

Chapter 1

Introduction to Computer Networks

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Learning Outcomes (Chapter 1)

LO1

Explain the meaning and core functions of computer networks in supporting communication and resource sharing.

LO2

Interpret the differences among major types of computer networks (e.g., PAN, LAN, MAN, WAN, CAN, SAN, VPN).

LO3

Summarize the historical development of the Internet and describe its impact on global communication.

Overview

- **Lecture 1:** Network Fundamentals
- **Lecture 2:** Network Types, Internet History, Devices & Topologies

Includes:

- Class Activities
- Formative Assessments

Lecture 1

Introduction & Network Fundamentals

Topics (Lecture 1)

- What is a **Computer Network**?
- **Key Functions** of Computer Networks
 - Resource Sharing
 - Communication
 - Centralized Data Access
- Why We Need Networks
- Types of Networks (Part 1)
 - PAN, LAN, MAN

Learning Outcomes (Lecture 1)

- **LO1:** Explain the purposes and functions of computer networks.
- **LO2 (partial):** Distinguish PAN, LAN, MAN.

What Is a Computer Network?

A **computer network** is a collection of interconnected devices that exchange data and share resources.

Examples of networked devices:

- Computers
- Printers
- Servers
- Switches, Routers, Access Points

Primary Purposes of Computer Networks

- Efficient communication
- Resource sharing
- Collaborative work

Key Function 1: Resource Sharing

- Shared printers, storage, and Internet access
- Reduces cost and eliminates redundant hardware
- Simplifies centralized maintenance

Key Function 2: Communication

- Email, instant messaging, VoIP, video conferencing
- Based on **TCP/IP** protocols for reliable delivery

Key Function 3: Centralized Data Access

- File servers and databases
- Ensures consistency and access control
- Supports secure data management

Why We Need Computer Networks (1)

Cost-efficient Resource Utilization

- Shared hardware resources
- Centralized management
- Cloud-based scalability
- Lower communication costs

Why We Need Computer Networks (2)

Remote Access & Telecommuting

- Work from anywhere
- Global talent availability
- Reduced office costs
- Business continuity
- Enhanced team collaboration

Why We Need Computer Networks (3)

Distributed Computing & Cloud Services

- Parallel processing
- High scalability and availability
- Access to **SaaS, PaaS, IaaS**
- Supports **AI, ML, Big Data** workloads

Types of Computer Networks

- Personal Area Network (**PAN**)
- Local Area Network (**LAN**)
- Storage Area Network (**SAN**)
- Metropolitan Area Network (**MAN**)
- Wide Area Network (**WAN**)
- Virtual Private Network (**VPN**)
- Campus Area Network (**CAN**)

Personal Area Network (PAN)

Characteristics

- Very short-range (a few meters)
- Connects personal devices: smartphones, laptops, wearables

Technologies

- Bluetooth
- Infrared (IR)
- Wi-Fi Direct

Local Area Network (LAN)

Characteristics

- Limited geographical area (homes, offices, campus buildings)
- High data rates, relatively low cost
- Wired **Ethernet** or wireless **Wi-Fi**

Common Use Cases

- File sharing
- Local communication
- Internet access

Storage Area Network (SAN)

Purpose

- High-speed dedicated network for storage systems

Technologies

- Fibre Channel
- iSCSI
- NVMe over Fabrics

Used In

- Data centers
- High-performance computing environments

Metropolitan Area Network (MAN)

Characteristics

- Covers a city or metropolitan area
- Uses fiber optics or high-speed microwave links

Example

- University interbuilding connections across a city

Class Activity (Lecture 1)

Activity 1: "Network Around You" Mapping

Group Activity (15–20 minutes)

Instructions:

- Draw your real-life network (home / dorm / café / university).
- Include:
 - Devices (PC, phone, AP, router)
 - Connection types
 - Network type (PAN, LAN, MAN)
- Identify weaknesses or limitations.

Activity 1: Purpose

- Relate theoretical content to real environments
- Visualize network structure
- Check conceptual understanding of network types

Formative Assessment (Lecture 1)

Exit Ticket (5–7 minutes)

1. State **two main functions** of a computer network.
2. Give an example of **resource sharing** in daily life.
3. Identify the network type:
 - “Devices inside one office building.”

Learning Outcome Check: LO1, LO2

Lecture 2

Advanced Networks, Internet History, Devices & Topologies

Topics (Lecture 2)

- Types of Networks (Part 2):
 - **SAN / WAN / VPN / CAN**
- Internet History
 - Internet Milestones
 - Internet in Thailand
- Network Devices:
 - PC, Switch, Router, Gateway, Firewall, Access Point (AP)
- Network Topologies & Architectures:
 - Physical and Logical Topologies
 - Peer-to-Peer vs Client–Server
 - Centralized vs Distributed
 - Broadcast Domains, VLANs

Learning Outcomes (Lecture 2)

- **LO2:** Distinguish all major network types.
- **LO3:** Summarize Internet evolution.
- Apply knowledge of network devices and topologies.

