QUESTION 7: PURPOSE OF EXPERIMENT

Complete Program of Research and Experimentation

Virginia Tech will conduct path loss measurements between a transportable transmitter and one or more C-band earth stations. The purpose of the experiment is to assess the compatibility of point-to-multipoint transmission in spectrum shared with C-band earth stations, as studied, for example, in a previous filing to the FCC in the C-band proceeding.

Our assumption is that actual propagation losses, which will be measured in the course of this experiment, will be substantially greater than propagation losses predicted by traditional models, such as the Longley-Rice Irregular Terrain Model (ITM), commonly used to predict interference.[1] In fact, measurements made in an adjacent band show that actual losses can exceed ITM predictions by 40 - 60 dB, even over distances as short as 1 km.[2] The difference is due to the effects of clutter, including buildings and trees/foliage, which are not taken properly accounted for in most models. While terrain data have traditionally been straightforward to obtain, especially in the last ~20 years, data on the location, size, and shape of clutter such as buildings and foliage have not. Today, the situation is changing rapidly, and many sources of such information such as geodata based on Google Street View and other data sets, are proliferating, with increasingly sophisticated physical descriptions of clutter and its potential impact on radio propagation. When compatibility models do not take such effects into account, substantial amounts of spectrum are left unavailable for sharing, for no legitimate reason other than poor propagation prediction models.

In the FCC's C-band proceeding, several commenters noted that, under realistic propagation loss assumptions, the spectrum could be shared, even co-channel, with point-to-multipoint systems, providing substantial opportunity for high-throughput broadband services, particularly in underserved areas, such as rural communities. The purpose of this experiment is to complement the studies filed in that proceeding and demonstrate that such sharing is indeed possible. In this experiment, Virginia Tech will experiment using a transportable transmitter at various sites, transmitting test signals towards Virginia Tech's own C-band facilities, and will compare the received signal strength to predictions using ITM, combined with the published antenna pattern of its earth station dish. Virginia Tech has control over the C-band facility and can experiment using a variety of configurations, such as geostationary arc pointing angle, or even pointing outside of the geostationary arc. Virginia Tech's C-band facilities contain multiple models of earth stations, ranging from a large (~10 m) gateway dish down to small (~3 m) receive-only earth stations. Like many C-band earth station antennas, the facilities are no longer actively used and are available for full-time experimentation.

Virginia Tech is partnering with others to maximize the utility of these experiments. First, we are

[1] For example, ITM is required to be used in predicting interference protections for fixed-satellite earth stations in spectrum shared with the Citizens Broadband Radio Service. [Reference WF TS-0112]
[2] https://www.wirelessinnovation.org/assets/Proceedings/2019/TS1.3%20Clegg%20updated.pdf

partnering with a local wireless broadband provider, All Points Broadband ("All Points"). All Points provides point-to-multipoint wireless Internet service in the southwest Virginia area from the various tower- and building-based transmitting facilities, including some within the radius of operations of this requested experimental authorization. While no commercial operations will be conducted under this experimental license, All Points has extensive experience providing commercially-viable broadband services in rural areas, and will contribute their expertise in practical issues, including siting and coverage. Second, we will partner with Google, which is providing expertise in terrain and geodata and the application of such data to propagation prediction, as well as its knowledge related to CBRS broadband deployments in the adjacent band. Third, we are working with Microsoft, which brings valuable knowledof rural broadband opportunities through its TV White Space deployments. While we are partnering with others, Virginia Tech will remain solely responsible for the operations under this experimental authorization.

Some transmissions will be conducted on the Virginia Tech campus, but those transmissions will be operated under Virginia Tech's existing Program Experimental license.[3] The current license is being applied for so that we can test propagation paths that extend into the surrounding area, as would be appropriate when demonstrating the ability to provide point-to-multipoint services over a wide area.

We are requesting the ability to transmit over the entire 3700-4200 MHz band to allow for maximum flexibility to avoid frequencies currently being used by any operational C-band facilities in the local area. When possible, we will concentrate our experimentation in the 4000-4200 MHz portion, which is that portion of C-band that, in the long run, will be allocated for FSS earth station operation, after the clearing and rebanding of the lower portion of the band. We will generally use highly directional antennas pointed directly at our own C-band facility, avoiding pointing in the direction of other C-band facilities. The width of the beam at the half-power point will be (3 - 360) degrees and the orientation in the horizontal and vertical planes would be (0 - 360) and (0 - 10) degrees respectively. We will avoid operating configurations that will cause the predicted in-band signal level at any other C-band facilities from exceeding -129 dBm/MHz, which is the FSS interference threshold adopted in the adjacent CBRS band. We will also avoid creating a blocking interference level of -60 dBm or greater at any C-band facility unaffiliated with Virginia Tech. Nonetheless, we will inform C-band licensees within the operating area of our experimentation, and provide them with contact information for immediate stop-buzzer action in the unlikely event of interference.

Objectives sought to be accomplished

Operations under this experimental license will support the analysis of compatibility between broadband point-to-multipoint services in C-band spectrum with existing fixed-satellite service earth stations.

[3] Virginia Tech Program Experimental Licenses call sign WA3XCQ, file number 0077-EX-PN-2019, confirmation number EL343278 and call sign WA3XBY, file number 0093-EX-PN-2018, confirmation number EL304303.

Description of proposed research and experimentation

We will conduct propagation testing in this C-band, usually consisting of a transportable or temporary fixed transmitter emitting a constant signal of various bandwidths (including CW and wider bandwidths to study selective fading), and a receiver that is fixed in location and generally connected to Virginia Tech's existing C-band earth station facilities. We will compare the received signal strength to that predicted using standard propagation models.