NATIONAL RADIO ASTRONOMY OBSERVATORY
GREEN BANK, WEST VIRGINIA 24944

GREEN BANK INTERFERENCE OFFICE MEMO #3

Title: **Green Bank RFI Monitoring Station**

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Introduction

This report will discuss the present RFI monitoring capabilities at NRAO, Green Bank and will provide equipment descriptions and a block diagram of the fixed monitoring station. The report will conclude with recommendations for future upgrades.

Present RFI Monitoring Station

The present monitoring station is located at the 40' telescope at NRAO, Green Bank and is capable of monitoring the frequency range from 100 to 1500 MHz with some degradation of the higher frequencies. Figure 1 is a block diagram of the present system.

Antenna System

The 100-1000 MHz log-periodic antenna is of NRAO design (Rick Fisher) and provides an average gain of 6.0 dB. This antenna is mounted on an Emotator Model EV-800DX azimuth/elevation rotor at the top of a 50' Rohn tower. The Emotator rotor is controlled by the 'RealTrak' tracking software and the 'Kansas City Tracker' rotor interface which are installed in a 386SX/20 computer. This system allows automatic antenna movement and tracking of satellites.

The 100-1300 MHz discone antenna is an ICOM Model AH-7000 and is side-mounted on the tower below the log-periodic antenna and provides omni-directional coverage.

Amplifiers

The first amplifier is a Miteq Model AFS3-00050200-15-4 which provides a minimum gain of 34 dB from 0.05 to 2.0 GHz with a noise figure of approximately 2.0 dB. The amplifies is connected to a Transco Y-type SPDT, 0-11 GHz coaxial switch which allows selection of either antenna. A Texscan programmable attenuator Model PA-51 is in-line between the coaxial switch and the log-periodic antenna to prevent overloading of the first amplifier.

The second amplifier is an Avantek Model AWL-1200M-09 which provides a minimum gain of 25 dB from 100-1200 MHz with a noise figure of approximately 5.0 dB. This amplifier is connected to the output of the first amplifier by approximately 100 feet of Andrew LDF4 foam-dielectric cable and is installed in the back-end rack in the 40' control building. Various filters can be inserted between the first and second amplifiers.

Communications Receiver

The communications receiver is an AOR Model AR-3000A which provides continuous frequency coverage from 100 KHz to 2036 MHz. This receiver can be operated via its front panel controls or via computer control using an RS-232 serial port and AOR software.

Spectrum Analyzer

The spectrum analyzer is an HP Model 8558B which covers the frequency range from 0.1 to 1500 MHz. This instrument is approximately 20 years old and does not provide an accurate frequency measurement. The output of the spectrum analyzer can be plotted on an HP Model 7470A X-Y plotter.

Future Modifications to the RFI Monitoring Station

I want to evolve the present monitoring station into one that is completely automated and remotely controllable. This will allow the station to be used by me from a remote location such as my home or office and by others, such as the telescope operator or receiver engineer/technician, that may require real-time RFI monitoring. Eventually, this system may be placed at the GBT with the antenna system on the GBT. Figure 2 is a block diagram of what I hope the system will become. The first steps in this procedure have been take by purchasing a 386SX/20 computer which now controls the antenna rotor and the communications receiver. The next step is to upgrade the present spectrum analyzer, which is the heart of the RFI monitoring system, with a new state-of-the-art one.

In deciding which spectrum analyzer to purchase, several things should be considered. Not only will it be the heart of the RFI monitoring station but it will be the primary test instrument for testing equipment to be placed in or on the GBT. The spectrum analyzer will also be used to test fixed radio transmitter sites in the NRQZ for compliance with required power limitations and for use in identifying, locating and correcting local sources of RFI both on and off site. Because the spectrum analyzer will be the most expensive item, we should endeavor to purchase one that will not only satisfy present but also future needs.

