CLASS 10 · COMPUTER SCIENCE · CDC NEPAL · UNIT 1

Computer Network &Data Communication

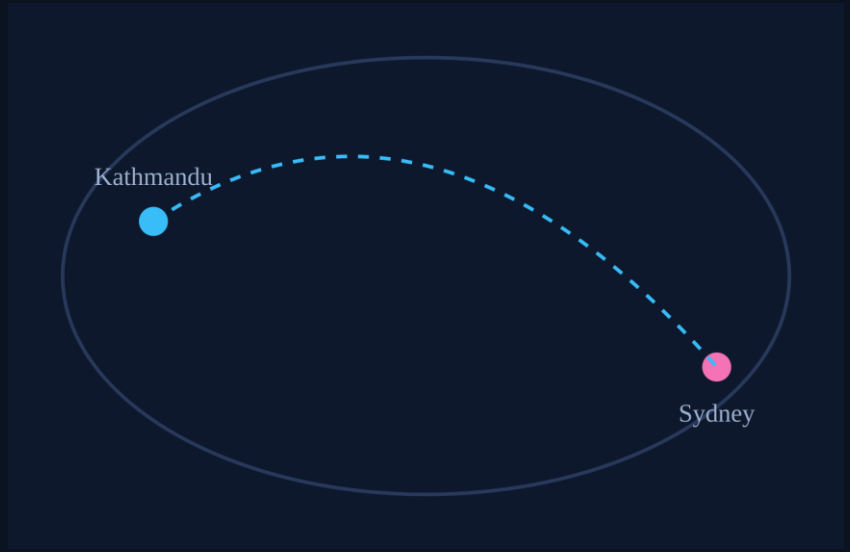
Interactive slides · animations · section quizzes · board-exam practice

Interactive HTML version included — open Unit1_Computer_Network_Interactive_Slides.html for animations & self-check quizzes

START · THE 5-SECOND MYSTERY

How did your message reach Australia?

- You message a cousin in Sydney — reply in seconds
- Your voice becomes data, travels ~11,000 km
- Cables under oceans, towers, satellites carry it
- This unit reveals the whole journey, step by step



Think & discuss: List every device/technology you guess the message passes through. Keep your list — we will check it at the end of the unit!

START · UNIT ROADMAP · 9 STOPS

Your journey through this unit

1.1 Telecommunication

Broadband, bandwidth, throughput, 3G/4G/5G, packets, frequency

1.2 Media

CAT6, optical fiber · Wi-Fi, Bluetooth, RFID, satellite

1.3 Connectors

RJ45 & media converter

1.4 Devices

Repeater, hub, switch, bridge, router

1.5 Topologies

Bus, star, ring, hybrid + pros & cons of networks

1.6 Network types

PAN · LAN · MAN · WAN

1.7 Architecture

Client-server, P2P + 10 protocols

1.8 IP addressing

IPv4 vs IPv6

1.9 Net · Intranet · Extranet

+ real-life practicals & board practice

Think & discuss: Board exam: Unit 1 carries 11 marks — MCQ + short + long questions. Every section ends with exam-style practice.

1.1

Concept of Telecommunication

- Define telecommunication, broadband, bandwidth, throughput
- Compare 3G, 4G and 5G mobile generations
- Explain data packets, frequency and communication modes

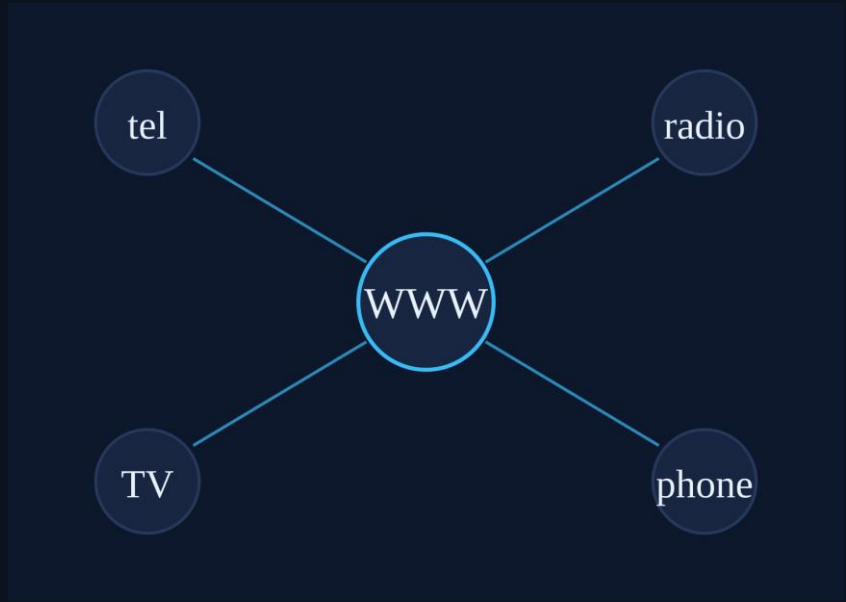
🎯 Problem of the day

Ramesh's family pays for "100 Mbps fiber" but his speed test in his room shows only 23 Mbps. Is the ISP cheating? By the end of this section, you will be able to judge.

1.1 · KEY TERM

What is Telecommunication?

- Tele (Greek: far) + communicare (Latin: share)
- Sending & receiving information over long distances electronically
- Devices: telephone, mobile, radio, TV, computer
- Examples: phone call, SMS, watching a TV program

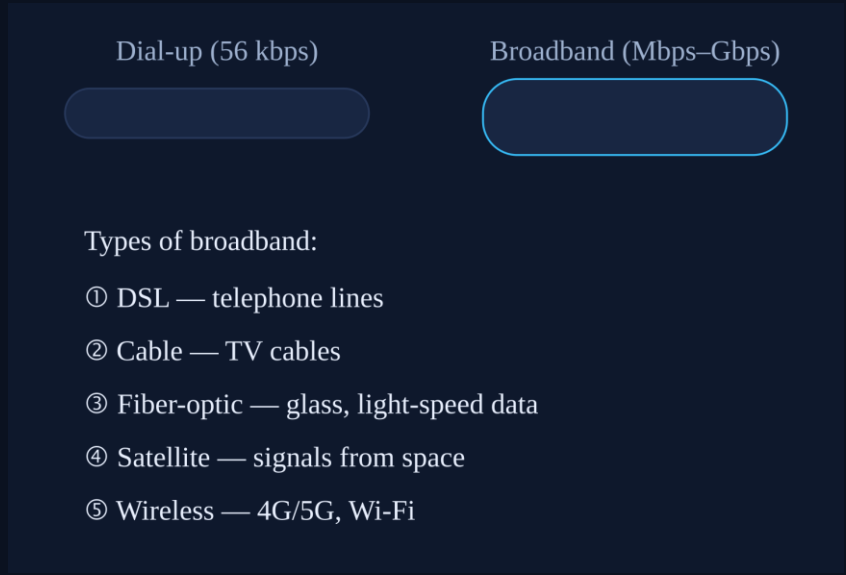


Think & discuss: Your grandparents' era: letters took 2 weeks. What changed the world faster — roads or telecommunication? Why?

1.1 · KEY TERM

Broadband — the fast highway to the Internet

- High-speed Internet carrying large data quickly
- Far faster than old dial-up telephone Internet
- Enables video classes, streaming, gaming, big downloads
- Used in homes, schools, offices, public places



Think & discuss: Which broadband type does YOUR home or school use? How could you find out today?

1.1 · KEY TERM

Bandwidth — how wide is the road?

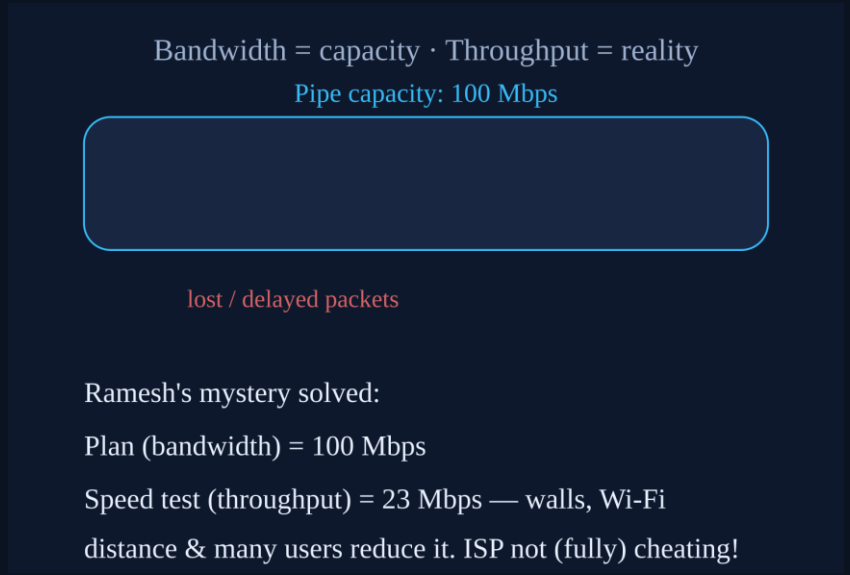
- Maximum data a network can carry per second
- Like the number of lanes on a highway
- Measured in bps, Kbps, Mbps, Gbps
- More bandwidth → smoother streaming, faster downloads

Think & discuss: If a highway has 8 lanes but a traffic jam, do cars still move fast? (Hint: this leads to our next term!)

1.1 · KEY TERM

Throughput — the real speed you get

- Actual data successfully delivered per second
- Always ≤ bandwidth — traffic, distance, interference reduce it
- Measured in bps, Mbps, Gbps (same units)
- Speed-test apps measure throughput, not bandwidth



Think & discuss: Design an experiment: how would you prove throughput drops as you walk away from the router?

1.1 · MOBILE GENERATIONS

3G → 4G → 5G: the evolution

3G · 3rd Generation

- Mobile Internet became practical
- Video calls, MMS, mobile apps
- Speed: up to a few Mbps

4G · LTE

- Fast download/upload, HD streaming
- Low latency (less delay)
- Smooth gaming, cloud apps

5G · 5th Generation

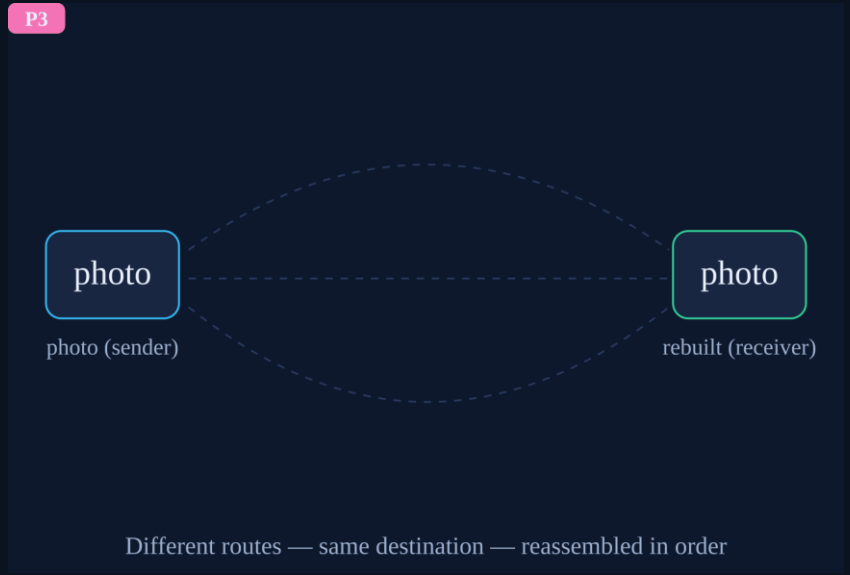
- Super-fast, near-zero delay
- AR/VR, self-driving cars, IoT
- Millions of devices per area

Think & discuss: Nepal Telecom & Ncell run 4G nationwide; 5G is being tested. What would 5G change for a farmer in Jumla? A doctor in Kathmandu?

1.1 · CORE IDEA

Data Packets — messages travel in pieces

- Big data is broken into small packets before sending
- Each packet carries sender & receiver address
- Packets may take different routes, then reassemble
- Result: faster, reliable, efficient long-distance transfer

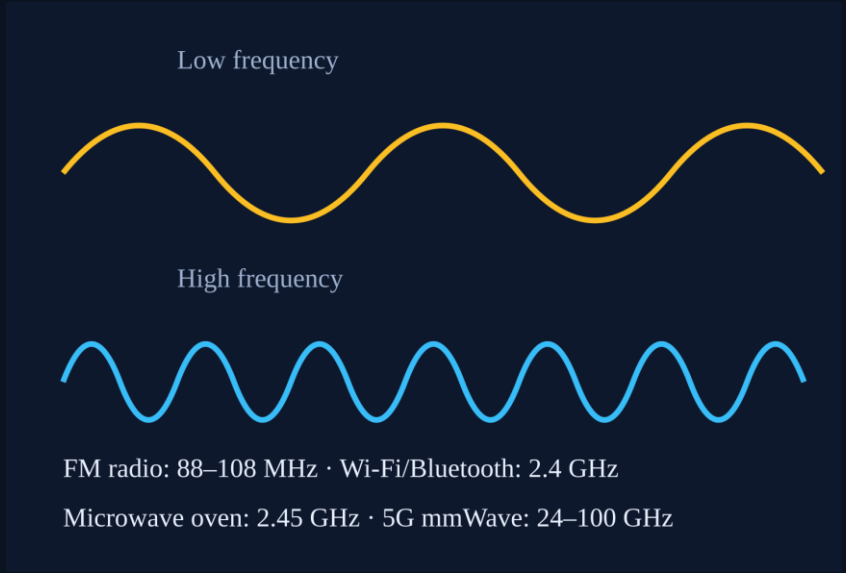


Think & discuss: Analogy: moving a house through a narrow door — brick by brick, each labeled. Why is labeling (addresses) essential?

1.1 · KEY TERM

Frequency — how often signals vibrate

- How often a signal is sent per second
- Units: kHz (thousand), MHz (million), GHz (billion)
- Decides speed & clarity of wireless transmission
- Used by Wi-Fi, Bluetooth, 4G/5G, radio, TV, RFID



Think & discuss: Wi-Fi and your microwave oven both use ~2.4 GHz. Predict: what happens to Wi-Fi when the oven runs? Test it at home!

1.1 · REFERENCE TABLE

Frequency in daily life

Technology	Frequency range	Use
AM Radio	530 – 1710 kHz	Long-distance radio
FM Radio	88 – 108 MHz	Music & news
TV (UHF)	470 – 890 MHz	Digital TV signals
RFID (UHF)	860 – 960 MHz	Smart cards, tracking
Wi-Fi / Bluetooth	2.4 – 2.5 GHz	Wireless Internet, device pairing
Microwave oven	2.45 GHz	Heating food
5G mmWave	24 – 100 GHz	Ultra-fast short-range mobile

Think & discuss: Spot the pattern: as frequency rises, range falls but speed rises. Why does 5G need many more towers than FM radio?

Simplex, Half Duplex, Full Duplex

- Simplex: one direction only — radio, TV, keyboard
- Half duplex: both directions, one at a time — walkie-talkie
- Full duplex: both directions simultaneously — telephone
- Duplex = two-way; simplex = one-way street

Think & discuss: Classify: FM radio, walkie-talkie, Zoom call, TV remote, mobile phone call. Defend each answer!

