

COMPUTER NETWORKING

Computer Networks

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Outline

- 1 The Signal and the Noise
- 2 Networking Protocols
- 3 Networks Segmentation



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1 The Signal and the Noise

2 Networking Protocols

3 Networks Segmentation



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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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.



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:

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

where:

- A is the amplitude of the signal,
- f is the frequency of the signal,
- ϕ 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 ϕ .



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.



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**.



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.



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.



Subnetting



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Thanks!

Questions?



Repo:

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