The basic requirements for a new spectrum analyzer should include frequency coverage from a few hertz to several gigahertz, high sensitivity and precision frequency reference. It should also be computer controllable and portable. An example is the HP-8561E which covers the range 30 Hz to 6.5 GHz, has a -144 dbm sensitivity at 1 GHz, a frequency accuracy of plus or minus 135 Hz at 1 GHz, and is computer controllable via an IEEE-488 bus. The cost of the HP-8561E would be approximately $30K.

The next step is to extend the frequency range of the monitoring station to several GHz and make it remotely accessible. This will require new amplifiers and antennas to cover the higher frequencies and computer software and modem for remote accessibility.

Summary

The present RFI monitoring capabilities are inadequate. The increased use of the spectrum by both government and commercial users will require additional RFI monitoring in order to maintain a suitable environment for radio astronomy. Several areas will need to be addressed.

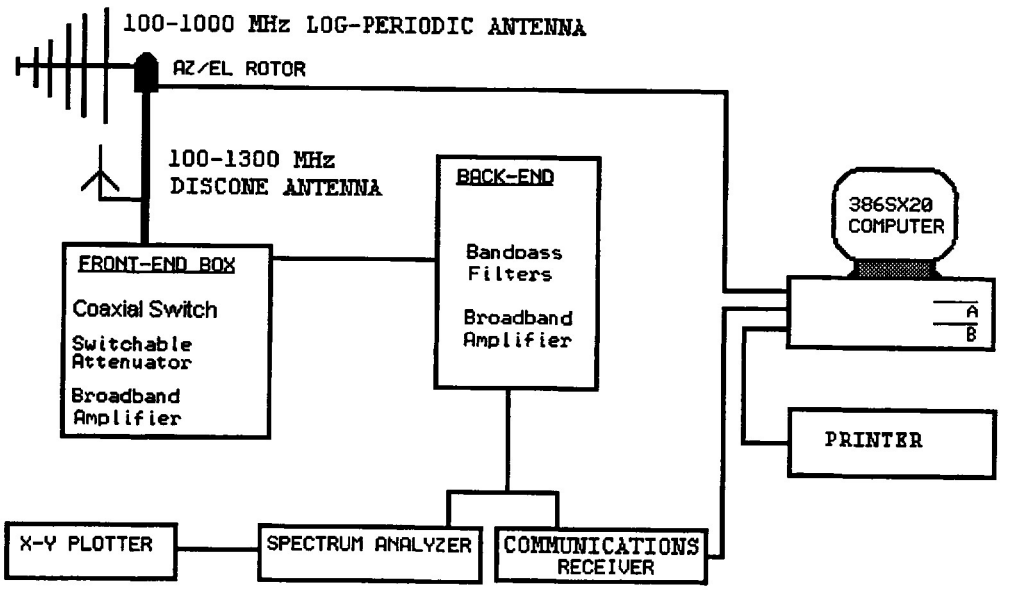
The first area will be monitoring the local RFI environment and the NRQZ. With the recent proliferation of consumer electronics that use higher frequencies, (i.e. 900MHz cordless telephones) a routine monitoring program is becoming necessary to maintain an awareness of the local environment. There has also been an increase in the use of higher frequency fixed transmitters in the NRQZ such as cellular telephones in the 800-900 MHz range and multimedia multipoint distribution systems that operate in the 2500-2700 MHz range. I feel it is necessary to monitor the NRQZ and to visit fixed transmitter sites in the NRQZ to insure compliance with required power limitations. This will demonstrate to the users of the spectrum that the NRQZ is necessary to our research and not just a government regulation that serves no purpose.

The second area to address will be to make the monitoring system remotely accessible. The GBT will change the observing to a dynamic schedule that will require real-time RFI monitoring. Now is the time to prepare.

The third area will be insuring that the equipment purchased by or built at Green Bank does not produce interference. This will require more effort in testing such equipment.

