COMPUTER NETWORKS

FUNDAMENTALS OF COMPUTER NETWORKS

Lecture 01

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WHAT? & WHY?

What is a computer networks? Why Do We Need it? and Why should you take this course, then?

1 DEFINITION & IMPORTANCE

Definition: A computer network is a collection of interconnected devices that share resources and data.

It allows data exchange between devices such as computers(Clients), servers, and network hardware.

Importance:

- ✓ **Facilitates communication:** Email, social media, and real-time messaging rely on networks.
- ✓ **Resource sharing:** Devices (e.g., printers) and data can be shared across a network.
- ✓ **Enhances efficiency:** Enables collaboration in real-time, enhancing productivity.
- ✓ **Provides scalability:** Networks grow with the organization's needs.

Why Students from All Departments Should Take This Course?

NETWORK ENGINEERS

Needs to **master the foundation** of network design, Devices, setup, configurations, and security. Which is vital for managing modern infrastructure.

SOFTWARE ENGINEERS

Understanding networks helps in **application development** that relies on network communication. Software solutions often require **integrations with network protocols** (e.g., HTTP (s), FTP, SMTP).

INFO MANAGEMENT

Understand how networks impact data accessibility, security, and storage for efficient system management.

2 TYPES OF NETWORKS

PAN, LAN, MAN, and WAN

- **A Personal Area Network (PAN)** is designed for short-range communication between personal devices, such as connecting a phone to a headset via Bluetooth. PANs usually operate within a range of 1-10 meters, providing low-power, short-distance connectivity for personal device interactions.

- **A Local Area Network (LAN)** connects devices within a small geographic area, such as a **building, office, or campus.** It typically operates within a range of **up to 100 meters**. LANs offer high-speed connections, often reaching 1 Gbps or more, making them ideal for **homes, offices, or schools** where devices are closely situated.

TYPES OF NETWORKS

PAN, LAN, MAN, and WAN

- **A Metropolitan Area Network (MAN)** serves as a middle ground between LAN and WAN, connecting networks across a city or large campus. It can cover up to **50 kilometers** and offers faster speeds than a WAN while still providing broader coverage than a LAN. MANs are often used for city-wide Wi-Fi or connecting large institutions.

- **A Wide Area Network (WAN),** on the other hand, covers a much larger geographic area, connecting multiple LANs across cities, countries, or even globally. WANs can span thousands of kilometers, providing long-distance communication, such as the internet. However, they tend to be slower than LANs due to the vast distances involved.

3 NETWORK TOPOLOGIES

RING, STAR, MESH, BUS, AND HYBRID TOPOLOGIES.

- **Ring:** Each node connects to two others forming a circular pathway. Data travels in one direction.
- **Star:** All nodes are connected to a central hub. Easy to manage and expand.
- **Mesh:** Every node connects directly to every other node. Highly reliable but expensive.
- **Bus:** All devices share a single communication line. Simple but can be less reliable.
- **Hybrid:** Combination of two or more topologies. Flexible and scalable.

4 PROPRIETARY SYSTEMS

Introduction to Proprietary Systems

- A proprietary system is a system that uses technologies controlled and kept private by a specific vendor, restricting compatibility and communication.

- **Key Challenges:**
  - Proprietary systems hinder communication between different technologies.
  - Each vendor's system is unique, preventing interoperability with others.
- **Example:**
  - Early computer networks were vendor-specific, meaning systems from different manufacturers couldn't communicate.

SOLUTION

The Need for Interoperability

- Interoperability refers to the ability of software and hardware from multiple machines, and often from multiple vendors, to communicate effectively.

- **Importance:**
  - Seamless communication between devices and systems is critical for the growth of global networking.
  - It enables collaboration across different systems, regardless of their underlying vendor technologies.
- **Early Networking Issues:**
  - Without interoperability, organizations struggled to connect different vendor products in a single environment.

OPEN SYSTEMS

Emergence & Benefits of Open Systems

- Open systems are those based on a common, standardized model of network architecture that any vendor can adopt.

- **Key Characteristics:**
  - Built around publicly available standards
  - .Encourage competition by enabling interoperability across different vendor products.
  - Open systems ensure scalability and flexibility in networks.
- **Goal:**
  - To create universal networking standards that allow different systems to communicate without the limitations of proprietary technology.

ISO & OSI MODEL

ISO and the Establishment of the OSI Model

- ISO's Role
  - The International Organization for Standardization (ISO) took the lead in developing a standardized network model to support open systems.

- **OSI Model Overview:**
  - Open Systems Interconnection (OSI) Model is a conceptual framework for understanding network interactions in seven layers.
  - Each layer serves a specific function and interacts with the layers above and below it, creating a universal blueprint for network communication.
- **Layers & Technique:**
  - **A**pplication, **P**resentation, **S**ession, **T**ransport, **N**etwork, **D**ata link, **P**hysical
  - **A**ll **P**eople **S**eems **T**o **N**eed **D**ata **P**rotection.

OSI LAYERS MODEL

LAYERS AND THEIR FUNCTIONS

7. Application	End-user services and application protocols.
6. Presentation	Data translation and encryption.
5. Session	Manages sessions between applications.
4. Transport	Reliable data transfer; TCP/UDP protocols.
3. Network	Routing data packets; IP addressing.
2. Data Link	Node-to-node data transfer; MAC addresses.
1. Physical	Physical connection; cables and switches.

SUMMARY

In this first week, we covered the foundational concepts of networking, including the definition and importance of computer networks. We explored various types of networks—LAN, WAN, MAN, and PAN—and discussed their characteristics. We then examined different network topologies such as star, ring, mesh, bus, and hybrid topologies, highlighting their advantages and disadvantages.

Finally, we introduced the OSI model as a crucial framework for understanding how different networking protocols interact across seven distinct layers, each with specific functions and associated protocols or devices.

Thank you!