E-Glass and Wall Effects of 60 GHz Applications in a Residential Home Environment

Dylan Rice*(1), Sungkyun Lim(1), and J.R. Flesch(2)
(1) Department of Electrical and Computer Engineering
Georgia Southern University, Statesboro, GA 30460
(2) ARRIS Enterprises, Inc., Suwanee, GA 30024

As internet service providers move to higher frequencies such as 60 GHz to increase wireless data transfer using increased bandwidth, it becomes increasingly difficult to provide coverage to the entirety of a house. Due to the frequency, 60 GHz, having a short wavelength means the electrical length traveled by 60 GHz is much longer in terms of wavelength making 60 GHz applications more susceptible to propagation loss and multipath fading even inside an interior home environment with a small physical space. This makes the placement of 60 GHz routers and receivers more important when propagation paths and power received can drastically change from reflections or transmission through objects in the home interior.

In this paper, the path effects of 60 GHz in a home interior environment is observed. Using Wireless Insite, an EM propagation software, the propagation effects of 60 GHz are observed in a residential two-story model house, which is slightly larger than the US "average" home, filled with furniture. The effects of outside brick, $\varepsilon_r = 4.4$, and E-glass windows, $\varepsilon_r = 6.25$, have a negligible effect on received power. The main effect to 60 GHz propagation is due to interior changes and obstacles such as walls or furniture. By adding furniture to the house the range of coverage can be changed depending on furniture location or transmitter location as the reflections off of these objects affects the total power received by receivers placed throughout the house. Figure 1 shows an example simulation result of the received signal strength indicator (RSSI) throughout the house with various receiver locations numbered with RSSI power received at that location in dBm. A minimum value of -87.5 dBm will still allow data to be transmitted at 1 Gbps at the receiver locations in the house with a single high-mounted 60 GHz transmitter. For example, the transmitter is located in the upper-right corner (Location 1) of the living room, and simulation results shows little difference in received power with or without E-glass windows in the receiver positions 1-20. Overall for 60 GHz the transmitter location is preferred to be above human height near the ceiling to reduce the effects of scattering and absorptive losses in the home environment as much as possible. The effect of outside materials surrounding the house has a minimal effect as reflected power off of the outside walls back to the receivers contributes a negligible amount due to power loss from electrical distance traveled.

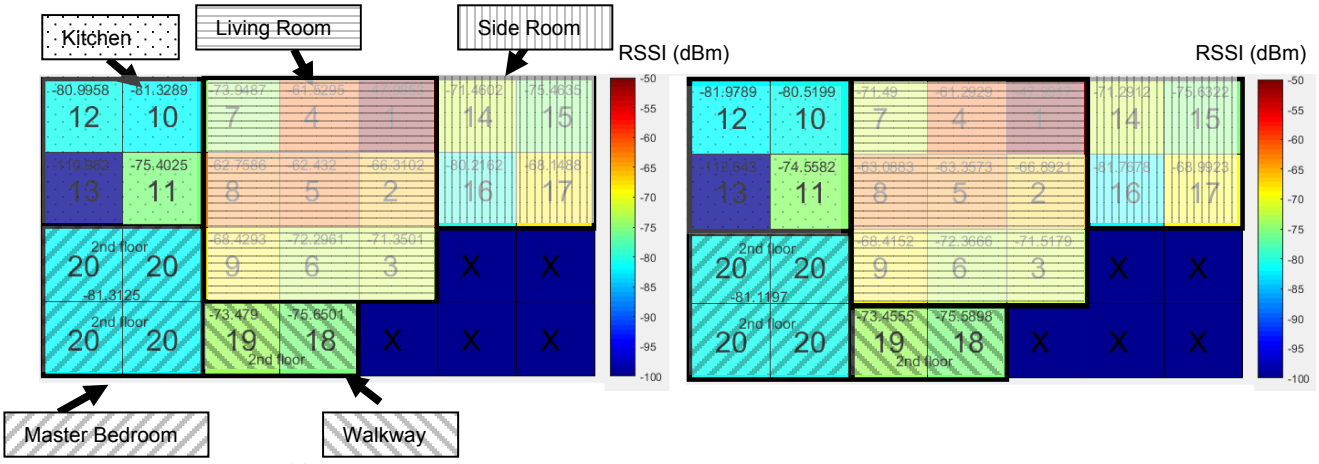

Figure 1. RSSI in 60 GHz house, (a) no E-Glass Windows, (b) E-Glass Windows included.