SECTION 1.1 · EXAM PRACTICE

🎯 MCQ Drill — Telecommunication (1/3)

Q1 [K] Which of the following is a broadband Internet connection?

a) DSL
b) Fiber optic
c) Cable Internet
d) All of the above

Q2 [U] What is throughput?

a) Theoretical speed of a network
b) Actual data transferred in a given time
c) Length of a network cable
d) Number of users online

Q3 [U] Bandwidth is best compared to…

a) The speed of one car
b) The number of lanes on a highway
c) The fuel in a vehicle
d) The traffic police

Q4 [K] What is a data packet?

a) A physical network device
b) A unit of data sent over a network
c) A type of wireless method
d) A security tool

Answer key + explanations: next key slide (and speaker notes)

SECTION 1.1 · EXAM PRACTICE

🎯 MCQ Drill — Telecommunication (2/3)

Q5 [K] **Which mobile generation first made video calls and mobile Internet practical?**

a) 2G
b) 3G
c) 4G
d) 5G

Q6 [U] **A key advantage of 5G over 4G is…**

a) Cheaper SIM cards
b) Almost zero delay and massive device support
c) Better SMS delivery
d) Longer battery in feature phones

Q7 [K] **Frequency is measured in…**

a) Metres
b) Hertz (kHz, MHz, GHz)
c) Bits per second
d) Volts

Q8 [K] **Wi-Fi and Bluetooth commonly share which frequency band?**

a) 88–108 MHz
b) 470–890 MHz
c) 2.4–2.5 GHz
d) 24–100 GHz

Answer key + explanations: next key slide (and speaker notes)

SECTION 1.1 · EXAM PRACTICE

🎯 MCQ Drill — Telecommunication (3/3)

Q9 [U] **A walkie-talkie is an example of…**

a) Simplex mode
b) Half duplex mode
c) Full duplex mode
d) No-communication mode

Q10 [A] **Your 100 Mbps plan gives a 23 Mbps speed test result. The 23 Mbps is the…**

a) Bandwidth
b) Throughput
c) Frequency
d) Latency

Q11 [A] **TV broadcasting is which communication mode?**

a) Simplex
b) Half duplex
c) Full duplex
d) Multiplex

Q12 [HA] **Which technology suits self-driving cars and smart cities best?**

a) 2G
b) 3G
c) 4G
d) 5G

Answer key + explanations: next key slide (and speaker notes)

SECTION 1.1 · EXAM PRACTICE

Answer Key — MCQ Drill — Telecommunication

#	Ans	Why
1	d) All of the above	DSL, cable and fiber are all high-speed (broadband) connections — much faster than dial-up.
2	b) Actual data transferred in a given time	Throughput is the REAL measured transfer rate; bandwidth is the theoretical maximum capacity.
3	b) The number of lanes on a highway	Bandwidth = capacity (lanes). Throughput = actual traffic flow through those lanes.
4	b) A unit of data sent over a network	Data is broken into small labelled units (packets), each carrying sender & receiver addresses.
5	b) 3G	3G brought usable mobile Internet, MMS and video calling; 4G/5G improved speed and latency.
6	b) Almost zero delay and massive device support	5G offers ultra-low latency and can connect huge numbers of IoT devices simultaneously.
7	b) Hertz (kHz, MHz, GHz)	Frequency counts signal cycles per second — 1 GHz = 1 billion cycles per second.
8	c) 2.4–2.5 GHz	Both operate around 2.4 GHz — which is also why a microwave oven can interfere with Wi-Fi!
9	b) Half duplex mode	Both sides can talk, but only one direction at a time — that is half duplex.
10	b) Throughput	The measured, actual rate is throughput. The 100 Mbps plan is the advertised bandwidth (capacity).
11	a) Simplex	TV sends one way only — the station transmits, you receive. You cannot reply through the TV signal.
12	d) 5G	Self-driving cars need near-instant (millisecond) responses — only 5G's ultra-low latency is safe enough.

SECTION 1.1 · EXAM PRACTICE

✍ Short & Long Questions

- [SQ · 2 marks] What is broadband? How is it different from dial-up?
- [SQ · 2 marks] Define bandwidth. How is it measured?
- [SQ · 2 marks] Differentiate bandwidth and throughput.
- [SQ · 2 marks] What is a data packet in networking?
- [SQ · 2 marks] What is frequency in telecommunication?
- [LQ · 4 marks] Compare 3G, 4G and 5G with their main features and uses.
- [LQ · 4 marks] Explain simplex, half-duplex and full-duplex modes with one example each.
- [HA · 4 marks] Your neighbour's '50 Mbps' connection feels slow every evening 7–9 pm. Diagnose the likely cause and suggest two solutions.

Model answers: speaker notes below ↓ (full worked answers also in the interactive HTML deck)

1.2

Communication Channel / Media

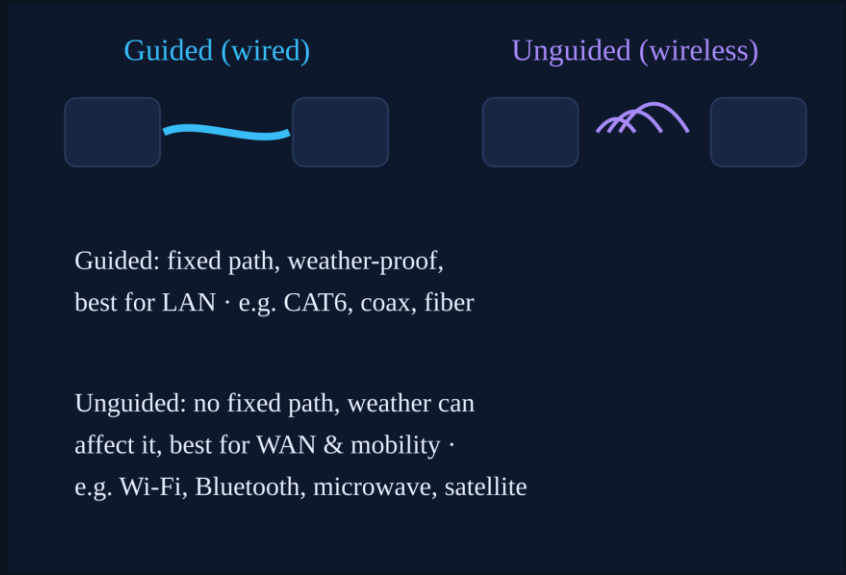
- Distinguish guided (wired) from unguided (wireless) media
- Describe CAT6 and optical fiber cables
- Explain Wi-Fi, Bluetooth, RFID and satellite communication

🎯 Problem of the day

Your school gets budget for Internet in 2 buildings, 300 m apart, crossing a road. Cable or wireless? Copper or fiber? Every choice costs differently — let's learn enough to advise the principal.

Guided vs Unguided media

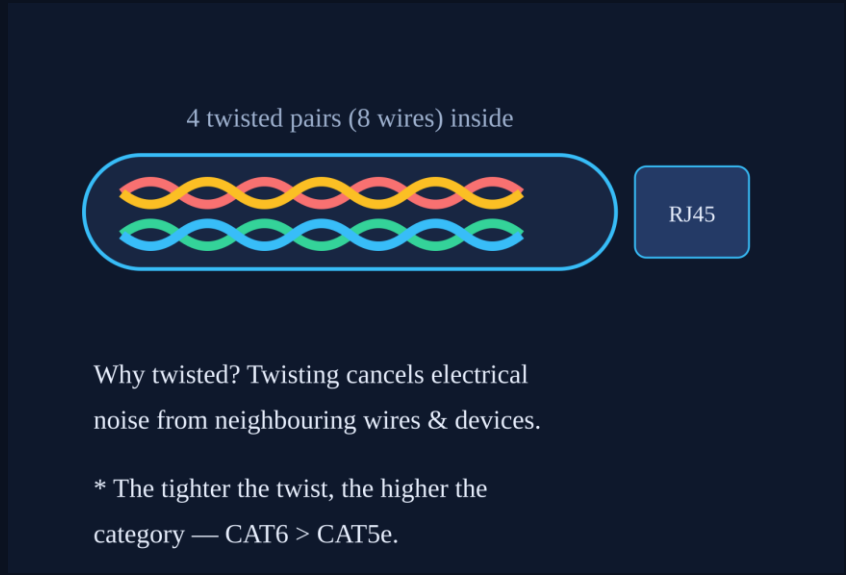
- Communication media = path carrying data between devices
- Guided: physical cables — twisted pair, coaxial, fiber
- Unguided: wireless signals through air — Wi-Fi, Bluetooth, radio
- Wired = faster, safer · Wireless = mobile, flexible



Think & discuss: Why do banks prefer cables for their core systems while buses offer Wi-Fi? List two reasons each.

CAT6 — the workhorse Ethernet cable

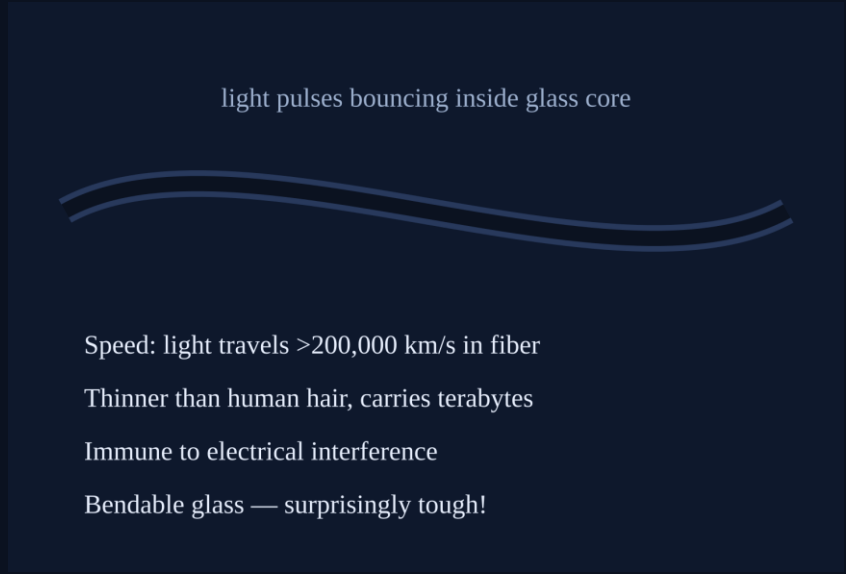
- Category 6 twisted-pair cable for Ethernet networks
- Up to 1 Gbps over 100 m; 10 Gbps shorter runs
- Tightly twisted pairs + better insulation → less interference
- Used in homes, offices, labs, data centers



Think & discuss: Your lab's CAT6 run must be 130 m to reach a new room. What problem appears, and what device (coming in 1.4) can fix it?

Optical Fiber — data at the speed of light

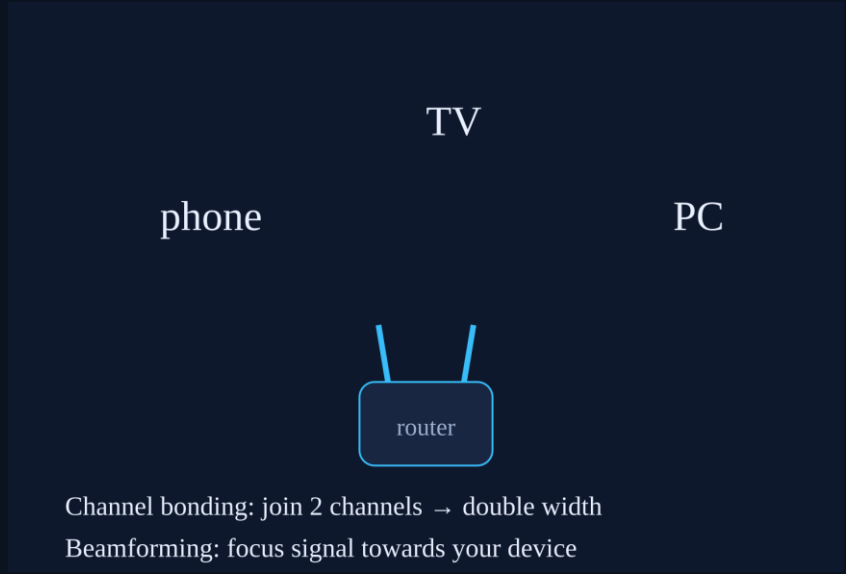
- Hair-thin glass/plastic strands carrying data as light pulses
- Very high speed, very low loss, long distances
- Backbone choice of ISPs (WorldLink, NT fiber-to-home)
- Connectors: ST, SMA, SC



Think & discuss: Copper carries electrons, fiber carries photons. Why can't lightning storms corrupt fiber data the way they disturb copper?

Wi-Fi — Internet through the air

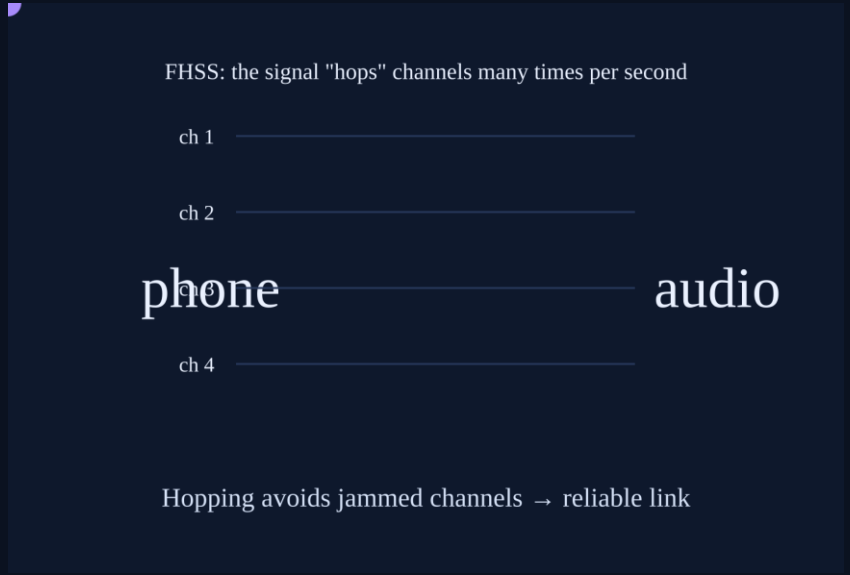
- Wireless Internet using radio signals, no cables
- Bands: 2.4 GHz (long range) & 5 GHz (faster)
- Access points (routers) connect many devices at once
- Smart tricks: channel bonding & beamforming



Think & discuss: 2.4 GHz passes walls better; 5 GHz is faster but shorter range. Which band for a 3-floor house? For an open cyber café?

