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Radio Noise Measurement in HF/VHF Band at Antarctica

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Abstract.

Long distance communication from Antarctica is heavily dependent on HP propagation which, in turn, is influenced by local and non-terrestrial noise levels. Present study shows that local noise level in Antarctica is much less as compared to latter. The study has been conducted keeping in background the noise level at different frequencies in a city like Calcutta.

The performance of communication systems in HF and VHF bands is found to be severely affected in Antarctica. For long distances HF mode is still considered as the easiest way of communication. For local-communication at Antarctica, VHF remains the only solution. In Antarctica, the performance of a VHF walkie-talkie, which can maintain communication within about 15 kms aerial distance in a city like Calcutta; becomes so poor that it fails to maintain communication sometimes even between points just 2 kms apart. In principle, performance of a communication system is controlled grossly by radio noise level of tie location of operation. Radio noise is generated from different sources. One is man-made noise which originates mainly from most electrical instruments. Any spark or loose contact in an electrical instrument can develop strong radio noise in that locality. Other sources of noise are the stars, Sun, galaxies, etc. from which radio noise are showered on the earth. Man-made noise could be' reduced to some extent by ensuring proper shielding of the instrument producing the noise. We, however, do not have any control over the non-terrestrial noise. So the local noise and terrestrial noise together influence the communication. To understand the mechanism of degradation in transmitter and receiver performance, actual noise level prevailing around Maitri station in Antarctica is taken into account.

Experimental set-up

Radio noise at low frequencies were measured by means of dipole antennas. Two dipoles were used, one to cover 1-10 MHz and another to cover 10-20 MHz frequency bands. For higher frequencies, log periodic antenna is most suitable for receiving wide band signals. Therefore, a similar antenna was employed to measure the noise level around Maitri station. A log periodic antenna of 8 dB gain was developed by computer aided design software written by the author. The antenna was fabricated with aluminium pipes and channels of standard dimensions that are readily available in market. The design specifications are siven below:

Lower frequency range	:	20 MHz
Higher frequency range	:	300 MHz
Antenna gain	:	8 dB
Total number of elements	:	13
Boom length	:	7.6 metres

All electrical waveforms or signals are composed of a combination of sinusoidal signals of varying amplitude and frequencies. The combination of sine waves can be observed in the frequency domain with the spectrum analyser. A spectrum analyser permits observation of the amplitudes and frequencies of various discrete sinusoidal signals during the measurement interval, the vertical scale being the amplitude scale and the horizontal axis being the frequency axis. The spectrum analyser used for the measurement has following specifications:

Male	:	Advantest, USA. .
Range	:	lOKHz - 4.5 GHz
Model	:	TR 4110
Sensitivity	:	-150 dBm

Results

The atmospheric radio noise level has been studied from 2 January to 14 February, 1992 from 0500 to 2300 at suitable intervals. Fig 1 (a) and Fig 1(b) show the distribution of locally transmitted signal of 4 MHz and 18 MHz, respectively, which appear in the photograph as high peaks. Small peaks are the associated noise close to those frequency spectrum. A table below shows

(a)

