

Competency 06

Explores the Data Communication and Computer Networking Technologies to share Information effectively

6.1 Explores Signals and their properties

Time: 4 periods

Learning Outcomes

- Graphically represents digital and analog signals and their properties
- Solves problems related to the relationship between signal properties

Introduction to Data Communication

Data communications refers to the transmission of digital data (usually in binary form) between two or more computers or any communicating devices over some transmission media.

Teachers' guide definition

Data communication is the process of transmitting data between two or more communicating devices over some transmission media. Establishing such connections between computing devices is called computer networking.

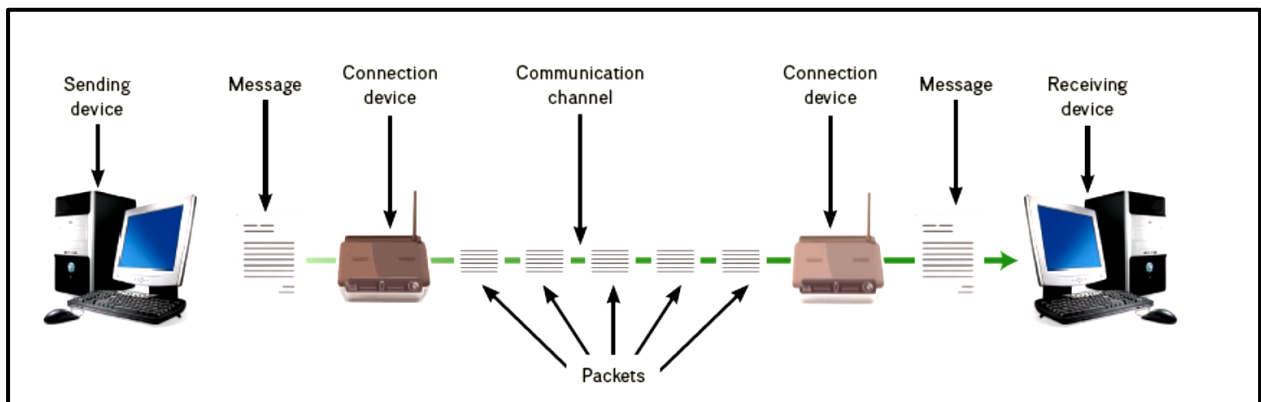
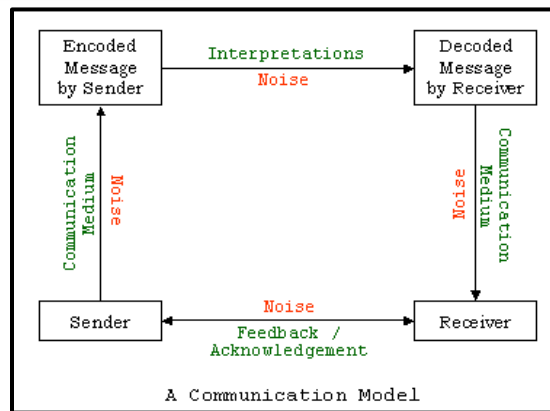
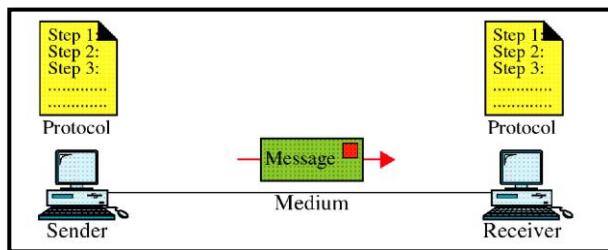
What is a Computer Network?

A system of interconnected computers and computerized peripherals such as printers is called computer network. This interconnection among computers facilitates information sharing among them. Computers may connect to each other physically by either wired or wireless media. The best-known computer network is the Internet.

