

Introduction to Computer Networking

Introduction to Computer Networking

Key concepts, components, and fundamentals for beginners

1. What Is a Computer Network?

Definition	Purpose
A collection of interconnected devices that can exchange data.	Enable communication, resource sharing, and collaboration across distances.
Networks can be wired (cables) or wireless (radio, infrared).	Provide flexibility for different environments (home, office, data center, IoT).

2. Basic Network Terminology

Term	Meaning
Node	Any device (computer, printer, smartphone, router, etc.) attached to the network.
Link	Physical or logical connection between nodes (e.g., Ethernet cable, Wi-Fi link).
Protocol	A set of rules governing how data is formatted, transmitted, and received (e.g., TCP, IP, HTTP).
Topology	Physical or logical layout of the network (star, bus, ring, mesh, tree).
Bandwidth	Maximum data rate a link can carry (measured in bits per second, e.g., Mbps, Gbps).
Latency	Time for a packet to travel from source to destination (measured in milliseconds).
Throughput	Actual data transferred over a period of time (often lower than bandwidth due to overhead).

3. Network Types (by Scope)

Scope	Typical Size	Example Use Cases
PAN – Personal Area Network	<10m	Bluetooth headsets, smartwatches.
LAN – Local Area Network	Building or campus	Office Ethernet, home Wi-Fi.

Introduction to Computer Networking

Scope	Typical Size	Example Use Cases
MAN – Metropolitan Area Network	City-wide	City-wide fiber, municipal Wi-Fi.
WAN – Wide Area Network	Country/continent	The Internet, corporate VPNs.
CAN – Campus Area Network	Multiple LANs on a campus	University networks.
SAN – Storage Area Network	Dedicated storage traffic	Data-center block storage.

4. The OSI & TCP/IP Models

4.1 OSI Reference Model (7 layers)

Layer	Name	Primary Function
7	Application	End-user services (HTTP, FTP, SMTP).
6	Presentation	Data format translation, encryption, compression.
5	Session	Manages dialogs, synchronization.
4	Transport	End-to-end reliability (TCP) or best-effort (UDP).
3	Network	Routing, logical addressing (IP).
2	Data Link	MAC addressing, error detection (Ethernet, Wi-Fi).
1	Physical	Electrical/optical signaling, cables, connectors.

4.2 TCP/IP Model (4 layers)

Layer	Corresponding OSI Layers	Key Protocols
Application	5-7	HTTP, DNS, SMTP, SSH
Transport	4	TCP, UDP
Internet	3	IP, ICMP, IGMP
Link	1-2	Ethernet, ARP, PPP

Both models help designers isolate responsibilities and troubleshoot problems.

5. Core Networking Devices

Introduction to Computer Networking

Device	Role	Typical Placement
--------	------	-------------------

Hub	Repeats incoming	
-----	------------------	--