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HF Packet Beacon Experiment from Antarctica

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Abstract

High frequency communication between India and Antarctica is a case of multihop communication. This is strongly affected by the magnetic storms which occur very frequently in Antarctica. As a result, the communication is presently available only for about 3-4 hours per day. To extend this communication window, a packet beacon experiment was conducted during the XII Antarctica expedition. The aim of the beacon experiment was to find out new communication slots by transmitting a standard fixed text message again and again after a prespecified interval of time. The details of the experiment alongwith the results are brought out in this paper.

Introduction

High Frequency (HF) communication between India and Antarctica is being explored as a backup communication mode in voice and data starting from XI Antarctica expedition (1992-93). Presently, the HF communication is available only for 3-4 hours/day duration, thereby seriously limiting its utility. There are also periods of complete communication blackouts when HF communication is not possible for days altogether. Such abnormalities in HF communication arise from the phenomenon of Magnetic Storms which is experienced in polar regions like Antarctica. Further, the communication between Antarctica and India being a case of multihop communication, the reliability associated with the communication is low.

To make HF communication available on a round the clock basis, the selection of correct frequency is a prerequisite. This has led us to design a packet beacon experiment to find out new communication slots between Maitri, Antarctica and DEAL, Dehradun. The experiment is based on transmitting a fixed text message konwn as 'Beacon text' after a predetermined time using a packet radio modem. The received beacon packet is date and time stamped thereby generating window timings corresponding to the particular frequency.

Design and Implementation

The transmission of 'Beacon text' again and again after a prespecified interval of time forms the basis of the design of packet beacon experiment. The experiment makes use of a radio modem conforming to American Radio Relay League's (ARRL) AX.25 protocol standard for transmitting beacon text using AFSK modulation at 300 bauds.

Experimental Setup

The packet beacon experiment makes use of an experimental setup consisting of a HF transceiver, radio modem, personal computer and log periodic antenna etc. as shown in Fig. 1. The transceiver is a Yaesu make FT-757GX II with a power output of 100 W which could be boosted up to 1200 W PEP using a linear amplifier. The radio modem used is Kantronics' make KAM modem which is a versatile modem offering different HF data communication modes, *e.g.*, CW, RTTY, AMTOR and Packet etc. The radio modem is commonly referred to as TNC, an acronym for Terminal Node Controller.

Terminal Program

The terminal program is a software mainly responsible for performing functions of beacon initialization and transmission on the transmitting end. These functions are implemented using software routines developed in-house using BASIC language. The details of the software implementation are discussed below.

