Analog vs. Digital Transmission

There are three predominant methods of encoding a transmission signal. Amplitude modulation(AM), and frequency modulation(FM) are both analog modulation schemes. The third method is digital modulation. The Table 1 outlines the basic characteristics of the three modulation schemes.

Table 1 - Comparison of AM, FM, and Digital Encoding Techniques			
Parameter	**AM**	**FM**	**Digital**
Signal-to-Noise Ratio	Low-to-Moderate	Moderate-High	High
Performance vs.Attenuation	Sensitive	Tolerant	Invariant
Transmitter Cost	Moderate-High	Moderate	High
Receiver Cost	Moderate	Moderate-High	High
Receiver Gain Adjustment	Often Required	Not Required	Not Required
Installation	Adjustments Requires	No Adjustments Required	No Adjustments Required
Multichannel Capabilities	Require High LinearityOptics	Fewer Channels	Good
Performance Over Time	Moderate	Excellent	Excellent
Environmental Factors	Moderate	Excellent	Excellent

AM, FM, and digital modulation are described in detail in other sections of this web site. One key difference between analog and digital transmission involves the bandwidth, or transmission capacity required for both schemes. Analog signals require much less bandwidth, only about 4.5 MHz with a 143.2 Mb/s data rate. for the average NTSC video signal. By comparison, some digital video transmission standards require as much as 74.25 MHz with a data rate of 1485 Mb/s. Advances in single-mode optical fiber make these higher rates more accessible for longer distances. Copper coax fails to perform at these data rates. Another difference between analog and digital transmission deals with the hardware's ability to recover the transmitted signal. Analog modulation, which is continuously variable by nature, can often require adjustment at the receiver end in order to reconstruct the transmitted signal. Digital transmission, however, because it uses only 1's and 0's to encode the signal, offers a simpler means of reconstructing the signal. Both types of modulation can incorporate error detecting and error correcting information to the transmitted signal. However, the latest trend in signal transmission is forward error correcting (FEC). This scheme, which usesbinary numbers, is suited to digital transmission. Extra bits of information are incorporated into the digital signal, allowing any transmission errors to be corrected at the receive end. A third important difference relates to the cost of analog transmission links compared to digital transmission links. Because the circuitry required for digital transmission is more complex, the cost is often much higher. In short distance applications, analog modulation will almost always be the most cost-effective system to specify. However, today's demand for high speed Internet, video-on-demand, videoconferencing, and "pushed" data directly to our home computers requires moderate to long-distance transmission systems to specify digital equipment. And as is the case with any form of technology, greater demand will lead to mass production, inevitably driving the cost of digital systems down. However, it will always be true that the decision to specify one type of modulation over the other involves the same system design considerations.

Source: http://www.fiber-optics.info/articles/analog_vs._digital_transmission