

Satellite Communication from Antarctica

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A reliable communication facility has been a major requirement for setting up of remote research stations, particularly when it is in Antarctica, where the problems are more severe. None of the traditional communication equipments can effectively overcome the distances and elements covered.

A new all solid-state generation of satellite communication equipment (Debeg 3211) is available today to meet the requirements of reliable communication—telex, voice and slow-scan video transmission. The equipment operates with all C. band (4/6 GHz) domestic satellites. This type of satellite terminal has opened up a whole new era of private reliable communications from Antarctica.

Maritime satellite communication provides a number of advantages over the conventional radio communications. Among them are :

- instantaneous, high-quality service at any time of the day or night, unaffected by weather or ionospheric disturbances;
- privacy of communications;
- direct dial capability for voice and telex communications;
- interconnection of services to the worldwide public telecommunications networks.

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INMARSAT Global Coverage

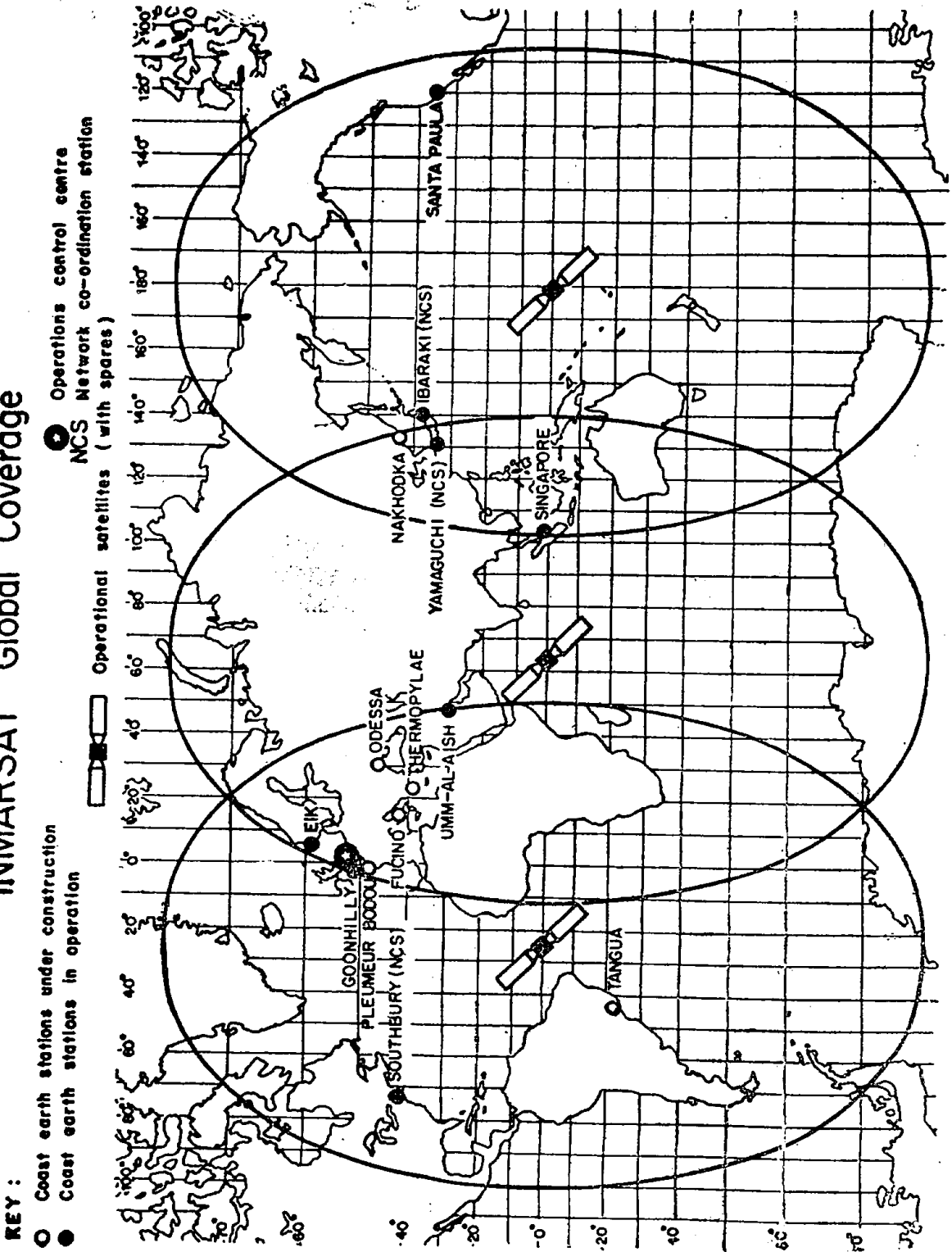


Fig. 1.

Introduction

The International Maritime Satellite Organisation (INMARSAT) was established on 16 July 1979. With its headquarters in London, INMARSAT began operations on 1 February 1982, with 40 countries (including India) as members.

The INMARSAT satellites are in geostationary orbit, 36,000 kms above the equator, over the Atlantic (26 deg W) Indian (63 deg E) and Pacific oceans (176 deg E) providing near-global coverage (upto the 75 degrees latitudes) (as shown in Fig. 1 and 2).

The satellite system has three major components :

