# Computer Networking

## Computer Networks

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# Outline



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# Basic Concepts of Signals

A signal is a message that is transmitted from one place to another.

- Analog Signals are continuous and can take any value within a range.
- Digital Signals are discrete and can take only a limited number of values.
- Periodic Signals repeat themselves at regular intervals.
- Aperiodic Signals do not repeat themselves.
- Simple Signals are the building blocks of more complex signals.
- Complex Signals are made up of simple signals.
- Composite Signals are made up of simple and complex signals.
- Random Signals are unpredictable.

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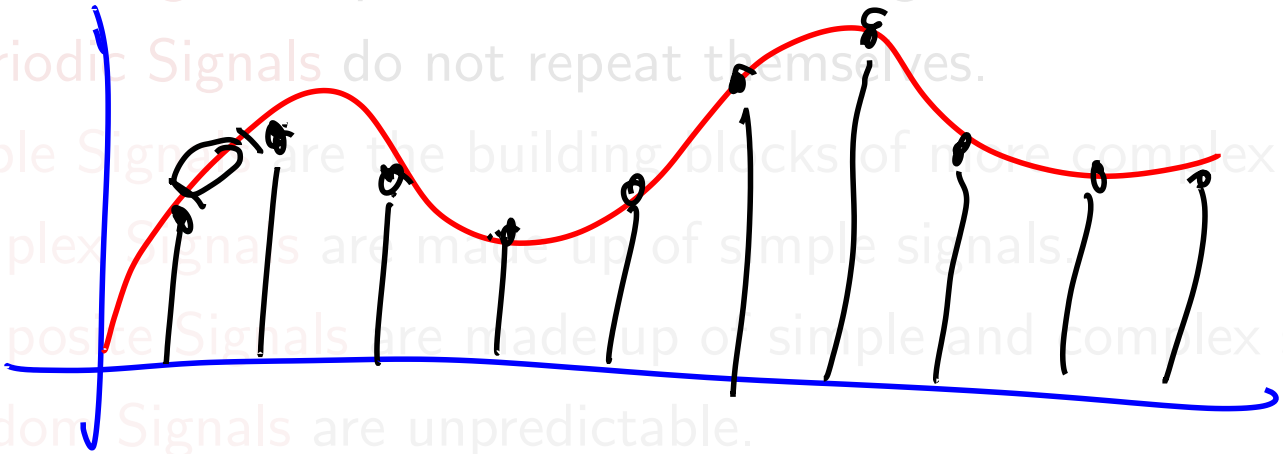

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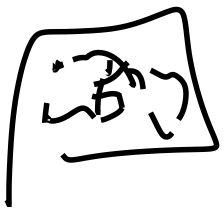

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# Networks Signals

In computer networks, signals are used to transmit data from one place to another. Signals can be transmitted through a variety of media, including:

- Copper Wires: Used in telephone lines and Ethernet cables. Digital signals are transmitted as electrical impulses.
- Fiber Optic Cables: Used in high-speed networks. Digital signals are transmitted as light pulses.
- Wireless Signals: Used in Wi-Fi, Bluetooth, and cellular networks. Digital signals are transmitted as radio waves.
- Satellite Signals: Used in satellite communications. Digital signals are transmitted as radio waves.

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# Math Representation of Signals

A function of time $f(t)$ can be used to represent a signal, where $t$ is time and $f(t)$ is the value of the signal at time $t$.
For example, a sinusoidal signal can be represented by the function:

$$f(t) = A\sin(2\pi f t + \phi)$$

where:

- $A$ is the amplitude of the signal,
- $f$ is the frequency of the signal,
- $\phi$ is the phase of the signal.

This function describes a signal that oscillates between $-A$ and $A$ over time, with a frequency of $f$ cycles per second, and a phase shift of $\phi$.

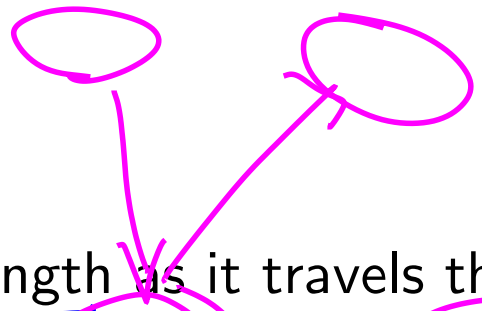
# Noise in the Signals

Noise is any unwanted signal that interferes with the transmission of a message.
Noise can be introduced by a variety of sources, including:

- Electrical Interference: Caused by other electrical devices.
- Atmospheric Interference: Caused by weather conditions.
- Physical Interference: Caused by obstacles in the transmission medium.

Noise can be reduced by using error correction codes and error detection codes.

# Transmission Troubles with Signals



Attenuation is the loss of signal strength as it travels through a medium. Attenuation can be reduced by using repeaters and amplifiers.

Delay is the time it takes for a signal to travel from one place to another. Delay can be reduced by using faster transmission media and shorter transmission paths.

