Grade 12 A/L ICT

Lesson 6: Data Communication and Networking

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- 6.12 ISPs, Home Networks and NAT

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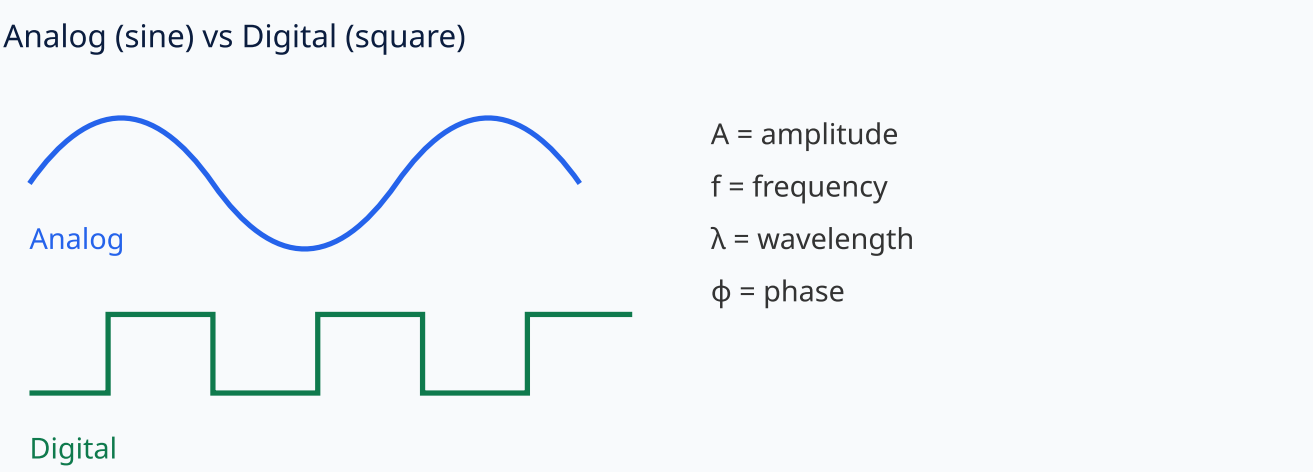
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6.1 Signals and Their Properties

Syllabus 6.1. Data moves as **signals**. Compare **analog** and **digital** and study **amplitude**, **frequency**, **wavelength**, **phase** and **propagation speed** (λ = v / f).

1. Analog and digital

Analog varies smoothly. **Digital** uses discrete levels (often two voltages for 0 and 1).



Analog vs digital

2. Properties

- **Amplitude** – height/strength.
- **Frequency f** – cycles/s (Hz).
- **Wavelength λ = v/f**.
- **Phase** – timing in the cycle.
- **Propagation speed** – depends on medium.

🧱 **Worked example: f=100 MHz, v=3×10⁸ m/s. Find λ and T.**
λ=3 m; T=10 ns.

💡 Higher f → shorter λ at same speed.

🚀 **Beyond the syllabus (2026 update)** *Not required for the exam – read for interest.* 5G/Wi-Fi still use frequency bands; exam wants λ=v/f and sketches.

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Key Words

Analog signal – Smooth continuous signal.	**Digital signal** – Discrete-level signal.
Amplitude – Height/strength of a wave.	**Frequency** – Cycles per second (Hz).
Wavelength – λ = v/f.	**Phase** – Timing offset in a cycle.
Propagation speed – Wave speed in a medium.	**Hertz** – Unit of frequency.
Period – T = 1/f.	**Medium** – Path the signal travels.
Bit – Binary 0 or 1.	**Sine wave** – Common analog shape.

Sample Q&A

1. Define analog vs digital.

> **Answer:** Analog continuous; digital discrete.

2. What is frequency?

> **Answer:** Cycles per second (Hz).

3. State λ = ?

> **Answer:** v/f.

4. What is phase?

> **Answer:** Timing position in the cycle.

5. λ for 100 MHz at 3e8 m/s?

> **Answer:** 3 m.

6. Why does medium matter?

> **Answer:** Sets propagation speed and delay.

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MCQ

1. A digital signal mainly uses

A. random heat
B. paper letters
C. discrete levels such as two voltages
D. only smooth sine waves
E. folder icons

2. Frequency unit

A. metres only
B. amperes only
C. candela
D. kilograms
E. hertz (Hz)

3. λ equals

A. v / f
B. v + f
C. f / v
D. v × f
E. 1 / v

4. f=100 MHz, v=3×10^8 → λ

A. 300 m
B. 0.3 m
C. 3 km
D. 3 m
E. 30 m

5. Period T

A. v × f
B. v + f
C. 1 / f
D. λ × f
E. f

6. Amplitude is

A. IP address
B. height or strength of the wave
C. GUI theme
D. MAC address
E. port number

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7. Phase describes

A. timing shift within the cycle
B. disk size
C. printer ink
D. CPU brand
E. cable colour

8. Propagation speed depends on

A. folder icon
B. file name
C. the medium
D. username
E. GUI theme

9. Which term means: “Smooth continuous signal”?

A. Amplitude
B. Bit
C. Phase
D. Hertz
E. Analog signal

10. Which term means: “Discrete-level signal”?

A. Period
B. Digital signal
C. Propagation speed
D. Sine wave
E. Frequency

11. Which term means: “Height/strength of a wave”?

A. Hertz
B. Wavelength
C. Analog signal
D. Medium
E. Amplitude

12. Which term means: “Cycles per second (Hz)”?

A. Bit
B. Digital signal
C. Period
D. Frequency
E. Phase

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13. Which term means: “λ = v/f”?

A. Medium
B. Amplitude
C. Sine wave
D. Wavelength
E. Propagation speed

14. Which term means: “Timing offset in a cycle”?

A. Phase
B. Analog signal
C. Hertz
D. Bit
E. Frequency

15. Which term means: “Wave speed in a medium”?

A. Propagation speed
B. Sine wave
C. Period
D. Wavelength
E. Digital signal

16. Which term means: “Unit of frequency”?

A. Medium
B. Amplitude
C. Analog signal
D. Phase
E. Hertz

17. Which term means: “T = 1/f”?

A. Bit
B. Period
C. Digital signal
D. Frequency
E. Propagation speed

18. Which term means: “Path the signal travels”?

A. Hertz
B. Sine wave
C. Medium
D. Amplitude
E. Wavelength

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19. Which term means: “Binary 0 or 1”?