Bluetooth — short-range partner

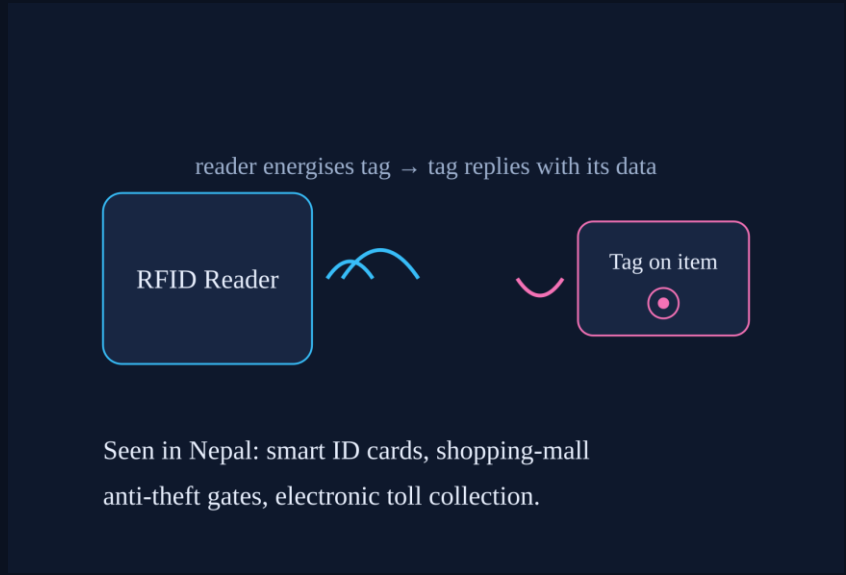
- Wireless sharing over short distances (~10 m)
- Uses radio waves at 2.4 GHz, very low power
- FHSS: hops between frequencies to dodge interference
- Earbuds, smartwatches, keyboards, speakers, file sharing



Think & discuss: Why does Bluetooth (not Wi-Fi) power your smartwatch all day? Hint: think battery.

RFID — identify things by radio

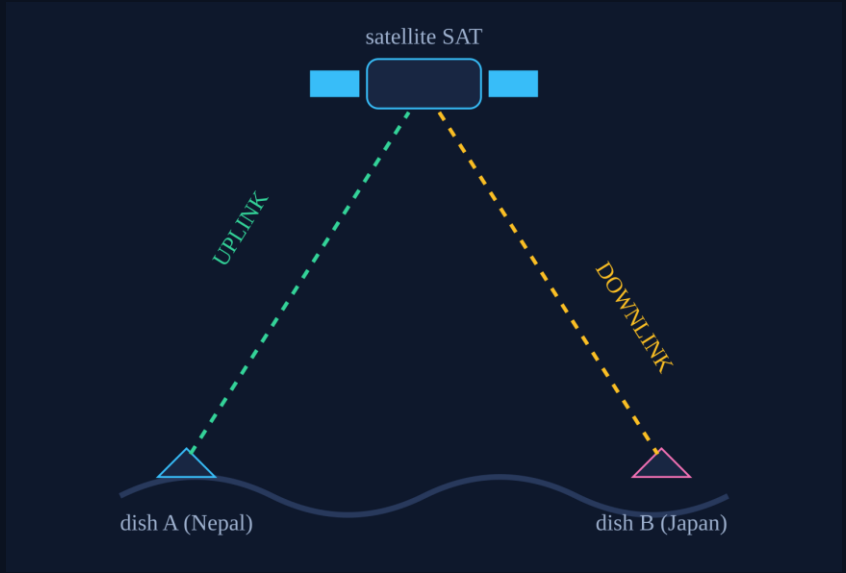
- Radio Frequency Identification: tags ↔ reader via radio waves
- Passive tags: no battery · Active tags: battery, longer range
- Uses: inventory, ID/access cards, contactless payment
- Fast, reliable, no line-of-sight needed



Think & discuss: A library wants to find any book in seconds and stop theft at the gate. Design the RFID solution: what goes where?

Satellite — the relay station in the sky

- Global wireless communication via artificial satellites (since 1965)
- Uplink: Earth → satellite · Downlink: satellite → Earth
- Works like a microwave relay station in space
- TV, weather, GPS, military, Internet in remote areas



Think & discuss: After the 2015 earthquake, phone towers failed but satellite phones worked. Why? What does this teach about network design?

1.2 · COMPARE & CONTRAST

Guided vs Unguided — head to head

Guided (wired)	Unguided (wireless)
Data travels through wires/cables	Data travels through air, no wires
Not affected by rain or wind	Weather can weaken signals
Best for nearby devices (LAN)	Best for distant devices (WAN)
Fixed path for data	No fixed path — travels freely
e.g. CAT6, coaxial, optical fiber	e.g. Wi-Fi, Bluetooth, microwave, satellite

Think & discuss: Back to the school problem: 2 buildings, 300 m, road in between. Argue for fiber underground vs wireless bridge — cost, speed, digging, permission!

SECTION 1.2 · EXAM PRACTICE

🎯 MCQ Drill — Communication Media (1/3)

Q1 [K] Which of the following is a guided (bounded) medium?

a) Fiber optic
b) Infrared
c) Microwave
d) Laser

Q2 [K] CAT6 cable supports up to what speed over 100 m?

a) 100 Mbps
b) 1 Gbps
c) 10 Mbps
d) 100 Gbps

Q3 [K] Optical fiber transmits data using…

a) Electric pulses
b) Sound waves
c) Light waves
d) Magnetic fields

Q4 [K] Which are common optical fiber connectors?

a) ST, SMA, SC
b) USB, HDMI, VGA
c) RJ45, RJ11
d) AM, FM

Answer key + explanations: next key slide (and speaker notes)

SECTION 1.2 · EXAM PRACTICE

🎯 MCQ Drill — Communication Media (2/3)

Q5 [K] Wi-Fi operates on which frequency bands?

a) 2.4 GHz and 5 GHz
b) 88 and 108 MHz
c) 530 and 1710 kHz
d) 1 and 2 Hz

Q6 [U] Bluetooth avoids interference using…

a) Beamforming
b) FHSS (Frequency Hopping Spread Spectrum)
c) NAT
d) Terminators

Q7 [K] An RFID tag WITHOUT a battery is called…

a) Active tag
b) Passive tag
c) Dead tag
d) Smart tag

Q8 [K] Sending data from Earth to a satellite is called…

a) Downlink
b) Modulation
c) Uplink
d) Download

Answer key + explanations: next key slide (and speaker notes)

SECTION 1.2 · EXAM PRACTICE

🎯 MCQ Drill — Communication Media (3/3)

Q9 [U] Which medium is most affected by bad weather?

a) CAT6 cable
b) Optical fiber
c) Satellite signals
d) Coaxial cable

Q10 [U] Beamforming in Wi-Fi means…

a) Combining two channels
b) Focusing signal toward a device
c) Blocking hackers
d) Increasing frequency

Q11 [A] An ISP must link two towns 40 km apart with maximum speed. Best choice?

a) CAT6 cable
b) Bluetooth
c) Optical fiber
d) RFID

Q12 [HA] A hospital needs to track hundreds of equipment items moving between rooms. Best technology?

a) RFID
b) FM radio
c) Satellite
d) Dial-up

Answer key + explanations: next key slide (and speaker notes)

SECTION 1.2 · EXAM PRACTICE

Answer Key — MCQ Drill — Communication Media

#	Ans	Why
1	a) Fiber optic	Guided media use physical cables: twisted pair, coaxial and fiber optic. The rest travel through air.
2	b) 1 Gbps	CAT6 does 1 Gbps up to 100 m, and can reach 10 Gbps over shorter distances.
3	c) Light waves	Fiber carries data as light pulses inside glass/plastic strands — fast, low loss, interference-free.
4	a) ST, SMA, SC	Straight Tip (ST), Screw-Mounted Adaptor (SMA) and Subscriber Connector (SC) are fiber connectors.
5	a) 2.4 GHz and 5 GHz	2.4 GHz travels further; 5 GHz is faster over shorter range.
6	b) FHSS (Frequency Hopping Spread Spectrum)	FHSS rapidly hops between frequencies so a jammed channel doesn't break the connection.
7	b) Passive tag	Passive tags are powered by the reader's radio energy; active tags have batteries and longer range.
8	c) Uplink	Earth → satellite = uplink; satellite → Earth = downlink.
9	c) Satellite signals	Unguided (wireless) media like satellite links can be weakened by rain and storms; cables are not.
10	b) Focusing signal toward a device	Beamforming aims the radio energy at your device instead of spreading equally — stronger signal.
11	c) Optical fiber	Only fiber combines multi-km range with huge bandwidth. CAT6 dies at 100 m; Bluetooth at ~10 m.
12	a) RFID	RFID tags on each item + readers at doors give automatic, fast identification and tracking.

SECTION 1.2 · EXAM PRACTICE

✍ Short & Long Questions

- [SQ · 2 marks] What is communication media? List its two types with one example each.
- [SQ · 2 marks] Write any four features of CAT6 cable.
- [SQ · 2 marks] How does Wi-Fi transmit data without cables?
- [SQ · 2 marks] Mention one real-life use of satellite communication and why it suits that use.
- [SQ · 2 marks] Why is wireless communication becoming more popular today?
- [LQ · 4 marks] Differentiate between guided and unguided media (any four points).
- [LQ · 4 marks] Explain optical fiber cable. Why do ISPs prefer it?
- [HA · 4 marks] Your school's two buildings are 300 m apart. Recommend a medium to connect their LANs and justify against one alternative.

Model answers: speaker notes below ↓ (full worked answers also in the interactive HTML deck)

1.3

Connectors

- Identify the RJ45 connector and its purpose
- Explain what a media converter does and when it is needed

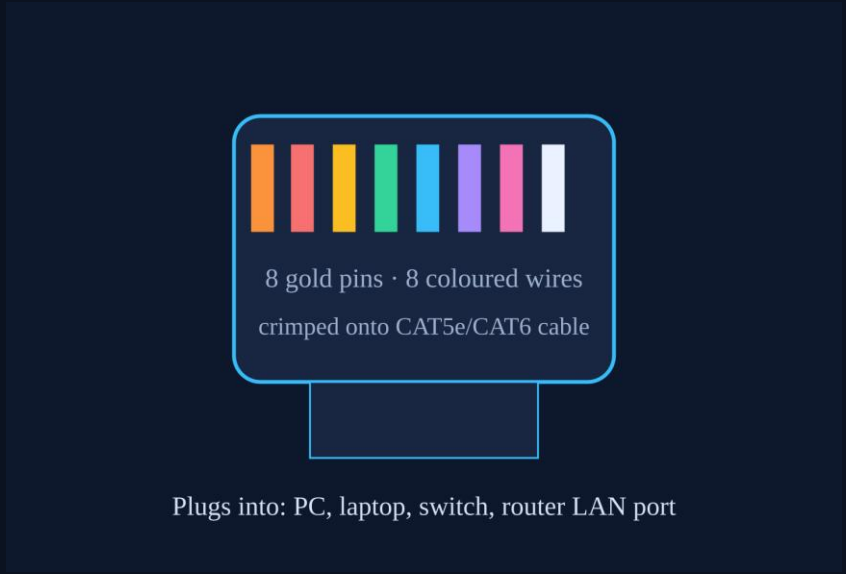
🎯 Problem of the day

The ISP's fiber reaches your school gate, but your computers only have copper Ethernet ports. Two small, cheap devices bridge this world of glass and copper. Meet them now.

1.3 · CONNECTOR

RJ45 — the click you know

- Registered Jack 45 — standard Ethernet connector
- 8 pins in a modular jack format
- Easy click-in insertion & removal, standard wiring schemes
- Reliable high-speed data over Ethernet networks

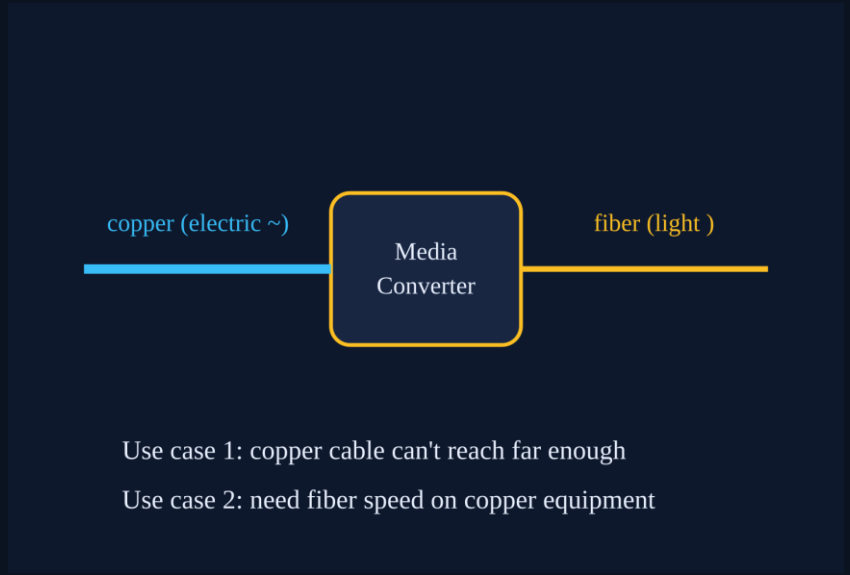


Think & discuss: Find an RJ45 port in your school today. Photograph 3 different devices that have one.

1.3 · CONNECTOR

Media Converter — copper ⇄ fiber translator

- Connects different cable types: copper ↔ optical fiber
- Converts electrical pulses ⇄ light signals
- Needed when copper is too short or fiber speed required
- Common in schools, offices, data centers



Think & discuss: CAT6 dies after 100 m; fiber runs kilometres. Sketch how two media converters + fiber link two distant buildings' copper LANs.

SECTION 1.3 · EXAM PRACTICE

🎯 MCQ Drill — Connectors (1/2)

Q1 [K] The RJ45 connector is mainly used for…

a) USB connections
b) Telephone lines
c) Ethernet networking
d) Fiber optics

Q2 [K] How many pins does an RJ45 connector have?

a) 4
b) 6
c) 8
d) 16

Q3 [U] A media converter converts…

a) AC to DC power
b) Electrical signals ⇄ light signals
c) Analog TV to digital
d) IPv4 to IPv6

Q4 [U] When is a media converter most useful?

a) When copper cable is not long enough
b) When you need a new keyboard
c) When Wi-Fi password is lost
d) When the printer jams

Answer key + explanations: next key slide (and speaker notes)

SECTION 1.3 · EXAM PRACTICE

🎯 MCQ Drill — Connectors (2/2)

Q5 [K] **RJ45 connectors are attached to cables by…**

a) Welding
b) Crimping
c) Gluing
d) Soldering only

Q6 [A] **Fiber arrives at a building but computers have copper ports. You need…**

a) A repeater
b) Two RJ11 jacks
c) A media converter
d) A new ISP

Answer key + explanations: next key slide (and speaker notes)

SECTION 1.3 · EXAM PRACTICE

Answer Key — MCQ Drill — Connectors

#	Ans	Why
1	c) Ethernet networking	RJ45 is the standard connector on Ethernet (CAT5e/CAT6) cables. RJ11 is the smaller telephone one.
2	c) 8	RJ45 has 8 pins, matching the 8 wires (4 twisted pairs) inside an Ethernet cable.
3	b) Electrical signals ⇄ light signals	It bridges copper (electric) and fiber (light) so the two cable types can work in one network.
4	a) When copper cable is not long enough	Copper is limited to ~100 m; converting to fiber extends the link to kilometres.
5	b) Crimping	A crimping tool presses the 8 wires into the connector pins in a standard wiring order.
6	c) A media converter	The media converter turns the fiber's light signals into electrical Ethernet the computers understand.

SECTION 1.3 · EXAM PRACTICE

✍ Short & Long Questions

- [SQ · 2 marks] Describe the RJ45 connector. Where is it commonly used?
- [SQ · 2 marks] What is a media converter? Mention its main function.
- [LQ · 4 marks] Compare RJ45 connectors and fiber connectors (SC/ST/LC).
- [HA · 4 marks] Draw/describe the full connection: ISP fiber → school computer. Name every connector and device in order.

