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Communication System at Dakshin Gangotri, Antarctica

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Abstract

A reliable communication system is a major requirement for a remote station like 'Dakshin Gangotri' where traditional equipments cannot function effectively due to long distances and peculiar weather and ionospheric conditions. The satellite communication system overcomes these difficulties and provides a reliable and high quality telex, telephone and video communication which facilitates instantaneous contact over the entire world without much loss in the communication quality. The Satcom 'Hind' was put into operation after repairs in the hangar garage as an alternative communication system, during the Fifth Indian Expedition to Antarctica.

Introduction

INMARSAT (International Maritime Space Organisation) is providing space segment for maritime communication, thereby assisting in improving distress and safety of the sea communication efficiency and management of ships and maritime public correspondence. INMARSAT was established on 16th July, 1979, and has fiftythree countries as its members.

INMARSAT system uses satellites to relay communication from ship and coast-earth stations. The INMARSAT satellites are placed in geostationary orbit (36,000 km above the equator), on Altantic, Pacific and Indian Oceans at longitudes of W 026°, E 179° and 063° respectively, providing near-global coverage (Fig. 1).

The system has four major components:

1. Space segment consists of a number of satellites, operational and spare, in geostationary orbit, 36,000 km above the equator. These satellites receive signals from ship and coast-earth stations, amplify them and retransmit. They also perform frequency conversion i.e., in the ship-to-shore direction 6 GHz (Gega Hertz) to 1.5 GHz and shore-to-ship direction 1.6 GHz band to 4.6 GHz band.

Three types of satellites are used in the space segment :— (a) MARECS - A, MARECS - B— Two dedicated maritime communication satellites of 40 voice

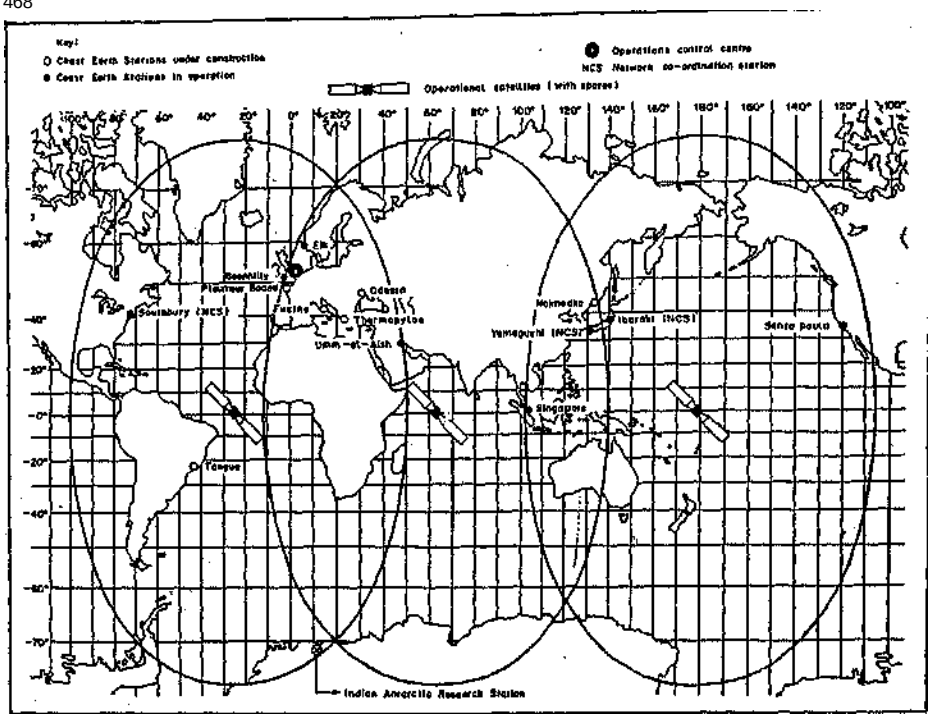

Fig. 1. INMARSAT global coverage

grade channel each. (b) INTELSAT V— Three multi-purpose communication satellites with maritime communication sub system (MCS) with about 30 voice grade channel each, (c) MARISAT—Three multi-purpose maritime communication satellites of 7-13 voice channels each.

2. *Coast Earth Station (CES):* The function of the CES is to communicate with SES (Ship Earth Station) via satellite and provide an interface with external network. The CES suitable for Dakshin Gangotri are Southbury (USA), Goonhilly (UK), Yamaguchi (Japan) and Eik (Norway). It functions in frequencies: 6410.0-6425.0 MHz (transmission) and 4180.0-4200.0 MHz (reception).

