To discuss signals, its types and transmissions take a short excursion to understand the nature of electricity and magnetism. If you don't understand the basic physics, you will not understand some of the errors and techniques used in data communications to overcome them.

Electricity and Magnetism In Brief

Electricity and magnetism are important aspects of human life. We are all familiar with walking across a carpet in the winter time and getting zapped when you touch the door knob. This is an example of static electricity. Static electricity stays in one place. An electrical current, on the other hand, flows and we use that movement to power our households. We are also familiar with a bar magnet which has north and south poles. In school, you may have poured fine iron particles around a bar magnet to see the "magnetic field". Like poles will repel and unlike poles (north, south) attract. Today we know that electricity and magnetism are two aspects of the signal force an "electromagnetic field". A moving magnet will generate electricity and an electrical current will generate a magnetic field. To understand these properties, we need to look at the atom.

Any material is a collection of atoms which have nucleus (positively charged) and orbiting electrons (negatively charged). Some material such as glass, wood and rubber are very stable because their atoms have no free electrons. We call these materials insultors. On the other hand, materials like, gold, copper and silver are called conductors because they possess free electrons; when an electrical force comes near, these free electrons will move from atom to atom creating an electrical current. The flow of electrons, however, generates an electromagnetic field. In school, you may have learned the "right hand rule". Hold you right hand up and if the current is flowing in the direction that your thumb is pointing, the magnetic field is generated in the direction of your curled fingers.[i]

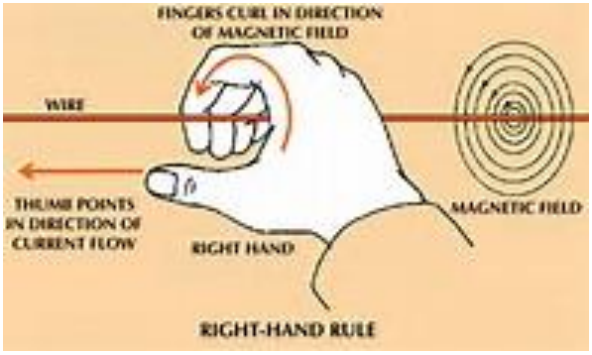

Figure 1: Right Hand Rule

This magnetic field will tend to "pull" electrons away from the center of the current to the outside edge. Thus, as the current flows, its' strength is continually weakened. This loss is called attenuation. If the signal gets too weak, then the receiving computer can't differentiate between a zero or a one and a retransmission will be required. Consequently, the IEEE has established strict rules on how far a signal can travel before it needs to be repeated. For example, the maximum distance of UTP cable is 100 meters (which is the primary reason by LANs are confined to a small geographical area).

https://www.youtube.com/watch?v=XiHVe8U5PhU

[i] Right hand rule image from http://media.web.britannica.com/eb-media/79/63079-004-F04BAA10.gif