BROWN

Supplemental Statement of Brown University

FCC Experimental License File 0231-EX-CN-2017

This application is for facilities. intended to be used by Prof. Daniel Mittleman[1] of the School of Engineering, for propagation measurement experiments on the Brown University campus in Providence RI. Prof. Mittleman is a qualified researcher in this field who has written extensively on the subject of terahertz propagation.[2] The purpose of the experiment is to gather measurement data in a complex environment at frequencies of approximately 100, 200, 300 and 400 GHz.

We believe that the technology being tested here is "new technology in the context of 47 U.S.C. 157 and that the results from this experiment will help to further other use by others of spectrum above 95 GHz that now lacks any FCC rules[3]. Therefore we ask that this be treated under the provisions of Section 7, particularly with respect to the burden test of § 157(a):

> Any person or party (other than the Commission) who opposes a new technology or service proposed to be permitted under this chapter shall have the burden to demonstrate that such proposal is inconsistent with the public interest. (Emphasis added)

Some of the spectrum covered in the application overlaps with passive allocations. Thus we readily acknowledge that following provisions of §5.85(a)(2) apply to this application:

> (2) Applications to use any frequency or frequency band exclusively allocated to the passive services (including the radio astronomy service) must include an explicit justification of why nearby bands that have non-passive allocations are not adequate for the experiment. Such applications must also state that the applicant acknowledges that long term or multiple location use of passive bands is not possible and that the applicant intends to transition any long-term use to a band with appropriate allocations.

The spectrum with primary passive allocations involved is 100-102 GHz, 200-205 GHz. In addition, while there are no ITU or US allocations above 275 GHz, 292-308 GHz and 390-410 GHz are "identified" in ITU Radio Regulation 5.565 for passive applications. The RR provision also states

---

[1] https://www.brown.edu/research/labs/mittleman/http%3A/www.brown.edu/research/labs/mittleman/people/daniel-m-mittleman

[2] https://scholar.google.com/citations?hl=en&user=O3T1F7cAAAAJ&view_op=list_works

[3] There are two minor exceptions: ISM and Amateur Radio Service use on small slivers

> "The use of the range 275-1 000 GHz by the passive services does not preclude use of this range by active services. Administrations wishing to make frequencies in the 275 1 000 GHz range available for active service applications are urged to take all practicable steps to protect these passive services from harmful interference until the date when the Table of Frequency Allocations is established in the above-mentioned 275 1 000 GHz frequency range." (Emphasis added.)

Brown believes that the experiment described in this application uses "all practicable steps" to protect passive services and thus meets the requirements of 5.565.

Brown would be willing to participate in any reasonable coordination activities with passive interests that the Commission find necessarily in order to comply with the letter and spirit of both §5.85(a)(2) and RR 5.565.

Statements required by § 5.85(a)(2)

> **Justification of why nearby bands that have non-passive allocations are not adequate for the experiment.** The basic purpose of this experiment is propagation measurement in a complex outdoor environment. At these frequencies atmospheric absorption is a key issue and varies with frequency.[4] In many cases multipath is also important and varies with frequency. A wide variety of frequencies are needed to fully characterize the nature of propagation at the regions being studied. Transmitters at these frequencies are not in general production and are usually quite expensive. Brown has identified a readily available signal source that has the tuning range specified in the application and that is available at a realistic price for this research. Avoiding the passive bands that overlap with the tuning range would either require a much more expensive custom made signal source or would result in less data collected on this area of the spectrum there little measurement data is available for complex paths.
>
> **Applicant acknowledgements**: The applicant has no intention of long term use of these frequencies and understands that their use in multiple locations may not be possible. The sole purpose of this experiment is to generate propagation data and propagation models that characterize terrestrial propagation in the region above the present 95 GHz upper limit of the Commission's Rules.

Technical Issues in Application

The application asks for mobile use as the transmitter will be moved around the university campus in making the tests. Unlike most mobile use, the experiments will use a high gain antenna which will be directed in different azimuth during the tests. The antenna system can not be readily indicated in the format of FCC Form 442 so we are taking this opportunity to clarify our intentions.

---

[4] FCC, "Millimeter Wave Propagation: Spectrum Management Implications", OET Bulletin No. 70, July 1997, https://www.fcc.gov/bureaus/oet/info/documents/bulletins/oet70/oet70a.pdf

The antennas to be used in this project are listed below with key parameters:

Virginia Diodes Model Number	Frequency Range in Experiment (GHz)	Beam Width (Degrees)	Gain (dBi)
WR 8.0 CH	97.5-103	13	21
WR 5.1 CH	195-205	13	21
WR 3.4 DH	292-308	12	25
WR 2.2 DH	390-410	12	25

The application form submitted uses the 13 degree maximum beamwidth in all bands for simplification.

The closest radio astronomy facility with known capability at these frequencies is the MIT Haystack Observatory in Westford MA[5] which is 88 km away but without a line of sight path. The azimuth from Brown to Haystack is 355^{o}. Out of an abundance of caution, Brown will avoid all transmissions in azimuths from 340^{o} to 370^{o}.

All transmissions will be at a zero degree or less elevation angle and this should contribute to the protection of any passive satellite sensors in these bands in both GSO and NGSO orbit. Atmospheric absorption is also a key factor in sharing in this range.

The STOP BUZZER contact for this experiment is Dr. Mittleman who can be reached at (713) 992-4137, daniel_mittleman@brown.edu

Any questions about this application should be directed to Dr. Michael Marcus, consultant to Brown University, 301-229-7714, mjmarcus@marcus-spectrum.com

/s/

Daniel M. Mittleman, Ph. D.
Professor of Engineering
401-863-9056
daniel_mittleman@brown.edu

[5] http://www.haystack.mit.edu/