A. Period
B. Bit
C. Analog signal
D. Frequency
E. Phase

20. Which term means: “Common analog shape”?

A. Propagation speed
B. Wavelength
C. Medium
D. Sine wave
E. Digital signal

Structured Questions

1. Define analog and digital. *(2 marks)*

> Analog continuous; digital discrete.

2. List four properties. *(4 marks)*

> Amplitude; frequency; wavelength; phase.

3. Compute λ and T for f=100 MHz, v=3×10^8. *(2 marks)*

> λ=3 m; T=10 ns.

4. Explain propagation speed. *(2 marks)*

> How fast the wave travels in the medium.

5. Why sketch both types? *(2 marks)*

> Contrast smooth vs stepped bit levels.

Summary

- Analog vs digital signals.
- Amplitude, f, λ, phase.
- λ=v/f, T=1/f.
- Speed depends on medium.
- Digital levels encode bits.

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MCQ answer key – 6.1

1. **C** – Discrete levels.
2. **E** – Hz.
3. **A** – λ=v/f.
4. **D** – 3 m.
5. **C** – T=1/f.
6. **B** – Height.
7. **A** – Timing.
8. **C** – Medium.
9. **E** – Analog signal – Smooth continuous signal.
10. **B** – Digital signal – Discrete-level signal.
11. **E** – Amplitude – Height/strength of a wave.
12. **D** – Frequency – Cycles per second (Hz).
13. **D** – Wavelength – λ = v/f.
14. **A** – Phase – Timing offset in a cycle.
15. **A** – Propagation speed – Wave speed in a medium.
16. **E** – Hertz – Unit of frequency.
17. **B** – Period – T = 1/f.
18. **C** – Medium – Path the signal travels.
19. **B** – Bit – Binary 0 or 1.
20. **D** – Sine wave – Common analog shape.

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6.2 Signal Transmission Media

Syllabus 6.2. Signals need a **medium**. You classify **guided** (wires, fiber) and **unguided** (free space) media and explain **latency**, **bandwidth**, **noise**, **attenuation** and **distortion**, plus a simple **point-to-point** link.

1. Guided vs unguided

Guided media guide the signal along a path: twisted pair, coaxial cable, optical fiber. **Unguided** media use free space (radio, microwave, infrared, Wi-Fi).



Guided and unguided media

2. Transmission qualities

- **Latency** – delay before data arrives.
- **Bandwidth** – how much data per second the channel can carry.
- **Noise** – unwanted extra signals.
- **Attenuation** – signal gets weaker with distance.
- **Distortion** – shape of the signal changes.

🧱 **Worked example: A 5 MB file on a 10 Mbps link. Transmission time ≈ size_bits / bandwidth.**
$5 \times 8 \times 1024 \times 1024 / 10 \times 10^6 \approx$ **4.19 s**.

🧱 **Worked example: Fiber path 1500 km at 2×10^8 m/s. Propagation delay?**
$1.5 \times 10^6 / 2 \times 10^8 =$ **7.5 ms**.

💡 Point-to-point = one link between two ends.

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🚀 **Beyond the syllabus (2026 update)** *Not required for the exam – read for interest.* Home fiber (FTTH) and 5G still fight latency, noise and attenuation – same syllabus words, faster hardware.

Key Words

Guided media – Signal follows a cable/fiber path.	**Unguided media** – Signal through free space.
Twisted pair – Two insulated wires twisted together.	**Coaxial cable** – Centre conductor with shield.
Optical fiber – Glass/plastic guiding light.	**Latency** – Delay before data arrives.
Bandwidth – Data capacity per second.	**Noise** – Unwanted interference.
Attenuation – Loss of signal strength with distance.	**Distortion** – Change of signal shape.
Point-to-point – Direct link between two nodes.	**Free space** – Air/vacuum as unguided medium.

Sample Q&A

1. Name three guided media.

> **Answer:** Twisted pair, coaxial, optical fiber.

2. What is latency?

> **Answer:** Delay before data arrives.

3. What is bandwidth?

> **Answer:** How much data per second a channel can carry.

4. Attenuation means?

> **Answer:** Signal weakens with distance.

5. Tx time for 5 MB at 10 Mbps?

> **Answer:** ≈ 4.19 s.

6. Prop delay 1500 km at 2e8 m/s?

> **Answer:** 7.5 ms.

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MCQ

1. Guided media include

A. twisted pair, coaxial and fiber
B. only Wi-Fi air
C. paper mail
D. only vacuum
E. USB icons

2. Unguided media use

A. only paper
B. free space
C. only copper cores
D. only USB sticks
E. only glass cores

3. Latency is

A. delay before data arrives
B. GUI theme
C. cable colour
D. font name
E. folder size

4. Bandwidth is about

A. user passwords
B. screen brightness
C. data capacity per second
D. cable paint
E. mouse DPI

5. Attenuation means

A. MAC doubles
B. signal gets weaker with distance
C. IP changes colour
D. ports freeze
E. signal gets louder always

6. 5 MB at 10 Mbps ≈

A. 0 s
B. 1 year
C. 10 hours
D. 4.19 s
E. 7.5 ms

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7. 1500 km at 2×10^8 m/s delay

A. 7.5 ms
B. 1 hour
C. 75 ms
D. 0 ms
E. 7.5 s

8. Point-to-point means

A. a full mesh only
B. no link at all
C. only satellites
D. only hubs
E. a direct link between two ends

9. Which term means: “Signal follows a cable/fiber path”?

A. Guided media
B. Point-to-point
C. Latency
D. Twisted pair
E. Noise

10. Which term means: “Signal through free space”?

A. Coaxial cable
B. Unguided media
C. Attenuation
D. Free space
E. Bandwidth

11. Which term means: “Two insulated wires twisted together”?

A. Guided media
B. Noise
C. Distortion
D. Twisted pair
E. Optical fiber

12. Which term means: “Centre conductor with shield”?

A. Latency
B. Point-to-point
C. Unguided media
D. Attenuation
E. Coaxial cable

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13. Which term means: “Glass/plastic guiding light”?

