Analog or Digital: Which is Best?

May 5, 1995

We Give You the Criteria to Make the Right Call

Traditional communication systems (telephone, radio, video) have always relied on analog technology. More recently, communications between computer systems has launched a large migration toward digital technology. Still, analog communication hardware remains the first choice for many computer users. Which should you choose for a given application-and why?

A Technology Primer

An analog signal is a waveform that varies continuously within a certain amplitude, frequency or phase range. In a typical data comm application, a computer device sends data to a modem (modulator/ demodulator). The modem converts the computer's data signal into an analog format that is compatible with the analog POTS (Plain Old Telephone Service) wires. The digital to analog conversion process, called modulation, creates tones to convey information. As the modem receives data via RS232, it generates the appropriate amplitude, frequency or phase modulated tone and then transmits it over the link. For a received signal, the modem decodes the tones and produces the digital code that the receiving computer can recognize. Modems transmit and receive data at 9600bps. Speeds up to 28.8bps can be achieved by using modems that perform data compression and error correction techniques.

A digital signal alternates between two or more discrete values such as +1 volt and -1 volt. Digital access equipment, such as a CSU/DSU receives data from computer equipment, but then transmits and receives digitally encoded data over the phone company's digital services. In the U.S., CSU/DSUs provide access to digital services such as switched or dedicated 56kbps, 64kbps and T1 (1.544Mbps). In Europe, G.703 and G.704 digital modems provide similar access to E1 (2.048Mbps) digital services.

Which of these two technologies is the best choice depends upon at least three factors: signal quality, throughput and cost.

Signal Quality

Because an analog signal fades (attenuates) over distance, it must be periodically re-amplified to prevent it from disappearing. Unfortunately, the noise(EMI/RFI) accompanying the signal is also re-amplified. This results in a distorted data signal. Complicating matters further, noisy lines cause modems to step down to lower speeds in order to compensate for the distortion. Therefore, speed is sacrificed to gain clarity.

A digital signal, by contrast, is not only amplified, but is periodically re-constructed by carrier-owned devices called regeneration amplifiers. Using these regeneration amplifiers, digital service customers can use the full bandwidth that is available. Therefore, a doctor's office in Chicago can view clean, 40 megabyte X-ray images of a patient in Pittsburgh in about 10 and a half minutes instead of an hour and a half with 9.6 dial-up.

Throughput
Analog modems can be a cost-effective solution when a small number of PCs or workstations need to communicate with a remote server, but at 9600bps they often create a bottleneck for large-scale, image or interactive LAN applications. This is a significant factor when moving large amounts of data. LAN to LAN data traffic that chugs along over non-compressed 9.6 dial-up finishes five times faster over switched 56. A retail store that sends daily cash register receipts from a file server in Houston to it's home office in Memphis would create a bottle-neck if they tried to send files over 9.6 dial-up. If they used switched 56 services, they could send the same files in a fraction of the time at any time during the day and avoid the bottleneck.

Cost
As the saying goes, "you get what you pay for". Digital services can cost more, but sometimes the increased throughput and lower error rates justify the expense. Often, the overall cost is less for digital service. For example, a switched 56-kbps circuit might cost 20% more than dedicated analog leased lines, but it provides 500% more bandwidth! With a digital access equipment, a technology marketing company can provide email to five sales engineers rather than just one. Tariffs may vary widely, but it normally takes two or three 9.6 circuits to justify a switched 56 circuit, and about five or six 56k circuits to justify a T1 or E1 circuit.

Analog modem manufacturers have gone to great lengths to include sophisticated compression and correction techniques in their modems to compensate for the inherent impediments of analog lines. Whether these enhancements will convince you to go with analog technology depends upon your signal quality and throughput requirements. Your application (and budget) will likely make the choice for you. Should you go the digital route, you will want to consider the Patton Model 2500 Series CSU/DSU and Model 2703 G.703 Digital Modem/Converter, both rack card and standalone.

PATTON Electronics Co.

7622 Rickenbacker Drive, Gaithersburg, MD 20879 USA
Phone: +301-975-1000 or Fax: +301-869-9293