Spread Spectrum RF Channel Sounding in a Mountain Shadow Zone

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In this work we present non-line-of-sight (NLOS) RF channel impulse response data collected in a deep mountain shadow zone using a novel spread spectrum channel sounding system. Results indicate that topographic reflection is strongly dependent on the angle of incidence between the transmitter and the reflector, the reflector and the receiver. Channel coherence bandwidth depends on the relative roughness of the reflecting mountainside, and the receiver's proximity and angle of incidence to the reflecting mountainside. These findings suggest that the deliberate use of mountain reflectors in the NLOS RF channel may be a viable alternative to installing vulnerable ridgetop repeaters or using other costly technologies to establish NLOS communications in the mountains.

The channel sounder system was developed specifically to characterize the NLOS channel in mountainous terrain with the following key features: Operational frequency range of 20 to 4200 megahertz, 25 megahertz maximum transmission bandwidth, 20-watt maximum power, portable 50-pound receiver station with battery capacity for over six hours of continuous operation and 500 gigabytes of onboard disk space for storing over 1.2 hours of captured data at a maximum receiver sampling frequency of 25 mega samples per second. The transmitter and receiver are mini-Wireless Instrumented Streaming Platform (mWISP) units designed by Echo Ridge LLC, and each contain an N200 universal software radio peripheral and UBX daughterboard created by Ettus Research. The study area for this work is Franconia Notch State Park in the White Mountains of New Hampshire.

Future work involves comparing measured channel impulse responses with channel impulse responses determined by a computational propagation model and GIS topography. The goal is to understand the relative importance of mountain reflector geometry and material properties, looking towards improving RF propagation models with effective topographic surface roughness and reflection coefficients.