Networking Tools

🔧 Tool	📝 Function	☐ Use Case
Ping	Checks if a device is reachable over the network. Measures response time.	Test the internet or server connectivity.
traceroute *(Windows: tracert)*	Shows the path data takes to reach a destination, including each router hop.	Diagnose slow or broken network routes.
Netstat	Displays active connections, open ports, and network statistics.	Check which apps/services use the network
ipconfig *(Linux: ifconfig)*	Shows IP address, subnet mask, default gateway, etc.	View or refresh network settings.
Nslookup	Finds the IP address from a domain name or vice versa by querying DNS servers.	Troubleshoot DNS and domain issues
Wireshark	Captures and analyses all network packets in real time.	Deep traffic analysis and protocol debugging

Network Topologies

1. Bus Topology

- **Structure:** All devices are connected to a single central backbone cable (the bus).
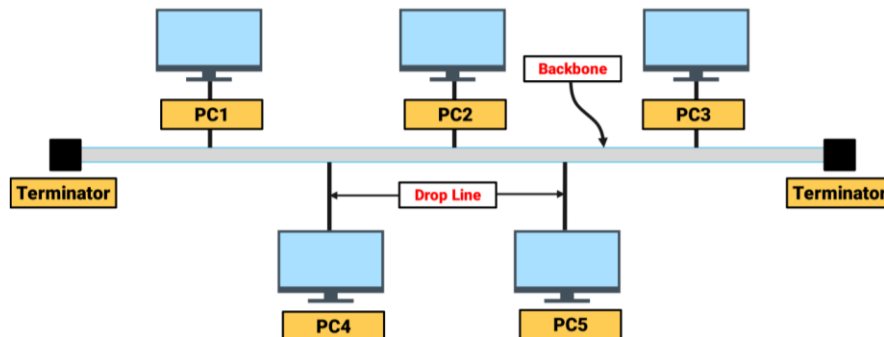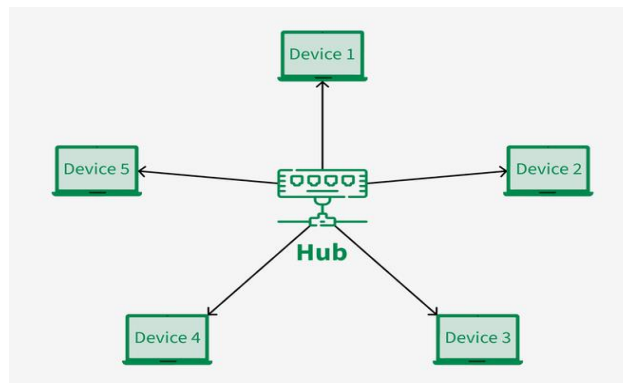

- **Advantages:**
  - Easy and cheap to install.
  - Requires fewer cables.
- **Disadvantages:**
  - If the main cable fails, the whole network goes down.
  - Difficult to troubleshoot.
- **Used in:** Small networks, early LANs.

2. Star Topology

- **Structure:** All devices are connected to a central device (hub/switch).
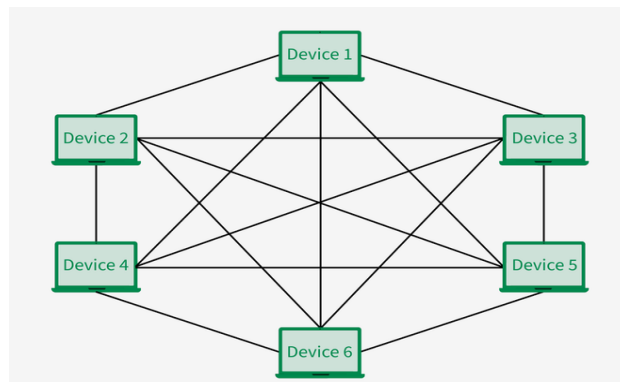- **Advantages:**
  - Easy to manage and troubleshoot.

o The failure of one device doesn't affect the others.

- **Disadvantages:**
  - o If the central hub fails, the whole network stops.
  - o More cabling is required than the bus.
- **Used in:** Most modern LANs.

3. Mesh Topology

- **Structure:** Every device is connected to every other device.

- **Advantages:**
  - o High reliability and redundancy.
  - o Data can take multiple paths.
- **Disadvantages:**
  - o Expensive and complex to set up.
  - o Requires a lot of cabling.
- **Used in:** Military networks, high-reliability systems.

Overview

Topology	Cost	Reliability	Ease of Setup	Use Case
Bus	Low	Low	Easy	Small or temporary setups
Star	Moderate	Moderate-High	Easy	Home, office LANs
Mesh	High	Very High	Complex	Critical communication systems

Troubleshooting Basics

Issue	What It Means	Symptoms	Common Causes	Tools / Fixes
Latency	Delay in data travel time (measured in ms)	Slow loading, lag in calls/gaming	- Network congestion- Long distance- Routing issues	ping, `traceroute`, `Restart router, use` wired connection
Packet Loss	Data packets get lost during transmission	Choppy video/audio, dropped connections	- Weak signals- Faulty cables- Overloaded network	ping, WiresharkCheck cablesReduce load
DNS Failures	Domain names not resolving to IP addresses	"DNS not found", can't open websites	- DNS server down- Wrong settings- Expired domain	nslookup, `dig` Use `8.8.8.8` Flush DNS cache

Introduction to Mini Projects

1. Chat Application

- **What it is:**
  A real-time messaging app that allows two or more users to send and receive text messages over a network.
- **Key Concepts:**
  - Client-server or peer-to-peer communication
  - Sockets and ports
  - TCP or UDP for data transfer
- **Learning Outcome:**
  Understand how data is exchanged in real-time, socket programming, and message handling.

2. File Transfer Application

- **What it is:**
  An app that allows sending and receiving files (e.g., PDFs, images) between devices over a network.
- **Key Concepts:**
  - TCP for reliable data transfer
  - Chunking and reassembly of files
  - Progress tracking and error handling
- **Learning Outcome:**
  Learn file encoding, networking protocols, and handling large data transfers.

3. Network Monitor

- **What it is:**
  A tool that monitors active devices, IP addresses, bandwidth usage, and connection status in a network.
- **Key Concepts:**
  - Packet sniffing (Wireshark-like)
  - Network statistics (using netstat, psutil, etc.)
  - Visual dashboards (optional: with graphs)
- **Learning Outcome:**
  Understand how networks operate in real time, data flow analysis, and security monitoring.

Why These Projects Matter:

- Improve **practical networking skills**
- Learn **real-world tools and protocols**
- Enhance **coding + debugging experience**
- Great additions to **resumes and portfolios**