WIRELESS PROPAGATION ANALYSIS FOR 57 - 65 GHZ LICENSE FREE BAND

G.A.Ellis*, Y.H.Kho

School of Engineering, Nazarbayev University, Astana, Kazakhstan; *grant.ellis@nu.edu.kz

INTRODUCTION.

This project examines the feasibility of using the 57 – 65 GHz license free band for broadband communications. The portion of this band in the United States alone is about one hundred (100) times the size of the 2.4 GHz wi-fi band and thereby offers a revolutionary improvement in terms of available bandwidth and data rates for broadband wireless communications. This wide frequency range can be used to alleviate situations where bandwidth may be scarce for various applications such as real-time video, data streaming and enterprise cloud computing.

METHODOLOGY.

Techniques for mitigating the effects due to the presence of multipath and atmospheric attenuation unique to the 57 – 65 GHz band for minimizing bit error rate and thereby maximize channel capacity will be considered. These techniques include use of Orthogonal Frequency Domain Multiplexing (OFDM) modulation, Multiple Input Multiple Output (MIMO) antenna systems, and antenna diversity and polarization techniques. OFDM systems transmit broadband signals over multiple narrow bands. MIMO systems transmit broadband signals over multiple antennas that are electrically isolated.

The objectives of this research are to answer the following questions regarding future communications systems using this band:

- Which is better? Phased array, multiple-input, multiple-output (MIMO) systems, Orthogonal Frequency Domain Multiplexing (OFDM), or combinations of all three for maximum channel capacity.
- What are the effects of atmospheric loss and line-of-sight (LOS) and non-line-of-sight (NLOS) multipath on data rate and bit error rate (BER).

Propagation analysis will be performed to develop a channel model of a realistic urban setting to evaluate potential for future 57 – 65 GHz communications systems and for use in follow-on experiments. The urban setting shall be the large indoor Atrium area located at Nazarbayev University (NU) in Astana. This setting is ideal because it is typical of shopping malls, airports, convention centers, and dense urban settings. For example, it is large (260 meters x 35 meters) enough to support propagation paths that are both line-of-sight and non-line of sight, it consists of several buildings, it includes vegetation including trees and soil, and it has a high ceiling (27.25 meters). It is also located indoors which makes it ideal for conducting future experiments year round. The tasks to be completed are:

- Use uniform theory of diffraction (UTD) with ray tracing to characterize the 57 - 65 GHz channel model of the Atrium for different transmitter – receiver locations.
- Simulate OFDM BER by including the propagation model above such as MatlabTM or ScilabTM.
- Perform propagation measurements and design configurations for 57 - 65 GHz future communications systems using mostly off-the-shelf hardware.

New measurement equipment consisting of signal generator, spectrum analyzer, and network analyzer for characterizing propagation effects in the 57 – 65 GHz band is planned. This equipment will provide a unique capability for characterizing the effects of building materials and corroborating our propagation models.

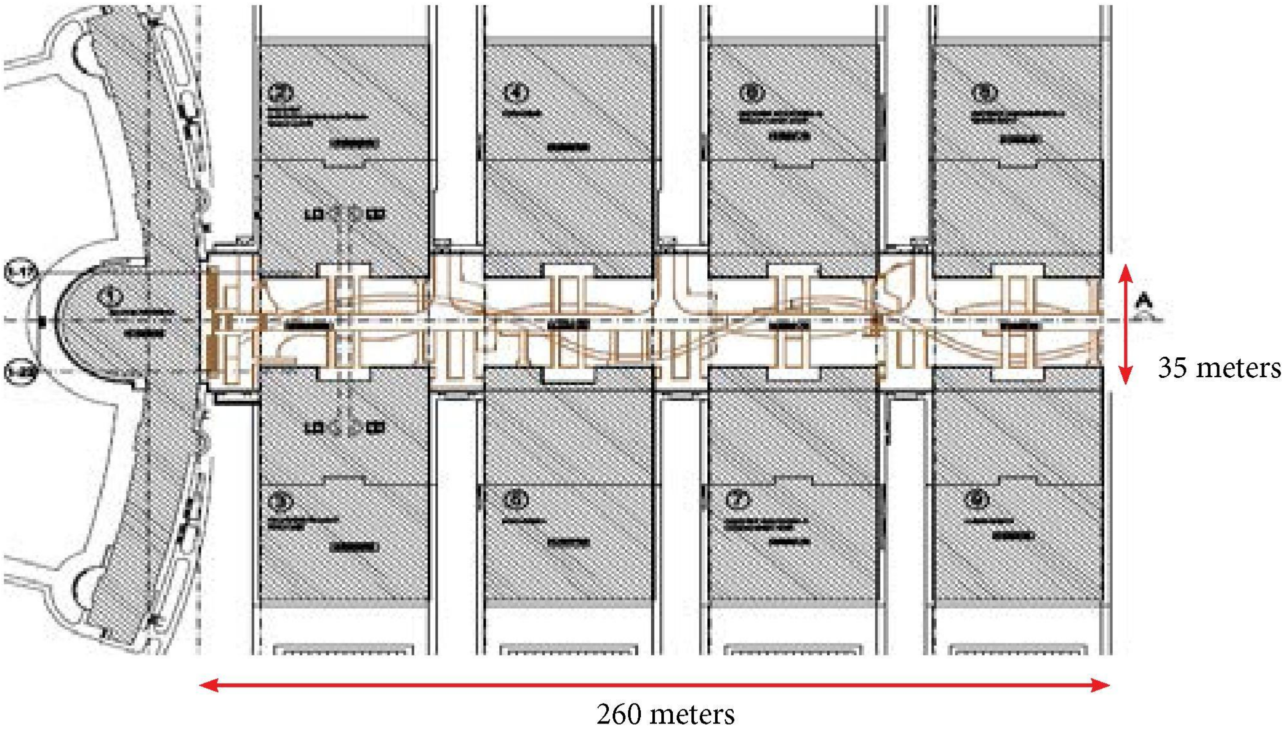

Figure 1: Plan view of Nazarbayev University Atrium for propagation study.

CONCLUSIONS.

Typical scenarios for application of this technology are shopping malls, airports, convention centers, or dense urban settings and situations where a large number of users transmit and receive large amounts of data. This includes real-time video and cloud computing. For non line of sight situations having the presence of multipath, each antenna of a Smart or MIMO antenna e.g. upcoming 5G system could use a phased array to increase capacity.