

# 1 Communication Theory

Communication theory is a field of information theory and mathematics that studies the technical process of information. Communication theory consists of:

- Analyzing real world communication systems using structured thinking or mathematics.
- Synthesizing real world communication systems from mathematics.

## 2 Signals

Signals are defined to be a function that conveys information about a phenomenon. They can also be said to be a medium which carry information relevant to a receiver.

Electromagnetic wave, voltage or current, digital signals carrying information are some examples of signals.

### 2.1 Are there any non-time based signals?

- Images: They are represented as a combination of monochrome images in three primary colors.

$$Image : \mathbb{R}^2 \rightarrow \{R, G, B\}$$

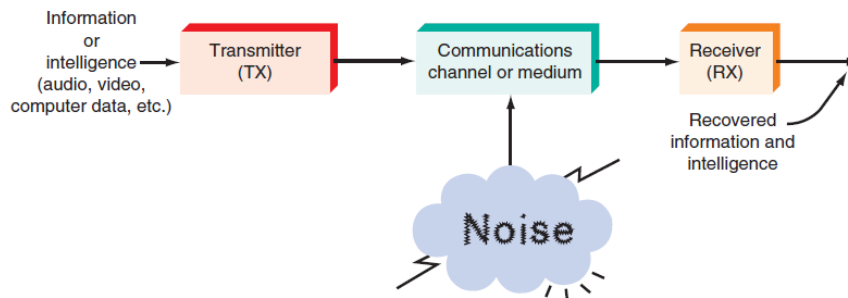
- Temperature at various points in a room.

$$Temperature : \mathbb{R}^3 \rightarrow K \quad (\text{or Celsius})$$

- Videos: A video signal is a sequence of images.
- Text or a page in a book.

## 3 Communication

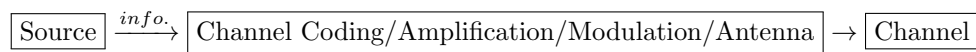
Communication is the process of exchanging information. Transmission, reception and reconstruction of the transmitted signal take place in this process.



Channel: Separates the source and receiver and is not directly under our control. This leads to some disturbances or imperfections in the channel, which is called noise.

### 3.1 Transmitter

The first step in sending a message is to convert it into electronic form suitable for transmission. The transmitter consists of various components designed to convert the electrical signal to a signal for sending it through the medium.



The transmitter is also called TX or TRX.

### 3.2 Receiver



A receiver is a collection of electronic components and circuits that accepts the transmitted message from the channel and converts it back to an understandable form. The detection and estimation step is called ‘demodulation’.

Channel coding and decoding is mainly used in digital communication systems. The receiver is called RX.

### 3.3 Features of a good communication system

- Low degradation in quality of original signal, called high fidelity.
- Quick reception of information, called high rate communication. (in digital comms., this happens via intelligent modulation, power control)
- Time delay between transmission and communication should be small, called latency. (eg: high latency required in video streams but not for downloads)

### 3.4 Modes of Communication

1. Point-to-point communication, in which the communication process takes place over a link between a single transmitter and a receiver. eg: Wired phone call.
2. Broadcasting, which involves the use of a single transmitter and multiple receivers. eg: Radio/TV broadcast, wi-fi, wireless cellular downlink
  - Multiple access channel, consists of multiple transmitters and a single receiver. eg: Cellular uplink.