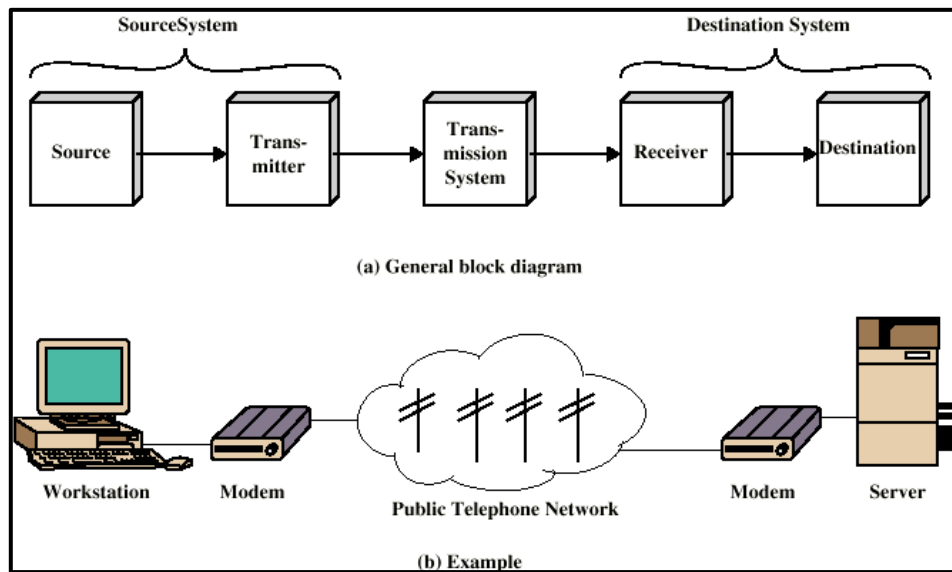
A Data Communication Model

For the successful data communication there should be some relevant components and following are 3 basic components.

1. Transmitter/ Sender/ Source – Generates and prepares data to be transmitted
2. Transmission System – Responsible for transmitting data towards destination
3. Destination/Receiver/ Sink –Receives data from the transmission system and hands over it to the application



Simplified Communications Model – Diagram



1. Sender

The computer or device that sends the data or message is called sender. In data communication system, computer is usually used as a transmitter. It is also called sender. A sender may be computer, workstation, telephone, video camera etc.

2. Receiver

The device that receives the data or messages is called receiver. Receiver is also known as sink. The receiver can be a computer, workstation, printer or a fax machine.

3. Transmission System

In a transmission system include Message, Protocol, transmission media and transmitting signals

- Transmission Media (Communication Channels)

Transmission media is an essential element of every communication system. It is the intermediate path to carry the data from sender to receiver. There are two categories of communication channels. One category connects sending and receiving devices by providing a physical connection, such as wire or a cable such as coaxial, twisted pair etc. The other category is wireless radio wave, micro wave etc.



Ethernet cable



Coaxial cable



Fiber-optic cable



Microwave dish

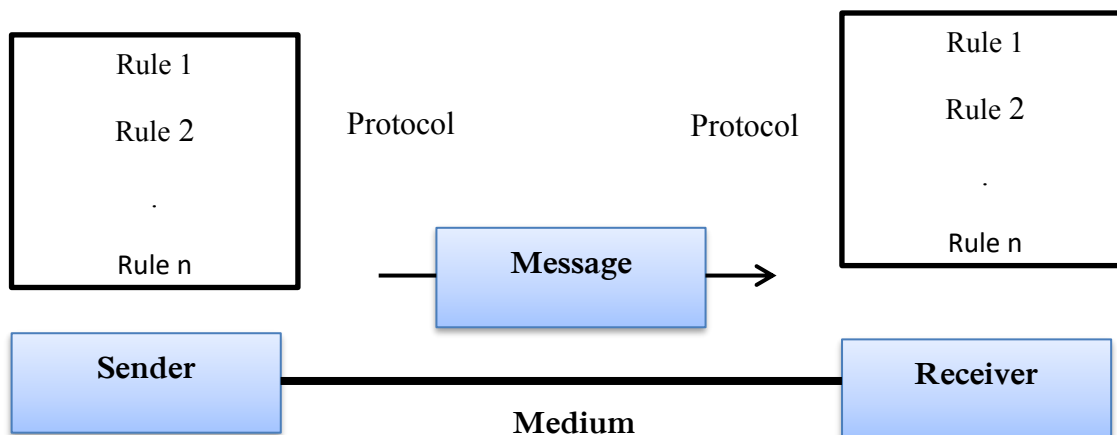
- **Protocols**

For data transmission to be successful, sending and receiving devices must follow a set of communication rules for the exchange of information. These rules for exchanging data between computers are known as protocols. It represents an agreement between the communicating devices. Without a protocol, two devices may be connected but not communicating.

