Basics of Computer Networking

Your Name

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What is Computer Networking?

Computer Networking is the practice of interconnecting computers to share resources and exchange data. Networks can be as simple as connecting two computers or as complex as the global Internet.

Types of Networks

Computer networks can be classified into different types based on their size and purpose:

- **LAN** - Local Area Network, typically within a building or campus.
- **WAN** - Wide Area Network, spanning large geographical areas.
- **MAN** - Metropolitan Area Network, larger than LAN but smaller than WAN.

Network Topologies

Network topology refers to the layout of how devices are connected in a network:

1. **Bus Topology** - All devices share a single communication line.
2. **Star Topology** - Devices are connected to a central hub.
3. **Ring Topology** - Devices form a closed loop.
4. **Mesh Topology** - Devices are interconnected with many redundant connections.

Networking Layers

The OSI model is divided into seven layers, which allows for abstraction and modularity in networking.

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- Data Link Layer
- Network Layer
- Transport Layer
- Session Layer
- Presentation Layer
- Application Layer

Network Protocols Comparison

Here's a comparison of some common networking protocols:

Protocol	Layer	Use Case	Port Number
HTTP	Application	Web Traffic	80
FTP	Application	File Transfer	21
TCP	Transport	Reliable Data Transfer	N/A
IP	Network	Routing Packets	N/A
Ethernet	Data Link	LAN Communication	N/A

Data Transmission Formula

The data transmission rate formula in networking is:

$$\text{Data Rate} = \text{Bandwidth} \times \log_2(1 + \text{Signal-to-Noise Ratio})$$

where:

- Bandwidth is the maximum frequency range (in Hz).
- Signal-to-Noise Ratio (SNR) is a measure of signal strength relative to background noise.

Key Networking Components

Router
A device that forwards data packets between networks.

Switch
A device that connects devices within a LAN, managing data transmission between them.

Firewall
A security system that monitors and controls network traffic based on security rules.

IP Addressing

Each device in a network has a unique IP address for identification. IP addresses are of two main types:

IPv4: 192.168.1.1   IPv6: 2001:0db8:85a3:0000:0000:8a2e:0370:7334

IPv4 is widely used, but IPv6 addresses are becoming more common to accommodate more devices.

OSI Model

The OSI model defines a layered framework for how data is transmitted over networks:

- **Layer 1: Physical** - Hardware transmission (cables, signals).
- **Layer 2: Data Link** - Error detection and frame control.
- **Layer 3: Network** - Routing of packets (e.g., IP).
- **Layer 4: Transport** - End-to-end communication (e.g., TCP).
- **Layer 5-7** - Session, Presentation, and Application layers.

Sample Network Diagram
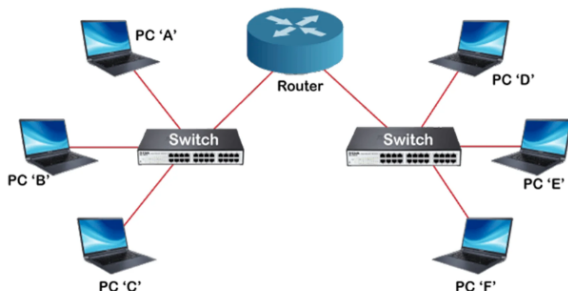
Example layout of a small network with routers, switches, and connected devices.

Common Network Protocols

- **HTTP/HTTPS** - For web browsing and secure data transmission.
- **FTP/SFTP** - For file transfers.
- **SMTP** - For sending emails.
- **DNS** - Domain Name System, for resolving domain names to IP addresses.

Network Security Basics

Encryption

Protects data by encoding it, making it accessible only to those with the correct key.

Firewalls

Monitors and controls incoming and outgoing network traffic based on security policies.

VPN

A Virtual Private Network creates a secure connection over a public network.

Conclusion

Networking enables connectivity across devices and allows sharing of resources. Understanding basic network types, topologies, and security measures is essential for creating and maintaining effective networks.

Further Reading

- **Books:** "Computer Networking: A Top-Down Approach" by Kurose and Ross.
- **Websites:** Cisco Networking Academy, Network World.
- **Courses:** "Introduction to Computer Networking" on Coursera.