

A new generation of satellite terminals has opened the way to more reliable communication between remote sites and base stations through the Inmarsat network. M. Ravindranath Nayak reports.

Digital links free the air waves to Antarctica

Perched on the edge of the ice cap at a latitude of 70 degrees, the Indian Antarctic Research Station is one of the world's most remote settlements.

Clearly, reliable communications is vital to such a community, but its remoteness creates difficulties which traditional communications methods and equipment cannot always overcome. Until recently, the only available transmission medium was radio, which is highly vulnerable to ionospheric disturbance and poor weather. Moreover, it provides only voice links.

Now, however, these problems have been overcome by using satellite communication links provided through the Inmarsat network.

Such links supply privacy, direct dialling, and connection into the world's telecommunications network.

They have been made possible in particular by a new generation of all solid state equipment (Debeg 3211), which can provide telex and slow scan as well as voice links.

Capable of operating with all C band (4.6 GHz) domestic satellites, the equipment includes a 1.5m diameter dish which has a right hand circular polarisation and has a gain of 37dBw + 1dB saturated.

The L band transmitter transmits at 1.6 GHz and receives at 1.5GHz. The equipment was supplied by Magnavox.

To understand how links are established between the Antarctic research station and its 'head office' - the National Institute of Oceanography in Goa, India - some understanding of the Inmarsat network is needed.

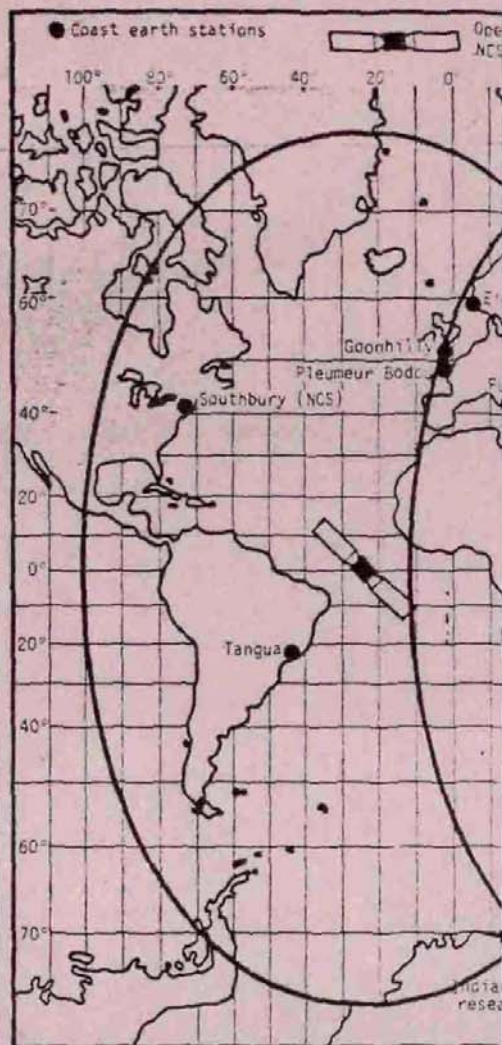
This can be divided into three: the satellites, the coast earth stations and the ship earth stations.

The satellites are positioned above the world's three main oceans - the Pacific, the Atlantic and the Indian (see figure 1 above).

These satellites communicate with 13 coast earth stations (CES), which are at Southbury and Santa Paula, USA; Ibaraki and Yamaguchi, Japan; Goonhilly, UK; Sentosa, Singapore; Pleumeur Bodou, France; Tangua, Brazil; Fucino, Italy; Odessa, USSR (2); Umm-al-Aish, Kuwait and Eik, Norway.

Each CES has a 13m dish antenna which transmits to the satellite at 6GHz and receives at 4GHz.

The third component of the Inmarsat network is the Ship Earth Station (SES). The SES at the Indian Antarctic Research Station normally works to the Marecs A satellite, which is