A. Distortion
B. Bandwidth
C. Twisted pair
D. Free space
E. Optical fiber

14. Which term means: “Delay before data arrives”?

A. Noise
B. Latency
C. Guided media
D. Point-to-point
E. Coaxial cable

15. Which term means: “Data capacity per second”?

A. Attenuation
B. Unguided media
C. Optical fiber
D. Bandwidth
E. Free space

16. Which term means: “Unwanted interference”?

A. Twisted pair
B. Guided media
C. Noise
D. Distortion
E. Latency

17. Which term means: “Loss of signal strength with distance”?

A. Bandwidth
B. Unguided media
C. Coaxial cable
D. Attenuation
E. Point-to-point

18. Which term means: “Change of signal shape”?

A. Optical fiber
B. Noise
C. Distortion
D. Free space
E. Twisted pair

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19. Which term means: “Direct link between two nodes”?

A. Guided media
B. Attenuation
C. Point-to-point
D. Coaxial cable
E. Latency

20. Which term means: “Air/vacuum as unguided medium”?

A. Optical fiber
B. Unguided media
C. Bandwidth
D. Distortion
E. Free space

Structured Questions

1. Classify guided and unguided media with examples. *(2 marks)*

> Guided: TP/coax/fiber; unguided: radio/Wi-Fi.

2. Explain latency and bandwidth. *(2 marks)*

> Latency=delay; bandwidth=capacity per second.

3. How do noise, attenuation and distortion affect transmission? *(3 marks)*

> Noise adds errors; attenuation weakens; distortion changes shape.

4. Calculate tx time for 5 MB on 10 Mbps. *(2 marks)*

> ≈4.19 s.

5. Calculate prop delay 1500 km at 2e8 m/s. *(2 marks)*

> 7.5 ms.

Summary

- Guided vs unguided media.
- Latency, bandwidth, noise.
- Attenuation and distortion.
- Tx time = size/bandwidth.
- Prop delay = distance/speed.

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MCQ answer key – 6.2

1. **A** – Cables/fiber.
2. **B** – Free space.
3. **A** – Delay.
4. **C** – Capacity.
5. **B** – Weaker.
6. **D** – ≈4.19 s.
7. **A** – 7.5 ms.
8. **E** – Two ends.
9. **A** – Guided media – Signal follows a cable/fiber path.
10. **B** – Unguided media – Signal through free space.
11. **D** – Twisted pair – Two insulated wires twisted together.
12. **E** – Coaxial cable – Centre conductor with shield.
13. **E** – Optical fiber – Glass/plastic guiding light.
14. **B** – Latency – Delay before data arrives.
15. **D** – Bandwidth – Data capacity per second.
16. **C** – Noise – Unwanted interference.
17. **D** – Attenuation – Loss of signal strength with distance.
18. **C** – Distortion – Change of signal shape.
19. **C** – Point-to-point – Direct link between two nodes.
20. **E** – Free space – Air/vacuum as unguided medium.

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6.3 Digital Data Encoding and Parity

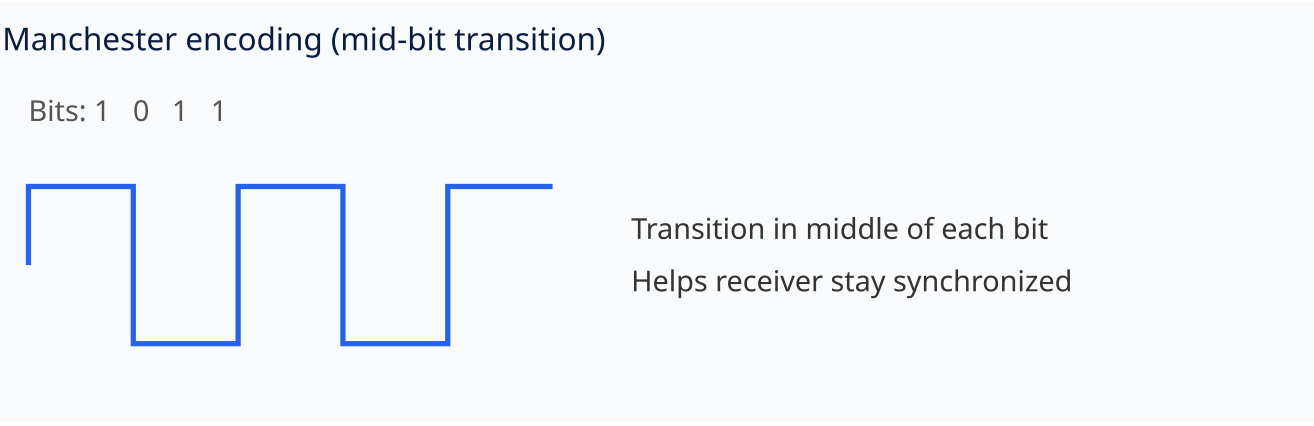
Syllabus 6.3. Digital bits are sent as agreed **signal elements** (e.g. two voltages). You meet **Manchester encoding**, the need for **synchronization**, and **parity** for detecting bit errors.

1. Signal elements and protocols

Sender and receiver must **agree** what voltage (or frequency/phase change) means 0 or 1 – that agreement is part of a **protocol**.

2. Manchester and sync

Manchester encoding puts a transition in the middle of each bit so the receiver can recover timing. Without sync, bits are misread.



Manchester mid-bit transitions

Simple two-voltage coding can change once per bit; Manchester often needs about **twice** the signal-element rate for the same bit rate.

3. Parity

An extra **parity bit** makes the number of 1s even (or odd). One flipped data bit changes parity and can be **detected** (not always corrected).

🧱 **Worked example: Bits 1011001 (four 1s). Even parity bit?**
Already even → parity bit **0**.

🚀 **Beyond the syllabus (2026 update)** *Not required for the exam – read for interest.* Modern links use CRC and FEC; parity still teaches the exam idea of an extra check bit.