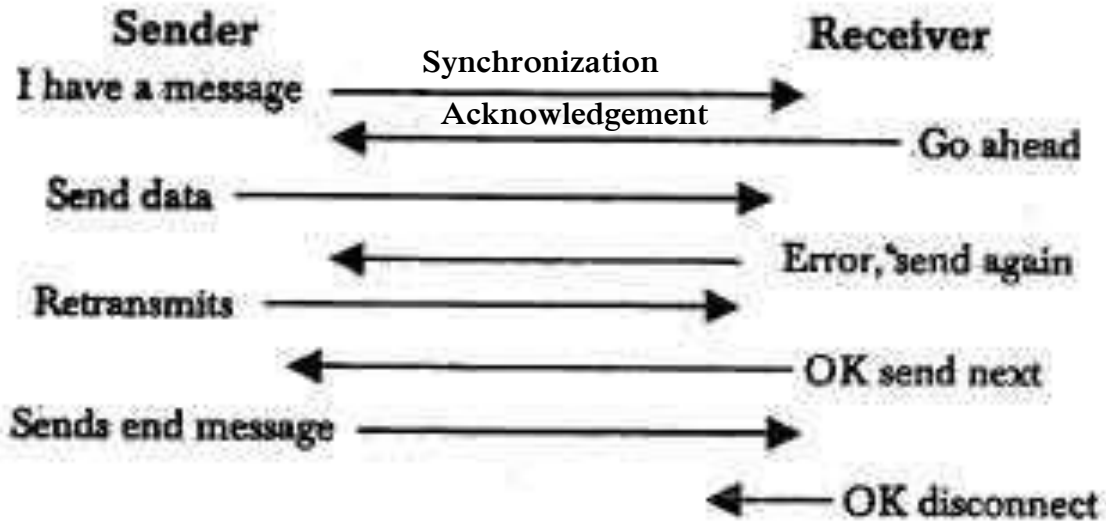
HTTPS (Hypertext Transfer Protocol) is widely used to protect the transfer of sensitive information and TCP/IP (Transmission Control Protocol/Internet Protocol) are widely used as internet protocol.

Examples for protocols.

Ethernet,	IP
IEEE 802.3,	TCP
CSMA/CD,	UDP
Token Ring,	FTP



Synchronization and Acknowledgement



Communication between sender and receiver in COP

- Message

It is the information to be communicated. Popular forms of information include text, pictures, audio, video etc. which are created by digital signals or analog signals.

- Signals

A signal is an electrical or electromagnetic current that is used for carrying data from one device or network to another.

It is the key component behind virtually all:

- Communication
- Computing
- Networking
- Electronic devices

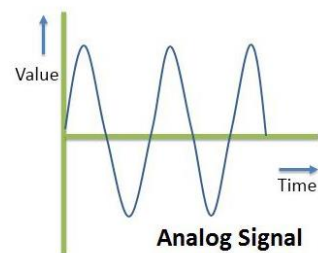
A signal can be either analog or digital.

Analog Signal

Analog signal is a kind of continuous wave form that changes over time.

An analog signal is described using amplitude, period or frequency and phase. Amplitude marks the maximum height of the signal. Frequency marks the rate at which signal is changing. Phase marks the position of the wave with respect to time zero.

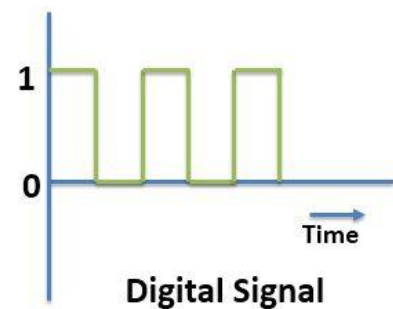
An analog signal is not immune to noise hence, it faces distortion and decrease the quality of transmission. The range of value in an analog signal is not fixed.



Digital Signal

Digital signals must have a finite set of possible values. The number of values in the set can be anywhere between two and a-very-large-number-that's-not-infinity.

Most commonly digital signals will be one of **two values**-- like either 0V or 5V. Timing graphs of these signals look like **square waves**.



Computers, in contrast, send and receive digital signals. These represent the presence or absence of an electronic pulse – the on/off binary signals.

Properties of Signals

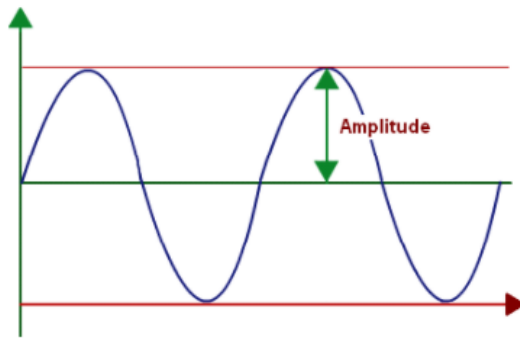
There are several properties of a signal such as,

- Amplitude
- Frequency
- Wavelength
- Phase

Amplitude

Amplitude is the height of the wave, measured in meters and often related to power.

