

National Radio Astronomy Observatory
Socorro, New Mexico

VLBA Test Memo

Problems with Internet at Kitt Peak VLBA from RFI

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Summary:

The deleterious effect of Radio Frequency Interference (RFI) on observations can be other than the direct corruption of astronomical data. At the Kitt Peak VLBA site, disruptions to Internet communications were traced to RFI on the microwave telephone link leading to the site. Internet is used for remote monitor and control of the antenna and observing equipment by the VLBA operators and by maintenance personnel. The identification and correction of the problem is recounted here for the record.

Weather Radar the Culprit

Communications to the astronomical community at Kitt Peak, located on an Indian reservation southwest of Tucson, is provided via microwave link from Tucson by the Tohono O'odham Utility Authority (TOUA). The microwave antenna at the Tucson end is located near a National Weather Service WSR 74C radar, which emits at 5.625 GHz. The Northern Telcom common carrier microwave link uses frequencies of 6.09345 and 6.25654 GHz, seemingly well removed from the radar frequency, but measurement with a spectrum analyzer at Kitt Peak clearly showed spurious emissions from the radar overlaying the microwave radio carrier (Figure 1). The WSR 74C radar had only -28 dBc of frequency-dependent rejection of spurious emissions from the radar into command carrier telephone microwave systems operating at 6 GHz according to the data taken. Figure 2 shows the paths and locations of the radio equipment. Neither the radar nor the telephone microwave antennas for the Tucson link are line-of-site with the Kitt Peak VLBA antenna.

According to a consultant for TOUA, spurious emissions from the radar caused bursts of errors in the microwave digital systems which in turn caused the microwave control system to switch to the diversity channel. The switching caused a delay during which communications were held up. The radar also overloaded the front end of the microwave radio; protection circuits for the radio amplifiers block communication when overloaded resulting in further delays. Indeed, the Internet communication to the VLBA site was hampered by long delays between key strokes and delayed update of monitor information at

the Operator's console in Socorro. Case studies at similar WSR 74C installations support the consultant's recommendation. Figure 3 shows reduction in radiated spectrum of 40 - 45 dB at a site in Beckley, West Virginia, when a filter was installed.

Solution

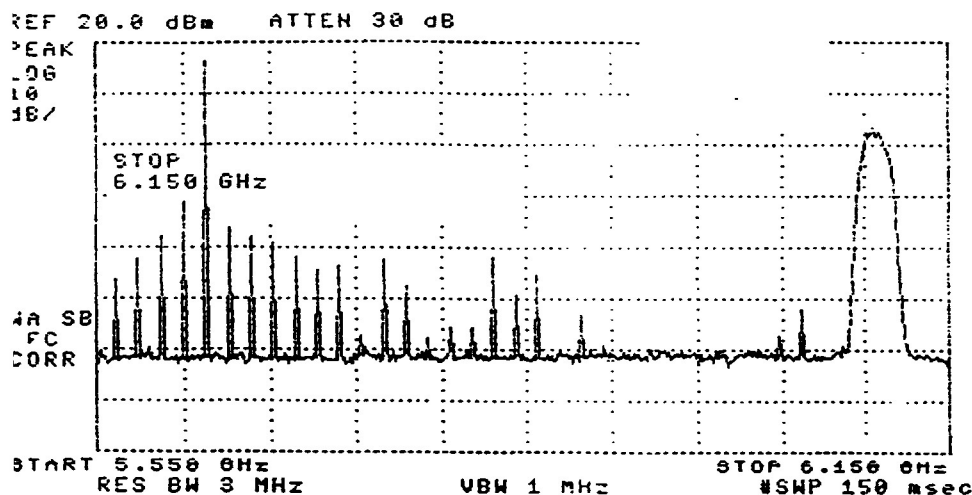
The TOUA consultant recommended the installation of a Mitec band pass filter on the front end of the WSR 74C radar to reduce spurious emissions, and the installation of a high pass filter at the front end of the TOUA microwave system. The recommended filter was installed on the radar unit only on May 26, not at NRAO expense. A filter on the TOUA radio proved unnecessary.

Figure 1 Spectrum analyzer plot showing radar emissions and microwave carrier frequency

Figure 2 Path lengths and locations of radar and microwave antennas

Figure 3 Before and after spectrum analyzer plots of radar emissions at Berkley, WV