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Key Words

Signal element – Physical change that stands for a bit.	**Protocol** – Agreed rules for communication.
Manchester encoding – Mid-bit transition coding.	**Synchronization** – Keeping sender and receiver clocks aligned.
Parity bit – Extra bit for even/odd check.	**Even parity** – Total number of 1s made even.
Odd parity – Total number of 1s made odd.	**Bit rate** – Bits sent per second.
Baud – Signal-element changes per second.	**Error detection** – Finding that a bit error occurred.
Voltage level – Common two-level signal element.	**Clock** – Timing reference for sampling bits.

Sample Q&A

1. What is a signal element?

> **Answer:** Physical representation of a bit (e.g. voltage).

2. Why Manchester helps sync?

> **Answer:** Mid-bit transition recovers timing.

3. What if clocks disagree?

> **Answer:** Bits are sampled wrongly.

4. Even parity for 1011001?

> **Answer:** 0 (already even).

5. Parity detects what?

> **Answer:** Many single-bit errors.

6. Manchester vs simple 2-level rate?

> **Answer:** Often ~2× signal changes per bit.

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MCQ

1. Manchester places a transition

A. never
B. in the middle of each bit
C. only in DNS
D. only at dawn
E. only in IP headers

2. Parity bit is used to

A. paint cables
B. charge batteries
C. help detect bit errors
D. name folders
E. set GUI themes

3. Even parity for 1011001

A. undefined
B. parity 11
C. 1
D. 0
E. 2

4. Without synchronization

A. DNS vanishes
B. bits may be misread
C. cables paint themselves
D. printers invent ink
E. OSI deletes layer 1

5. A protocol here means

A. a school bell only
B. a lunch break
C. a textbook cover
D. a chair
E. agreed rules including signal meanings

6. Bit rate measures

A. cows per farm
B. tabs per browser
C. metres per bit
D. icons per desktop
E. bits per second

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7. Two voltage levels can encode

A. binary 0 and 1
B. only temperatures of tea
C. only font sizes
D. only colours
E. only smells

8. Odd parity makes

A. the MAC empty
B. the IP private
C. the count of 1s odd
D. the fiber dark
E. the port 80 only

9. Which term means: “Physical change that stands for a bit”?

A. Signal element
B. Manchester encoding
C. Even parity
D. Voltage level
E. Bit rate

10. Which term means: “Agreed rules for communication”?

A. Odd parity
B. Protocol
C. Clock
D. Baud
E. Synchronization

11. Which term means: “Mid-bit transition coding”?

A. Manchester encoding
B. Bit rate
C. Parity bit
D. Signal element
E. Error detection

12. Which term means: “Keeping sender and receiver clocks aligned”?

A. Voltage level
B. Even parity
C. Baud
D. Protocol
E. Synchronization

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13. Which term means: “Extra bit for even/odd check”?

A. Odd parity
B. Manchester encoding
C. Error detection
D. Parity bit
E. Clock

14. Which term means: “Total number of 1s made even”?

A. Voltage level
B. Bit rate
C. Synchronization
D. Even parity
E. Signal element

15. Which term means: “Total number of 1s made odd”?

A. Clock
B. Protocol
C. Odd parity
D. Baud
E. Parity bit

16. Which term means: “Bits sent per second”?

A. Bit rate
B. Signal element
C. Error detection
D. Manchester encoding
E. Even parity

17. Which term means: “Signal-element changes per second”?

A. Synchronization
B. Voltage level
C. Baud
D. Odd parity
E. Protocol

18. Which term means: “Finding that a bit error occurred”?

A. Parity bit
B. Manchester encoding
C. Bit rate
D. Error detection
E. Clock

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19. Which term means: “Common two-level signal element”?

A. Signal element
B. Voltage level
C. Even parity
D. Synchronization
E. Baud

20. Which term means: “Timing reference for sampling bits”?

A. Odd parity
B. Protocol
C. Parity bit
D. Error detection
E. Clock

Structured Questions

1. Explain two-voltage encoding. *(2 marks)*

> Agree which level is 0/1; send levels as bits.

2. Describe Manchester encoding. *(2 marks)*

> Transition in middle of each bit for timing.

3. Why is synchronization needed? *(2 marks)*

> Receiver must sample at correct times.

4. Compute even parity for 1011001. *(2 marks)*

> Parity bit 0.

5. Compare bit rate and Manchester baud idea. *(2 marks)*

> Manchester often needs ~2 signal changes per bit.

Summary

- Signal elements represent bits.
- Manchester aids synchronization.
- Clocks must stay aligned.
- Parity detects many single-bit errors.
- Protocols agree meanings of signals.

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MCQ answer key – 6.3

1. **B** – Mid-bit.
2. **C** – Error detect.
3. **D** – Four 1s → 0.
4. **B** – Misread bits.
5. **E** – Agreed rules.
6. **E** – bits/s.
7. **A** – 0 and 1.
8. **C** – Odd count.
9. **A** – Signal element – Physical change that stands for a bit.
10. **B** – Protocol – Agreed rules for communication.
11. **A** – Manchester encoding – Mid-bit transition coding.
12. **E** – Synchronization – Keeping sender and receiver clocks aligned.
13. **D** – Parity bit – Extra bit for even/odd check.
14. **D** – Even parity – Total number of 1s made even.
15. **C** – Odd parity – Total number of 1s made odd.
16. **A** – Bit rate – Bits sent per second.
17. **C** – Baud – Signal-element changes per second.
18. **D** – Error detection – Finding that a bit error occurred.
19. **B** – Voltage level – Common two-level signal element.
20. **E** – Clock – Timing reference for sampling bits.

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6.4 PSTN, Modems and Modulation

Syllabus 6.4. The **PSTN** provides an **analog voice** circuit between two points. **Modems modulate** digital data onto analog signals and **demodulate** them at the far end so two computers can talk over a phone line.

1. What is the PSTN?

The **Public Switched Telephone Network** connects phones through switches. Classically it carries **analog voice** between two points once a circuit is set up.

2. Modems

A **modem** (**mo**dulator–**dem**odulator) turns bits into analog tones (modulation) and back (demodulation) so digital devices can use the analog line.

Two PCs linked by modems over PSTN



PC–modem–PSTN–modem–PC

💡 Draw: PC A → Modem → PSTN cloud → Modem → PC B.

🧱 **Worked example: A 4 kHz voice band is modulated onto a carrier so bits ride the analog PSTN loop; the far modem demodulates back to bits.**
Modem = modulator + demodulator for analog lines.