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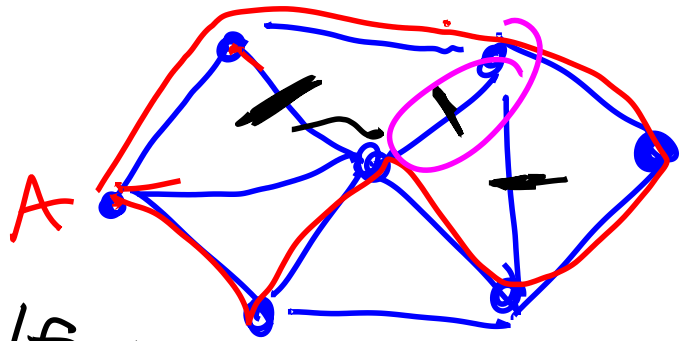
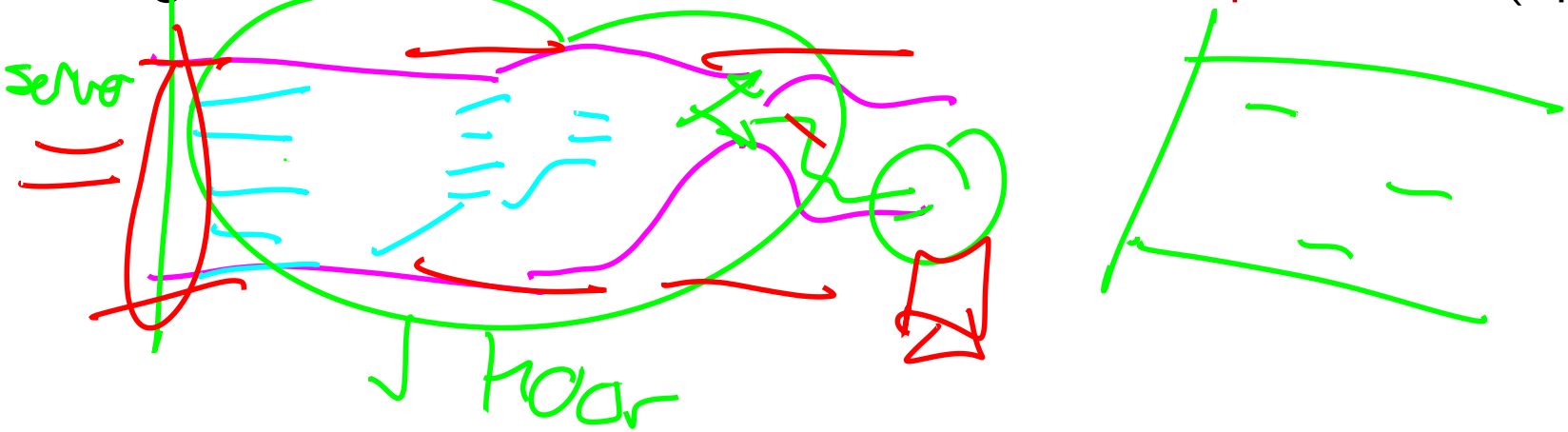


# Transference Rate

The transference rate is the amount of data that can be transmitted in a given amount of time. It is measured in bits per second (bps).

- Bandwidth is the range of frequencies that can be transmitted over a medium. It is measured in hertz (Hz).
- Throughput is the actual amount of data that can be transmitted in a given amount of time. It is measured in bits per second (bps).



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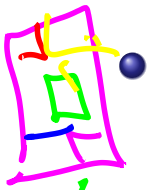
# Networks Protocols

Networks protocols are a set of rules and conventions that govern the way data is transmitted over a network.



- Physical Protocols govern the way data is transmitted over a physical medium.
- Data Link Protocols govern the way data is transmitted over a data link.

- Network Protocols govern the way data is transmitted over a network.

- Transport Protocols govern the way data is transmitted over a transport medium.

- Application Protocols govern the way data is transmitted over an application.

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# Internet Protocols

The Internet Protocol Suite is a set of protocols that govern the way data is transmitted over the Internet. It is also known as the TCP/IP protocol suite.

The Internet Protocol Suite is made up of the following protocols:

- Internet Protocol (IP): Governs the way data is transmitted over the Internet.
- Transmission Control Protocol (TCP): Governs the way data is transmitted over a transport medium.
- User Datagram Protocol (UDP): Governs the way data is transmitted over a transport medium.
- Internet Control Message Protocol (ICMP): Governs the way data is transmitted over the Internet.
- Internet Group Management Protocol (IGMP): Governs the way data is transmitted over the Internet.

# Structure of a Protocol

A protocol is made up of the following components:

- Header: Contains information about the data being transmitted.
- Payload: Contains the actual data being transmitted.
- Trailer: Contains information about the data being transmitted.

# Datagrams

A datagram is a self-contained unit of data that is transmitted over a network.

Datagram-based protocols are connectionless, meaning that each datagram is transmitted independently of the others.

Datagram-based protocols are used in packet-switched networks, where data is transmitted in discrete units called packets.

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# Data Encapsulation

Data encapsulation is the process of adding headers and trailers to a payload in order to transmit it over a network.

- Trailers are used to verify the integrity of the data being transmitted.
- Headers are used to route the data to its destination.

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# Networks Segmentation

Network segmentation is the process of dividing a network into smaller, more manageable segments.

- Subnetting is the process of dividing a network into smaller, more manageable subnets.
- VLANs are used to divide a network into smaller, more manageable virtual LANs.
- Load Balancers are used to divide a network into smaller, more manageable load balancing domains.

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# Nets and SubNets

A network is a collection of devices that are connected to each other. A subnet is a collection of devices that are connected to each other and share the same network address.

Subnetting is used to divide a network into smaller, more manageable subnets.

- Subnetting is used to reduce the size of broadcast domains.
- Subnetting is used to reduce the size of collision domains.
- Subnetting is used to improve the performance of a network.

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# Subnetting

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# Thanks!

# Questions?

Repo:

*github.com/engandres/ud-public/main/tree/computer-networks*