Lesson Transcript

In this lesson, we will become acquainted with analog and digital signals, the characteristics of each, and how they are used in data transmission. We will also discuss why modulation and demodulation processes are required for sending and receiving data over a transmission media.

What are Analog and Digital Signals?

Have you ever sat by the phone waiting for it to ring? Well, I guess we don't sit by the phone anymore since we carry it with us wherever we go. Regardless, in anticipation of great news we all have probably looked at the phone and mumbled, ''Come on, ring!'' When the telephone finally rang, we answered it, connecting to the individual with the good news on the other end. As we speak into a microphone, sound waves from our voice are transmitted by the telephone in the form of radio waves (both sound waves and radio waves are **analog signals**), and when combined with **digital signals**, we begin moving data along the telephone line. We will come back to our good news in a few minutes, but first let's define analog and digital signals, and then discuss what happens during the conversation.

Analog Signal

An **analog signal** is a continuous wave denoted by a sine wave (pictured below) and may vary in signal strength (amplitude) or frequency (time). The sine wave's amplitude value can be seen as the higher and lower points of the wave, while the frequency (time) value is measured in the sine wave's physical length from left to right.

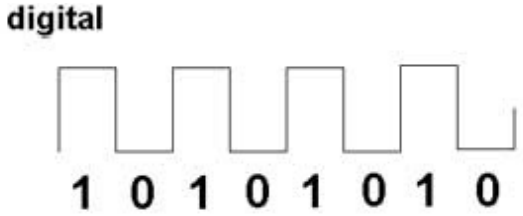
There are many examples of analog signals around us. The sound from a human voice is analog, because sound waves are continuous, as is our own vision, because we see various shapes and colors in a continuous manner due to light waves. Even a typical kitchen clock having its hands moving continuously can be represented as an analog signal.

Analog signal represented as a sine wave

Digital Signal

A **digital signal** - a must for computer processing - is described as using binary (0s and 1s), and therefore, cannot take on any fractional values. As illustrated in the graphic below, digital signals retain a uniform structure, providing a constant and consistent signal. Because of the inherent reliability of the digital signal, technology using it is rapidly replacing a large percentage of analog

applications and devices. For example, the wristwatch, showing the time of day, with its minute, hour, and sweeping second hands, is being replaced by the digital watch, which offers the time of day and other information using a numerical display. A typical digital signal is represented below. Note the equally dispersed 1s and 0s.



Digital signal with binary

What is a Modem?

Within a communications environment a **modem** is a combination of two networking devices: a **modulator** and a **demodulator** (modem for short). These devices perform modulation and demodulation algorithms simultaneously, to convert a signal from analog-to-digital and digital-to-analog, enabling data transmission to and from various computing resources.

What is Modulation/Demodulation

Let's look at a typical data flow using the illustration below as a reference. A good place to start is at the telephone, with you making a call. Remember, as we speak into a microphone, sound waves from our voice are transmitted by the telephone in the form of radio waves (analog signals), which characteristically vary in signal strength or frequency. The analog signals travel from the telephone into the modem. It is the modem's job to demodulate, that is transform analog signals into digital signals for computer processing, and then eventually modulate the signal, reverting the digital signals back into analog signals.

In other words, two modems are required to perform the analog-to-digital (demodulation) and the digital-to-analog (modulation) transformations. When your call is returned, the digital signal is received from the telephone company's telecommunications network and passes through your telephone line, into the modem where the signal is modulated (converted to analog). This enables you to hear and hopefully understand the good news being passed by the caller. It is not a stretch to say that without modulation and demodulation technology, we would not be able to send and receive information over a common transmission media such as your telephone line.

What are Digital and Analog Signals? - Definition & Explanation Related Study Materials