🚀 **Beyond the syllabus (2026 update)** *Not required for the exam – read for interest.* Today many "phone lines" are digital (VoIP), but the exam story of modem over analog PSTN remains.

Key Words

PSTN – Public Switched Telephone Network.

Analog voice circuit – Path that carries voice-band analog signals.

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Modulation – Imprinting data onto an analog carrier.	**Demodulation** – Recovering data from the analog signal.
Modem – Modulator–demodulator device.	**Carrier** – Analog wave that is modulated.
Dial-up – Connecting via ordinary phone call.	**Remote device** – Device reached over the PSTN path.
Switch – Telephone exchange switching element.	**Voice band** – Frequencies used for telephony audio.
Digital data – Bits from the computer.	**Schematic** – Block diagram of the link.

Sample Q&A

1. What does PSTN stand for?

> **Answer:** Public Switched Telephone Network.

2. What does a modem do?

> **Answer:** Modulates and demodulates between digital and analog.

3. Why modulate?

> **Answer:** To send digital data on an analog voice line.

4. Draw the five blocks of a modem link.

> **Answer:** PC–modem–PSTN–modem–PC.

5. Is classic PSTN voice analog or digital?

> **Answer:** Analog voice circuit.

6. Demodulation recovers?

> **Answer:** The original digital data.

MCQ

1. PSTN classically carries

A. only fiber colours
B. only USB power
C. analog voice
D. only MAC frames
E. only IP packets always

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2. Modem means

A. modulator–demodulator
B. memory only
C. monitor only
D. mouse only
E. magnet only

3. Modulation puts data on

A. a wooden desk
B. a shoe
C. a paper form
D. a lunch tray
E. an analog carrier

4. Link order is

A. switch–switch only
B. PC–modem–PSTN–modem–PC
C. DNS–DNS
D. PC–PC only
E. modem–modem with no line

5. Demodulation happens

A. only in the GPU
B. only in the speaker
C. at the receiving modem
D. only in the keyboard
E. only in the fan

6. A switched network can

A. invent parity
B. remove all clocks
C. delete gravity
D. set up a path between two subscribers
E. paint fiber blue

7. Digital PCs need modems on PSTN because

A. MAC needs tea
B. OSI bans layer 1
C. PCs dislike copper
D. the classic line expects analog voice-band signals
E. IP forbids phones

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8. Schematic diagrams should show

A. only one PC
B. both modems and the PSTN in between
C. only printers
D. only icons
E. only games

9. Which term means: “Public Switched Telephone Network”?

A. Carrier
B. Modulation
C. Digital data
D. Remote device
E. PSTN

10. Which term means: “Path that carries voice-band analog signals”?

A. Analog voice circuit
B. Dial-up
C. Demodulation
D. Switch
E. Schematic

11. Which term means: “Imprinting data onto an analog carrier”?

A. Voice band
B. Modulation
C. Modem
D. PSTN
E. Remote device

12. Which term means: “Recovering data from the analog signal”?

A. Digital data
B. Switch
C. Demodulation
D. Carrier
E. Analog voice circuit

13. Which term means: “Modulator–demodulator device”?

A. Dial-up
B. Voice band
C. Schematic
D. Modulation
E. Modem

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14. Which term means: “Analog wave that is modulated”?

A. Carrier
B. Digital data
C. PSTN
D. Demodulation
E. Remote device

15. Which term means: “Connecting via ordinary phone call”?

A. Schematic
B. Modem
C. Analog voice circuit
D. Dial-up
E. Switch

16. Which term means: “Device reached over the PSTN path”?

A. PSTN
B. Voice band
C. Carrier
D. Remote device
E. Modulation

17. Which term means: “Telephone exchange switching element”?

A. Digital data
B. Dial-up
C. Analog voice circuit
D. Demodulation
E. Switch

18. Which term means: “Frequencies used for telephony audio”?

A. Modem
B. Voice band
C. Modulation
D. Remote device
E. Schematic

19. Which term means: “Bits from the computer”?

A. Switch
B. Carrier
C. Digital data
D. PSTN
E. Demodulation

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20. Which term means: “Block diagram of the link”?

A. Schematic
B. Dial-up
C. Analog voice circuit
D. Modem
E. Voice band

Structured Questions

1. Define PSTN. *(2 marks)*

> Public network providing switched voice circuits.

2. Explain modulation and demodulation. *(2 marks)*

> Encode bits on analog; recover bits from analog.

3. Role of a modem. *(2 marks)*

> Does both modulation and demodulation.

4. Sketch PC–modem–PSTN–modem–PC. *(2 marks)*

> Five labelled blocks in order.

5. Why not send raw digital levels on classic PSTN? *(2 marks)*

> Line designed for analog voice-band signals.

Summary

- PSTN = switched analog voice network.
- Modems bridge digital and analog.
- Modulation / demodulation pair.
- Draw the five-block schematic.
- Circuit connects two remote devices.

MCQ answer key – 6.4

1. **C** – Analog voice.
2. **A** – Mod/demod.
3. **E** – Analog carrier.
4. **B** – Via PSTN.
5. **C** – Receive modem.
6. **D** – Path between users.
7. **D** – Analog line.

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8. **B** – Full path.
9. **E** – PSTN – Public Switched Telephone Network.
10. **A** – Analog voice circuit – Path that carries voice-band analog signals.
11. **B** – Modulation – Imprinting data onto an analog carrier.
12. **C** – Demodulation – Recovering data from the analog signal.
13. **E** – Modem – Modulator–demodulator device.
14. **A** – Carrier – Analog wave that is modulated.
15. **D** – Dial-up – Connecting via ordinary phone call.
16. **D** – Remote device – Device reached over the PSTN path.
17. **E** – Switch – Telephone exchange switching element.
18. **B** – Voice band – Frequencies used for telephony audio.
19. **C** – Digital data – Bits from the computer.
20. **A** – Schematic – Block diagram of the link.