Model answers: speaker notes below ↓ (full worked answers also in the interactive HTML deck)

1.4

Networking Devices

- Explain repeater, hub, switch, bridge and router
- Choose the right device for a given networking problem

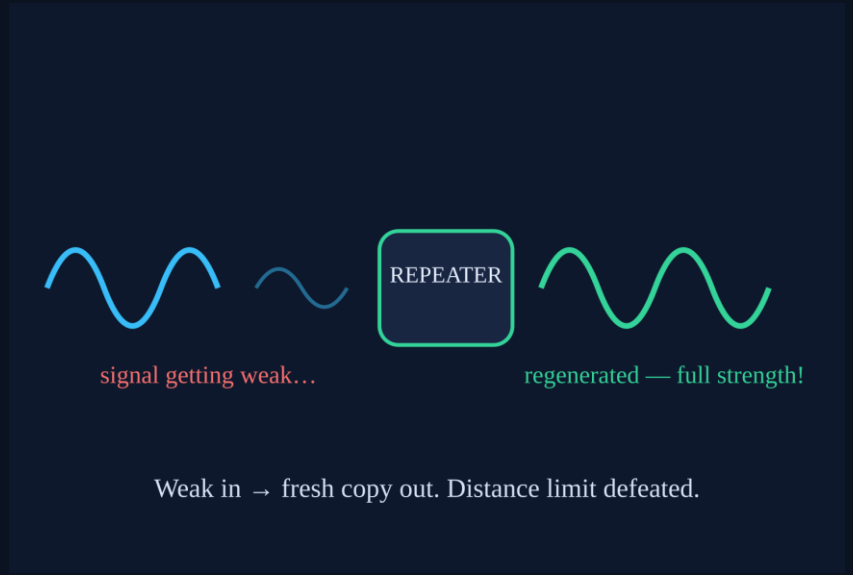
🎯 Problem of the day

Five gadgets sit in a dusty server rack. One boosts, one shouts to everyone, one whispers to the right PC, one joins twins, one finds the best road across the world. Can you match names to jobs by the end?

1.4 · DEVICE 1

Repeater — the signal booster

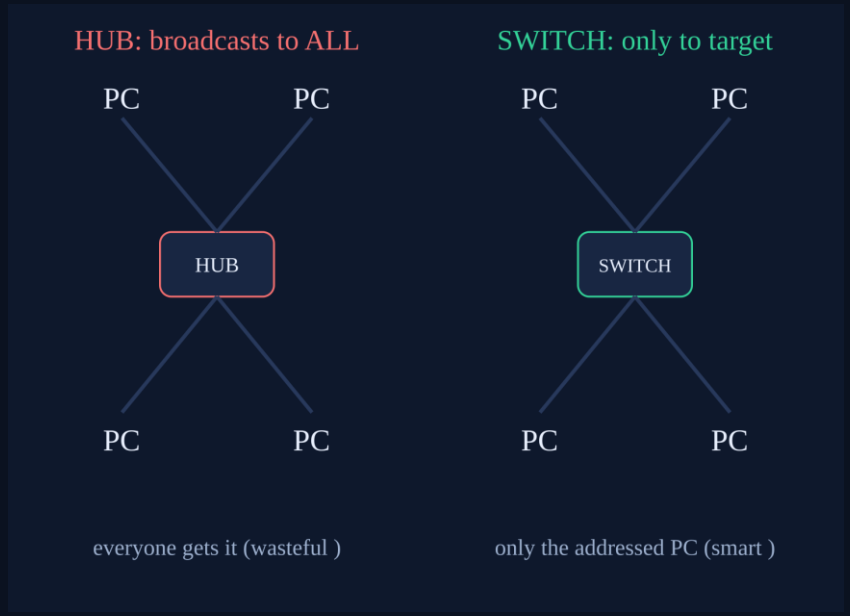
- Accepts weak signals, regenerates them fresh & strong
- Enables long-distance data transfer
- Works at signal level — does not read addresses
- Real life: Wi-Fi range extenders in big houses



Think & discuss: CAT6 fades after 100 m. Where exactly would you place repeaters on a 250 m cable run?

Hub vs Switch — shouting vs whispering

- Hub: multi-port box; copies data to every computer
- Cheap, simple, connects star topology — now outdated
- Switch: learns addresses; sends data only to target
- Faster, less traffic, more secure — replaced hubs

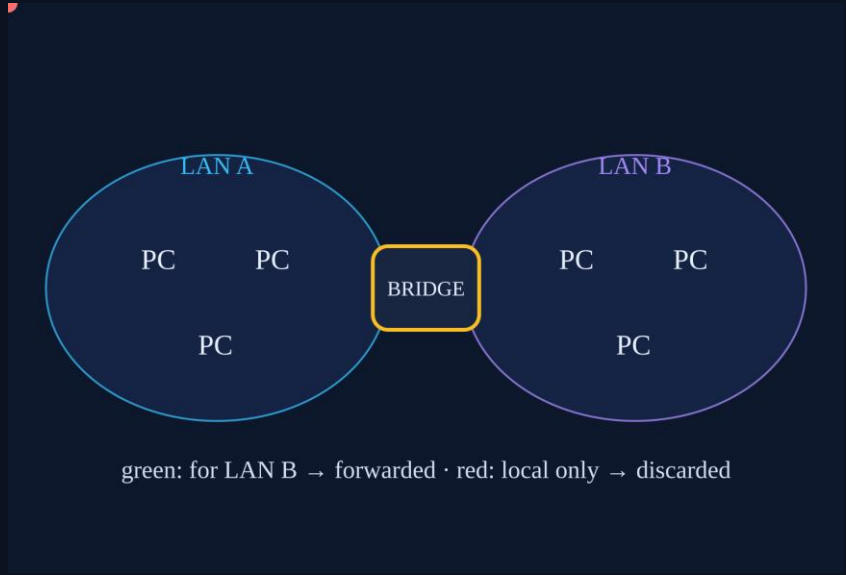


Think & discuss: Hub = teacher announcing to whole class. Switch = passing a private note. Which leaks secrets? Which wastes time?

1.4 · DEVICE 4

Bridge — joining twin networks

- Interconnects two networks with similar protocols
- Inspects incoming signals: forward or discard?
- Reduces unnecessary traffic between segments
- Like a checkpoint between two similar neighbourhoods

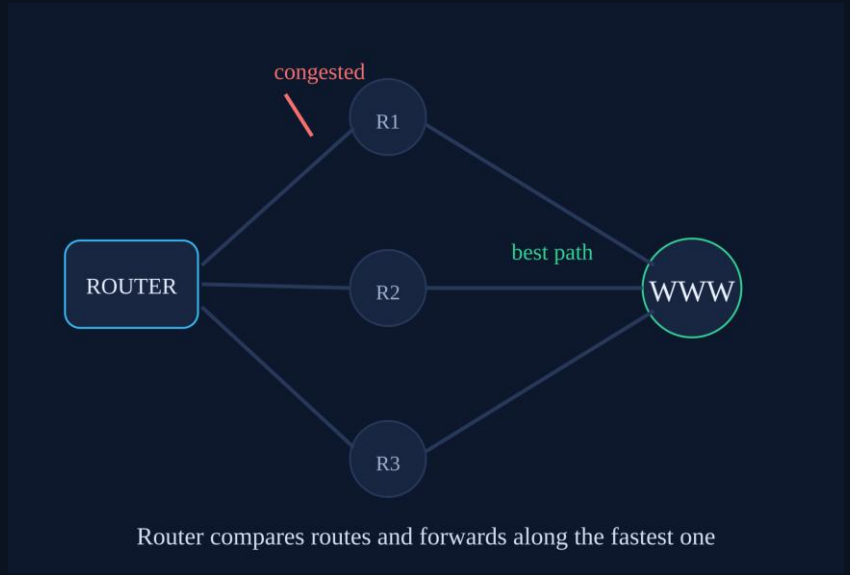


Think & discuss: Bridge vs switch — both filter by address. What key difference remains? (Hint: how many networks vs how many devices?)

1.4 · DEVICE 5

Router — the intelligent path-finder

- Joins multiple networks, wired or wireless
- Works using IP addresses
- Intelligent: picks the best possible path for data
- Your home "Wi-Fi box" is a router + more



Router compares routes and forwards along the fastest one

Think & discuss: Google Maps reroutes you around a traffic jam. Routers do the same for packets. What "jams" exist on the Internet?

1.4 · MASTER TABLE

Five devices — one glance

Device	Main job	Smartness	Everyday analogy
Repeater	Regenerates weak signals for distance	None — just boosts	Megaphone relay
Hub	Connects PCs; copies data to all ports	None — broadcasts	Loudspeaker announcement
Switch	Connects PCs; sends only to target	Learns device addresses	Postman with names
Bridge	Joins two similar networks; filters	Forward or discard	Border checkpoint
Router	Joins different networks; best path	IP-based path finding	GPS navigator

Think & discuss: Field visit (Book Activity 1.1): visit an ISP/school lab, photograph each device, label its cables. Which did you find most of?

SECTION 1.4 · EXAM PRACTICE

🎯 MCQ Drill — Networking Devices (1/3)

Q1 [K] Which device strengthens weak network signals for long distances?

a) Switch
b) Router
c) Repeater
d) Bridge

Q2 [U] A hub sends received data to…

a) Only the destination computer
b) Every connected computer
c) The nearest router
d) The Internet directly

Q3 [K] Which device sends data ONLY to the intended computer?

a) Hub
b) Repeater
c) Switch
d) Terminator

Q4 [K] A bridge connects…

a) Two networks with similar protocols
b) A PC to a printer
c) Copper to fiber
d) A phone to Wi-Fi

Answer key + explanations: next key slide (and speaker notes)

SECTION 1.4 · EXAM PRACTICE

🎯 MCQ Drill — Networking Devices (2/3)

Q5 [K] A router chooses paths based on…

a) MAC colour
b) IP address
c) Cable length
d) Port number only

Q6 [U] Which device is 'intelligent' enough to find the best possible path?

a) Hub
b) Repeater
c) Router
d) Terminator

Q7 [A] Your 180 m CAT6 run keeps failing. Cheapest fix?

a) Buy a new ISP plan
b) Add a repeater mid-way
c) Replace all PCs
d) Use RJ11 connectors

Q8 [A] An office complains others' file transfers slow everyone down on their old hub. Best upgrade?

a) Another hub
b) A switch
c) More terminators
d) Longer cables

Answer key + explanations: next key slide (and speaker notes)

SECTION 1.4 · EXAM PRACTICE

🎯 MCQ Drill — Networking Devices (3/3)

Q9 [U] To connect your home LAN to the Internet you need a…

a) Bridge
b) Repeater
c) Router
d) Hub

Q10 [HA] Which comparison is correct?

a) Hub is faster than switch
b) Switch works faster than hub
c) Repeater reads IP addresses
d) Bridge joins dissimilar protocols

Answer key + explanations: next key slide (and speaker notes)

SECTION 1.4 · EXAM PRACTICE

Answer Key — MCQ Drill — Networking Devices

#	Ans	Why
1	c) Repeater	A repeater accepts weak signals, regenerates them and sends them on — defeating cable distance limits.
2	b) Every connected computer	Hubs broadcast to all ports — wasteful and insecure, which is why switches replaced them.
3	c) Switch	A switch learns device addresses and forwards frames only to the target port.
4	a) Two networks with similar protocols	Bridges join two similar networks and filter traffic — forward or discard after inspection.
5	b) IP address	Routers work on Internet Protocol (IP) addresses and intelligently pick the best route.
6	c) Router	The router compares available routes and forwards data along the best one — like a GPS for packets.
7	b) Add a repeater mid-way	CAT6 fades past 100 m; a repeater at ~90 m regenerates the signal for the rest of the run.
8	b) A switch	A switch sends traffic only where needed, eliminating the hub's wasteful broadcasting.
9	c) Router	Only a router joins different networks (your LAN + the ISP's network) using IP addresses.
10	b) Switch works faster than hub	The switch coordinates traffic per-device, so it is faster; repeaters read nothing; bridges need simil…

SECTION 1.4 · EXAM PRACTICE

✍ Short & Long Questions

- [SQ · 2 marks] What is the function of a repeater?
- [SQ · 2 marks] Differentiate between a hub and a switch.
- [SQ · 2 marks] What is a bridge in networking?
- [SQ · 2 marks] Why is a router called an intelligent device?
- [LQ · 4 marks] Explain any four networking devices with their functions.
- [HA · 4 marks] A cyber café has 15 PCs on an old hub; customers complain of slowness and one PC 'seeing' others' traffic. Identify both problems and the fix.

Model answers: speaker notes below ↓ (full worked answers also in the interactive HTML deck)

1.5

Network Topologies

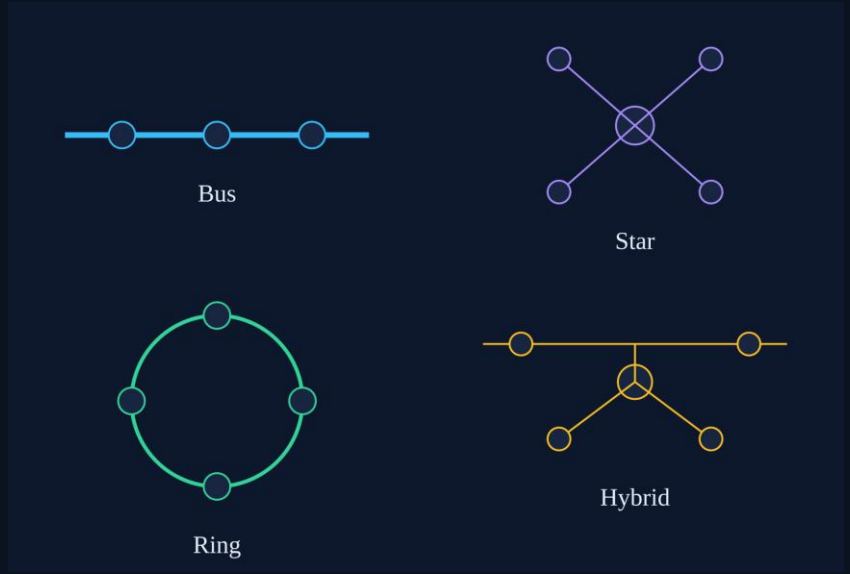
- Describe bus, star, ring and hybrid topologies with features
- State advantages and disadvantages of computer networks
- Select a suitable topology for a given scenario

🎯 Problem of the day

Your school lab has 36 computers to connect. One cheap cable through all? A central switch? A loop? Wrong choice = one loose cable kills the whole lab on exam day. Choose wisely!

Topology — the network's shape

- The connection pattern of network components
- Physical: hardware layout · Logical: data's path
- LAN topology = cabling structure of local computers
- Four mains: bus, star, ring, hybrid

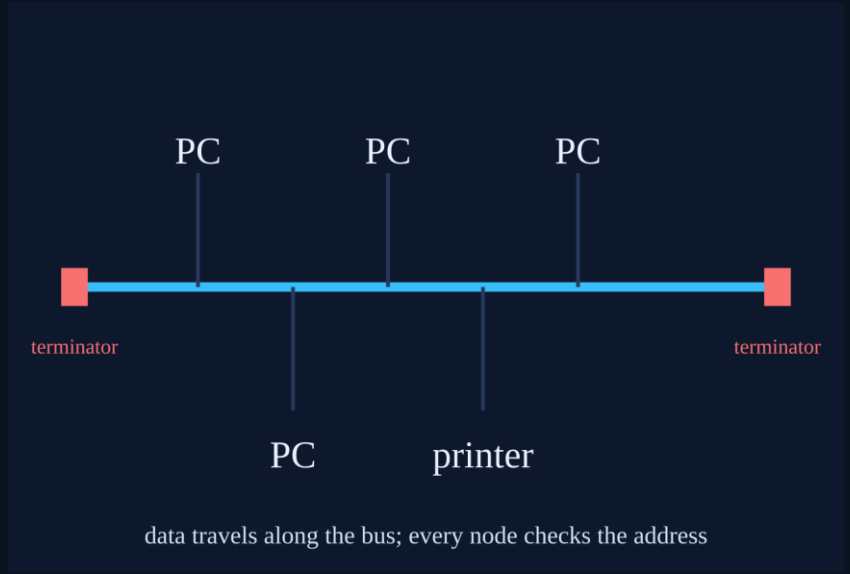


Think & discuss: City roads also have topologies: one main road, roundabout hub, ring road. Match each to a network topology!

