What Materials Block The Most Wi-Fi?

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This experiment was to determine how much Wi-Fi signal certain household items could block. The strength of the Wi-Fi signal was measured by placing a Chromebook 30 feet away from a Wi-Fi router, and testing the upload and download speed of the internet. The speed was tested using speedtest.net with five trials per material. The materials used in the test were: stainless steel, glass, plastic, and cardboard. The materials were shaped into a box completely surrounding the router. I also ran a speed test without anything blocking it, as the control. What I found was that all of the materials resulted in similar upload and download speeds to the control. Therefore, none of these materials were significant in blocking Wi-Fi.

Introduction

Have you ever wondered if you could get a better Wi-Fi signal at home? One factor in determining the strength and speed of your Wi-Fi signal at home may be the interference of materials in your home. Due to COVID-19, millions of people globally have been forced to work and learn from home, many for over a year. Poor Wi-Fi signals have become a major issue for the world's children and adults. People without a strong internet connection have a hard time working and keeping up in school.

What material blocks Wi-Fi signals the most? In this experiment I looked at how some common materials found at home such as steel, plastic, glass and cardboard may be blocking or weakening Wi-Fi signals.

Background Research

Wi-Fi stands for "Wireless Fidelity" and is also called WLAN which stands for "Wireless Local Area Network". According to *Encyclopedia Britannica*, "Wi-Fi is networking technology that uses radio waves to allow high-speed data transfer over short distances." Wi-Fi uses a similar frequency to a microwave, which is 2.4 GHz.

Nineteen million Americans, which is 6% of the population, do not have access to an internet connection. In tribal areas in the USA, about one third of the population does not have an internet connection. In rural areas of the USA, about one fourth of the population does not have an internet connection. President Biden plans to spend one hundred billion dollars to bring affordable internet access to Americans by 2029. According to *The Guardian*, "Covid-19 has forced many people to work and learn online, creating a digital divide amongst people who have internet access and those who do not."

One key part of Wi-Fi is the router. According to *ActionTec*, “a wireless router essentially takes the internet connection that comes into your home and breaks it up into millions of tiny pieces called packets, then it manages what packets (i.e. information) are sent to each device.” Some think the biggest advantage to Wi-Fi over an ethernet connection is portability, while some think that the biggest disadvantage is a limited connection range.

The best Wi-Fi router position is in the center of your house. Since routers tend to send the signal downward, it is better to put the router up high. It is best to keep the router a reasonable distance away from other interfering electronics such as a microwave. Wi-Fi signals are also donut-shaped and there is a hole in the middle of the signal where there is no coverage. The average internet download speed is 3-12 Megabytes per second (Mbps), and download speeds tend to be higher than upload speeds. Upload speeds range from 1-15 Mbps. The best ways to test speeds are: use multiple devices, test in the same place each time, double check, and perform multiple tests over the day. Some popular speed tests sites are: speedtest.net, speedof.me, testmy.net, xfinity speed test, internet health test, speed smart and test.com.

Some causes of slow internet are: network interference, bad equipment, poor placement of equipment, background programs, too many users at once, throttling, and malware. Some ways to improve your internet speed are to contact your provider, change providers, change equipment or placement of the equipment, or buy a Wi-Fi range extender.

A wireless signal is just like light because it bounces off certain surfaces. Refraction is the bending of a wave when it enters something where the speed is different and this can impact the signal. Diffraction is when waves hit an obstacle and go around it, this can also impact the signal.

Variables

My independent variable was the material encasing the router which included steel, cardboard, wood, and plastic. My dependent variable was the strength of the upload speeds

and the download speeds of the Wi-Fi signal. My hypothesis was that the steel would weaken the signal the most. My constants were the Chromebook used, the router used, the placement of the Chromebook and router, and the website used to measure the speed. The uncontrolled factors in this experiment were the number of other people using the internet at the same time as I was running my experiment, throttling by the cable company or thickness/size of the materials used to encase the router. My control group was running the same speed test the same amount of times, but with nothing encasing the router.