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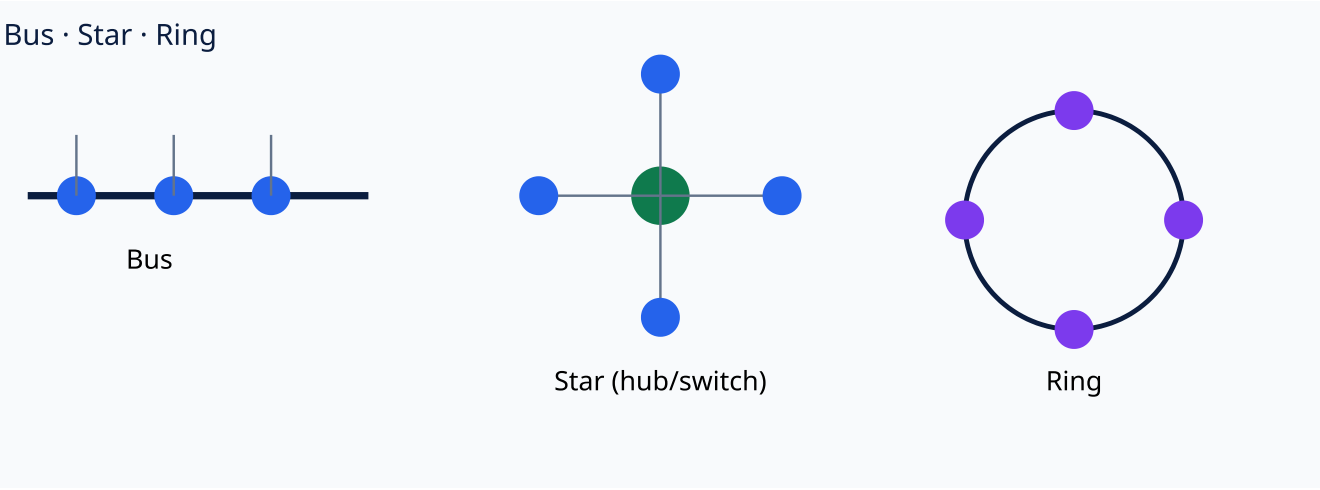
6.5 Network Topologies, Hubs and Switches

Syllabus 6.5. Connecting every device to every other (**all-to-all**) is impractical. A **bus** is simple but needs **media access** control. You also study **star**, **ring** and **mesh**, and how **hubs** and **switches** simplify wiring.

1. Why not all-to-all?

Links grow roughly with n^2 for n devices – costly and messy. Shared topologies reduce wiring.

2. Bus, star, ring, mesh



Bus, star and ring

- **Bus** – one shared cable; simple; access must be controlled.
- **Star** – devices to a centre (hub/switch).
- **Ring** – each to next in a loop.
- **Mesh** – many direct links (full or partial).

3. Hubs vs switches

A **hub** repeats bits to all ports (shared collision domain). A **switch** forwards frames more selectively using addresses, reducing collisions.

🧱 **Worked example: 24 PCs in a star to one switch: each PC–switch cable is its own collision domain; without VLANs the switch is one broadcast domain.**
Switch: per-port collision domains; hub: one shared collision domain.

🚀 **Beyond the syllabus (2026 update)** *Not required for the exam – read for interest.* School labs use Ethernet switches; “hub” is still in the syllabus for contrast.

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Key Words

Topology – Layout pattern of links.	**Bus** – Single shared medium.
Star – Centre device with spokes.	**Ring** – Loop of device-to-device links.
Mesh – Many direct interconnections.	**Hub** – Multiport repeater to all ports.
Switch – Forwards frames using addresses.	**Media access** – Who may transmit on a shared medium.
Collision – Two signals overlap on shared media.	**Wiring** – Physical cabling of the LAN.
All-to-all – Full mesh of every pair.	**Node** – A device on the network.

Sample Q&A

1. Why is all-to-all impractical?

> **Answer:** Too many links as n grows.

2. Name four topologies.

> **Answer:** Bus, star, ring, mesh.

3. Bus problem?

> **Answer:** Controlling access to the shared media.

4. Hub vs switch (one point).

> **Answer:** Hub floods all; switch forwards selectively.

5. Star centre device?

> **Answer:** Hub or switch.

6. Mesh idea?

> **Answer:** Many direct links between nodes.

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MCQ

1. All-to-all is impractical because

A. number of links grows very fast
B. OSI bans buses
C. IP deletes stars
D. cables hate copper
E. Wi-Fi forbids mesh

2. A bus uses

A. one shared cable/medium
B. only USB sticks
C. only DNS
D. only paper
E. only satellites

3. Star topology centres on

A. a random book
B. a hub or switch
C. a single pixel
D. a parity bit
E. a lunch box

4. A hub typically

A. runs DNS alone
B. assigns MAC randomly
C. encrypts with AES only
D. routes IP worldwide
E. repeats to all ports

5. A switch typically

A. paints fiber
B. forwards using addresses
C. ignores all frames
D. blocks electricity
E. eats packets

6. Ring means

A. devices linked in a loop
B. only wireless mist
C. a square only
D. only one PC
E. no links

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7. Media access is needed on a bus because

A. MAC is paint
B. the medium is shared
C. IP is optional
D. the medium is imaginary
E. fiber is dry

8. Mesh provides

A. only one wire forever
B. only stars
C. many direct interconnections
D. only rings
E. zero links

9. Which term means: “Layout pattern of links”?

A. Star
B. Hub
C. All-to-all
D. Topology
E. Media access

10. Which term means: “Single shared medium”?

A. Node
B. Collision
C. Bus
D. Switch
E. Ring

11. Which term means: “Centre device with spokes”?

A. Media access
B. Topology
C. Wiring
D. Star
E. Mesh

12. Which term means: “Loop of device-to-device links”?

A. Bus
B. Ring
C. All-to-all
D. Hub
E. Collision

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13. Which term means: “Many direct interconnections”?

A. Star
B. Node
C. Wiring
D. Mesh
E. Switch

14. Which term means: “Multiport repeater to all ports”?

A. Topology
B. Media access
C. All-to-all
D. Ring
E. Hub

15. Which term means: “Forwards frames using addresses”?

A. Mesh
B. Node
C. Switch
D. Collision
E. Bus

16. Which term means: “Who may transmit on a shared medium”?

A. Hub
B. Wiring
C. Media access
D. Star
E. Topology

17. Which term means: “Two signals overlap on shared media”?

A. Ring
B. Switch
C. All-to-all
D. Bus
E. Collision

18. Which term means: “Physical cabling of the LAN”?

A. Wiring
B. Star
C. Node
D. Media access
E. Mesh

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19. Which term means: “Full mesh of every pair”?