1.5 · TOPOLOGY 1

Bus — one cable for everyone

- All nodes share a single backbone cable
- Terminators at both ends absorb signals
- Cheap, least cable, easy for small networks
- Weakness: backbone cut = whole network down

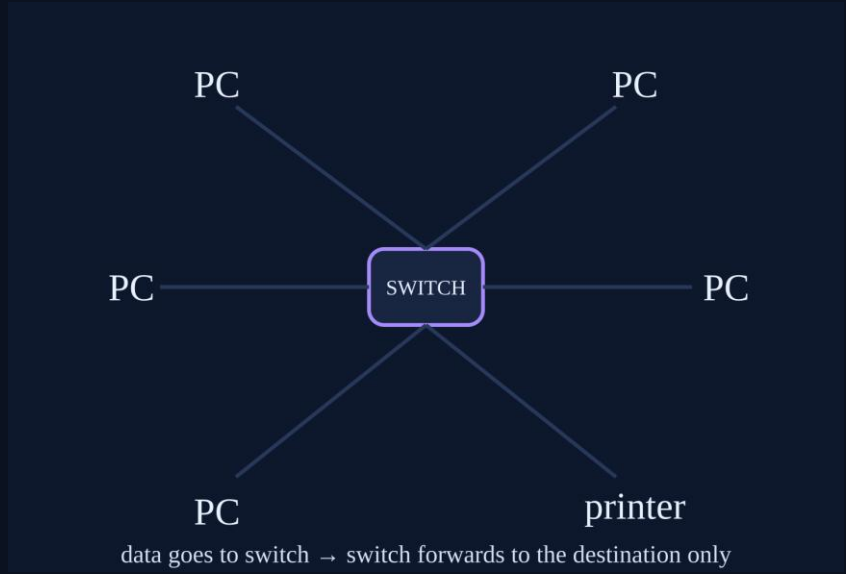


Think & discuss: Like one water pipe serving a whole street — what happens to all houses if the pipe bursts in the middle?

1.5 · TOPOLOGY 2

Star — everyone to the center

- All nodes connect to a central hub/switch
- Fast performance, low traffic, easy to troubleshoot
- One node fails → others keep working
- Weakness: central device fails → all down

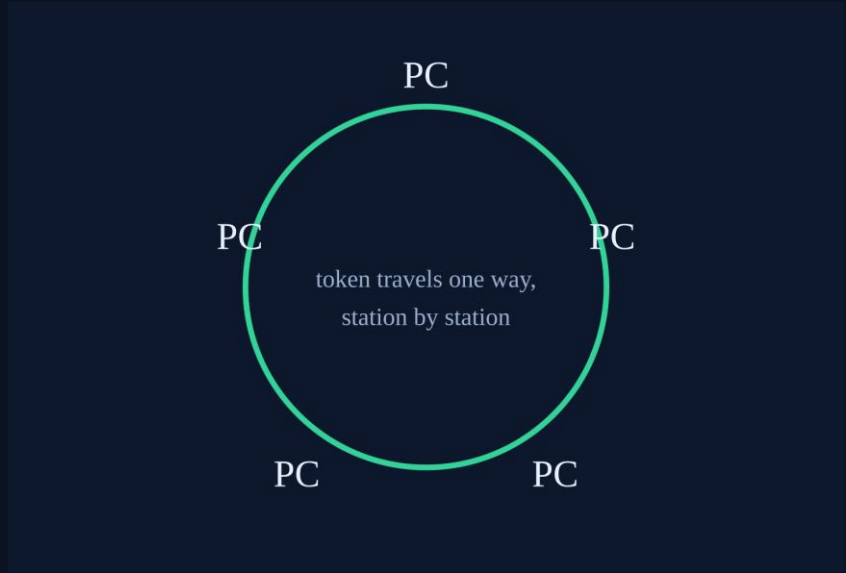


Think & discuss: Star is today's most common LAN topology. Why do schools accept its "single point of failure" risk anyway?

1.5 · TOPOLOGY 3

Ring — pass it around the loop

- Each computer connects to the next — closed loop
- Data moves sequentially, node to node
- All computers have equal responsibility
- Handles high traffic well; uses fiber, repeaters for size

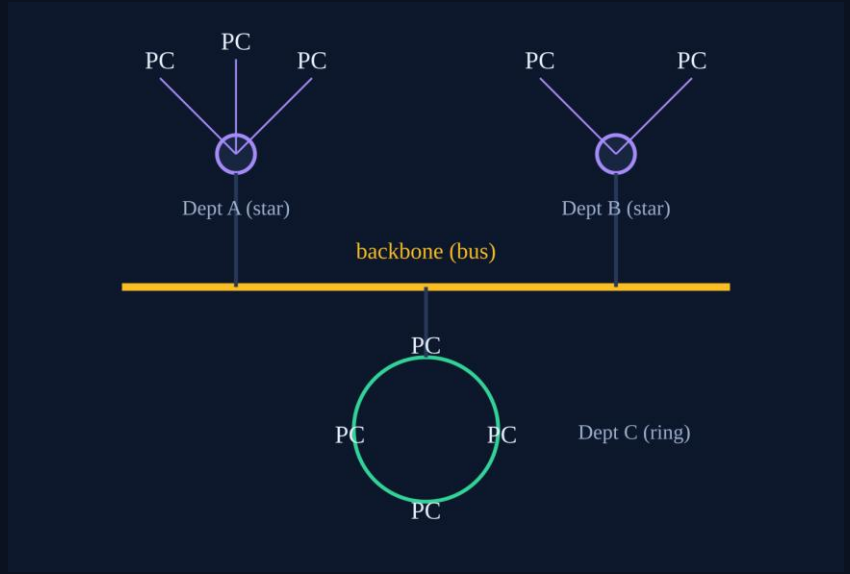


Think & discuss: A relay race: the baton passes runner to runner. What happens if one runner leaves the track? How could TWO tracks fix it?

1.5 · TOPOLOGY 4

Hybrid — mix and match strengths

- Combination of two or more topologies in one network
- e.g. star networks per department + bus/ring backbone
- Flexible & scalable — grows with the organization
- Reduces chance of complete network failure



Think & discuss: Nepal's banks: star LANs in each branch, WAN links between cities. Why does almost every real network end up hybrid?

1.5 · THE BIGGER PICTURE

Computer networks — worth it?

✓ Advantages

- Share hardware: printers, scanners, storage
- Share data & software; worldwide communication
- Centralized administration and backup systems
- Services: file, print, message, database, application

✗ Disadvantages

- Setup cost: devices, cabling, skilled technicians
- Virus & malware spread quickly across nodes
- Security risk: hacking, data theft without protection
- Server failure can stop dependent work

Think & discuss: Your school shares one printer over the LAN instead of buying 20. Calculate roughly how much money that saves!

SECTION 1.5 · EXAM PRACTICE

🎯 MCQ Drill — Topologies (1/3)

Q1 [K] The connection pattern of computers in a network is called…

a) Protocol
b) Topology
c) Twisted pair
d) Structure

Q2 [K] Which topology uses a single backbone cable with terminators?

a) Star
b) Ring
c) Bus
d) Hybrid

Q3 [K] Which topology connects all devices to a central hub/switch?

a) Ring topology
b) Bus topology
c) Star topology
d) Hybrid topology

Q4 [U] In star topology, if ONE computer fails…

a) The whole network stops
b) Other computers keep working
c) The switch burns
d) Data reverses

Answer key + explanations: next key slide (and speaker notes)

SECTION 1.5 · EXAM PRACTICE

🎯 MCQ Drill — Topologies (2/3)

Q5 [K] In which topology does data travel sequentially in a closed loop?

a) Bus
b) Star
c) Ring
d) Mesh

Q6 [K] A hybrid topology is…

a) Only star + star
b) A combination of two or more topologies
c) A wireless-only design
d) An outdated design

Q7 [U] Which is an ADVANTAGE of computer networks?

a) Viruses spread faster
b) Hardware like printers can be shared
c) Higher electricity bills
d) Hacking becomes easy

Q8 [U] The single biggest risk of star topology is…

a) Too much cable per node
b) Central device failure stops everything
c) Terminators falling off
d) Tokens getting lost

Answer key + explanations: next key slide (and speaker notes)

SECTION 1.5 · EXAM PRACTICE

🎯 MCQ Drill — Topologies (3/3)

Q9 [A] **A school lab with 36 PCs needs easy troubleshooting and stability. Best topology?**

a) Bus
b) Ring
c) Star
d) Daisy chain

Q10 [A] **Company HQ uses star per floor, floors joined by a backbone. This is…**

a) Pure bus
b) Pure star
c) Hybrid topology
d) Ring topology

Q11 [HA] **Why did bus topology lose popularity despite low cost?**

a) Cable was too colourful
b) One backbone fault kills the whole network
c) It was too fast
d) Terminators were expensive

Answer key + explanations: next key slide (and speaker notes)

SECTION 1.5 · EXAM PRACTICE

Answer Key — MCQ Drill — Topologies

#	Ans	Why
1	b) Topology	Topology is the interconnected pattern (shape) of network components — physical or logical.
2	c) Bus	Bus topology connects all nodes to one cable; terminators at both ends absorb the signal.
3	c) Star topology	In star topology, every node has its own cable to the central device — today's most common LAN design.
4	b) Other computers keep working	Each node has an independent link, so one node's failure doesn't affect the rest.
5	c) Ring	Ring topology passes data node-to-node around the loop; each computer has equal responsibility.
6	b) A combination of two or more topologies	Hybrid combines e.g. star departments with a bus/ring backbone — flexible and scalable.
7	b) Hardware like printers can be shared	Sharing hardware, data, software plus centralized backup are key network advantages.
8	b) Central device failure stops everything	Everything depends on the hub/switch — its failure downs the entire network.
9	c) Star	Star with a switch: a faulty PC or cable affects only itself, and finding faults is simple.
10	c) Hybrid topology	Multiple topologies combined in one network = hybrid — the real-world norm.
11	b) One backbone fault kills the whole network	A single cable break stops everyone, and finding the break is hard — reliability beat cheapness.

SECTION 1.5 · EXAM PRACTICE

✍ Short & Long Questions

- [SQ · 2 marks] What is network topology? Name its four main types.
- [SQ · 2 marks] Write any three features of star topology.
- [SQ · 2 marks] How does data flow in a ring topology?
- [SQ · 2 marks] Write two advantages and two disadvantages of computer networks.
- [LQ · 4 marks] Explain bus and star topology with figures and features.
- [HA · 4 marks] (Board-style) A school lab of 36 computers needs a stable, easily maintained network with Internet and instant file sharing. Recommend a topology and justify.

Model answers: speaker notes below ↓ (full worked answers also in the interactive HTML deck)

1.6

Networks by Coverage: PAN · LAN · MAN · WAN

- Classify networks by geographical coverage
- State features and examples of PAN, LAN, MAN and WAN

🎯 Problem of the day

Your earbuds, the school lab, Kathmandu's cable TV network and the Internet itself — four networks, four sizes. From 10 metres to the whole planet: let's zoom out step by step.

1.6 · ZOOM OUT

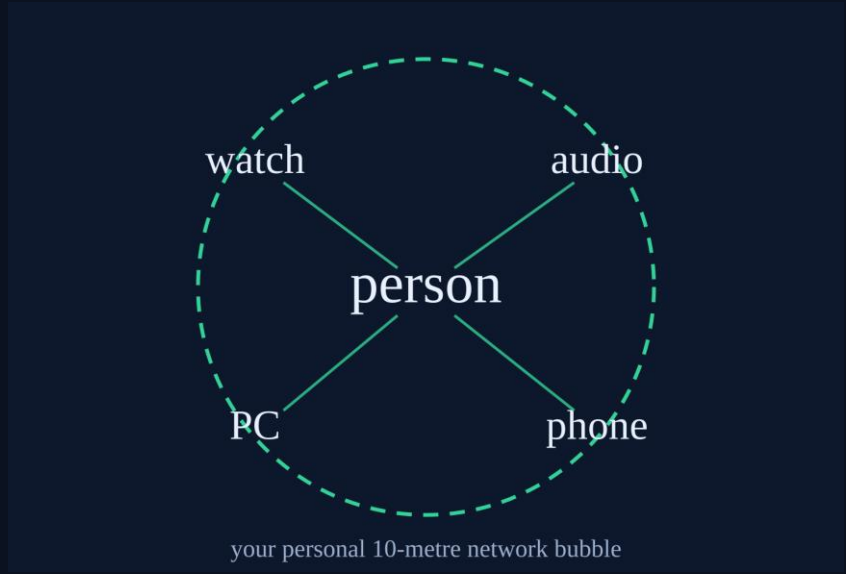
Four circles of coverage

- PAN: around one person (~10 m)
- LAN: a room, building, school (~1 km)
- MAN: a city or valley
- WAN: countries → the whole world

Think & discuss: Trace one WhatsApp message: phone (PAN Bluetooth headset) → home Wi-Fi (LAN) → city ISP (MAN) → world (WAN). Every layer, every day!

PAN — the personal bubble

- Connects devices around one person, up to ~10 m
- Phone ↔ smartwatch, earbuds, laptop, printer
- Transfers files, photos, videos between own devices
- Easy setup — basic configuration only

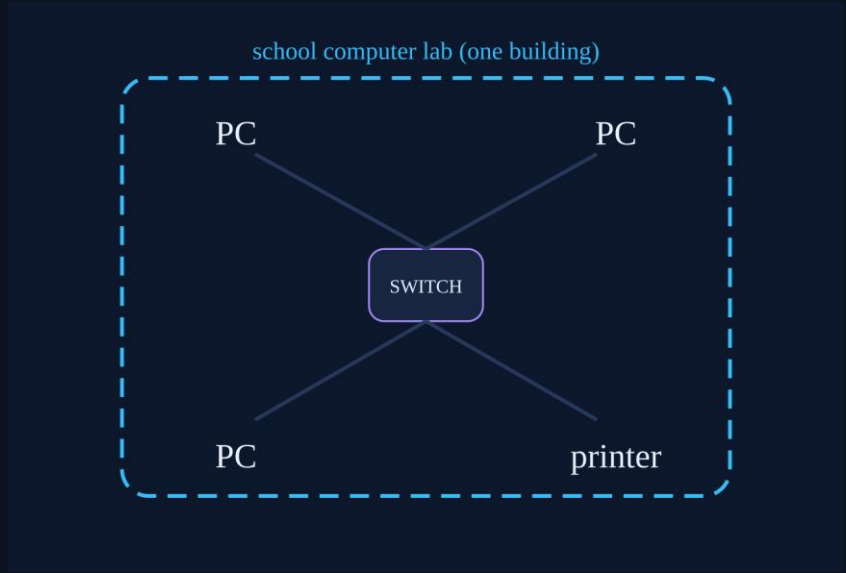


Think & discuss: Count YOUR PAN right now: how many devices are wirelessly linked around you or a family member?