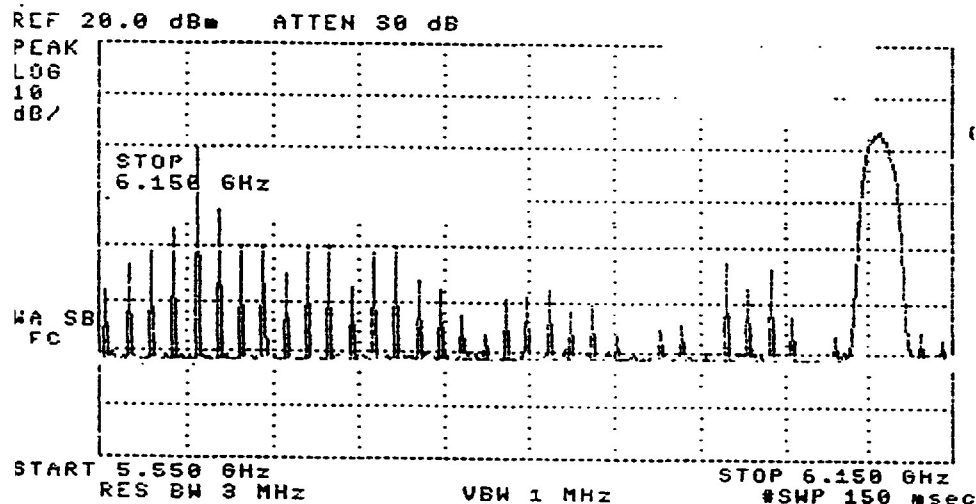
MEASUREMENT AT KITT PEAK - MAIN ANTENNA FROM SAN XAVIER



Kitt Peak Receive Site
Radar On Cycle, w/LNA

Sweep of Radar to
Carrier frequencies
(5550 - 6150) with San
Xavier transmitter on

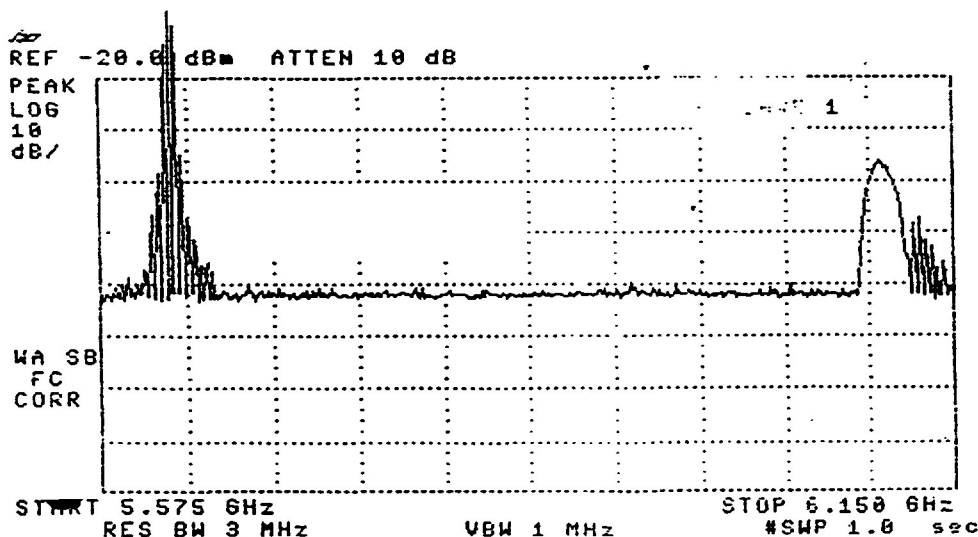
Display level = -10 dBm
at top of display chart



Kitt Peak Receive Site
Radar On Cycle, w/LNA

Sweep of Radar to
Carrier Frequencies
(5550 - 6150) with San
Xavier transmitter on

Display level = -10 dBm
at top of display chart

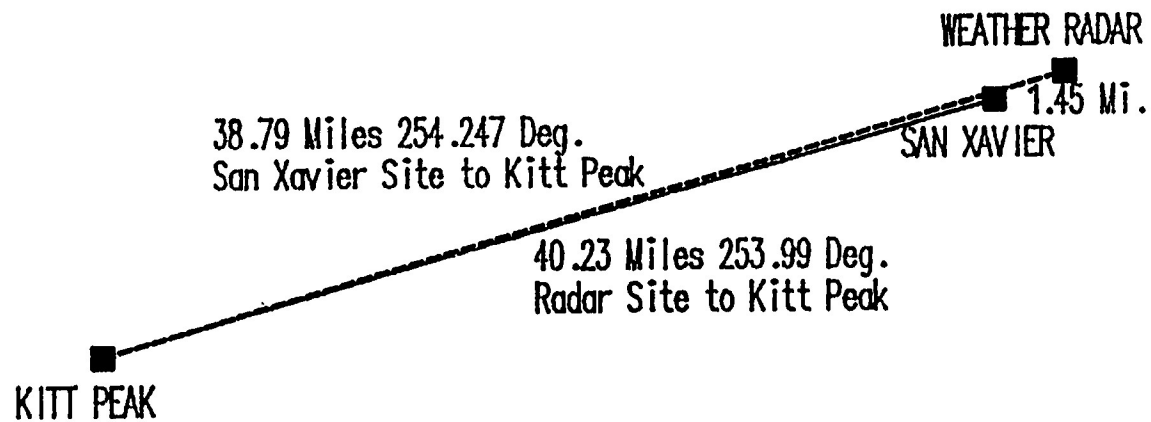


Kitt Peak Receive Site
Radar On Cycle, w/o LNA

Sweep of Radar to
Carrier Frequencies
(5575 - 6150) with San
Xavier transmitter on