These CES have 10-13 m parabolic dish antennae which are pointed towards the operational satellites of the ocean region, receiving and transmitting equipment and a computer for controlling the station operation. It is also useful for interfacing with international network.

nv Jn The \ °r er S, S "* established « Santa Paula (USA), Idakari and Eik Norway) Goonhilly UK), Sentosa (Singapore), Pleumeur Bodou (France) and Umm-al-Aish (Kuwait).

3. Ship *Earth Station (sty;* The Dakshin GangQtri ^ . ^ ^ $?Q0 ^ 12° works with Marecs A Atlantic satellite. It performs reception of telephone,

telex and group calls and transmission of telephone, telex and data. Each SES is assigned 6 to 7 digit identification number which is permanently stored in the memory.

4. *Network Co-ordination Station (NCS):* This serves as a network co-ordination station and performs necessary functions for control and signalling purposes.

The NCS for Dakshin Gangotri SES are Yamaguchi in Indian ocean and Southbury in Atlantic Ocean region.

The system works in following frequencies and communication modes:—

a) Frequencies:

SES to satellites	—	1636.5 to 1645.0 MHz
Satellites to CES/NCS	—	4192.5 to 4200.0 MHz
NCS/CES to satellites	—	6417.5 to 6425.9 MHz
Satellites to SES	—	1535.5 to 1543.5 MHz

b) Communication modes:

i) Teletype	—	50 baud, full duplex
ii) Voice	—	Full duplex per CCITT
iii) Data	—	Full duplex, voice limit

The system consists of approximately 339 channels with channel separation of 25 kHz.

System Description

The satellite communication terminal DEBEG 3211 is a solid state satellite communication system consisting of two major units:

Above Deck Unit (ADE): The ADE unit consists of a parabolic antenna, stabilised antenna pedestal, antenna controller, servo electronic and driven motors for antenna pointing and stabilization. The ADE simulates transmitting and receiving signals of the carrier frequencies with L-band transmit power amplifier, L-band receiver, low noise amplifier, translation electronic for up/down converting the UHF/L-band frequency and frequency separating duplexer. A power supply unit is provided inside ADE which supplies required voltage for the electronic system in ADE.

Below Deck Unit (BDW): The BDW consists of electronic unit, operation interface unit and teleprinter. Electronic unit is based on Z80 microprocessor in the digital section and association memory, system monitor and input/output interfaces. The R/T assembly modulates the UHF carrier with BPSK modulation for teleprinter units and frequency modulates the UHF carrier for telephone units via CPU. The down converted satellite signals are demodulated in the electronic unit. The data channel is a phase modulated, time-division multiplexed

carrier and the voice channel is frequency modulated. The data carrier contains data control information with modulated data.

Operator interface unit has telephone hand set, system status indicators and command push buttons and special button is provided for 'SOS'. The SOS signal can be sent either by telephone or telex form. The PABX interface is inserted as an additional module in the electronic unit to enable slow scan TV transmission and reception.

The teleprinter is an MSR-72 Qwint teleprinter with internal memory which enables the use of store and forward facility. It is primarily peripheral printer and communicates through RS-232 signals at speed upto 9600 baud rate. The answer back is a memory buffer which transmits a short character sequence to identify this specific terminal.

Function Description

The system works on Z80 processor with CPU/memory board, control interface board and R/T interface board co-ordinated, the antenna pointing, receiving and transmitting, data processing, channel assignment, teleprinter and telephone operations.

Transmit function: The system used is to be initialised by the processor and put in request mode and ask the shore station for channel assignment and switched to the mode selected by the operator and the frequency assigned by the shore station.

The TTY is routed to the RT interface board via system interface board. The audio signal from the operator interface unit is routed into the telephone interface board via system interface board. The modulator receives the data from RT interface board or the audio from the telephone interface board and modulates .180 MHz IF carrier signal. This signal is amplified by IF/LO board and then up-converted by hytrodying 1460 MHz to produce final L-band frequency of 1640 MHz transmission by translation electronics unit on the antenna assembly.

Receiver function: The signals 1538.5 MHz are received by, parabolic reflector from the satellites. These signals are amplified and down-converted to 78.5 MHz by modulating it with 1460 MHz. This is further amplified in IF/LF board of electronic unit and sent to TDM and FM channel boards where these signals are filtered to pass either TTY data or FM signals respectively.

