Information Communication*

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Abstract

Introduction to the subject of Information Communication and describes the necessity of a digital communication strategy for eliminating errors.

As far as a communications engineer is concerned, signals express information. Because systems manipulate signals, they also affect the information content. Information comes neatly packaged in both analog and digital forms. Speech, for example, is clearly an analog signal, and computer files consist of a sequence of bytes, a form of "discrete-time" signal despite the fact that the index sequences byte position, not time sample. **Communication systems** endeavor not to manipulate information, but to transmit it from one place to another, so-called **point-to-point communication**, from one place to many others, **broadcast communication**, or from many to many, like a telephone conference call or a chat room. Communication systems can be fundamentally analog, like radio, or digital, like computer networks.

This chapter develops a common theory that underlies how such systems work. We describe and analyze several such systems, some old like AM radio, some new like computer networks. The question as to which is better, analog or digital communication, has been answered, because of Claude Shannon's[1] fundamental work on a theory of information published in 1948, the development of cheap, high-performance computers, and the creation of high-bandwidth communication systems. **The answer is to use a digital communication strategy**. In most cases, you should convert all information-bearing signals into discrete-time, amplitude-quantized signals. Fundamentally digital signals, like computer files (which are a special case of symbolic signals), are in the proper form. Because of the Sampling Theorem, we know how to convert analog signals into digital ones. Shannon showed that once in this form, **a properly engineered system can communicate digital information with no error despite the fact that the communication channel thrusts noise onto all transmissions**. This startling result has no counterpart in analog systems; AM radio will remain noisy. The convergence of these theoretical and engineering results on communications systems has had important consequences in other arenas. The audio compact disc (CD) and the digital videodisk (DVD) are now considered digital communications systems, with communication design considerations used throughout.

Go back to the fundamental model of communication[2]. Communications design begins with two fundamental considerations.

1. What is the nature of the information source, and to what extent can the receiver tolerate errors in the received information?
2. What are the channel's characteristics and how do they affect the transmitted signal?

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[1] http://www.lucent.com/minds/infotheory/

[2] "Structure of Communication Systems", Figure 1: Fundamental model of communication <http://cnx.org/content/m0002/latest/#commsys>

In short, what are we going to send and how are we going to send it? Interestingly, digital as well as analog transmission are accomplished using analog signals, like voltages in Ethernet (an example of **wireline** communications) and electromagnetic radiation (**wireless**) in cellular telephone.