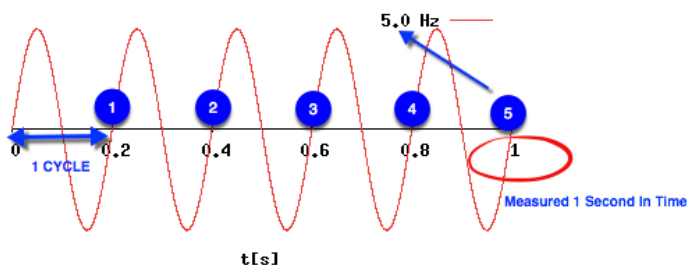
High electric field = High magnetic field = High amplitude = High power



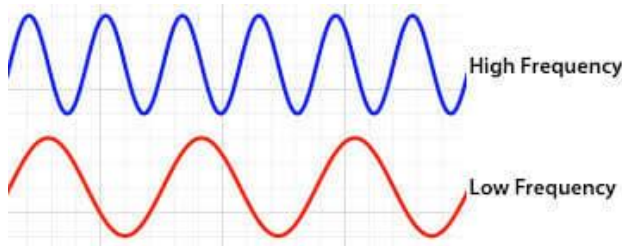
Frequency

Frequency is the number of times a specified event occurs within a specified time interval. A standard measure of frequency is hertz (Hz) - *The CWNA definition of frequency v106*

The number of complete waves (cycles) that pass a point in one Second, Measured in Hertz (Hz)



Five cycles, specified events, measured 1 second in time which equals 5 Hz.



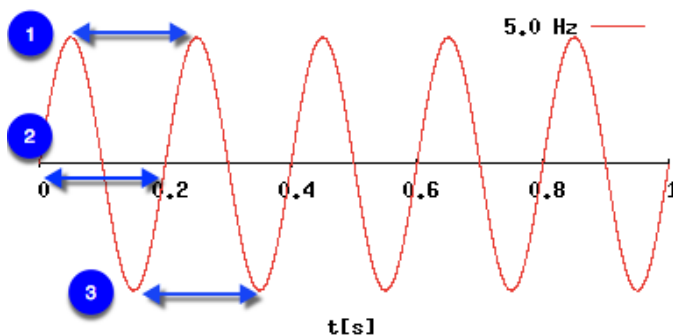
Wavelength

Wavelength is the distance between similar points on two back-to-back waves.

- *The CWNA definition of Wavelength v106*

Or

The distance between adjacent crests, measured in meters



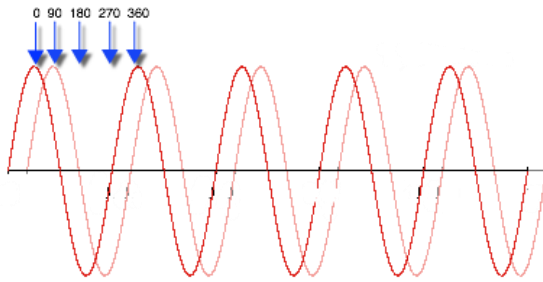
Phase

Phase is the same frequency, same cycle, same wavelength, but are 2 or more wave forms not exactly aligned together. Phase is a position of a point in time (instant) on a waveform cycle.

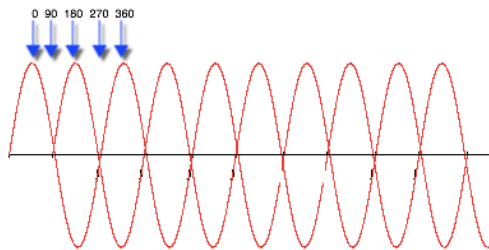
Phase is not a property of just one RF (Radio frequency) signal but instead involves the relationship between two or more signals that share the same frequency. The phase involves the relationship between the position of the amplitude crests (tops) and troughs of two waveforms.

Phase can be measured in distance, time, or degrees.

Below is an example of 2 wave forms 90 degree out of phase.



Below is an example of 2 wave forms 180 degree out of phase.



Propagation speed in a media

The **speed** at which a wave propagates (broadcast) through a given **medium**. The propagation speed also varies from medium to medium depending on the properties of the medium

References

<https://blogs.arubanetworks.com/industries/frequency-cycle-wavelength-amplitude-and-phase/>