Eleventh Indian Expedition to Antarctica, Scientific Report, 1995
Department of Ocean Development, Technical Publication No. 9, pp. 337-340

HF Voice Data Communication Between DEAL, Dehradun And Maitri,Antarctica

KALI RAM

Defence Electronics Applications Laboratory
Rajpur Road, Dehradun

Abstract

An experimental low power HF station with a log periodic antenna was installed at Maitri station in December 1991 during the eleventh Indian expedition to Antarctica. Both, voice and PC based data communication were provided between Maitri and India. The communication window was found for a duration of 4 to 5 hours daily except, when due to high magnetic storms there were complete blackouts. This work was undertaken as a joint mission by DEAL and R & D E(E),Pune.

Introduction

Strong communication link with rest of the world being the backbone of Antarctic research, Indian scientists have addressed themselves to such need and carried out research, especially on High Frequency (HF) communication right since our first venture in that distant continent (Sengupta,1983; Andhere,1985; Hanjura,1986 and Singh,1986).

Indian station, Maitri at Antarctica is about 12000 km away from India. HF communication can cover this range without any relay station using multi-hop sky wave mode via ionosphere. The HF communication is possible for a period of 4 to 5 hours every day. There was a long felt need of voice and data communication from Maitri to India. To serve this goal, DEAL, Dehradun set up an experimental HF station at Maitri.

System Configuration

The following HF system was configured and installed at Maitri for providing voice/data communication between Maitri and India.

The system consists of an HF Transceiver, a data modem and a PC as data terminal. The modem is connected to the PC with a RS 232-C interface. The

modem and a transceiver are connected through PTT, AF out and PATCH IN for data communication (Fig 1).

The modem generates the AFSK (Audio frequency shift keying) audio tones as per digital data received from PC which is further modulated in SSB, amplified and transmitted by the transceiver. The signal is detected by the Receiver and demodulated to form digital data. The system specifications are given below:

System specifications

1. **Tx Power 100 Watt**
2. **Frequency Band 1.2 to 30 MHz**
3. **Modulation AFSK/SSB**
4. **Data Rate 45,50,75,100,300 baud**
5. **Receiver Sensitivity 0.3 uv at 10 dB SINAD**
6. **Frequency Stability 1 x 10''**
7. **Antenna Dipole and LPA**
8. **Interface RS232-C**

A multi dipole antenna was fabricated and installed for communication. The SWR measurements were taken and found within acceptable limits (i.e.below 2). One compact HF log periodic antenna with gain around 9 dB in frequency range 14 to 40 MHz was installed (Fig 2).

Data communication makes use of FEC and ARQ techniques as defined in CCIR 476.3(6). In FEC mode each character is transmitted twice to provide redundancy. The receiver checks for 4B/3Y (B-Mark Y-Space) ratio in the received data for determining the validity of the received character. No coding is done in this type of FEC.

ARQ (Automatic Repeat Request) mode uses a group of three characters for exchanging data. The transmitting station sends one block of three characters at the fixed rate of 100 baud and waits for acknowledgement. If 4B/3Y ratio is not maintained at receiver,the Rx generates negative acknowledgement. On

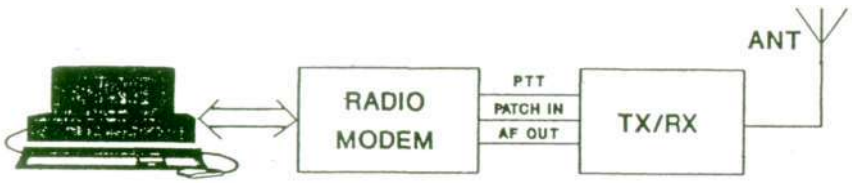

Fig 1 : Block diagram of HF communication system.

Fig 2 : A compact HF Log Periodic Antenna (LPA) installed at Maitri.

receiving positive acknowledgement, the sending station takes up next three characters, otherwise the same block is transmitted again and again till it is acknowledged. Character error was measured by comparing received data with a standard text and found to be minimal.

RF Power vs. Performance

A linear amplifier of 1200 PEP was employed to observe the effect of increased RF power. The experiment confirmed that there was no significant change in the performance with increase of power in the presence of magnetic storm. Communication, both in voice and data, was found to be satisfactory using 100 Watts power most of the time.

Results

Out of the 42 days for which communication was tried between 1900 hrs and 2400 hrs IST, the HF communication was satisfactory on 33 days. Many useful text messages including scientific data were exchanged between Maitri and India. Sometimes strong magnetic storms caused HF black-out. The HF communication was found to be possible only for around four hours daily. This may be attributed to the following reasons :

a) **Unique ionospheric characteristic at the high latitude region characterized by strong magnetic activity.**

b) **High path loss of RF energy due to multi - hop propagation.**

c) **The effect of magnetic disturbances are more pronounced for region involving auroral zones.**

Recommendations

To increase the available communication window and to get reliable HF communication during austral winters, following recommendations are made :

i) **Beacon trials should be conducted throughout the year for HF propagation studies.**

ii) **Link can be upgraded using adaptive HF system providing automatic connectivity.**

Acknowledgement

I express my sincere gratitude to Shri V.P.Sandlas, Director DEAL for his permission and expert guidance on all matters related to HF communication. I thank Dr.S.Mukerji, Leader, XI Indian expedition to Antarctica for his kind cooperation. My sincere thanks are also due to my colleagues at DEAL and R&DE(E) for operating the link from India.

References

Andhere,A.K.(1985): High frequency communication in Antarctica. Sci.Rep.Second Ind.Exped.to Ant.,DOD Tech.Pub.No.2,pp 125-130.

Hanjura,A.K.(1986): Study of the ionised and non-ionised atmosphere.Sci.Rep.Third Ind.Exped.to Ant.,DOD Tech.Pub.No. 3,pp 251-254.

Sengupta,A.(1983): Radiowave transmission characteristics in Antarctica. Sci.Rep.First Ind.Exped.to Ant.,DOD Tech.Pub.No. l,pp 46-52.

Singh,A.(1986): Amateur radio operation during the third Indian expedition to Antarctica. Sci.Rep.Third Ind.Exped.to Ant.,DOD Tech.Pub.No.3,pp 265-266.