A Low-Cost Satellite Terminal for Measuring Ka-Band Propagation to Low Earth Orbit using the CASSIOPE Satellite

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Although Ka-band links to communication satellites in geostationary orbit (GEO) have been used for many years, their use in communicating with communication and remote sensing satellites in low earth orbit (LEO) is still emerging. Of particular interest to designers is characterization of the rate of fading, i.e., the so-called fade slope, which is accentuated on links to satellites to LEO by the rapid manner in which the Earth-space path sweeps though rain cells in the vicinity of the Earth station as the satellite passes across the sky. Fade slopes steepen as the orbital altitude of the satellite decreases and as the intensity of individual rain cells increases. The result has important implications for the design of the power control loops and other mitigation strategies used to mitigate rain fading on such links. Only a few satellites in LEO carry Ka-band propagation beacons or receivers suitable for use in propagation studies and, for various reasons, relatively little measurement data to support design of such links is available.

The launch of the CASSIOPE satellite on 29 September 2013 with its Ka-band Cascade communications transponder has provided propagation researchers with another opportunity to characterize Ka-band propagation on Earth-LEO links. However, the relatively complex nature of the uplink and downlink beacons employed by the Ka-band transponder make design of a downlink propagation receiving terminal a somewhat complex undertaking. In response, we have devised and implemented an uplink terminal that takes maximum advantage of onboard satellite systems to simplify the design and reduce costs substantially. The success of our approach points the way forward to verifying previous simulation-based work that predicts that fade slope on Ka-band links to LEO are up to several times higher than fade slope on links to GEO.