1.6 · THE CLASSIC

LAN — one building, high speed

- Limited to small areas: room, building, school (≤ ~1 km)
- Generally wired; wireless version = WLAN
- Fastest data transfer of all network types
- Low error rate; common topologies: bus, star, ring

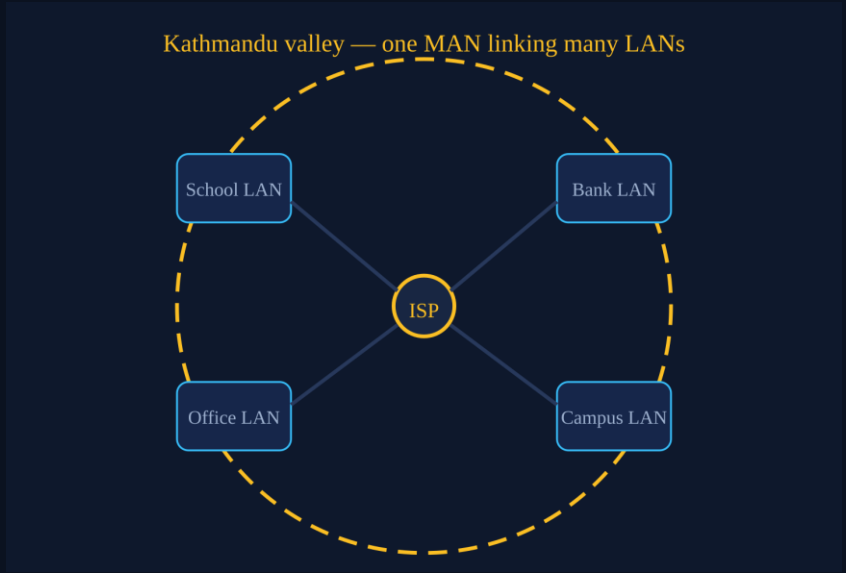


Think & discuss: Why is LAN faster than MAN and WAN? Think: distance, cable quality, number of hops.

1.6 · CITY SCALE

MAN — the metropolitan web

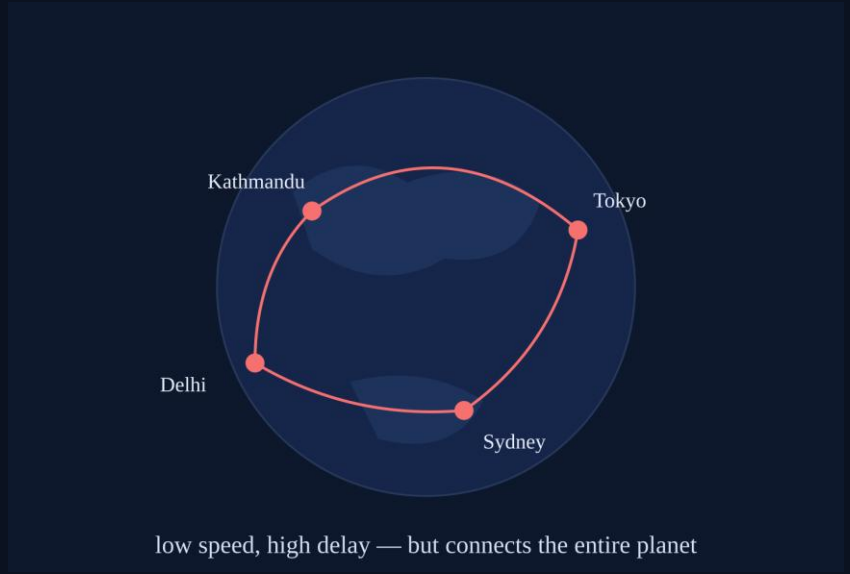
- Covers a city, valley or metropolitan area
- Bigger than LAN, smaller than WAN; medium speed
- Owned by single or multiple organizations
- Examples: cable TV networks, city DSL, LAN-to-WAN uplinks



Think & discuss: Dish Home cable TV serves the whole valley. Which network type is that? What about WorldLink linking its city offices?

WAN — the world-wide giant

- Extends over large geographical areas — the largest network
- Uses satellites, public carriers, undersea cables
- Owned by multiple organizations, not one
- Examples: the Internet, 4G mobile broadband, satellite links



low speed, high delay — but connects the entire planet

Think & discuss: WAN has the LOWEST speed yet is the most valuable network. Why do we tolerate its delays?

1.6 · MASTER TABLE

PAN vs LAN vs MAN vs WAN

	PAN	LAN	MAN	WAN
Coverage	~10 m, one person	Room–building, ≤1 km	City / valley	Country → world
Speed	Low–medium	Highest	Medium	Lowest, high delay
Ownership	Individual	One organization	Single/multiple orgs	Multiple orgs
Media	Bluetooth, USB	CAT6, Wi-Fi	Fiber, DSL, wireless	Satellite, public carriers
Example	Phone ↔ earbuds	School lab	Cable TV network	The Internet

Think & discuss: Board favourite: "Differentiate LAN and MAN/WAN." Practice writing any 4 rows of this table from memory!

SECTION 1.6 · EXAM PRACTICE

🎯 MCQ Drill — Network Types (1/3)

Q1 [K] A network connecting your phone, smartwatch and earbuds is a…

a) LAN
b) MAN
c) PAN
d) WAN

Q2 [K] A school computer lab network is an example of…

a) PAN
b) LAN
c) MAN
d) WAN

Q3 [U] Which network type has the HIGHEST data transfer speed?

a) WAN
b) MAN
c) LAN
d) All equal

Q4 [K] Cable TV and city DSL networks are examples of…

a) PAN
b) LAN
c) MAN
d) WAN

Answer key + explanations: next key slide (and speaker notes)

SECTION 1.6 · EXAM PRACTICE

🎯 MCQ Drill — Network Types (2/3)

Q5 [K] What type of network connects LANs over large areas?

a) PAN
b) MAN
c) WAN
d) CAN

Q6 [U] Which is TRUE about WAN?

a) Owned by one person
b) Highest speed
c) Owned by multiple organizations
d) Limited to one building

Q7 [K] WLAN means…

a) Wide LAN
b) Wireless Local Area Network
c) World LAN
d) Wired LAN

Q8 [A] A company with branches in Kathmandu, Pokhara and Biratnagar needs one network. Which type?

a) PAN
b) LAN
c) MAN
d) WAN

Answer key + explanations: next key slide (and speaker notes)

SECTION 1.6 · EXAM PRACTICE

🎯 MCQ Drill — Network Types (3/3)

Q9 [A] **Transferring photos from phone to laptop via Bluetooth uses which network?**

a) PAN
b) LAN
c) MAN
d) WAN

Q10 [HA] **Why does WAN have higher propagation delay than LAN?**

a) Cheaper cables
b) Signals travel enormous distances via many devices
c) Fewer users
d) Better protocols

Answer key + explanations: next key slide (and speaker notes)

SECTION 1.6 · EXAM PRACTICE

Answer Key — MCQ Drill — Network Types

#	Ans	Why
1	c) PAN	A Personal Area Network connects devices around one person, typically within 10 metres.
2	b) LAN	LANs cover small areas — a room, building or campus up to about 1 km.
3	c) LAN	Short distances, quality cabling and few hops give LANs the fastest, most error-free transfer.
4	c) MAN	MANs span a city/valley — bigger than LAN, smaller than WAN.
5	c) WAN	WANs use satellites and public carriers to span countries and continents — the Internet is the biggest.
6	c) Owned by multiple organizations	No single owner: telephone companies, ISPs, cable systems and satellite operators share it.
7	b) Wireless Local Area Network	A LAN connected through wireless media (Wi-Fi) is called a WLAN.
8	d) WAN	Cities hundreds of km apart exceed MAN range — a WAN using leased lines/Internet links is required.
9	a) PAN	Two personal devices within a few metres = Personal Area Network.
10	b) Signals travel enormous distances via many devices	Data crosses thousands of km through many routers/satellites — each hop and km adds delay.

SECTION 1.6 · EXAM PRACTICE

✍ Short & Long Questions

- [SQ · 2 marks] What is a computer network? How is it useful?
- [SQ · 2 marks] Write any three features of PAN.
- [SQ · 2 marks] Write any three features of WAN.
- [LQ · 4 marks] (Board 2078-style) Differentiate between LAN and MAN.
- [LQ · 4 marks] Explain the four types of networks based on coverage with one example each.
- [HA · 4 marks] (Board-style) Your school wants to network three separate buildings on one compound. Which network type? Justify with communication, file sharing and Internet access.

Model answers: speaker notes below ↓ (full worked answers also in the interactive HTML deck)

1.7

Network Architecture & Protocols

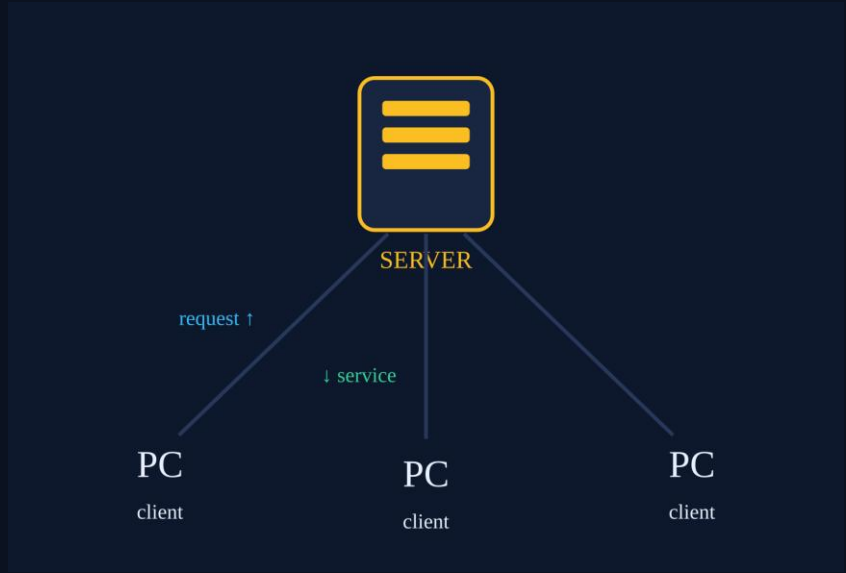
- Compare client-server and peer-to-peer architectures
- State benefits and limitations of each
- Identify 10 key protocols: IP, TCP, HTTP, HTTPS, FTP, SMTP, POP, DNS, DHCP, BGP

🎯 Problem of the day

A restaurant with waiters vs a potluck picnic where everyone shares — two ways to organize people, two ways to organize computers. And like any country, networks need laws. Meet the architectures and their rule-books (protocols).

Client-Server — the restaurant model

- Powerful server provides services; clients request them
- Server = central controller of network resources
- OS: Windows Server, Linux (Ubuntu Server), UNIX
- Examples: school result server, bank systems, Google

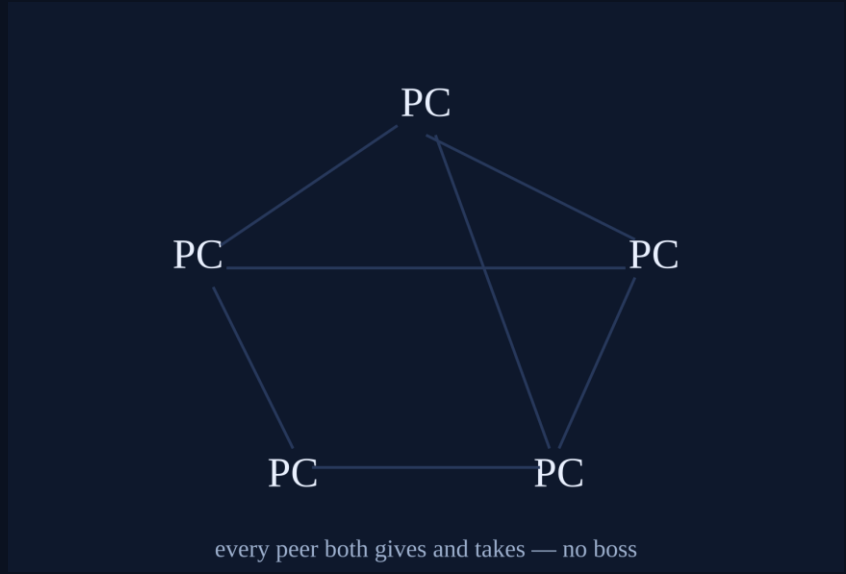


Think & discuss: When you open your school's result website, who is the client? Who is the server? What is requested; what is served?

1.7 · ARCHITECTURE 2

Peer-to-Peer — the potluck model

- All computers are equal — no central server
- Also called a workgroup; each shares own resources
- Best for small offices, rooms, buildings
- Works on Windows 11, macOS, Ubuntu — built-in support



Think & discuss: Group project with no leader: quick to start, but who keeps the master copy? What breaks first as the group grows?

1.7 · FACE-OFF

Client-Server vs Peer-to-Peer

Client-Server ✓ / ✗

- ✓ Centralized backup of all data
- ✓ Dedicated server → faster resource sharing
- ✓ Better security — central administration
- ✗ Costly server + admin needed; server fails → all suffer

Peer-to-Peer ✓ / ✗

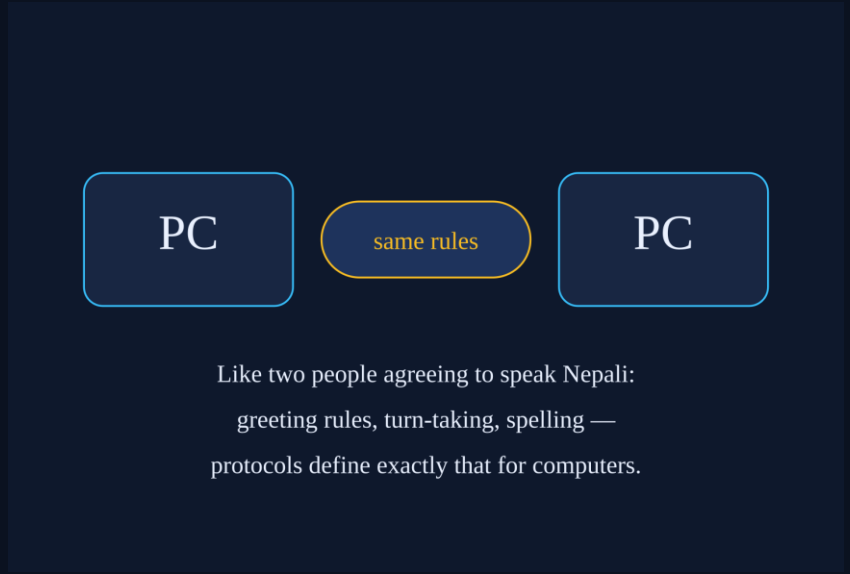
- ✓ Cheap & easy — no server, no admin
- ✓ One computer's failure doesn't stop others
- ✓ Each user controls own shared resources
- ✗ Weak security, scattered data, poor for big networks

Think & discuss: A 4-PC stationery shop vs a 200-PC bank: choose the architecture for each and defend with cost, security, scalability.