A. Topology
B. Collision
C. Hub
D. Ring
E. All-to-all

20. Which term means: “A device on the network”?

A. Mesh
B. Wiring
C. Bus
D. Node
E. Switch

Structured Questions

1. Explain why all-to-all fails at scale. *(2 marks)*

> Link count rises steeply with n.

2. Compare bus and star. *(2 marks)*

> Bus shared cable; star via centre.

3. Draw bus, star, ring. *(2 marks)*

> Correct labelled sketches.

4. Hub vs switch. *(2 marks)*

> Hub floods; switch selective forward.

5. What media-access problem does a bus create? *(2 marks)*

> Who transmits without collisions.

Summary

- All-to-all is costly.
- Bus, star, ring, mesh.
- Bus needs media access control.
- Hubs flood; switches filter.
- Wiring is simplified by centre devices.

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MCQ answer key – 6.5

1. **A** – Too many links.
2. **A** – Shared medium.
3. **B** – Hub/switch.
4. **E** – Floods ports.
5. **B** – Address-aware.
6. **A** – Loop.
7. **B** – Shared.
8. **C** – Many links.
9. **D** – Topology – Layout pattern of links.
10. **C** – Bus – Single shared medium.
11. **D** – Star – Centre device with spokes.
12. **B** – Ring – Loop of device-to-device links.
13. **D** – Mesh – Many direct interconnections.
14. **E** – Hub – Multiport repeater to all ports.
15. **C** – Switch – Forwards frames using addresses.
16. **C** – Media access – Who may transmit on a shared medium.
17. **E** – Collision – Two signals overlap on shared media.
18. **A** – Wiring – Physical cabling of the LAN.
19. **E** – All-to-all – Full mesh of every pair.
20. **D** – Node – A device on the network.

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6.6 MAC Addresses, Frames and Ethernet

Syllabus 6.6. On a **LAN**, devices need unique **MAC addresses**. Data is sent in **frames**. **MAC protocols** (from simple **ALOHA** toward **Ethernet**) give orderly access. Messages may be **broadcast** or **unicast**.

1. Addresses and frames

A **MAC address** names a network interface so sender and receiver are known on the LAN. A **frame** packages addresses, type/length, data and error check.

Ethernet frame (simplified)



Simplified Ethernet frame

2. Orderly access

ALOHA let stations transmit and retry after collisions – simple but wasteful. **Ethernet** improved sharing (CSMA/CD ideas in classic wired Ethernet).

3. Broadcast and unicast

Unicast goes to one MAC; **broadcast** goes to all on the LAN segment.

🧱 **Worked example: Frame = dest MAC | src MAC | type | payload | FCS. Switch looks up dest MAC and forwards out the matching port.**
MAC is 48-bit; unique per NIC (ideally).

🚀 **Beyond the syllabus (2026 update)** *Not required for the exam – read for interest.* Wi-Fi uses MAC frames too; modern Ethernet is full-duplex switched – collisions rare, syllabus history still matters.

Key Words

LAN – Local Area Network.

MAC address – Hardware address of an interface.

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Frame – Data-link unit with header and data.	**ALOHA** – Early random-access MAC protocol.
Ethernet – Widely used LAN technology/family.	**Broadcast** – Send to all stations.
Unicast – Send to one station.	**Collision** – Overlapping transmissions.
CSMA/CD – Classic Ethernet media access idea.	**FCS** – Frame check sequence for errors.
NIC – Network interface card/controller.	**Protocol** – Rules for orderly media access.

Sample Q&A

1. What is a MAC address?

> **Answer:** Unique address of a network interface on the LAN.

2. What is a frame?

> **Answer:** Data-link packet with addresses and payload.

3. ALOHA idea?

> **Answer:** Transmit; if collision, retry later.

4. Unicast vs broadcast?

> **Answer:** One receiver vs all on segment.

5. Why MAC protocols?

> **Answer:** Orderly shared-media access.

6. Ethernet evolved from?

> **Answer:** Improvements after simple ALOHA-style access.

MCQ

1. MAC addresses identify

A. only folders
B. network interfaces on a LAN
C. only CPU brands
D. only printers ink
E. only passwords

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2. Frames are used at

A. only DNS text
B. only paper mail
C. only the application GUI
D. only power plugs
E. the data-link / LAN level

3. ALOHA is

A. an IP version
B. a fruit only
C. a fiber colour
D. a simple early MAC protocol
E. a topology shape only

4. Broadcast means

A. encrypt gravity
B. send to none
C. send to all on the LAN segment
D. send to one phone only
E. delete frames

5. Unicast means

A. send to one address
B. ignore MAC
C. send to no one
D. send to every planet
E. flood forever

6. Ethernet improved

A. chair height
B. shoe size
C. shared-media access compared with plain ALOHA
D. pencil length
E. coffee taste

7. A simplified frame includes

A. destination and source MAC fields
B. only lunch menus
C. only parity of tea
D. only Wi-Fi passwords forever
E. only GPU clocks

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8. Collisions happen when

A. two icons move
B. two files open
C. two fonts change
D. two tabs blink
E. two stations transmit on shared media together

9. Which term means: “Local Area Network”?

A. Collision
B. Broadcast
C. NIC
D. LAN
E. Frame

10. Which term means: “Hardware address of an interface”?

A. Unicast
B. Protocol
C. CSMA/CD
D. ALOHA
E. MAC address

11. Which term means: “Data-link unit with header and data”?

A. LAN
B. Frame
C. Ethernet
D. Collision
E. FCS

12. Which term means: “Early random-access MAC protocol”?

A. ALOHA
B. CSMA/CD
C. Broadcast
D. NIC
E. MAC address

13. Which term means: “Widely used LAN technology/family”?

A. Frame
B. Ethernet
C. FCS
D. Unicast
E. Protocol

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14. Which term means: “Send to all stations”?