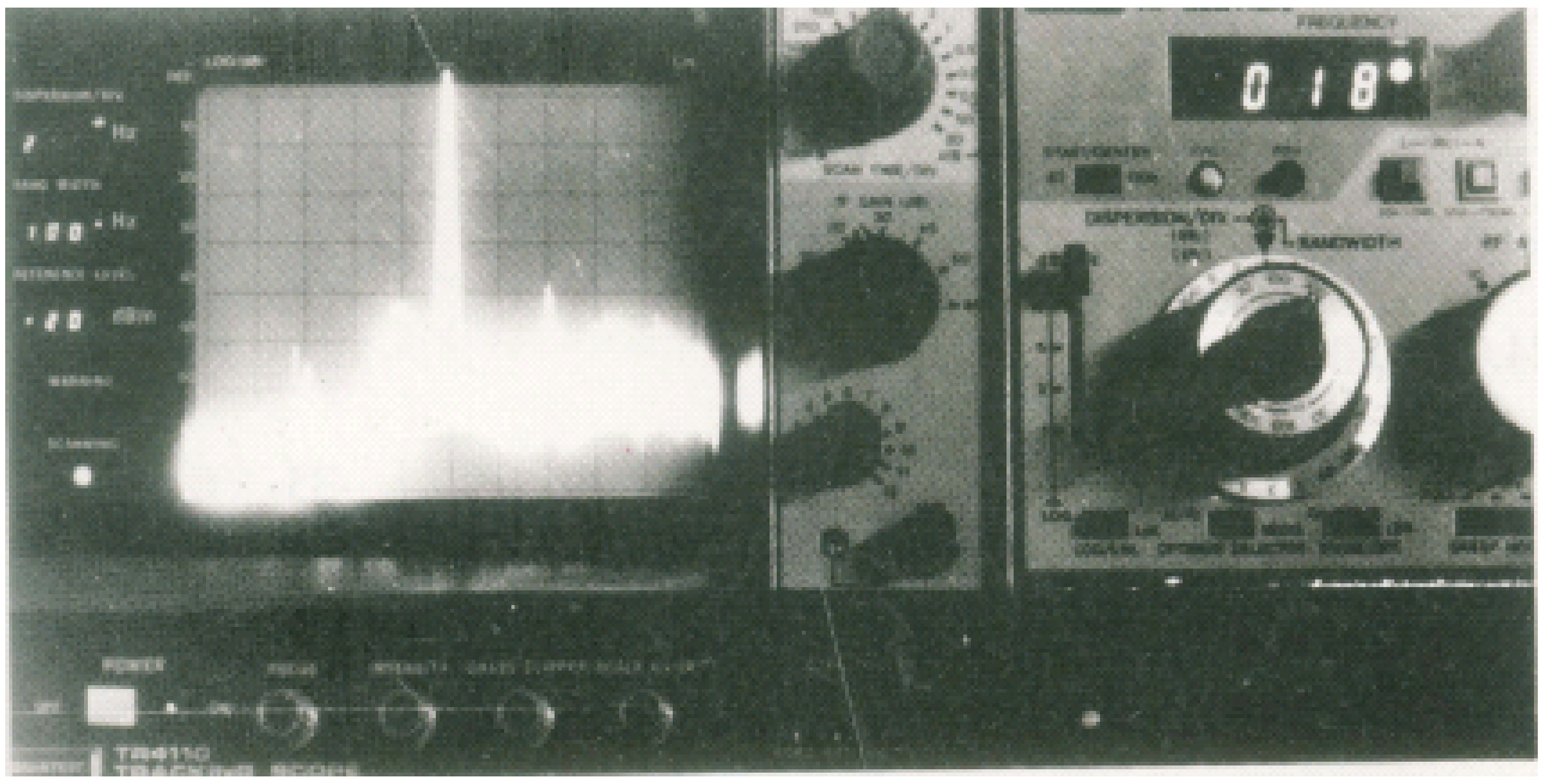

Fig 1:Photograph showing distribution of locally transmitted signals at Maitri, Antarctica - a) of 4 MHz and b) of 18 MHz frequency.

the results of continuous observation of radio noise around Maitri station. Several noise peaks at 4,12, 14,16, 17.6, 18, 22 MHz were noticed for which 4 and 18 MHz were identified to be the signals transmitted from Maitri station for communication with India. The communication links were used, at certain times of the day. Other sources of the signals were not known. However, there is a possibility that neighbouring Russian and German stations were the source for other signals. Different noise mean levels were found at different frequency

ranges which remained almost same throughout the observation period. These are listed below as mean levels :

Frequency in MHz	Power in dBm*	
	Maitri	Calcutta
Noise peaks:		
4.0	-18	No peaks are available at these frequencies
12.0	-30	
14.0	-24	
16.0	-65	
17.6	-22	
18.0	-22	
22.0	-55	
Noise mean levels :		
2.0-10.0	-76	-10
10.0-24.0	-80	-22
24.0-70.0	-90	-31
70.0 -300.0	-97	-35

*** The antenna gain = 8 dB is to be adjusted to get the actual values.**

Discussion

The average noise level at Maitri was found to be much lower as compared to any Indian location because of lower man-machine activities. Propagation in the HF band is found to be influenced much by the ionospheric conditions rather than the local noise levels. Propagation in the VHF band may be seriously affected by ice covered hilly terrain in the continent. Another reason for degradation may be due to the type of battery used in the system. Only Lithium battery has been found to maintain desired voltage level in cold temperatures. Ni-Cd batteries used in the systems may be the cause behind degradation. More

studies are required in VHF band to understand their propagation characteristics in different climatic conditions.

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