Satellite Downlinks Coordinated to Enable Successful Tracking of Phoenix Mars Lander with the Green Bank Telescope

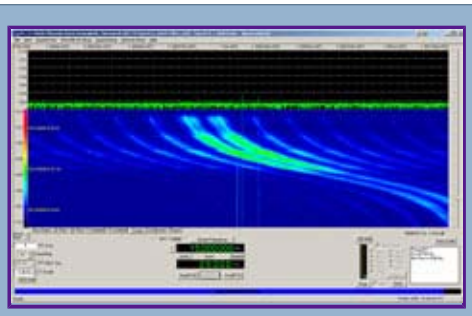

Figure A: Interference from a Low Earth Orbiter on 3/13/08 showing Doppler shif.

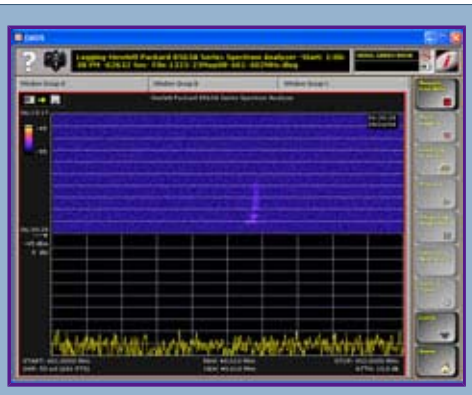

Figure B: A Low Earth Orbiter turns off its downlink in the middle of a pass over Green Bank in a test on 5/24/08 in preparation for the Phoenix Mars Landing on 5/25/08.

On March 13th, 2008, a team from the NASA/JPL Phoenix Mars Lander Project visited NRAO Green Bank to conduct a trial run in preparation for the May 25th, 2008 Entry, Descent, and Landing (EDL) phase of the Phoenix Mars Lander Mission. The Phoenix Lander will conduct studies of subsurface ice and soil composition near the Martian North pole. The team sent to Green Bank, headed by Dr. Peter Ilott, would use the Green Bank Telescope (GBT) to directly receive a UHF signal from the Lander on May 25th, but during this March 13th Operational Readiness Test (ORT-9), the GBT was looking instead for a signal at the same UHF frequency (401.56 MHz, topocentric) from the Spirit Mars rover. Just before Spirit crested the Martian horizon, very strong interference marched across the observational band, obliterating everything within about 30 kHz of its center frequency, which shifted about 20 KHz and then disappeared within about 11 minutes. About 30 minutes later, a second interferer with a similar signature was seen. Given the Doppler shift, these could only be low earth orbiter (LEO) satellites. A closer look at the data revealed a different modulation frequency for the two interferers, so it was clear that there were at least two orbiters that could potentially cause problems. How many more were there?

A comprehensive list of satellites by downlink frequency is not as easy to come by as one might imagine. (If you're reading this and you know of one, please send a link to interference@nrao.edu.) The RFI group at Green Bank (Carla Beaudet, Wesley Sizemore, and Paulette Woody) set about consulting their various spectrum

management contacts at NSF and at the darker, quieter agencies that don't like to be mentioned, and Feiming Morgan, a NASA/JPL spectrum manager, likewise sought LEOs with downlinks between 401 and 402 MHz, turning up one that was on a particularly critical interference path. Many 2-Line Orbital Element Sets later, (a 2-Line Orbital Element Set is a data set from which the orbit of a satellite can be predicted) the Green Bank RFI group was putting in odd hours monitoring satellite passes. In the end, coordination was possible thanks to cooperation from Los Alamos National Laboratories, and Sandia National Laboratories. The coordinations were *absolutely critical*
to the GBT receiving the EDL signal from the Pheonix Mars Lander on May 25th. Had the coordination not happened, approximately 12 minutes of the critical 14 minute landing window would have been lost to interference. The Mars orbiters would still have received and relayed the telemetry, allowing for a successful mission for Pheonix, but the Doppler information (from which e.g. Martian wind speed can be deduced) would have been lost, as would the signal from the GBT which was the first indication of a successful landing.

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