The Basics of Bandwidth

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Tutorial on Automatic Equalization and Gain Control

Some of you have asked questions about our automatic equalization and auto gain control features in the Model 1012A and the Model 1080A. But, before we can explain these two functions, we need to review some of the basics in bandwidth. Both automatic equalization (AEQ) and auto gain control (AGC) allow your equipment to use the bandwidth to convey data signals more accurately.

All electronic communication systems send information by transmitting electromagnetic energy. This electromagnetic energy can travel as a voltage or current through wires, as radio emissions through the air, or as light.

To pass information, a communication system must use a specific amount of the electromagnetic spectrum. For instance, music uses the range of frequencies from 0 to 20,000 cycles per second or hertz (Hz) and so it has a 20kHz bandwidth. To pass the entire music signal, the communications system must allocate a minimum bandwidth of at least 20 kHz.

Digital transmission generally represents the signals as voltages which alternate between two possible states (yes/no, on/off or 0 and 1). This is a baseband signal. Many Patton short range modems use a modulation scheme to transmit baseband signals over twisted pair wire. These signals combine many different frequencies. In contrast, dial up or leased line modems convert digital baseband signals into analog or broadband signals for transmission over 3300 Hz voice grade channels.

A typical computer to terminal connection requires from 1200 to 19,200 bps. Most Patton short haul modems transmit a baseband signal from 0 to 300kHz, where the speed in Hz is 2 or 3 times the bit rate. If you were to increase the bandwidth, you would increase the capacity linearly: a doubling of the bandwidth would double the capacity. However, other factors affect how much information the channel can carry and the operable bandwidth of the channel (noise, distortion effects, modulation schemes).

The voltage or current of a signal is decreased in strength as it is transmitted over a cable. As the length of the cable increases, it acts as a low pass filter and passes the low frequencies better than the high frequencies. This causes the high frequencies to decrease in strength or attenuate. If these high frequencies are cut off, the spectrum of bandwidth of the received signal is much narrower. In addition, noise and distortion sources on the cable may make the received signal unrecognizable. To overcome this problem, the AEQ and AGC features in the 1012A and 1080A attempt to reconstruct the original signal by amplifying the high frequencies. If the entire received signal is strong, very little amplification is required. If any part of the received signal is weak due to reduction in strength or distortion, the 1012A and 1080A amplify the weaker signal frequencies to produce a stronger signal. This technique widens the effective bandwidth!

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