1.7 · THE RULE-BOOKS

Protocols — languages of the network

- Protocol = set of rules for communication between computers
- Both sides must "speak" the same protocol
- First protocol ever: NCP (Network Control Protocol)
- Today's Internet runs on the TCP/IP family



Think & discuss: Imagine a phone call where you speak Nepali and they hear only French — that's two devices without a common protocol!

1.7 · PROTOCOL PACK 1

Moving & addressing data

IP — Internet Protocol

Gives every device a unique address; routes packets to the right destination.

TCP — Transmission Control Protocol

Breaks data into packets, checks delivery, reassembles in order. TCP/IP together run the Internet.

DHCP — Dynamic Host Configuration

Automatically hands out IP addresses when devices join a network — no manual setup.

BGP — Border Gateway Protocol

The Internet's postal system between ISPs: chooses routes between large networks worldwide.

Think & discuss: When your phone joins school Wi-Fi and "just works" — which of these four did the silent work first?

1.7 · PROTOCOL PACK 2

Web, files & email

HTTP

Transfers HTML web pages in the WWW.

HTTPS

HTTP + encryption 🔒 — protects passwords & payments from hackers.

FTP

File Transfer Protocol — uploads/downloads files between computers.

SMTP

Simple Mail Transfer Protocol — sends email out.

POP

Post Office Protocol — receives/downloads email to your device.

DNS

Domain Name System — translates names (google.com) into IP addresses.

Think & discuss: Memory trick: SMTP = "Send Mail To People", POP = "Pull Out Post". Invent your own trick for DNS!

1.7 · ANIMATION

One click, five protocols

- You type www.school.edu.np and press Enter
- DNS finds the IP · TCP connects reliably
- HTTPS fetches the page securely over IP routes
- Behind it all, BGP chose paths between ISPs

Think & discuss: DNS = the phonebook, TCP = the courier, HTTPS = the sealed envelope, IP = the address, BGP = the highway planner. Retell the story yourself!

SECTION 1.7 · EXAM PRACTICE

🎯 MCQ Drill — Architecture & Protocols (1/4)

Q1 [K] **In a client-server network, the central controller is the…**

a) Client
b) Server
c) Switch
d) Modem

Q2 [K] **A peer-to-peer network is also called a…**

a) Server farm
b) Workgroup
c) Domain
d) Mainframe

Q3 [U] **Which is an advantage of client-server networks?**

a) No server cost
b) Centralized backup
c) No administrator needed
d) Works only offline

Q4 [K] **A set of rules for communication between computers is called a…**

a) Topology
b) Protocol
c) Architecture
d) Firewall

Answer key + explanations: next key slide (and speaker notes)

SECTION 1.7 · EXAM PRACTICE

🎯 MCQ Drill — Architecture & Protocols (2/4)

Q5 [K] Which was the FIRST network protocol?

a) TCP/IP
b) HTTP
c) NCP
d) FTP

Q6 [K] Which protocol transfers files between computers?

a) FAQ
b) IRC
c) FTP
d) TPF

Q7 [K] Which protocol is used for SENDING email?

a) HTTP
b) FTP
c) SMTP
d) DHCP

Q8 [U] Which protocol translates google.com into an IP address?

a) DNS
b) DHCP
c) BGP
d) POP

Answer key + explanations: next key slide (and speaker notes)

SECTION 1.7 · EXAM PRACTICE

🎯 MCQ Drill — Architecture & Protocols (3/4)

Q9 [U] **Which protocol automatically assigns IP addresses to new devices?**

a) DNS
b) DHCP
c) SMTP
d) HTTPS

Q10 [U] **The 'S' in HTTPS provides…**

a) Speed
b) Security (encryption)
c) Storage
d) Simplicity

Q11 [K] **Which protocol chooses routes BETWEEN large networks/ISPs?**

a) POP
b) BGP
c) FTP
d) NCP

Q12 [A] **An online banking page must be loaded. Which protocol is essential?**

a) HTTP only
b) HTTPS
c) FTP
d) POP

Answer key + explanations: next key slide (and speaker notes)

SECTION 1.7 · EXAM PRACTICE

🎯 MCQ Drill — Architecture & Protocols (4/4)

Q13 [A] **A 4-computer shop with no technician should choose…**

a) Client-server
b) Peer-to-peer
c) Mainframe
d) MAN

Q14 [HA] **Your school server crashes and no computer can access files. This exposes which weakness?**

a) P2P's weak security
b) Client-server's single point of failure
c) DNS caching
d) BGP hijack

Answer key + explanations: next key slide (and speaker notes)

SECTION 1.7 · EXAM PRACTICE

Answer Key — MCQ Drill — Architecture & Protocols

#	Ans	Why
1	b) Server	The server is a specialized computer that controls network resources and provides services to clients.
2	b) Workgroup	With all nodes equal, P2P networks are called workgroups — suitable for small offices.
3	b) Centralized backup	Central storage means one place to back up, secure and administer all data.
4	b) Protocol	Protocols define exactly how data is formatted, sent and received.
5	c) NCP	NCP (Network Control Protocol) came first, later replaced by TCP/IP on the Internet.
6	c) FTP	File Transfer Protocol uploads and downloads files between computers.
7	c) SMTP	Simple Mail Transfer Protocol sends mail; POP receives/downloads it.
8	a) DNS	The Domain Name System is the Internet's phonebook — names in, IP addresses out.
9	b) DHCP	Dynamic Host Configuration Protocol hands out IPs the moment a device joins the network.
10	b) Security (encryption)	HTTPS encrypts data between browser and site, protecting passwords and payments from hackers.
11	b) BGP	Border Gateway Protocol is the routing system connecting the Internet's big networks together.
12	b) HTTPS	Banking demands encryption — HTTPS protects credentials and transactions in transit.
13	b) Peer-to-peer	P2P is cheap, easy, needs no dedicated server or system administrator — perfect for tiny networks.
14	b) Client-server's single point of failure	Central dependence is client-server's cost: when the server dies, dependent services die with it.

SECTION 1.7 · EXAM PRACTICE

✍ Short & Long Questions

- [SQ · 2 marks] What is network architecture? Name its two types.
- [SQ · 2 marks] What is a protocol? Give two examples.
- [SQ · 2 marks] Write the functions of DNS and DHCP.
- [SQ · 2 marks] Differentiate SMTP and POP.
- [SQ · 2 marks] Why is HTTPS preferred over HTTP?
- [LQ · 4 marks] (Board-style) Explain the differences between client-server and peer-to-peer network architectures.
- [HA · 4 marks] (Board-style) Which is more suitable for a small office: client-server or peer-to-peer? Compare cost, security, scalability and management.

Model answers: speaker notes below ↓ (full worked answers also in the interactive HTML deck)

1.8

Concept of IP Addressing

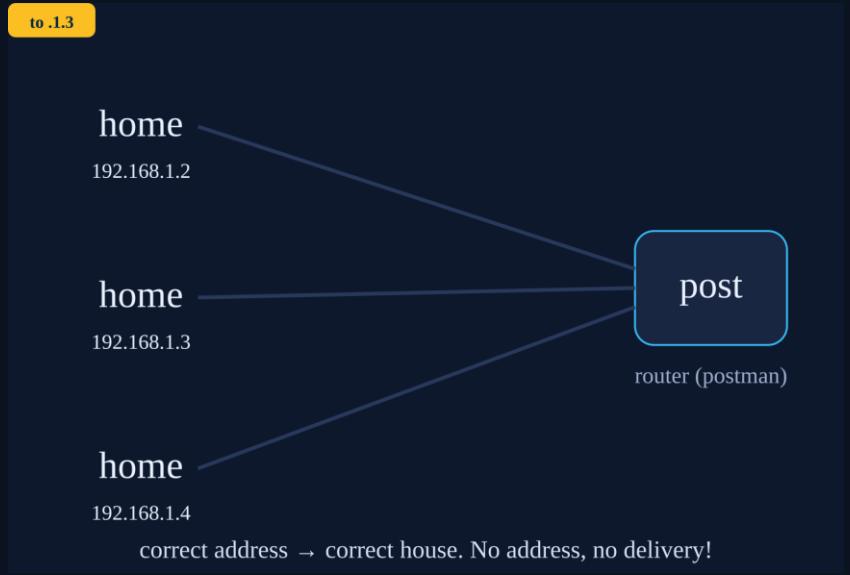
- Explain the purpose of IP addresses
- Describe IPv4 and IPv6 with their features
- Compare IPv4 and IPv6

🎯 Problem of the day

The world has ~8 billion people but IPv4 offers only 4.3 billion addresses — and we ran out! How does your new phone still get online? A 128-bit hero has the answer.

IP address — every device's home address

- IP gives each device a unique address on a network
- Routes data so it reaches the correct destination
- Like a house address for letters — but for packets
- Two versions in use: IPv4 and IPv6

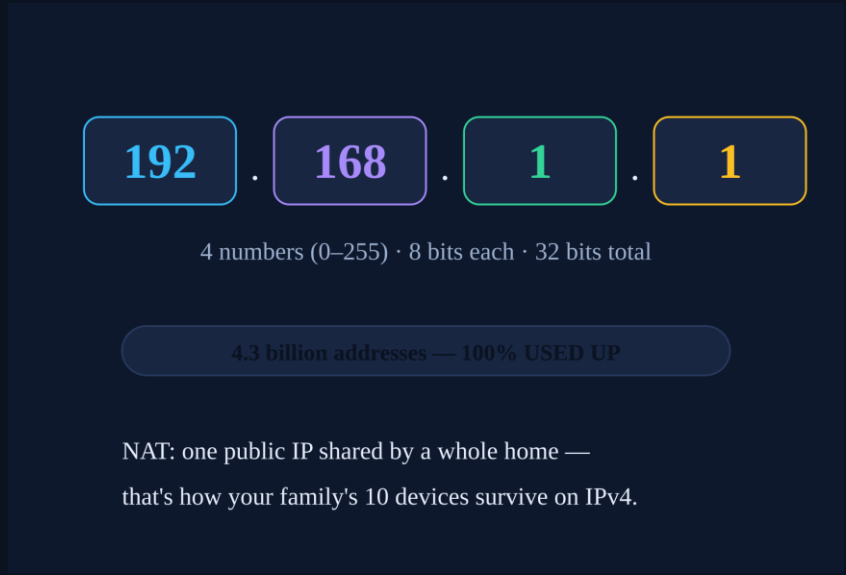


Think & discuss: Book Activity 1.2: open Command Prompt, type ipconfig. Find your IPv4 address, subnet mask and default gateway. What might the gateway be?

1.8 · VERSION 4

IPv4 — the classic that ran out

- 32-bit addresses → ~4.3 billion unique addresses
- Dotted-decimal: four numbers, e.g. 192.168.1.1
- Address exhaustion: devices outgrew supply
- Rescue tricks: NAT & private address ranges



Think & discuss: Estimate: phones + laptops + TVs + IoT ≈ 20+ billion devices. 4.3 billion addresses. What HAD to be invented?

1.8 · VERSION 6

IPv6 — an address for every grain of sand

- 128-bit addresses → 3.4×10^{38} — practically unlimited
- Hexadecimal: 8 colon-separated groups
- Built-in security, auto-configuration, multicast
- Adoption is gradual — IPv4 and IPv6 coexist today

Think & discuss: IPv6 was ready in 1998 — why is adoption still slow? (Hint: cost of replacing what already works.)

1.8 · MASTER TABLE

IPv4 vs IPv6 — board favourite!

IPv4	IPv6
32-bit address length	128-bit address length
Decimal, dotted: 192.168.1.1	Hexadecimal, colons: 2001:0db8:…
~4.29×10^{9} addresses	~3.4×10^{38} addresses
Manual / DHCP configuration	Auto & renumbering configuration
No built-in encryption/authentication	Encryption & authentication provided
Header 20–60 bytes (variable)	Header 40 bytes (fixed)
End-to-end integrity unachievable	End-to-end integrity achievable

Think & discuss: Exam tip: learn any 4 rows perfectly. "Differentiate IPv4 and IPv6" is a recurring board question!

SECTION 1.8 · EXAM PRACTICE

🎯 MCQ Drill — IP Addressing (1/3)

Q1 [K] What is the length of an IPv4 address?

a) 16 bits
b) 32 bits
c) 64 bits
d) 128 bits

Q2 [K] What does an IP address identify?

a) A software
b) A network cable
c) A specific device on the network
d) A computer brand

Q3 [K] IPv6 addresses are written in…

a) Decimal with dots
b) Hexadecimal with colons
c) Binary with spaces
d) Roman numerals

Q4 [U] Why was IPv6 developed?

a) To slow the Internet
b) IPv4 address exhaustion
c) To remove security
d) For gaming only

Answer key + explanations: next key slide (and speaker notes)

SECTION 1.8 · EXAM PRACTICE

🎯 MCQ Drill — IP Addressing (2/3)

Q5 [U] Which technique helps conserve scarce IPv4 addresses?

a) NAT (Network Address Translation)
b) FTP
c) Beamforming
d) FHSS

Q6 [A] 192.168.1.1 is an example of…

a) IPv6 address
b) MAC address
c) IPv4 address
d) Domain name

Q7 [K] How many addresses can IPv6 generate?

a) 4.29×10^{9}
b) 3.4×10^{38}
c) 6.5×10^{12}
d) 100 billion

Q8 [A] Which command shows YOUR device's IP address (Windows)?

a) ping
b) ipconfig
c) tracert
d) nslookup

Answer key + explanations: next key slide (and speaker notes)

SECTION 1.8 · EXAM PRACTICE

🎯 MCQ Drill — IP Addressing (3/3)

Q9 [HA] **Which is TRUE for IPv6 but NOT IPv4?**

a) Uses dots
b) 20–60 byte variable header
c) Built-in encryption & authentication
d) Only manual configuration

Answer key + explanations: next key slide (and speaker notes)

SECTION 1.8 · EXAM PRACTICE

Answer Key — MCQ Drill — IP Addressing

#	Ans	Why
1	b) 32 bits	IPv4 uses 32 bits — four 8-bit numbers in dotted decimal, e.g. 192.168.1.1.
2	c) A specific device on the network	Every device gets a unique IP so data can be routed to exactly the right destination.
3	b) Hexadecimal with colons	Eight groups of four hex digits separated by colons, e.g. 2001:0db8:85a3:…:7334.
4	b) IPv4 address exhaustion	IPv4's 4.3 billion addresses ran out; IPv6's 128 bits give 3.4×10^{38} addresses.
5	a) NAT (Network Address Translation)	NAT lets many home devices share one public IPv4 address; private ranges help too.
6	c) IPv4 address	Four decimal numbers separated by dots = IPv4 (this one is a common private router address).
7	b) 3.4×10^{38}	3.4×10^{38} — enough to address practically every object on Earth many times over.
8	b) ipconfig	ipconfig displays IPv4/IPv6 address, subnet mask and default gateway.
9	c) Built-in encryption & authentication	IPv6 provides encryption/authentication and auto-configuration; its header is fixed 40 bytes.

SECTION 1.8 · EXAM PRACTICE

✍ Short & Long Questions

- [SQ · 2 marks] What is IP? What is it responsible for?
- [SQ · 2 marks] What is IPv4 address exhaustion? How is it handled?
- [SQ · 2 marks] Write any three features of IPv6.
- [LQ · 4 marks] (Board favourite) Differentiate between IPv4 and IPv6 (any four points).
- [HA · 4 marks] Your home router shows devices as 192.168.1.x but websites see one different address. Explain what is happening and why.