Display level = -30 dBm
at top of display chart

Tohono O'odham Utility Authority



APPROXIMATE RELATIONSHIP BETWEEN SITES

FIGURE 2

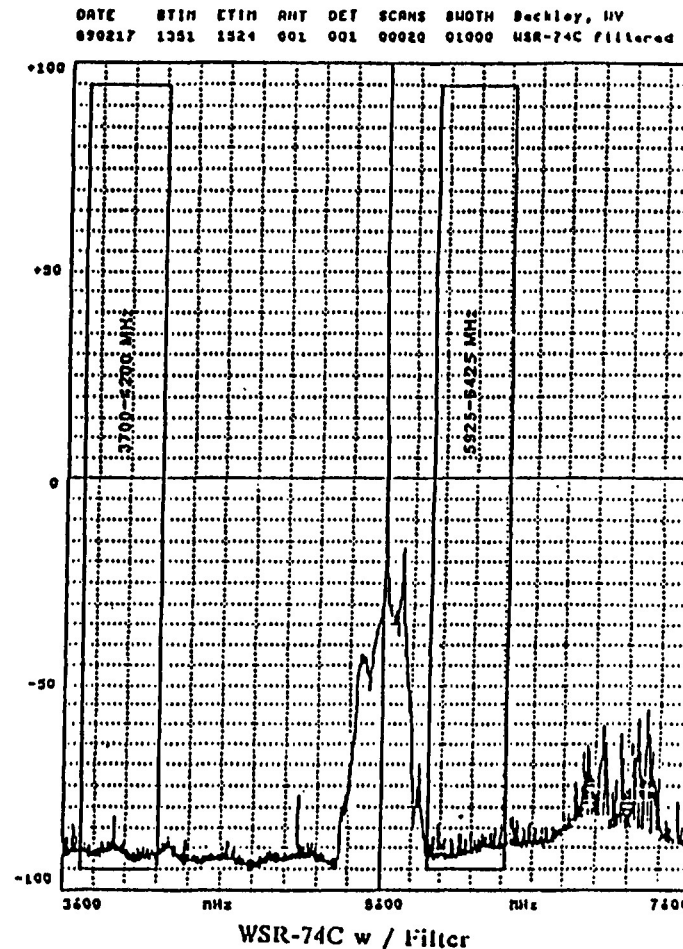
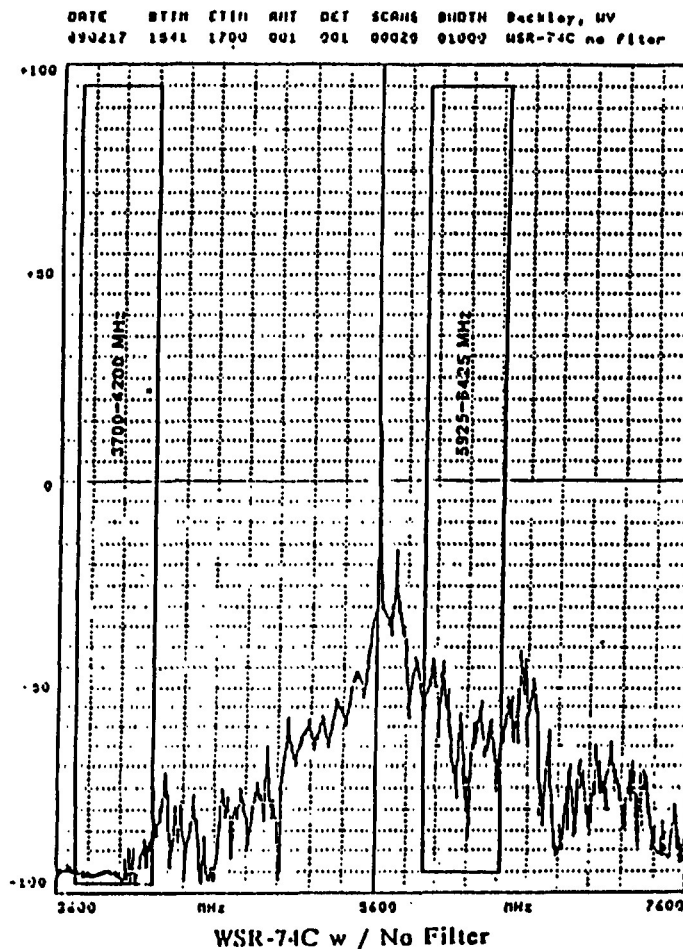


Figure 6-2. Radiated spectrum measurements of the WSR-74C radar at Beckley, WVA without and with an RF Filter.