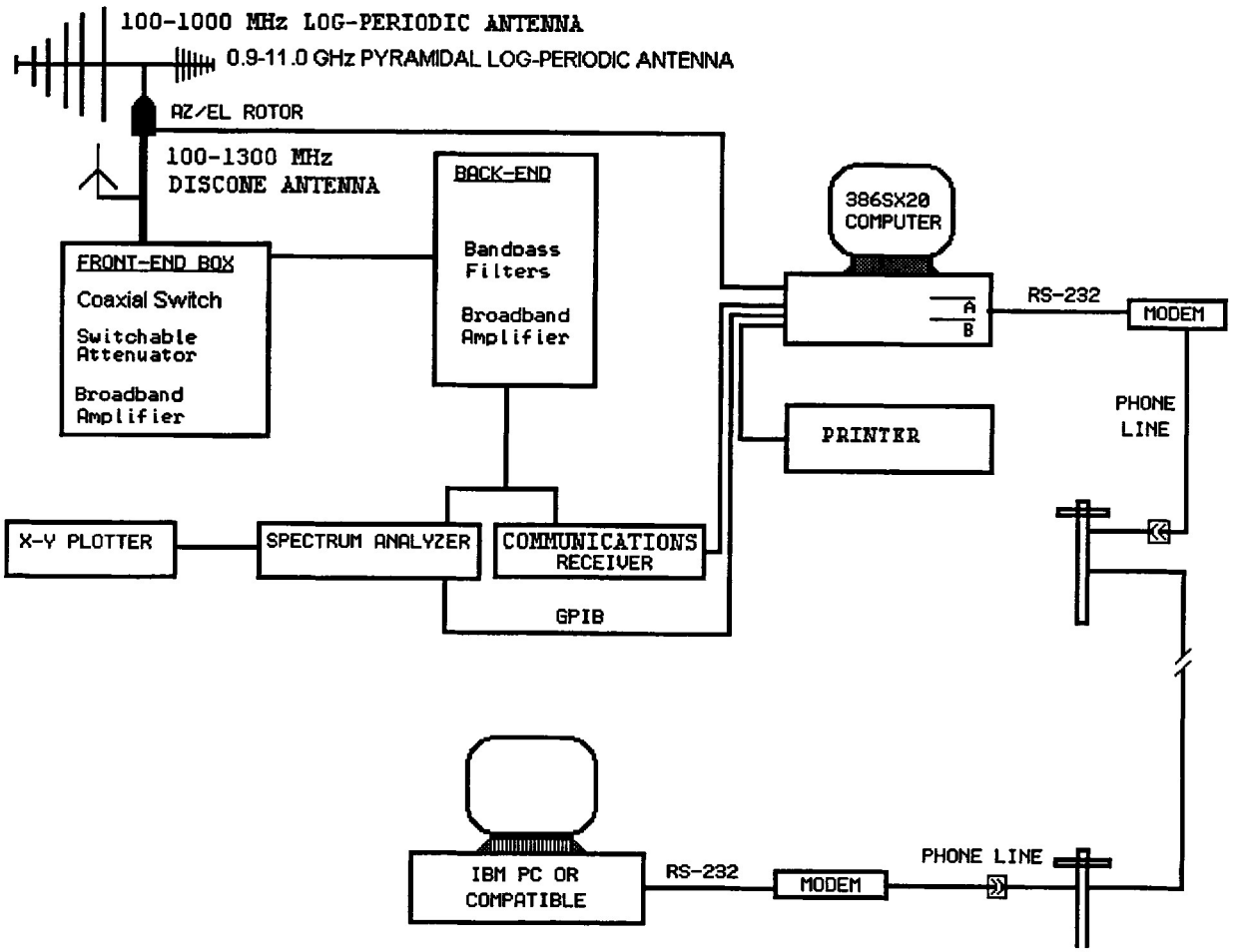
The fourth area is monitoring other potential sources of interference such as satellites.

In order to accomplish these goals, we must increase the sensitivity of the RFI monitoring equipment, extend its frequency range and increase its accuracy.



GREEN BANK RFI MONITORING STATION

(Figure 1)



FUTURE MODIFICATIONS TO THE GREEN BANK RFI MONITORING STATION

(Figure 2)