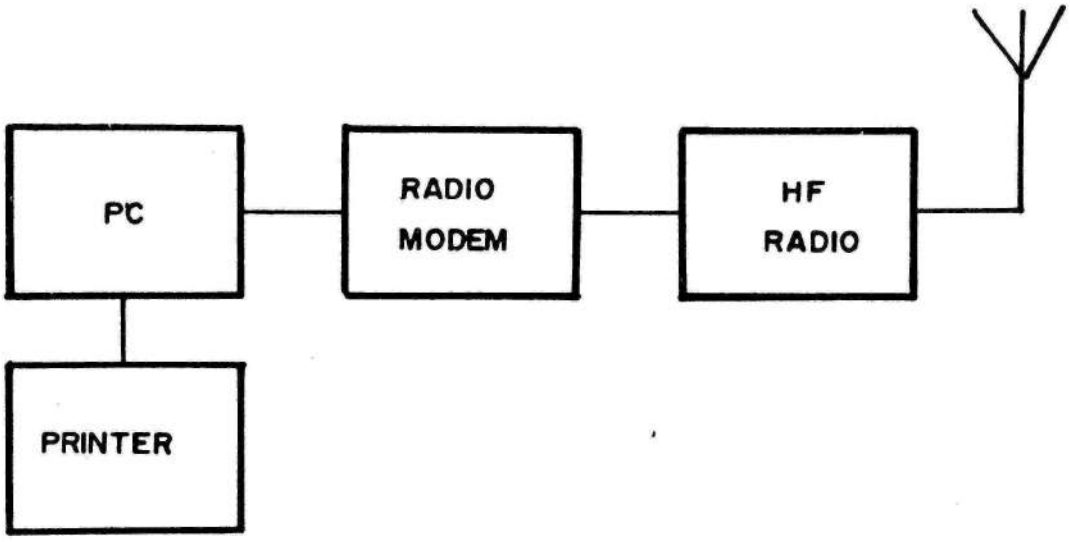

Fig. 1. Pocket Beacon experiment setup

Beacon Initialisation

The function of beacon initialization is basically concerned with specifying the beacon text message and establishing the time interval which is used as a duration between two successive beacon transmissions. The flowchart in Fig. 2 depicts the implementation of beacon initialization routine. The routine begins with initializing communication port parameters, namely baud rate, parity, character size and number of stop bits etc. The power on routine tests whether the TNC power is on before entering the Input/Output mode with TNC where the communication between PC and TNC comes through on character by character basis. Next, the interval time to send beacon and beacon text is specified and the control is left in I/O mode with TNC. This completes beacon initialization and makes transmitting station ready to transmit packet beacon regularly after specified time interval.

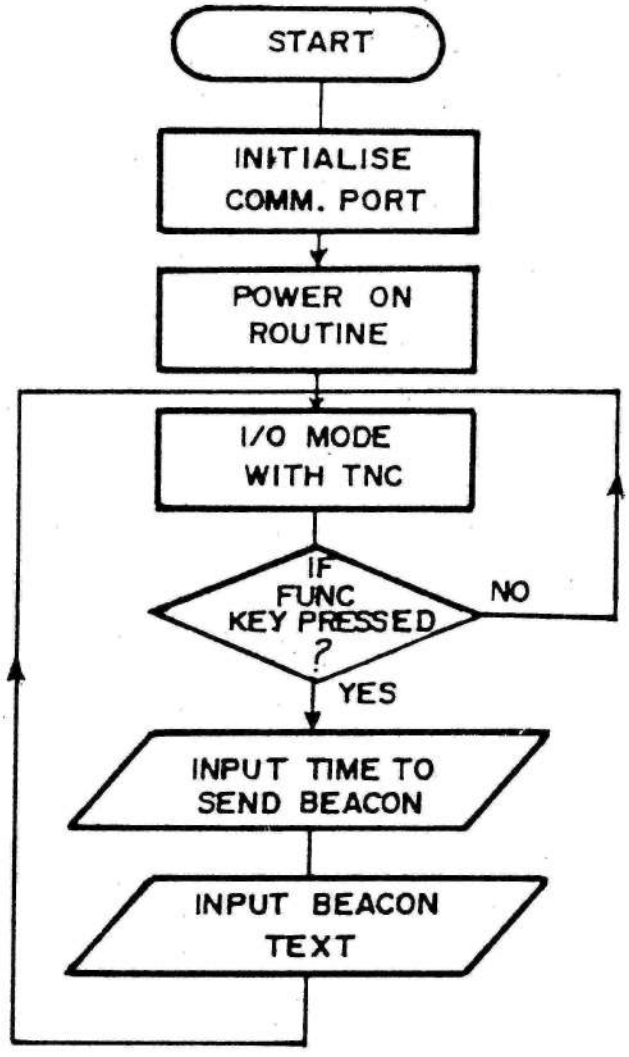

Fig. 2. Beacon initialization

Beacon Service Routine

The Beacon service routine is responsible for setting up a timer on the expiry of which the beacon text is transmitted. The text is transmitted using AX.25 layer 2 frames without establishing any connection. The system timer and interrupts are frequently used in the implementation. The flowchart in Fig. 3 brings out the sequence of steps involved in the beacon service routine.