- (a) The space segments : consists of a number of satellites both operational and spare, in geostationary orbit, 36,000 kms above the equator over the world's three main ocean regions—together with the tracking, telemetry, command, monitoring and related facilities and equipment needed to support them. Three types of satellites are used in the first-generation space segment viz. MARISAT, MARECS and INTELSAT V (MARECS and INTELSAT V are higher capacity systems than MARISAT to meet expected continued growth in demand).
- (b) Coast Earth Stations (CES) : are located at Southbury and Santa Paula (USA), Ibaraki and Yamaguchi (Japan), Eik (Norway), Groomhilly (UK), Sentosa (Singapore) Pleumeur Bodon (France) and Umm-al-Aish (Kuwait). These stations have a dish antenna about 13 metres in diameter, transmitting signals to the satellite at 6 GHz and receiving signals at 4 GHz. The nearest coast earth station to the shore call provide the user SES the possibility to select the CES station giving the lowest cost to a particular subscriber.
- (c) Ship Earth Station (SES) : in Antarctica at latitude 70°05'37" S and longitude 12°E works with the Marecs A satellite which is geostationary orbit over the Atlantic ocean (26 deg W).

Each satellite is under the control of a Network Coordinating Station (NCS) which also controls and monitors the traffic between the Ship Earth Stations (SES, Antarctica) and the Coast Earth Stations (CES).

The system operates in the following frequency bands :

SES (Antarctica) to	
Satellite	: 1636.525 MHz—4200.975 MHz
Satellite to CES/NCS	: 4192.525 MHz—4200.975 MHz
Satellite to SES	: 1535.025 MHz—1543.575 MHz
CES/NCS	: 6417.525 MHz—6425.975 MHz

NOTE:
 THE CHANNELS ARE NUMBERED BY
 USE OF OCTAL NUMBERS AS BELOW:
 (O - OCTAL)

OCTIMAL: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 64, 358, 359
 OCTAL: 1, 2, 3, 4, 5, 6, 7, 10, 11, 12, 13, 100, 522, 523

Three satellites in a geostationary orbit above
 the equator at approx 35700 Km. altitude

The Three Coverage Areas are Shown on the
 Map (Fig. 1)

