Exhibit – A – Form 442 Question 7: Experimental Description

7. If all the answers to Items 4, 5, 6 are "NO", include as an exhibit a narrative statement describing in detail the following items:

a. The complete program of research and experimentation proposed including description of equipment and theory of operation.

In order to consider moving broadband communications into higher frequencies due to the potential GHz of available spectrum, the design of such systems need to better understand radio frequency environment challenges. There has been an increased interest in using mmWave frequencies for short range NLOS communication with multi-Gbps data rates, especially at 60 GHz. These systems have been equipped with antenna arrays to support beamforming, which compensate for the path loss and enable NLOS communication for stationary users over short distances. Channel models for mmWave communication have been studied for outdoor, fixed environments for LMDS applications and for indoor, mobile for 60 GHz applications. However, deeper understanding of the mmWave channel is needed for outdoor, mobile environments to understand path loss, angular spread, delay spread, NLOS beamforming and blocking issues and is a focus of our on-going research. In this context, channel sounding and propagation measurements are needed to provide knowledge that is essential for the design of a mmWave communication system for mobile, outdoor environments.

b. The specific objectives sought to be accomplished.

Fully characterize the radio channel at mmWave frequencies for mobile, outdoor environments to understand path loss, angular spread, delay spread, NLOS beamforming and blocking issues.

c. How the program of experimentation has a reasonable promise of contribution to the development, extension, expansion or utilization of the radio art, or is along line not already investigated.

Samsung Telecommunications America was granted a 24-month experimental license from FCC at 28 GHz for measurements up to 1 km. [Call sign: WF2XXE, File number: 0362-EX-PL-2011]. The initial experiments done at 28 GHz have been very encouraging. We were able to operate at > 100 m distances and were able to perform path loss and angle-of-arrival experiments. The results showed that we could capture NLOS paths and reflections via objects such as concrete and the ground.

The current application will provide evaluation at 39GHz in order to perform more detailed measurements at 39GHz for outdoor, mobile channels, for an extended distance of up to 2 km radius around Samsung Telecommunications America in Richardson, TX USA. We now intend to investigate different channel environments such as urban, semi-urban and rural environments around Samsung Telecommunications America to investigate their impact on communication. In order to investigate mobility and different channel environments, and to test uplink communication, we require use of multiple fixed (base-stations) and mobile transmitters in the system

Once the required channel measurements data is collected, we plan to publicly share it with other research centers and standardization bodies in industry. This will help design mmWave communication systems, providing multi-Gbps data rates for wireless mobile services within new spectrum bandwidth and therefore meeting the challenges raised by the on-going mobile data explosion.

Ref: [1] Zhouyue Pi; Khan, F.; , "An introduction to millimeter-wave mobile broadband systems," Communications Magazine, IEEE , vol.49, no.6, pp.101-107, June 2011

Exhibit – B - Determination of compliance with the exposure limits in §1.1310 or §2.1093

As per the exposure limits in §1.1310, the MPE for occupational/controlled exposure at 28 GHz is 5 mW/cm^2 and for general population or uncontrolled exposure, it is 1 mW/cm^2. Since the tests are controlled as per the definition of controlled environments in Table 1 in §1.1310, we shall assume the MPE of 5 mW/cm^2 for our compliance.

For the base-station transmitter with 43 dBm output power and HPBW of 5 degrees, the MPE compliance will be met at 5.08 meters. Since the base-station is mounted on the roof, access to the roof during testing will be limited to personal aware of the required exclusion zones in the area of the antenna to ensure there is no exposure issue and compliance will be achieved. For 30 degree and 55 degree antennas, the MPE compliance will be easily met at 1.61 meters and 0.90 meters respectively due to their larger beam width.

For the mobile station transmitter with 30 dBm output power and HPBW of 5 degrees, the MPE compliance will be met at 1.18 meters. However, since there will be an engineer monitoring the receiver, the engineer will guarantee that no one is standing within an area of 5 degrees and 1.18 meters in front of the mobile transmitter. Due to the directionality of the horn antenna, the MPE is easily met outside the HPBW of the horn antenna. For 30 degree and 55 degree antennas, the MPE compliance will be easily met at 0.36 meters and 0.20 meters respectively due to their larger beam width.

Table 1: Distance at which MPE limit is met
(Per OET Bulletin-65, Equation 7)

Transmitter	**HPBW = 5**	**HPBW = 30**	**HPBW = 55**
Base-station (20 W)	5.08m	1.61m	0.90m
Mobile station (1 W)	1.14m	0.36m	0.20m

Exhibit – C – Antenna Registration Question 4: Directional Antenna Information

Half-power beam width (HPBW) : 55, 30 and 5 degrees

Gain: 10, 15 and 25 dBi (inversely proportional to HPBW)

The antennas used will be linearly polarized horn antennas. The antennas corresponding to the base-station will be fixed during a set of experiments. The base-station antenna will be around 3 m above the roof of the 3-story building and downtilted approximately 15 degrees. The mobile antenna will be at the ground level. In addition, the mobile transmit antenna will also be directional and point towards the best link towards the base-station which will further minimize interference. The mobile transmitter will be within a radius of 1 km to the base-station transmitters. The same antennas will be used for the purposes of experimentation at the base-station fixed transceiver and the mobile transceiver.