CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Jake H. Kuli

Project Number
31697

Project Title
What the WiFi? 2.4 GHz WiFi Signal Attenuation and Data Transmission through Different Materials

Abstract

Objectives/Goals
The objective of my experiment is to test the loss, or "attenuation" of 2.4 GHz electromagnetic wave signal as it passes through different materials and objects in addition to testing data transfer rates through these same materials.

Methods/Materials
Testing was done by placing each material or object to be tested between one cell phone in the stainless steel shielding cylinder running the wireless tether software (the signal source), and the other cell phone running wireless network analysis software. After completing attenuation readings for all materials, I selected representative samples of materials with certain average attenuation readings to determine what the effects of signal loss are on data transfer rates. Data transfer rates were determined by moving a 4 megabyte file between one phone and a computer.

Results
In testing materials such as aluminum, galvanized steel, and other conductors, the attenuation levels were high, as expected. In testing dielectrics, however, some proved to be more transparent to electromagnetic waves than expected. For example, water was one dielectric that created more dB loss than any of the metals tested. Eight feet of water attenuated the signal to the extent that it could not be detected above the surface whatsoever. On the other hand, electromagnetic waves through concrete walls showed virtually no attenuation. With regard to data transfer, my hypothesis was incorrect. My initial estimate was that for materials that showed attenuation between 0 and -70dB, the data transfer rates would be consistent. However, it turned out that the attenuation did adversely affect the transfer rates and was somewhat proportional.

Conclusions/Discussion
The data gathered during this experiment is easily applied in a real world setting. If line-of-sight placement of antennae is not practical, materials or objects which reflect electromagnetic waves, oriented correctly, may facilitate an adequate wireless connection between devices. Knowing the effects of signal strength on data transmission rate, an architect might specify additional wireless access points to ensure adequate network speeds. Overall, the deployment of a wireless network needs to involve scientific analysis of the environment in which it is located.

Summary Statement
My project involved determining how various materials and "real world" objects affect the propagation of WiFi signal in the form of 2.4 GHz electromagnetic waves.

Help Received
Father helped gather data