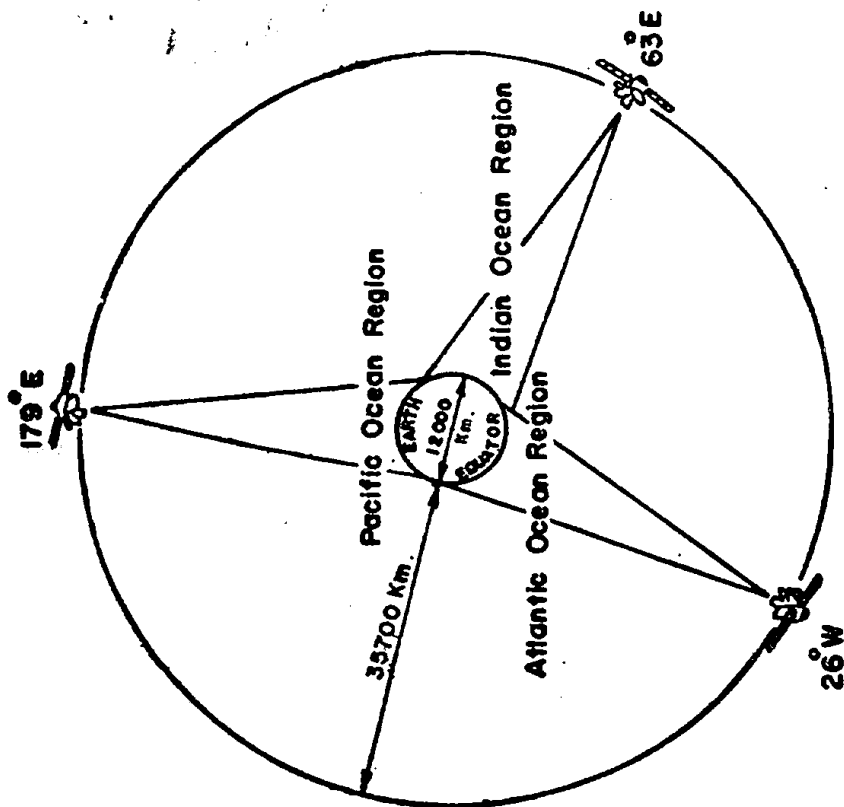


Fig. 2

Description

The satellite communication terminal Debeg 3211 (Mx-211) in the Indian Antarctic Research Station was installed and commissioned on 15th February 1984 consists of three facilities—voice, telex and slow-scan TV (Fig. 3).

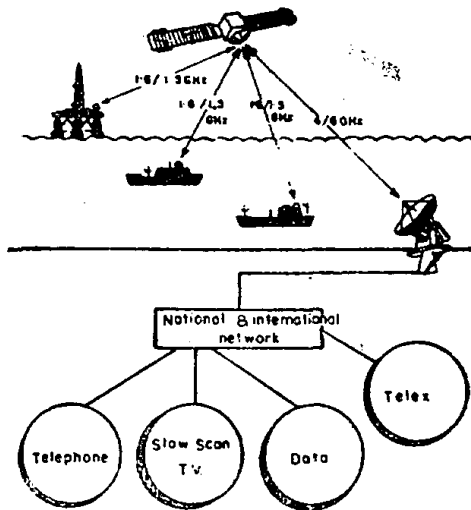


Fig. 3.

The SATCOM system provides a link from the telephone and the telex in Antarctic station to the telephone and telex network ashore. Once the connection is established, via the satellite and the CES, the telex and telephone form a part of the network.

In the idle state the system (SES) listens for messages or commands from the CES (Coast Earth Station). It can also contact the CES via a common request channel and ask for a communication channel to be established to the terrestrial telephone or telex networks. Similarly, a communication channel is established when a call is addressed to the Antarctic Station (SES) reaches the CES from a point in the terrestrial network.

Since the CES has full control over the terminal, operator's task will only be to set up the correct request for connection when an outgoing call is to be made, and to ensure that the connection is disabled after the call.

