

Introduction to Networks

Introduction to Networks – Study Notes

1. What Is a Network?

Term	Definition
Network	A collection of interconnected devices (nodes) that can share resources and exchange data.
Node	Any device that participates in the network (e.g., computer, printer, smartphone, router).
Link	The physical or logical connection between nodes (copper cable, fiber, wireless signal, etc.).

2. Types of Networks

Category	Scope	Typical Technologies	Example Use?Cases
Personal Area Network (PAN)	< 10?m (around a single person)	Bluetooth, Infrared, ZigBee	Wireless headphones, fitness trackers
Local Area Network (LAN)	Building or campus	Ethernet (Cat5e/6/7), Wi-Fi (802.11ac/ax)	Office computers, university labs
Metropolitan Area Network (MAN)	City?wide	Fiber optic rings, Metro Ethernet	City government services, ISP backbones
Wide Area Network (WAN)	Regional, national, or global	MPLS, leased lines, satellite, public Internet	Corporate branch connectivity, cloud services
Wireless Sensor Network (WSN)	Distributed sensor nodes	Low?power radio (LoRa, 802.15.4)	Environmental monitoring, smart agriculture
Virtual Private Network (VPN)	Logical overlay over any physical network	IPsec, SSL/TLS, WireGuard	Secure remote access, site?to?site connections

3. Network Topologies

Topology	Description	Advantages	Disadvantages
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Bus	All nodes share a single communication line.	Simple, uses minimal cabling.	Single point of failure; performance degrades with traffic.
Star	Each node connects to a central hub/switch.	Easy to manage; failure of one link doesn't affect others.	Hub is a single point of failure; more cabling than bus.
Ring	Nodes form a closed loop; data travels in one direction.	Predictable performance; easy to add/remove nodes.	Failure of one link can break the ring (unless dual-ring).
Mesh	Every node may connect to multiple others.	High redundancy, robust fault tolerance.	Expensive and complex to implement.
Tree (Hierarchical)	Combines star and bus; groups of stars connected to a backbone.	Scalable, easy to segment.	Backbone failure affects entire sub-trees.
Hybrid	Mix of two or more topologies (e.g., star-mesh).	Tailors strengths to specific needs.	Design and troubleshooting can be complex.

4. Core Networking Concepts

Concept	Brief Explanation
IP Addressing	Numerical label (IPv4: 4-byte, IPv6: 16-byte) that uniquely identifies a host on an IP network.
Subnetting	Dividing a larger network into smaller logical segments to improve management and security.
Routing	Process of moving packets from source to destination across multiple networks; performed by routers using routing tables and protocols.
Switching	Forwarding frames within the same LAN based on MAC addresses; performed by switches.
OSI Model	7 logical layers (Physical ? Data Link ? Network ? Transport ? Session ? Presentation ? Application) that standardize network functions.
TCP/IP Model	4 layers (Link, Internet