The TDM channel board provides frequency conversion, gain and data demodulation and is sent to R/T interface board, when it is converted and routed through printer. The FM channel board provide frequency conversion and demodulation of the FM (voice) signals and these signals are passed through hand operator interface unit via telephone interface board.

Frequency Conversion: The system functions on 5MHz basic clock which is

converted to ECL (Emitter coupled logic) and supplies the 5 MHz differential ECL signal which is routed to all boards through mother board.

On the LO board this clock is multiplied to produce 365 MHz and sent to transmission electronics in the antenna assembly. This frequency is further multiplied to generate 1460 MHz which is used for up/down conversion, when system is idle, the output of Tx/FM synthesiser is 110.9 MHz and TDM system is 114.375 MHz or 115.1 MHz.

Servo-function and antenna pointing: The electronic unit determines the azimuth and elevation of the satellite based on the data given by the operator about the latitude, longitude and satellite position.

The servo amplifier drives the servo motors to get desired bearing and actual antenna position decoded from the potentiometer on the antenna axis. This position is down linked to electronic unit by second Rs-422. In autotrack mode, the processor moves the antenna to the desired elevation and bearing changing the elevation and azimuth by ± 2.5°, 2.60° and position to the strongest point in the pattern.

Communication Systems Presently Available at Dakshin Gangotri

The following are some of the main communication equipment available with the Indian Station at Antarctica:

1. The station has two Satcoms. The 1640106 INDI which is in the main communication room, functions as normal terminal and the 1640105 HIND in hangar garage which functions as emergency system.

2. The station has 10 kW HF facility used for contact with Naval HQ, New Delhi.

3. 500 W HF sets used for communication link between Maitree and Dakshin Gangotri during summer.

4. 25 W VHF sets are installed in Dakshin Gangotri and on Piston Bulley for communication while these vehicles are away from station.

5. Portable VHF sets available for the participants to carry for short distances.

Repair of Satcom

A new SATCOM (Mx 211A) (Fig. 2). was brought to be installed in one of the cabins of hangar garage at Dakshin Gangotri as alternative for the 'HIND' porta cabin SATCOM which was to be replaced during the current expedition. Investigation was carried out for fault detection. The Satcom 'HIND' was put in operation after repairing with the help of navy communication group of the Second Wintering team. SATCOM 'HIND' was established on 23/01/86 at hangar garage communication room which is an alternative accommodation for the winter team in emergency. Sufficient tests were carried out to confirm the operation of SATCOM 1640105 HIND.

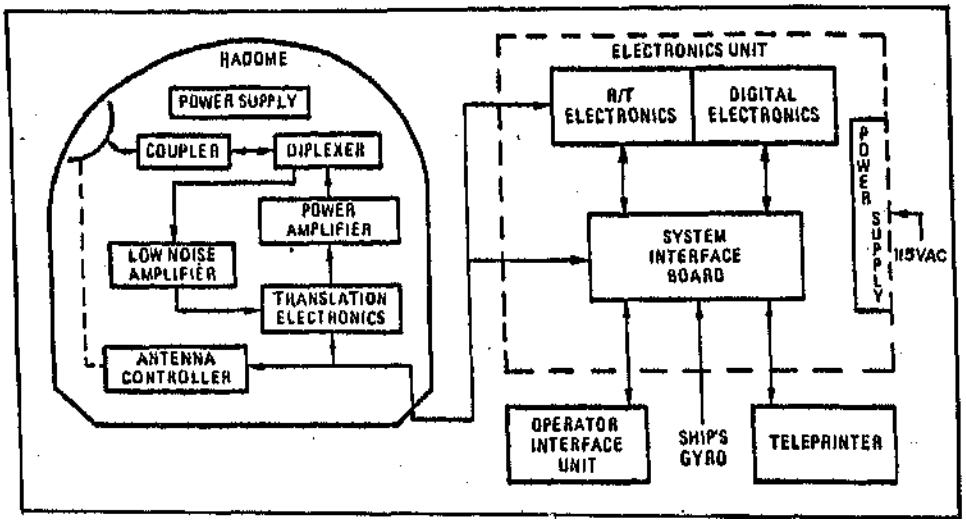

Fig. 2. MX 211A simplified diagram

Suggestions and Conclusions

The present SATCOM can be modified with a crt terminal for better efficiency for telex messages preparation and editing.

The present system can also be used for transmission of real time data from Antarctica to India. Present establishment of SATCOM at Dakshin Gangotri is useful from the point of view of undisturbed as well as high quality communication. From Dakshin Gangotri both Atlantic and Indian satellites can be used as it comes under the coverage area of both the satellites.

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