



**CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY**

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Project Title
How Do Wireless Signals Propagate through Different Media?

Abstract

Objectives/Goals
My objective is to determine how different materials (such as cardboard, plywood, aluminum, glass, plastic, steel, and bricks) affect the propagation of wireless signals in the 5.8Ghz bandwidth. The main goal of my research is to measure the attenuation of the wireless signal as it goes through materials with different characteristics.

Methods/Materials
In this project, I used two AirGrid M5 Ubiquiti radios. The first was set up as the transmitter while the second as the receiver. The Ubiquiti radio software enabled me to vary the amount of emitted power (in dBm and mW) and measure the amount of received power (in dBm and mW) at the receiver end. The two radios were separated by exactly 24ft. After establishing the free space path loss with no obstacles between the radios, I conducted the same experiment but with obstacles of known material characteristics between the two radios. With available materials at home, I fabricated cubes that measure 12"x12"x12" but have different materials. I then measured the received signal after it propagates through each of material. My data analysis focused on how different material characteristics affected the propagation of the wireless transmitted signal.

Results
The results of my experiment show that wifi signals are most affected by the electric and magnetic characteristics of materials. Dielectric materials such as glass and plastic had received signals that are four to sixteen times stronger than non-dielectric materials such as steel and foil.
Aluminum Foil received signal strength was -76dbm
Wood received signal strength was -74dbm
Steel received signal strength was -70dbm
Plastic received signal strength was -67dbm
Glass received signal strength was -64dbm

Conclusions/Discussion
This project shows that wireless signals propagate as electromagnetic waves that are most affected by the electric (mainly permittivity and conductivity) and magnetic (mainly permeability) characteristics of materials.
The data analysis in this project shows how important it is to select the right materials when good wireless signal reception is desired. A computer or receiving device received signal strength from an access point (or emitting source) is very much affected by the medium through which the wireless signal propagates

Summary Statement
My project is about how different material characteristics affect the propagation of wireless signals

Help Received
I would like to thank my science teacher Mr. Bud Smith at All Saints Day School, Carmel, CA