Procedure

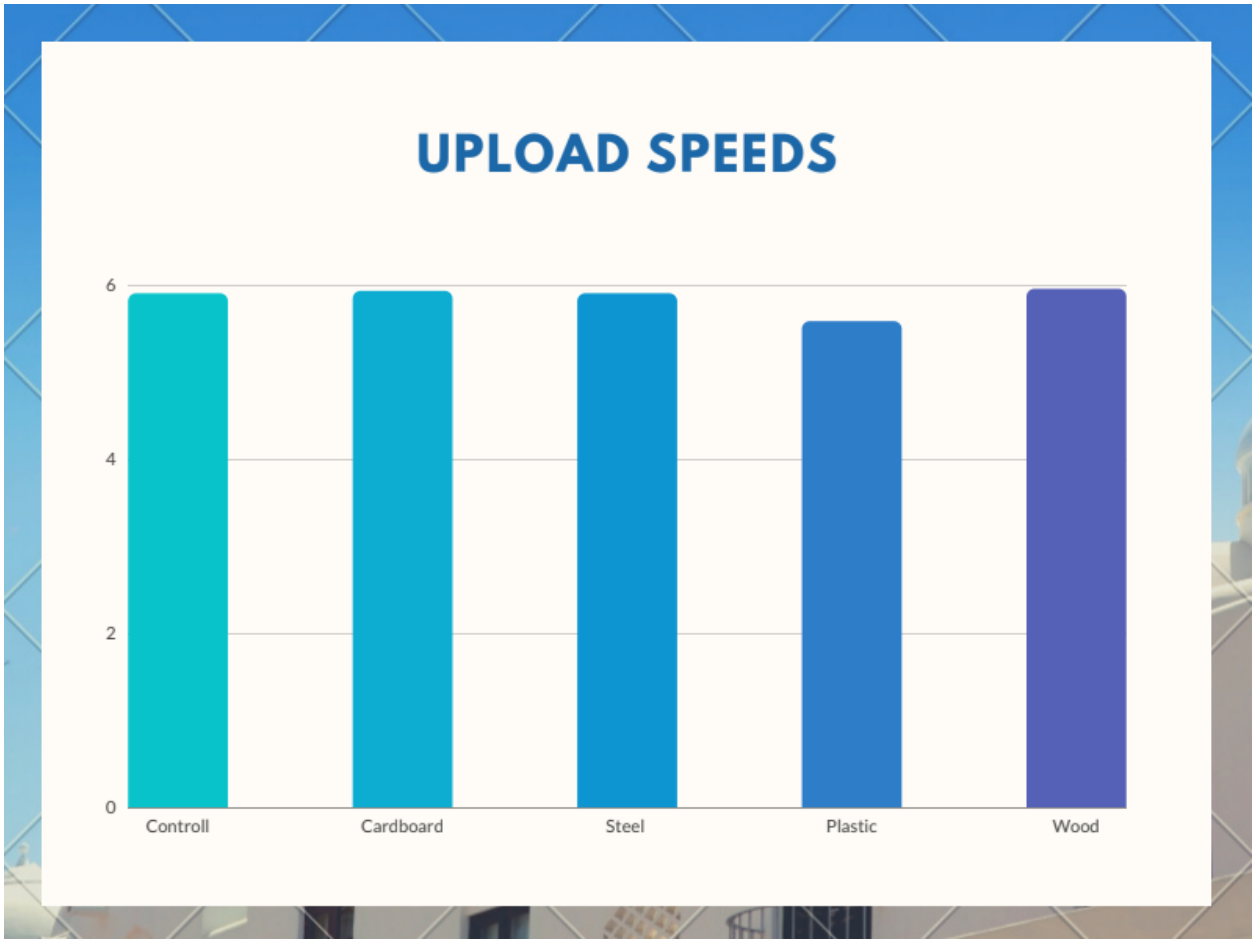
First, I set my Netgear R6200 Wi-Fi router on a chair. Then, I put my Acer Chromebook model CP311 on another chair 20 feet away from the Wi-Fi router. I then placed a steel trash can and a steel baking tray around the Wi-Fi router, to block the signal completely, and recorded the upload and download speed of the Wi-Fi. The site I used to measure the upload and download speeds was speedtest.net and the internet service was Wave Broadband high speed internet. I repeated this process five times. I then repeated the experiment with glass, then plastic, and lastly cardboard in place of the steel. I also recorded the upload and download speeds without any materials around the router, five times, as a control. All of the speed tests were performed between 2:30 and 3:00 pm. Then I averaged out the results for upload speed and download speed for each respective material, and concluded which blocked the most Wi-Fi.

Results and Analysis

The tables below show the upload and download trials for each material as well as the control.