Discussion

The packet beacon experiment between India and Antarctica was conducted for a limited period of about 20 days during the month of January and February in the year 1993. The beacons were transmitted for nearly 24 hours on 17 MHz frequency using interval times of 1 min. and 5 min. To receive beacon, the station was left unattended after initial tuning. The printer was programmed to print any beacons as soon as they were decoded by the modem.

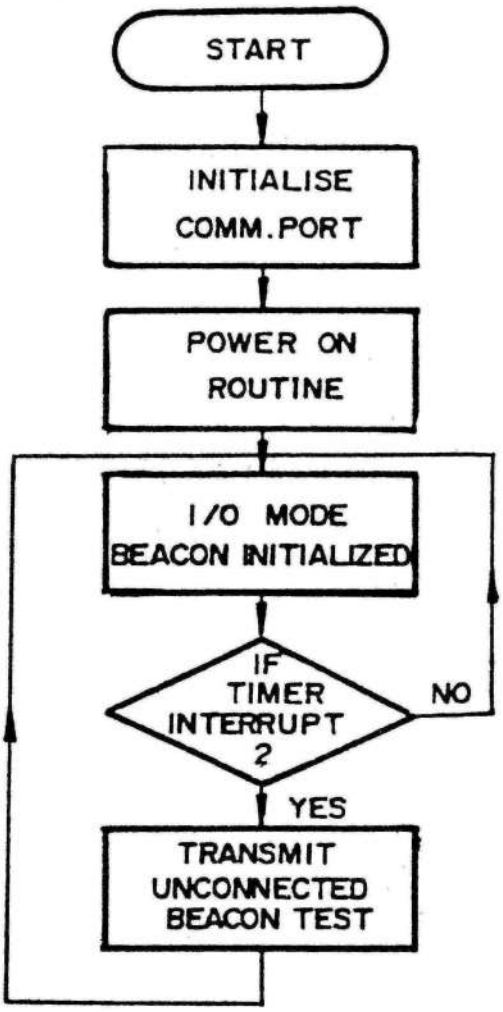

Fig. 3. Beacon service routine

```
MAITRI>BEACON / H (04-02-93 22:54:39):< UI>:maitri  freq 17.x mhz
MAITRI>BEACON / H (04-02-93 23:02:39):< UI>:maitri  freq. 17.x  mhz
MAITRI>BEACON / H (04-02-93 23:03:39):< UI>:maitri  freq 17.x  mhz
MAITRI>BEACON / H (04-02-93 23:04:39):< UI>:maitri  freq 17.x mhz
MAITRI>BEACON / H (04-02-93 23:05:39):< UI>:maitri  freq 17.x mhz
MAITRI>BEACON / H (04-02-93 23:06:39):< UI>:maitri  freq 17.x mhz
MAITRI>BEACON / H (04-02-93 23:07:39):< UI>:maitri  freq 17.x mhz
MAITRI>BEACON / H (04-02-93 23:08:39):< UI>:maitri  freq 17.x mhz
MAITRI>BEACON / H (04-02-93 23:09:39):< UI>:maitri  freq 17.x mhz
MAITRI>BEACON / H (04-02-93 23:10:39):< UI>:maitri  freq 17.x mhz
MAITRI>BEACON / H (04-02-93 23:11:39) :<UI>:maitri  freq 17.x mhz
MAITRI>BEACON / H (04-02-93 23:12:39) :<UI>:maitri  freq 17.x mhz
```

Fig. 4. Sample printout

A sample printout is shown in the Fig. 4. From the printout, it is evident that whenever a number of consecutive beacons are received in a short time period, there exists a communication window. By analysing the timing information, the experiment has indicated the presence of at least two new communication window timings, e.g. 2255-2340 hrs IST and 0725-0755 hrs IST.

Conclusion

The packet beacon experiment using a single frequency has indicated existence of two new HF communication window timings as stated earlier. However, there is a need to validate these timings by extensive experimentation in the forthcoming expeditions. Further, multiple frequencies need to be tried out to effectively enhance communication window as single frequency may not serve the purpose for round the clock.

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