Wide Area Network (WAN)

Characteristics

- Covers large geographical areas: cities, countries, or continents
- Uses telecommunications providers' infrastructure

Example

- The **Internet** as the most common WAN

Virtual Private Network (VPN)

Purpose

- Secure communication over public networks
- Uses **encryption** and **tunneling** mechanisms

Types

- Remote Access VPN
- Site-to-Site VPN

Campus Area Network (CAN)

Characteristics

- Interconnects multiple LANs within a campus, office park, or military base
- Uses high-speed backbone (typically fiber optic)

Internet: Historical Background

- Originated from **ARPANET (1969)**
- First operational packet-switching network
- Four initial nodes:
 - UCLA
 - SRI
 - UCSB
 - University of Utah

Key contribution:

- **IMP (Interface Message Processor)** — precursor to modern routers

Internet Milestones

- **1969:** First ARPANET communication
- **1974:** TCP specification published
- **1990:** First commercial ISPs
- **1991:** World Wide Web launched
- **1995:** Commercial VoIP
- **1999:** Mobile Internet services
- **2001:** 3G networks
- **2005:** First Wi-Fi-supported smartphones

Internet in Thailand

2 June 1988

- First successful international email from Prince of Songkla University (PSU), Hatyai campus.
- Sender: `kre@sritrang.psu.th`

This event is considered an important milestone in Thailand's digital era.

Network Devices: Overview

Fundamental devices for communication, security, and management:

- Personal Computers (PCs)
- Switches
- Routers
- Gateways
- Firewalls
- Access Points (APs)

Personal Computers (PCs)

Functions

- Endpoints generating and consuming data

Key Configurations

- IP address, Subnet Mask
- Default Gateway
- DNS

Security

- Host-based firewalls
- Antivirus software
- Regular OS and application updates

Switches

- Operate mainly at **Layer 2** (some multilayer switches at Layer 3)

Key Roles

- Forward frames using **MAC addresses**
- Create collision-free domains
- Support:
 - VLANs
 - Spanning Tree Protocol (STP)
 - Link aggregation

Routers

- Operate at **Layer 3**

Functions

- Select routes between networks
- Perform **NAT (Network Address Translation)**
- Separate broadcast domains
- Apply routing and control mechanisms:
 - ACLs (Access Control Lists)
 - Routing protocols (e.g., RIP, OSPF, EIGRP)

Gateways

- Act as **entry/exit points** for networks
- Translate between different protocols or architectures
- Default Gateway:
 - Routes traffic from the local network to external networks

Firewalls

- Enforce organizational security policies

Capabilities

- Filter packets (Layer 3–4)
- Next-Generation Firewalls (NGFW) provide deep inspection (Layer 7)
- Support:
 - NAT
 - VPN
 - Port and application filtering

Access Points (APs)

- Provide a **wireless bridge** to the wired LAN
- Use IEEE **802.11** standards

Capabilities

- Support WPA3 and enterprise authentication
- Provide multiple SSIDs
- Enable centralized wireless management

Physical Network Topologies

Common physical topologies:

- **Bus**
- **Star**
- **Ring**
- **Mesh**
- **Hybrid**

Each topology affects:

- Scalability
- Cost
- Fault tolerance and resilience

Logical Topologies

- Broadcast topology
- Token passing topology

Logical topology defines **how data flows** across the network, independent of the physical layout.

Network Architectures

Peer-to-Peer (P2P)

- No central control
- Simple and suitable for small networks

Client–Server

- Centralized resources and security
- Suitable for enterprise environments

Centralized vs Distributed Architectures

Centralized Architecture

- Easier management and control
- Single point of failure

Distributed Architecture

- High resilience and fault tolerance
- Requires more complex coordination mechanisms

Broadcast Domains

- A group of devices receiving mutual broadcast packets
- **Routers** separate broadcast domains
- **Switches** forward broadcasts within the same VLAN

Virtual LANs (VLANs)

- Logical segmentation of networks over shared physical hardware

Benefits

- Improved security and performance
- Traffic isolation between VLANs
- Implemented using **IEEE 802.1Q** tagging

End of Chapter 1

Introduction to Computer Networks

Questions and Discussion

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Class Activity (Lecture 2)

Activity 2: “Design Your Mini Campus Network”

Group Activity (20–25 minutes)

Scenario

Design a network for one university building:

- 3 Labs (30 PCs each)
- 1 Office (10 PCs)
- Wi-Fi for students
- Internet access

Constraints:

- Must use VLANs

Activity 2: Group Tasks and Learning Purpose

Group Tasks

- Draw the topology
- Select devices (switch, router, AP)
- Assign VLANs
- Identify which network type(s) (LAN / CAN / WAN)
- Show where firewall / gateway should be placed

Learning Purpose

- Apply knowledge to real network design
- Understand segmentation and device roles
- Demonstrate LO2 comprehension

End of Lecture Plan

- Lecture materials are ready for classroom use.
- Open for questions or revisions.