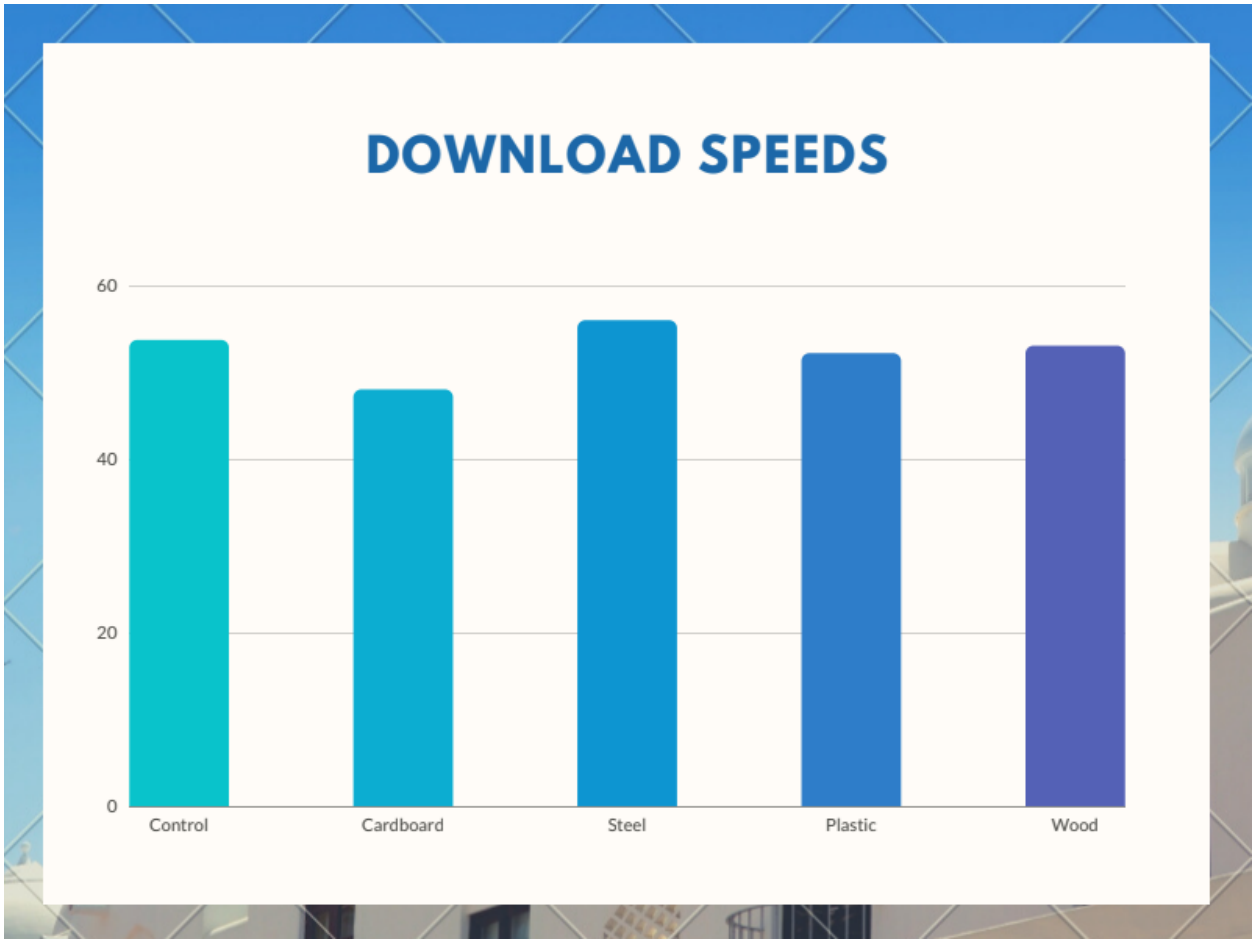
Upload Speeds

Material	Trial #1 Mbps	Trial #2 Mbps	Trial #3 Mbps	Trial #4 Mbps	Trial #5 Mbps	Average Mbps
Wood	5.94	5.98	5.98	5.9	5.96	5.952
Plastic	5.95	5.98	5.96	5.98	4.03	5.58
Steel	5.95	5.77	5.88	5.95	5.95	5.9
Cardboard	5.95	5.87	5.91	5.95	5.96	5.928
Control	5.67	5.95	5.95	5.98	5.95	5.9



Download Speeds

Material	Trial #1 Mbps	Trial #2 Mbps	Trial #3 Mbps	Trial #4 Mbps	Trial #5 Mbps	Average Mbps
Wood	57.1	58.5	49.99	57.65	41.89	53.026
Plastic	59.78	57.65	40.16	38.64	64.61	52.168
Steel	43.94	46.69	62.04	61.64	65.45	55.952
Cardboard	45.14	46.11	46.99	51.04	50.69	47.994
Control	59.68	49.67	59.08	53.83	46.19	53.69



Discussion

The variations in the upload and download results show that my data was subject to many outside forces and was not performed in the most advantageous time or place. The upload and download data for each material is also very similar, with little variation to each other and very little variation to the control data. In short, the results showed that the materials tested did not significantly weaken the Wi-Fi signal. Possible considerations could be the construction of the enclosures created. The enclosures were not air-tight and there is a possibility that Wi-Fi signal was able to escape the enclosures through small holes or cracks at the seams. Other considerations could be that the materials used to create the enclosures were not thick enough to have an effect.

Conclusion

My hypothesis was wrong because the results did not show data that steel blocks Wi-Fi signals in a significant way in the home. If I were to repeat this experiment, I would run far more trials and spread them out throughout the day to account for variations in how many others users are online. I would also try to come up with a consistent enclosure for the Wi-Fi router, where every material used is the same dimension and thickness, and there are no gaps or openings. If another person were to continue this experiment, the next step would be to run the tests with enclosures made of different thicknesses of materials to see if thicker steel, cardboard, plastic or wood have an effect on Wi-Fi strength. I feel this experiment (If performed to show helpful results) would be of importance because it would help people in need of ways to improve their Wi-Fi and troubleshoot problems related to Wi-Fi signal blocking.

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