

EES351 2022/1

Part I

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1 Introduction to communication systems

1.1. Shannon's insight [10]:

The fundamental problem of communication is that of reproducing at one point either exactly or approximately a message selected at another point.

Definition 1.2. Figure 1 shows a commonly used model for a (single-link or point-to-point) communication system.

(a) **Information¹ source:** produce a **message**

- Messages may be categorized as **analog** (continuous) or **digital** (discrete).

(b) **Transmitter:** operate on the message to create a **signal** which can be sent through a channel

(c) **Channel:** the medium over which the signal, carrying the information that composes the message, is sent

- Channel **impairments/degradation/contaminations.**

¹The concept of information is central to communication. But information is a loaded word, implying semantic and philosophical notions that defy precise definition. We avoid these difficulties by dealing instead with the message, defined as the physical manifestation of information as produced by the source. [3, p 2]

- Include *noise*², *interference*³, and *distortion*⁴
 - Although this degradation may occur at any point of the system, the standard convention is to lump them entirely on the channel [15, p 5] [3, p 4].
- (d) **Receiver:** transform the signal back into the message
- (e) **Destination:** a person or a machine, for whom or which the message is intended

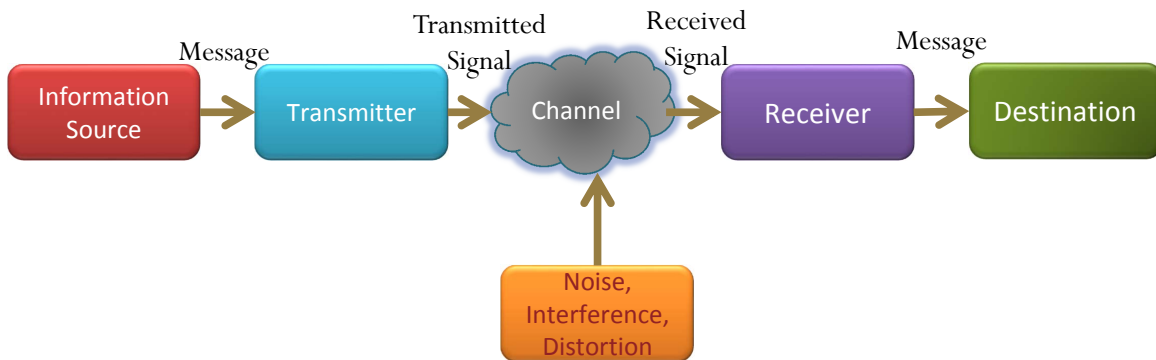


Figure 1: Schematic diagram of a general communication system [10, Fig. 1][3, Fig. 1.1-2 p 4]

Definition 1.3. Note that the system shown in Figure 1 represents one-way, or **simplex**, transmission.

- Two-way communication requires a transmitter and receiver at each end.
 - (a) **Full-duplex** system: allow simultaneous transmission in both directions.
 - (b) **Half-duplex** system: allow transmission in either direction but not at the same time.

²Random and unpredictable electrical signals produced by natural processes both internal and external to the system. [3, p 4]

³Contamination by extraneous undesired signals from human sources other transmitters, power lines and machinery, switching circuits, and so on. Interference occurs most often in radio systems whose receiving antennas usually intercept several signals at the same time. [3, p 4]

⁴Waveform perturbation caused by imperfect response of the system to the desired signal itself. Unlike noise and interference, distortion disappears when the signal is turned off. If the channel has a linear but distorting response, then distortion may be corrected, or at least reduced, with the help of special filters called equalizers. [3, p 4]