

Introduction to Networking

Definition and Key Components

A **computer network** is a set of devices (nodes) connected by communication links. These links allow devices to share resources, such as files, printers, and internet access.

Key Components:

- **Nodes:** Any device connected to the network (computers, servers, printers).
- **Links:** The communication pathways that connect the nodes (cables, wireless).
- **Topology:** The arrangement of nodes and links in a network (star, bus, ring, mesh).

The OSI Model

The **OSI (Open Systems Interconnection) model** is a conceptual framework that standardizes the functions of a telecommunication or computing system into seven different layers.

The 7 Layers:

1. **Physical Layer:** Transmits raw bit streams over a physical medium.
2. **Data Link Layer:** Provides error-free transmission of data frames between two directly connected nodes.
3. **Network Layer:** Routes data packets between different networks.
4. **Transport Layer:** Provides reliable and ordered delivery of data between applications.
5. **Session Layer:** Manages connections and sessions between applications.
6. **Presentation Layer:** Translates, encrypts, and compresses data.
7. **Application Layer:** Provides network services to applications.

The TCP/IP Suite

The **TCP/IP (Transmission Control Protocol/Internet Protocol) suite** is a set of protocols that govern communication over the Internet. It has four layers.

The Four Layers:

1. **Network Access Layer:** Handles physical connections to the network.
2. **Internet Layer:** Routes data packets across networks (IP).
3. **Transport Layer:** Provides reliable or unreliable data delivery (TCP, UDP).
4. **Application Layer:** Provides network services to applications (HTTP, DNS, etc.).

Comparison to OSI: The TCP/IP model compresses some layers of the OSI model. The TCP/IP model is the more practical model since it's based on the actual protocols used in the internet, whereas the OSI model is a more theoretical reference model.

Essential Protocols (Part 1)

- **IP (Internet Protocol):** Responsible for addressing and routing data packets.
- **TCP (Transmission Control Protocol):** Provides reliable, connection-oriented data transmission.
- **UDP (User Datagram Protocol):** Provides unreliable, connectionless data transmission. Often used for streaming or online gaming.

Essential Protocols (Part 2)

- **DNS (Domain Name System):** Translates domain names to IP addresses.
- **HTTP/HTTPS (Hypertext Transfer Protocol/Secure):** Used for transferring web pages and data.
- **DHCP (Dynamic Host Configuration Protocol):** Automatically assigns IP addresses to devices.
- **ARP (Address Resolution Protocol):** Resolves IP addresses to MAC addresses.

Hardware & Infrastructure

- **Switch:** Connects devices within a network (LAN) and forwards data based on MAC addresses.
- **Router:** Connects different networks together and routes data based on IP addresses.
- **Firewall:** Protects a network from unauthorized access and malicious traffic.

IP Addressing Basics

- **IPv4:** 32-bit IP address format (e.g., 192.168.1.1).
- **IPv6:** 128-bit IP address format (e.g., 2001:0db8:85a3:0000:0000:8a2e:0370:7334).
- **Subnet Mask:** Defines the network and host portions of an IP address.

Example: IP Address: 192.168.1.10, Subnet Mask: 255.255.255.0. The first three octets (192.168.1) represent the network address, and the last octet (10) represents the host address within that network.

Summary

This document provided an introduction to fundamental networking concepts. Key topics included the definition of computer networks and their essential components, an overview of the OSI and TCP/IP models, essential protocols like IP, TCP, DNS, and HTTP, common networking hardware such as switches, routers, and firewalls, and IP addressing basics.