Kyrghyzstan (2)	Development of computer based training on satellite communications, PC based network for distance education quality assessment, Snowmelt, Site suitability analysis.
7.	Mongolia (8)	Design of digital TV broadcasting system, internet broadcasting by cable radio network, software for satellite antenna foot print, CBT on satellite communication, web-based interactive programme for satellite communication, CDMA based MSS for Mongolia telecommunications company, satellite based internet service, high speed information backbone network
8.	Nepal (11)	satellite based radio & TV broadcasting system, Ku-band VSAT network, design of digital satellite news gathering system, internet service using VSAT, satellite based emergency communications system, satellite based telemedicine system, multicarrier radio broadcast using satellite communication, transportable SATCOM terminal for TV broadcasting, optimum remote area communication system, satellite based multimedia distance education system
9.	Philippines (1)	Ku band VSAT network for meteorological data dissemination,
10.	Republic of Korea (1)	rain attenuation on earth space downlink operating operating at 12 GHz in Korea.
11.	Sri Lanka (4)	voice coding & decoding system design, simulation of video & data compression technique for satellite based multimedia applications, satellite based met. data collection system, secure

		ship borne composite satellite communication system.
12.	Uzbekistan (3)	design & analysis of 3 m dia earth station antenna, design of shaped Cassegrain antenna for satellite earth station design of antenna for NOAA/AVHRR data reception station in Uzbekistan
13.	Vietnam (1)	satellite based VSAT business network for Vietnam.

Total 60 students from 13 countries

- In addition to long terms PG course on SATCOM last 10 years CSSTEAP organized 3 theme specific short term courses and 1 Workshop on SATCOM. These courses/workshop had benefitted 53 scientific/technical personnel from 12 countries of Asia Pacific region and also benefitted 7 participants from 7 countries outside Asia-Pacific region.

The various themes covered are mentioned below:-

- Workshop on distance education & training via satellite (year - 1997)
- Digital signal processing (year -1999)
- Application of satellite communications for development (year - 2000)
- Application of space science & technology for social scientists (year - 2001)

- During this 10 year period about 20 numbers of lecture notes volume covering the contents of long term PG & Short courses have been published.

Presently, fifth course is being organised at SAC, and gives me an immense satisfaction and courage to conduct the course, with ever changing scenario in satellite communication. The course during its last ten years of life has seen many changes due to new developments in the field but with certain aspects remaining same e.g. teaching of fundamentals about satellite communications to shed the inertia and build the required momentum for development of communication infra-structure in developing countries to fulfill the basic aims which is the objective of CSSTEAP.

The amount of positive feedback we have been receiving from our participants through various means has provided an impetus for doing better and better. I am sure the course team at SAC will not cease to put efforts to upgrade, improve the ability of participants, in making them successful in their carrier and extend all help in changing the scene in their respective countries and organization. The effort in the long run is bound to generate a feeling of oneness among the participating countries in Asia and the Pacific.