To get access to a communication channel the Ship Earth Station (SES), Antarctica transmits a REQUEST to the Coast Earth Station (CES) in Southbury (USA) or Goonbilly (UK). The CES responds with an ASSIGNMENT to the Network Coordinating Station (NCS), which then transmits an ASSIGNMENT MESSAGE to the SES, informing about assigned channel and time slot.

Two channels are reserved for requests from Antarctica to shore, channel 124 Q and channel 402 Q, monitored by CES. All assignment messages are transmitted on the common channel, (Ch. 156 Q). The common channel is also the channel to which all SES—stations are listening when in 'idle state', i.e. no traffic in progress.

Telex communication

When the CES is transmitting telex to SES (Antarctica), a special TDM (Time Division Multiplexing) format is used. In this format, the CES transmits two telex characters every 0.29 sec. in a specific time slot for each SES. Each SES operates on its own fixed TDM channel frequency and controls the telex traffic to and from the SES (Fig. 4).

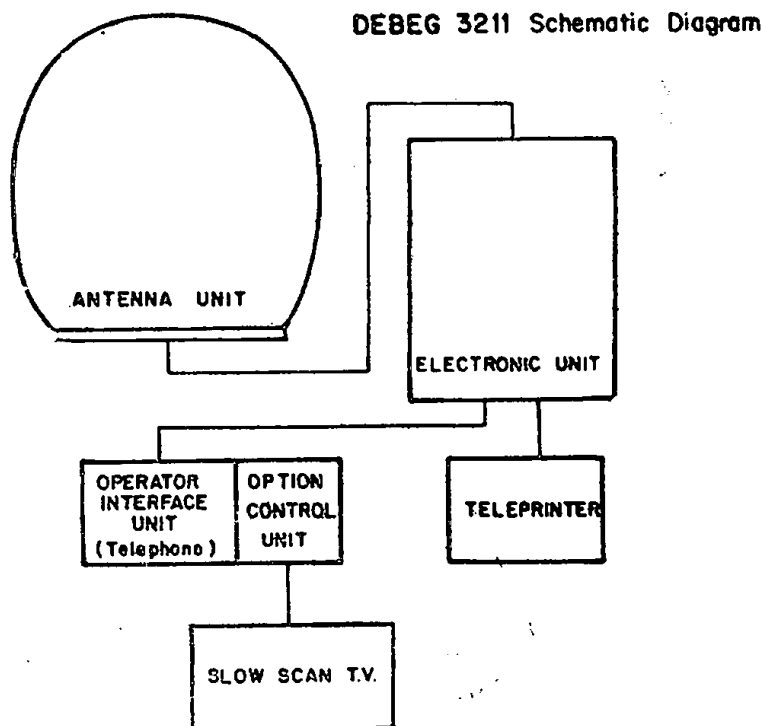


Fig. 4.

When SES is transmitting telex to a CES, the TDMA (Time Division Multiplexing Access) format is used. In this format the SES transmits 12 telex characters every 1.74 sec. in short bursts 37 ms (approx.) long. The transmission takes place in a specific time slot and on the SES's assigned TDMA Channel frequency.

Telephone communication

For telephone communication, FM (Frequency Modulation) is used. The FM signal occupies one pair of communication channel frequencies, once, one for shore-to-Antarctica and one for Antarctica-to-shore and only one station can communicate at the time on this frequency pair. The telephone channels are controlled by the NCS which assigns a free channel upon request. When a channel has been assigned it is controlled by the CES until end of call.

All SES's are continuously listening to one particular carrier frequency, the common TDM channel at 1537.750 MHz.

When a CES wants connection to a SES, the coordinating station (NCS) makes the SES's ID number (1640106 INDI X) appear in an assignment message on this carrier. The SES terminal recognizes its ID, reads the assignment message and tunes its communication equipment as required.

The SES cannot get access to a communication channel without prior assignment. For the TDM telex channels, such assignment is given by the CES via the NCS. For the telephone channels, such assignment is given by the NCS which also assigns the telephone channel.

