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# **Understanding Interference and Attenuation**

Don't let EMI and RFI "interfere" with your equipment

No, this week's article isn't about pesky in-laws or nosy neighbors who try to tell you how to run your lives. The type of interference we're talking about is the kind that disrupts electronic signals: electromagnetic interference (EMI), radio frequency interference (RFI), "crosstalk" from wires in close proximity to one another. We'll also talk about attenuation, which is the loss of signal strength over distance.

What do these have to do with your computer? Like all electronic devices, PCs both emit interference that can disrupt the functioning of other devices, and are susceptible themselves to interference from outside sources. PCs work by using electronic impulses to represent the zeros and ones of binary data. Networked computers send electronic impulses, pulses of light, or radio signals from one computer to another to communicate.

In this article, we'll discuss the different types of interference and how interference and cause problems for computer and network users.

#### Electromagnetic Interference (EMI)

When an electric current passes through a wire or circuit, this generates a magnetic field. EMI occurs when there is "leakage" of electromagnetic emissions from electrical devices and wires or cables that carry electricity. These emissions are in the form of energy waves. The integrated circuits that make up computers emit relatively high frequency energy waves, as compared to low frequency waves that are emitted by electromechanical devices.

When the emissions from one device interfere with the operation of another device, this is called electromagnetic interference. Shielding can be used to prevent this leakage and interference. In the U.S., the Federal Communications Commission (FCC) sets rules regulating the amount of energy that can "leak" from an electronic device. The manufacturer must provide shielding to prevent more than the prescribed amount of leakage in order for the device to be approved.

Electromagnetic emissions can be either conducted (carried over wires) or radiated (emitted into the air). The FCC has different regulations for devices that are typically used in business environments and for consumer products made for home use.

EMI can cause degradation of the performance of electronic devices. Most of us have experienced this in everyday life. For example, running an electric blow dryer or other appliance might cause a "snowy" picture on a television set in the vicinity, or a motor running nearby can cause breakup in radio reception. Hospitals often prohibit the use of cell phones for fear the EMI they emit can interfere with sensitive medical equipment.

The higher the frequency, the more difficult it is to shield the devices from EMI. This means that computers with faster processors present more of an EMI problem. Case modifications, something

that has grown in popularity over the last few years, can also cause excessive emissions.

## Is EMI Hazardous to your Health?

There is an ongoing debate over whether long term exposure to electromagnetic fields can be a health hazard. From time to time, concerns crop up regarding the electromagnetism generated by cell phones, high voltage power lines, and other sources of electromagnetic fields. Some studies have suggested that there could be a connection between high exposure and diseases such as cancer and leukemia, but there is no conclusive evidence. On the other hand, some proponents of alternative medicine claim that magnetic fields can cure all manner of ills.

While we don't know at this point what effect, if any, EMI might have on your health, we do know that it can be hazardous(or at least disruptive) to the operation of many electronic devices.

#### What Can You Do About EMI?

Electromagnetic interference can be reduced by ensuring that electronic devices are properly shielded. The goal is to achieve EMC, or electromagnetic compatibility. EMC is defined by the Institute of Electrical and Electronics Engineers (IEEE) as the ability of a device, equipment, or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.

Shielding materials can be metal, foil, spray coating, or conductive fabric or tape. Gaskets are used to shield seams and joints. An interesting paper on EMI shielding theory can be <u>found here</u>. Polymers/plastics can be used for shielding if they are made conductive by adding thin metal plates, or coating the surface with conducting film or paint, or filling the plastic with metal flakes.

As computer professionals, the most important thing to for us to be aware of regarding EMI emitted by our computers is that cases are designed to provide the necessary (and legally mandated) shielding. Making changes to the computer case (such as cutting holes in it) or running the computer without the case cover on – as many techies are prone to do – defeats this purpose.

#### What is RFI?

RFI is a type of EMI, specifically, interference in the radio frequency (RF) spectrum of 1kHz-10GHz. Radio frequencies are used for many devices. For example, the 2.4GHz frequency is used both for cordless telephones and for wireless networking components, so these devices can interfere with one another if they're in close proximity.

#### What is Crosstalk?

"Crosstalk" is a term used to describe the interference that occurs when copper wires are in close proximity to each other and the signal from one wire "bleeds" over to the other. Crosstalk is a specific type of EMI. Crosstalk can be a problem in the cabling used for network communications, because several pairs of thin copper wire exist together inside the cable. Twisting the two wires in a pair helps to protect against interference, thus we have "twisted pair" cabling, both shielded and unshielded. The shielding material around the latter further protects from outside interference.

A specific type of crosstalk is called terminal crosstalk; this refers to interferences at the ends of the wires, where they are not twisted.

## What is Attenuation?

Attenuation is not a type of interference, per se. Rather, it is the loss of signal strength as it over distance. This problem can be encountered when sending signals over a network from one computer to another. As the signals travel further, they will lose strength (thus, reliability of the transmission will be reduced and eventually fail). All media are not created equal; the distance that can be traveled before attenuation becomes a problem depends on the medium used. For example, fiber optic cabling is less vulnerable to attenuation than copper cabling, so it can be run for longer lengths without significant loss due to attenuation.

Radio signals that travel through the air are also subject to attenuation. You experience this when you're listening to a radio broadcast on a car radio and lose the signal as you travel too far from the broadcast tower. Signals can be boosted by devices called repeaters to increase the transmission distance.

#### Summary

Interference and attenuation are important topics for those working with computers and networks to understand, as these can have a profound effect on operation and transmission.

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