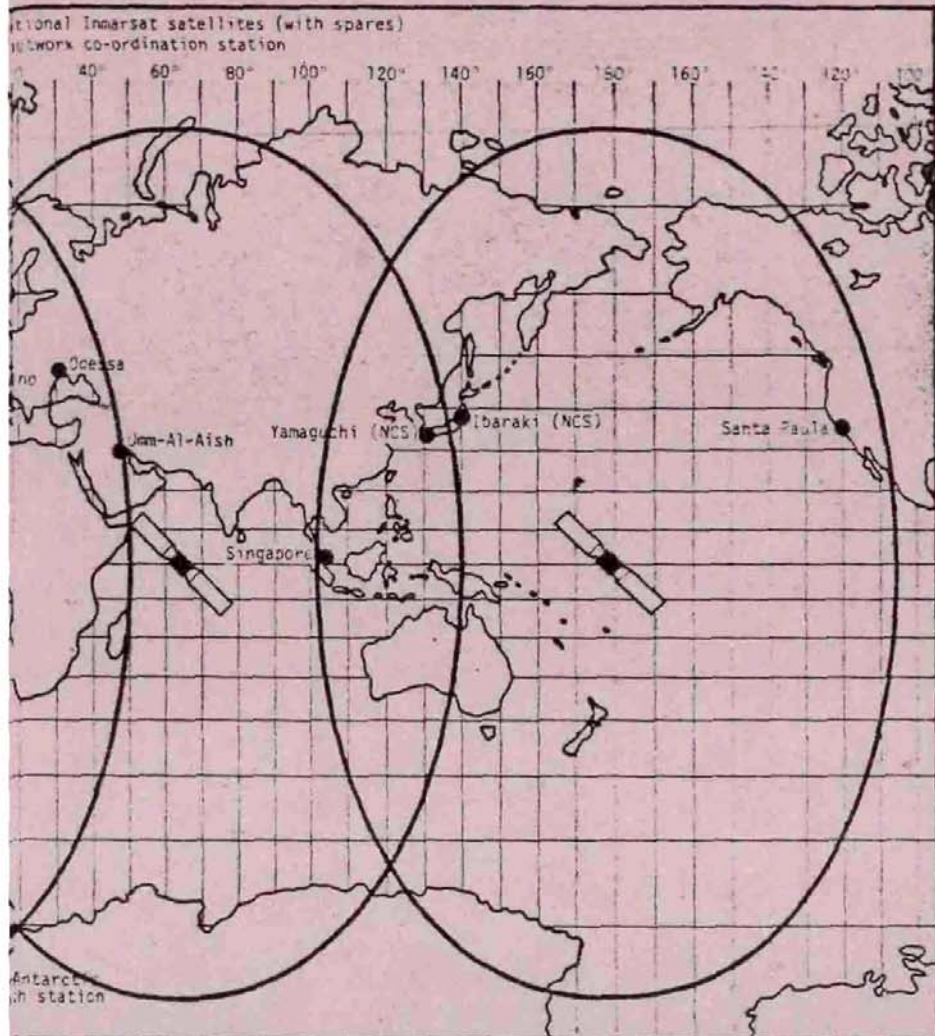
over the Atlantic. However, the SES's position means it can work also to the satellite over the Indian Ocean, so land line charges can be reduced by selecting the appropriate satellite and CES.

The satellite is under the control of a network coordinating station (NCS) which also controls and monitors the traffic between the SES and the CES.

The system operates in the following frequency bands:

SES (Antarctica)	1636.525MHz -
to satellite	: 4200.975MHz
Satellite to	4192.525MHz -
CES/NCS	: 4200.975MHz
Satellite to SES	: 1535.025MHz -
	1543.475MHz
CES/NCS	: 6417.525MHz -
	6425.975MHz

The purpose of the system is to link the telephone and telex on the Antarctic station to the telephone



telex networks ashore, so that they form part of the shore network.

In the idle state, therefore, the SES listens for messages or commands from the CES. To establish a terrestrial telephone or telex link, it contacts the CES via a common request channel and asks for a communications channel to be established. The CES responds with an 'Assignment' to the NCS, which then transmits an assignment message to the SES, telling it which channel and time slot it has been assigned.

Two channels are reserved for Antarctica to shore links, and assignment messages are transmitted on the common channel. The common channel is also used by the SES for listening when it is in the idle state.

Since the CES has full control over the SES terminal, the operator's only

task is to set up the correct request for connection when an outgoing call is made, and to ensure that the connection is disabled after the call.

All SES's share two request frequencies for initiation of station to shore calls, and the SES alternates between these two frequencies. The requests are very short - about 36ms - so the chances of two requests interfering with each other are slight. But if they do, the shore station will not respond, and a new request must be made.

We can now turn to the specific techniques used for each type of call - telephone, telex, and slow scan TV.

Telephone signals are frequency modulated on to a pair of channel frequencies, one for each direction. In this system only one station can communicate at a time on this pair.

Telephone channels are assigned

by the NCS on request, and once assigned, the call is controlled by one of the Coast Earth Stations.

When a CES wants connection to an SES, it takes advantage of the fact that the SES is continuously listening in on one carrier frequency, namely the common TDM channel at 1537.750MHz. The SES's ID number appears in an assignment message on this carrier, placed there by the NCS. The SES terminal recognises it, and tunes its communications equipment.

The SES cannot get access to a telephone channel without prior assignment by the NCS.

For telex communications, time division multiplexing is used. When the CES is transmitting to the SFS, a special TDM format is used, in which the CES transmits two telex characters every 0.29 seconds, in a specific time slot for each SES. Each SES operates on its own fixed TDM frequency, and controls the telex traffic to and from the SES.

When an SES is transmitting telex to a CES, TDMA is used. The SES transmits 12 characters every 1.74 seconds in short bursts about 37ms long, each transmission taking place in a specific time slot.

The Indian Antarctic Research Station also uses slow scan tv, to transmit, amongst other things, scientific and mechanical fabrication drawings.

At the research station, the system comprises a scan converter, a tv camera and a 12in monitor.

Standard tv signals are converted to slow scan tv audio signals which can be sent over a voice grade communications link.

The operator can check each picture on the monitor, and then stores it in memory or on ordinary audio cassette tape before transmitting it. It takes 32 seconds to send each picture.

When receiving, pictures are continuously stored on cassette tape recorder for off-line viewing. ■

M. Ravindranath Nayak is with the National Institute of Oceanography in Goa, India.