All SES's are sharing two request frequencies for initiation of station-to-shore calls. The SES will alternate between the two request frequencies. The requests are very short (36 ms, approx.) so the probability for two requests interfering is very small. If, however, the requests bursts should interfere, the shore station will not respond, and a new request must be initiated. Requests for telex and telephone channels are made from teleprinter and telephone units, respectively.

Slow-scan TV (DSC-2000)

The system mainly consists of the (DSC-2000) scan converter, a TV camera (CC-111) and a 12" Monitor (CTM-2000).

Standard TV video signals are converted to SSTV audio signals which can be transmitted over voice-grade communication link (Satcom telephone line) and standard SSTV audio signals are converted to conventional fast-scan TV, capable of being reproduced on any standard CCTV monitor.

At the beginning of the SSTV-transmission the right adjustment of the "contrast" and "brightness" control on the Monitor are made properly, so that all grey levels can be distinguished clearly.

(a) *Transmitting of SSTV-pictures*

Before storing and transmitting a SSTV-signal 'Brightness' and 'Contrast' are adjusted for best picture. Picture from the camera is displayed on the monitor and both the controls are adjusted in such a way that both lamps 'BL' and 'WH' start glowing slightly. After that, the memory is displayed. The picture is then stored in the selected memory or on the ordinary audio cassette tape-record. The picture of the selected memory is automatically displayed on the monitor and simultaneously converted into a SSTV-signal. To transmit the picture from memory, the mode switch is put to "TRM MEM" after getting OK signal from receiving party (Goa). Transmission of a picture lasts 32 secs.

When transmitting from the tape, the mode switch is kept at "TRM TAPE". The SSTV converter works in receiving mode so that the pictures coming from the tape are stored in the memory and displayed on the monitor.

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(b) *Receiving of SSTV-pictures*

For receiving pictures the mode switch is put to "RECEIVE" and pictures are continuously stored on cassette tape recorder (for off-line viewing) through the Monitor. Transmission and Reception of slow scan TV signals has been successfully achieved from the Indian Antarctic Research Station since 17th January, 1984 to NIO, Goa.

Observations

The location of the Indian Antarctic Research Station (at latitude $70^{\circ}05'37''S$ and longitude $12^{\circ}E$) provides a unique opportunity to use either Indian Ocean or Atlantic Ocean satellite, as the location falls in their area of coverage. This gives a facility to reduce land-line charges by appropriately selecting the suitable satellite and coast earth stations.

In the Indian Ocean region Yamaguchi (Japan) Eik (Norway), France, Kuwait and in the Atlantic Ocean Southbury (USA) and Goonhifly (UK) were used from Antarctica for communications.

The Antenna positions for the two satellites are :

	<i>Azimuth</i>	<i>Elevation</i>	<i>Gyro</i>	<i>LVL</i>
INDIAN	050	05	280	170
ATLANTIC	316	06	280	171

Conclusion

The Research station in Antarctica is provided with the best communication facility available today, by using the Satellite communication terminals (ID Nos. 1640105 HIND and 1640106 INDI). One spare identical unit is also made available in the Emergency shelter (Portakabin) with enough back-up spares for one year continuous operation, being manred by Capt. Paramjit Singh (signals).

ACKNOWLEDGEMENTS

I would like to take this opportunity to thank Dr. S.Z. Qasim (Secretary, Department of Ocean Development), Dr.V.V.R. Varadachari (Director, NIO, Goa) and Dr. H.K. Gupta, (Leader of the Third Antarctic Expedition), for the opportunity and guidance. I also wish to thank Dr. E. Desa (Head, Instrumentation Division, NIO, Goa) and my colleagues Dr. E.S. de Sa, Mr. A.P. Selvam, Mr. Oswald D'Souza, Mr. V.N. Chodankar, Mr. Sham Kalangutkar and Mr. V.B. Naik for their kind help.

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