Model answers: speaker notes below ⌄ (full worked answers also in the interactive HTML deck)

1.9

Internet · Intranet · Extranet

- Define Internet, intranet and extranet
- Compare the three by access, purpose and security
- Use network commands: ping, ipconfig, tracert, nslookup

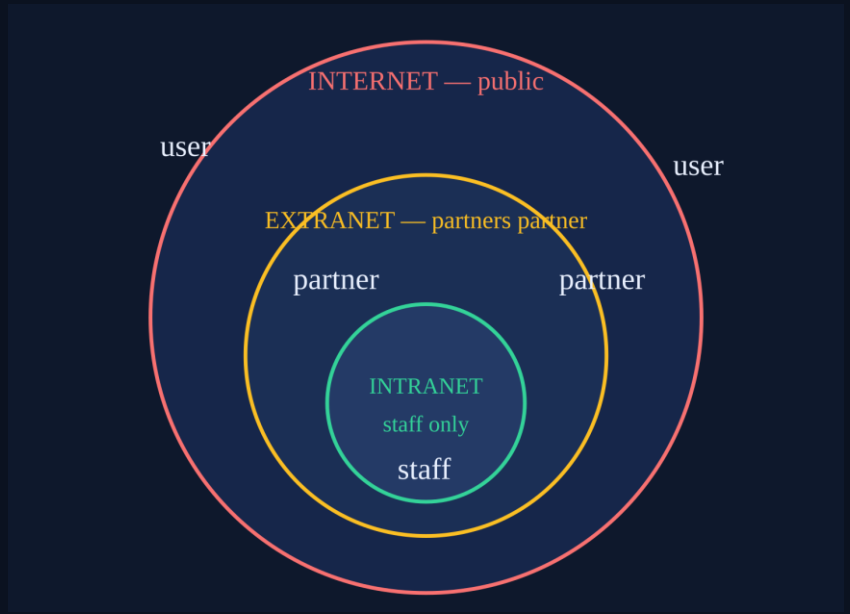
🎯 Problem of the day

A bank has: a public website for everyone, an internal portal only staff can open, and a secure portal its partner insurance company logs into. Three networks, three doors, three keys. Which is which?

1.9 · THE THREE RINGS

Who can enter which network?

- Internet: global network — everyone can access
- Intranet: private — only organization's staff
- Extranet: intranet + selected outsiders (partners, clients)
- All three use the same TCP/IP technologies



Think & discuss: Map the bank story: public website → ? · staff portal → ? · insurance partner portal → ?

1.9 · ONE BY ONE

Internet, Intranet, Extranet defined

Internet

- Global network of networks using TCP/IP
- Web, email, social media, shopping, streaming
- Less secure — needs firewalls, precautions

Intranet

- Private network within an organization
- Internal websites, file sharing, collaboration
- Goal: communication, productivity, easy resources

Extranet

- Controlled access for selected outsiders
- Vendor portals, client access systems
- Secure but balances outside accessibility

Think & discuss: Your school's e-library visible only inside campus = ? If parents get login access from home, it becomes = ?

1.9 · MASTER TABLE

Internet vs Intranet vs Extranet

	Internet	Intranet	Extranet
Access	Public — anyone	Organization staff only	Staff + authorized partners
Purpose	Connect people worldwide	Share within organization	Share with partner organizations
Security	Less secure; needs firewalls	More secure, restricted	Secure with balanced access
Example	Google, Facebook	Company portal	Vendor/client portals

Think & discuss: Which of the three would host: SEE results website? Teachers' internal mark-entry system? A bookseller's order portal for schools?

1.9 · HANDS-ON LAB

Four commands every networker knows

ping google.com

Tests if a device/website is reachable. Replies + time in ms = connection alive. Try: ping your own router!

ipconfig

Shows your IP address, subnet mask and default gateway — your device's network identity card.

tracert google.com

Traces every hop your data takes to a destination. Count the routers between you and Google!

nslookup google.com

Asks DNS for a domain's IP address — see the phonebook answer with your own eyes.

Think & discuss: Book Activity 1.3: run all four commands in your lab. Screenshot each. Which country did your tracert packets visit?

SECTION 1.9 · EXAM PRACTICE

🎯 MCQ Drill — Internet · Intranet · Extranet (1/3)

Q1 [K] The global network connecting millions of networks is the…

a) Intranet
b) Extranet
c) Internet
d) LAN

Q2 [K] A private network accessible ONLY to an organization's staff is an…

a) Internet
b) Intranet
c) Extranet
d) Ethernet

Q3 [K] A network giving controlled access to partners/clients is an…

a) Intranet
b) Internet
c) Extranet
d) ARPANET

Q4 [U] Which is an example of an extranet use?

a) Facebook
b) Vendor portal for suppliers
c) School lab LAN
d) FM radio

Answer key + explanations: next key slide (and speaker notes)

SECTION 1.9 · EXAM PRACTICE

🎯 MCQ Drill — Internet · Intranet · Extranet (2/3)

Q5 [A] Which command tests if a website is reachable?

a) ping
b) ipconfig
c) dir
d) copy

Q6 [A] Which command traces the path (hops) to a destination?

a) nslookup
b) tracert
c) ping
d) format

Q7 [A] Which command asks DNS for a domain's IP address?

a) ipconfig
b) nslookup
c) tracert
d) chkdsk

Q8 [U] Which is generally LEAST secure and needs firewalls?

a) Intranet
b) Extranet
c) Internet
d) All equal

Answer key + explanations: next key slide (and speaker notes)

SECTION 1.9 · EXAM PRACTICE

🎯 MCQ Drill — Internet · Intranet · Extranet (3/3)

Q9 [HA] **Teachers' internal mark-entry portal, unreachable from home, is an…**

a) Internet
b) Intranet
c) Extranet
d) PAN

Answer key + explanations: next key slide (and speaker notes)

SECTION 1.9 · EXAM PRACTICE

Answer Key — MCQ Drill — Internet · Intranet · Extranet

#	Ans	Why
1	c) Internet	The Internet connects private, public, academic, business and government networks worldwide via TCP/IP.
2	b) Intranet	Intranets use Internet technologies (TCP/IP, HTTP) but restrict access to employees.
3	c) Extranet	An extranet extends the intranet to selected, authorized external users.
4	b) Vendor portal for suppliers	Vendor portals and client access systems are classic extranets — outsiders with controlled logins.
5	a) ping	ping sends echo requests; replies with times prove the connection works.
6	b) tracert	tracert lists every router your packets cross — great for finding where delays occur.
7	b) nslookup	nslookup queries the DNS system directly, e.g. nslookup www.google.com.
8	c) Internet	Public access makes the Internet least secure; intranets/extranets restrict who can enter.
9	b) Intranet	Access limited to the organization's own network/staff = intranet. Give parents remote logins and it b…

SECTION 1.9 · EXAM PRACTICE

✍ Short & Long Questions

- [SQ · 2 marks] What is the Internet? List any four services it provides.
- [SQ · 2 marks] What is an intranet? What is its main goal?
- [SQ · 2 marks] Define extranet with one example.
- [SQ · 2 marks] State the purpose of ping and tracert commands.
- [LQ · 4 marks] Compare Internet, intranet and extranet (any four points).
- [HA · 4 marks] A hospital wants: a public site for appointments, an internal system for staff records, and lab-report access for partner clinics. Name each network type and one security measure for each.

Model answers: speaker notes below ↓ (full worked answers also in the interactive HTML deck)

Real-Life Problem Clinic

- Apply the whole unit to real situations — the way boards test Application & Higher Ability
- Method: read the case → answer the leading questions YOURSELF → then reveal the solution

🎯 How to use this clinic

Teachers: give each case to a group, let them argue through the leading questions for 5 minutes, then reveal. Students at home: write your answer BEFORE clicking — that's where learning happens.

PROBLEM CLINIC · CASE 1 (BOOK CASE STUDY 1)

The 36-computer lab

THE SITUATION A school modernizes its lab: 36 computers, all need Internet and instant file sharing. The network must be stable and easy to maintain.

Focus concepts: star topology, switch, Ethernet cables, LAN.

WORK IT OUT FIRST — leading questions

① What happens in bus/ring if one cable fails during an exam?

② How many switch ports do 36 PCs need?

③ Which cable type and why?

④ Where does Internet enter the design?

Think in groups first. Sketch your design on paper — then open the solution below and compare.

PROBLEM CLINIC · CASE 1 (BOOK CASE STUDY 1)

Model solution — The 36-computer lab

Recommendation: star topology LAN.

- ✓ Use one 48-port gigabit switch (or two 24-port switches linked): 36 PCs + printer + server + growth room.
- ✓ CAT6 cables (≤100 m runs) from each PC to the switch — 1 Gbps sharing = 'instant' file transfer.
- ✓ Stability: one faulty PC/cable affects only itself; bus/ring would fail entirely.
- ✓ Maintenance: all cables meet at one rack — faults found in minutes.
- ✓ Internet: router connects switch to ISP (fiber + media converter if needed).

PROBLEM CLINIC · CASE 2 (BOOK CASE STUDY 2)

Wi-Fi dies upstairs

THE SITUATION A student's home Wi-Fi works on the ground floor but is very slow on the first floor.

Focus concepts: Wi-Fi, bandwidth, signal interference, repeater, router placement.

WORK IT OUT FIRST — leading questions

① What weakens a 2.4/5 GHz signal between floors?
② Is bandwidth or throughput low upstairs?
③ Which cheap device from 1.4 extends signals?
④ Where would YOU place the router in a 2-floor house?

Hypothesize at least 3 causes and match a fix to each before revealing.

PROBLEM CLINIC · CASE 2 (BOOK CASE STUDY 2)

Model solution — Wi-Fi dies upstairs

Causes: concrete floors/walls absorb the signal; distance from router; interference (microwave, neighbours' Wi-Fi on same channel); router placed in a corner.Solutions:

- ✓ Move the router to a central, elevated spot (near the staircase).
- ✓ Add a Wi-Fi repeater/extender at the stair landing — regenerates the weak signal (repeater concept!).
- ✓ Use 2.4 GHz upstairs (better wall penetration); change to a less crowded channel.
- ✓ Best fix: run one CAT6 to the first floor and add an access point — wired backbone, wireless edge.

PROBLEM CLINIC · CASE 3 (BOOK CASE STUDY 3)

🏢 Birgunj office: 3G → 5G

THE SITUATION A Birgunj office on 3G with obsolete devices wants 5G for faster communication and cloud access.

Focus concepts: 3G vs 4G vs 5G, throughput, latency, IoT, mobile broadband.

WORK IT OUT FIRST — leading questions

① What EXACTLY improves from 3G→5G (name 3 metrics)?
② Which devices must be replaced for 5G?
③ What cloud benefits appear at low latency?
④ Any risk in upgrading everything at once?

Draft an upgrade plan with a budget order: what first, what later?

PROBLEM CLINIC · CASE 3 (BOOK CASE STUDY 3)

Model solution — Birgunj office: 3G → 5G

Benefits of 5G: far higher throughput (fast cloud file access), ultra-low latency (smooth video meetings, real-time apps), massive device support (office IoT — smart attendance, sensors, cameras).Upgrade plan:

- ✓ Replace 3G modems/routers with 5G-capable router (or fiber + 5G backup).
- ✓ Replace hubs with gigabit switches; ensure CAT6 cabling.
- ✓ Move services to cloud gradually; test with one team first.
- ✓ Keep 4G fallback — 5G coverage in Birgunj may still be growing.

PROBLEM CLINIC · CASE 4

🏠 Design a home network (board LQ!)

THE SITUATION (Board LQ) Create a home network: 3 PCs, 1 printer, 1 mobile — all on the Internet. Describe devices, connection types and technologies.

This exact question appears in the CDC book exercise — practice it as a diagram + description.

WORK IT OUT FIRST — leading questions

① Which device shares one Internet line among all?

② Wired or wireless for each gadget — decide and justify.

③ Where does the printer connect so ALL can print?

④ Draw it: ISP → ? → devices.

Sketch first! A labelled diagram earns marks in the board exam.

PROBLEM CLINIC · CASE 4

💡 Model solution — Design a home network (board LQ!)

Design: ISP line (fiber/DSL) → Wi-Fi router (the heart: modem + router + switch + access point).

✓ 3 PCs → wired CAT6 to router LAN ports (stable, fast for study/work), or Wi-Fi if rooms are far.

✓ Printer → connect to router (USB/Ethernet/Wi-Fi) so every device can print.

✓ Mobile → Wi-Fi (2.4 GHz for range or 5 GHz near router).

✓ Technologies: star topology, DHCP auto-assigns IPs, NAT shares one public IP, WPA2/3 password secures Wi-Fi.

PROBLEM CLINIC · CASE 5

Two buildings, one network

THE SITUATION A campus must join the LANs of two buildings 300 m apart (a road crosses between). Budget is limited but speed matters.

Focus concepts: CAT6 100 m limit, fiber, media converters, wireless bridge, repeater.

WORK IT OUT FIRST — leading questions

① Why does plain CAT6 fail here?

② List every option: repeaters? fiber? wireless bridge?

③ What can cross a road without digging?

④ Compare each on cost, speed, weather-resistance.

Build a comparison table of at least 3 options before revealing.

PROBLEM CLINIC · CASE 5

Model solution — Two buildings, one network

Options analysis:Verdict: fiber if digging is permitted; wireless bridge if the road cannot be crossed. State the trade-off — that's the higher-ability marks.

✓ CAT6 alone ✗ — 300 m > 100 m limit; two repeaters possible but messy and still copper across a road.

✓ Fiber + 2 media converters ✓ (best) — Gbps speed, kilometres of range, immune to weather/interference; needs one-time digging/permission for road crossing.

✓ Wireless point-to-point bridge ✓ (fallback) — no digging, quick; but weather and obstacles reduce reliability.

PROBLEM CLINIC · CASE 6

"Our Internet is slow!" — the diagnosis drill

THE SITUATION The computer teacher challenges you: 'Our staff-room Internet is slow. Diagnose it like a professional — no guessing!'

Focus concepts: throughput vs bandwidth, ping, tracert, ipconfig, interference, hub vs switch.

WORK IT OUT FIRST — leading questions

① Which command proves the connection is alive and measures delay?
② How do you separate 'slow Wi-Fi' from 'slow ISP'?
③ What does high ping to the ROUTER itself indicate?
④ Which old device in the rack could be broadcasting wastefully?

Write a numbered diagnosis procedure (like a doctor's checklist) before revealing.

PROBLEM CLINIC · CASE 6

💡 Model solution — "Our Internet is slow!" — the diagnosis drill

- ✓ ipconfig — confirm valid IP & gateway (DHCP working?).
- ✓ ping [router IP] — high/lost replies ⇒ local problem: Wi-Fi interference, bad cable, overloaded hub → test wired, replace hub with switch.
- ✓ ping google.com — fails while router ping works ⇒ ISP/DNS issue; try nslookup to isolate DNS.
- ✓ tracert google.com — find WHICH hop delays: inside school ⇒ our equipment; beyond ⇒ call the ISP with evidence.
- ✓ Speed test at different times ⇒ if only evenings are slow, it's peak-hour congestion (throughput vs bandwidth!).

UNIT 1 COMPLETE

You can now explain the Internet 🎓

Remember the first slide? Take out your list of guesses about the message to Sydney — how many did you get right?

✅ Board-exam checklist

□ All full forms (DSL, RFID, CAT6, TCP/IP, IPv6…) □ IPv4 vs IPv6 table □ Guided vs unguided table □ LAN vs MAN □ Client-server vs P2P □ One topology diagram drawn from memory □ All 6 clinic cases attempted