



Lecture Two: Introduction

Communication System Elements

1. Communication System Elements

Figure 1 shows a commonly used model for a single-link communication system. Although it suggests a system for communication between two remotely located points, this block diagram is also applicable to remote sensing systems, such as radar or sonar, in which the system input and output may be located at the same site. Regardless of the particular application and configuration, all information transmission systems invariably involve three major subsystems—a transmitter, the channel, and a receiver.

Input Transducer:

The wide variety of possible sources of information results in many different forms for messages. Regardless of their exact form, however, messages may be categorized as analog or digital. The former may be modeled as functions of a continuous time variable (e.g., pressure, temperature, speech, music), whereas the latter consists of discrete symbols (e.g., written text). Almost invariably, the message produced by a source must be converted by a transducer to a form suitable for the particular type of communication system employed. For example, in electrical communications, speech waves are converted by a microphone to voltage variations. Such a converted message is referred to as the message signal.

Transmitter:

The purpose of the transmitter is to couple the message to the channel. Although it is not uncommon to find the input transducer directly coupled to the transmission medium, as for example in some intercom systems, it is often necessary to modulate a carrier wave with the signal from the input transducer. Modulation is the systematic variation of some attribute of the carrier, such as amplitude, phase, or frequency, in accordance with a function of the message signal. There are several reasons for using a carrier and modulating it. Important ones are:



- (1) For ease of radiation.
- (2) To reduce noise and interference.
- (3) For channel assignment.
- (4) For multiplexing or transmission of several messages over a single channel.
- (5) To overcome equipment limitations.

Channel:

The channel can have many different forms; the most familiar, perhaps, is the channel that exists between the transmitting antenna of a commercial radio station and the receiving antenna of a radio. In this channel, the transmitted signal propagates through the atmosphere, or free space, to the receiving antenna. However, it is not uncommon to find the transmitter hard-wired to the receiver, as in most local telephone systems. This channel is vastly different from the radio example. However, all channels have one thing in common: the signal undergoes degradation from transmitter to receiver. Although this degradation may occur at any point of the communication system block diagram, it is customarily associated with the channel alone. This degradation often results from noise and other undesired signals or interference but also may include other distortion effects as well, such as fading signal levels, multiple transmission paths, and filtering.

Receiver:

The receiver's function is to extract the desired message from the received signal at the channel output and to convert it to a form suitable for the output transducer. Although amplification may be one of the first operations performed by the receiver, especially in radio communications, where the received signal may be extremely weak, the main function of the receiver is to demodulate the received signal. Often it is desired that the receiver output be a scaled, possibly delayed, version of the message signal at the modulator input, although in some cases a more general function of the input message is desired. However, as a result of the presence of noise and distortion, this operation is less than ideal.



Output Transducer:

The output transducer completes the communication system. This device converts the electric signal at its input into the form desired by the system user. Perhaps the most common output transducer is a loudspeaker. However, there are many other examples, such as tape recorders, personal computers, meters, and cathode-ray tubes.