A. ALOHA
B. Collision
C. Broadcast
D. LAN
E. NIC

15. Which term means: “Send to one station”?

A. CSMA/CD
B. Protocol
C. MAC address
D. Unicast
E. Ethernet

16. Which term means: “Overlapping transmissions”?

A. Collision
B. LAN
C. Frame
D. Broadcast
E. FCS

17. Which term means: “Classic Ethernet media access idea”?

A. ALOHA
B. MAC address
C. CSMA/CD
D. Unicast
E. NIC

18. Which term means: “Frame check sequence for errors”?

A. Frame
B. FCS
C. Collision
D. Protocol
E. Ethernet

19. Which term means: “Network interface card/controller”?

A. LAN
B. CSMA/CD
C. ALOHA
D. NIC
E. Broadcast

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20. Which term means: “Rules for orderly media access”?

A. MAC address
B. Ethernet
C. FCS
D. Unicast
E. Protocol

Structured Questions

1. Define MAC address and frame. *(2 marks)*

> Interface address; packaged LAN unit.

2. Why unique addresses? *(2 marks)*

> Identify sender and intended receiver.

3. Outline ALOHA to Ethernet. *(2 marks)*

> Random access → improved sharing (CSMA/CD era).

4. Broadcast vs unicast. *(2 marks)*

> All vs one.

5. Label main frame fields. *(2 marks)*

> Dest MAC, src MAC, type/data, FCS.

Summary

- MAC addresses name interfaces.
- Frames carry LAN data.
- ALOHA then Ethernet.
- Broadcast and unicast.
- MAC protocols order shared access.

MCQ answer key – 6.6

1. **B** – Interfaces.
2. **E** – Data link.
3. **D** – Early MAC.
4. **C** – All stations.
5. **A** – One address.
6. **C** – Better MAC.
7. **A** – MAC fields.

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8. **E** – Overlap.
9. **D** – LAN – Local Area Network.
10. **E** – MAC address – Hardware address of an interface.
11. **B** – Frame – Data-link unit with header and data.
12. **A** – ALOHA – Early random-access MAC protocol.
13. **B** – Ethernet – Widely used LAN technology/family.
14. **C** – Broadcast – Send to all stations.
15. **D** – Unicast – Send to one station.
16. **A** – Collision – Overlapping transmissions.
17. **C** – CSMA/CD – Classic Ethernet media access idea.
18. **B** – FCS – Frame check sequence for errors.
19. **D** – NIC – Network interface card/controller.
20. **E** – Protocol – Rules for orderly media access.

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6.7 IPv4 Addressing, Subnetting and Routing

Syllabus 6.7. Gateways join networks. **IPv4** gives global addresses; you calculate **subnets**, **masks** and **CIDR**, meet **private IPs** and **DHCP**, glimpse **IPv6**, and see **routing** with **packet switching** and best-effort delivery.

1. From LAN to Internet

A **gateway** connects networks. **IP addresses** are uniform and independent of MAC/LAN tech.

2. Subnetting worked example

Start with **192.168.10.0/24**. Borrow **2** bits → **/26**, mask **255.255.255.192**, **4** subnets, **62** hosts each.

192.168.10.0/24 → four /26 subnets

/26 block 0	/26 block 1	/26 block 2	/26 block 3
192.168.10.0	192.168.10.64	192.168.10.128	192.168.10.192
...192.168.10.62	...192.168.10.126	...192.168.10.190	...192.168.10.254
bcast 63	bcast 127	bcast 191	bcast 255
62 hosts	62 hosts	62 hosts	62 hosts

Four /26 subnets

🧮 **Worked example: Hosts in /26?**
2^(32-26)−2 = **62**.

🧮 **Worked example: Hosts in /20?**
2^12−2 = **4094**.

3. DHCP, private IPs, routing

Private ranges (e.g. 192.168.0.0/16) are not routed on the public Internet. **DHCP** assigns IPs dynamically. **Routers** choose paths; **packet switching** forwards packets hop by hop (**best effort**). **IPv6** eases IPv4 scarcity.

🚀 **Beyond the syllabus (2026 update)** *Not required for the exam – read for interest.* CGNAT and IPv6 deployment continue; exam still drills /24→/26 style sums.

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Key Words

IPv4 – 32-bit Internet address.	**Subnet mask** – Marks network vs host bits.
CIDR – Prefix length notation like /26.	**Gateway** – Device linking networks.
DHCP – Dynamic Host Configuration Protocol.	**Private IP** – Non-routable on public Internet.
Router – Forwards packets between networks.	**Packet switching** – Data sent as packets hop by hop.
Best effort – IP tries but does not guarantee delivery.	**IPv6** – Larger address space successor.
Host bits – Bits identifying hosts in a subnet.	**Broadcast address** – All-hosts address in a subnet.

Sample Q&A

1. Role of a gateway?

> **Answer:** Connects two or more networks.

2. Mask for /26?

> **Answer:** 255.255.255.192

3. Hosts per /26?

> **Answer:** 62.

4. 192.168.10.0/24 with 2 borrowed bits → ?

> **Answer:** /26 and 4 subnets.

5. DHCP does what?

> **Answer:** Assigns IP settings dynamically.

6. Packet switching means?

> **Answer:** Forward packets hop by hop.

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MCQ

1. /26 mask is

A. 255.255.255.0
B. 255.255.255.255
C. 255.0.0.0
D. 255.255.255.192
E. 255.255.0.0

2. /26 usable hosts

A. 62
B. 64
C. 2
D. 30
E. 32

3. Borrow 2 bits from /24 yields

A. 1
B. 4 subnets
C. 2
D. 8
E. 16

4. First subnet network

A. 192.168.10.64
B. 192.168.11.0
C. 192.168.10.0
D. 10.0.0.0
E. 192.168.10.128

5. DHCP assigns

A. IP addresses dynamically
B. only GUI themes
C. only MAC forever
D. only fiber colours
E. only parity bits

6. Routers mainly

A. boil water
B. draw icons
C. print essays
D. find paths / forward packets
E. cut fiber

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7. Private IPs are

A. always multicast only
B. always IPv6
C. always banned locally
D. always public
E. not routed on the public Internet

8. Hosts in /20

A. 254
B. 4096
C. 4094
D. 1022
E. 62

9. Which term means: “32-bit Internet address”?

A. Private IP
B. IPv4
C. Packet switching
D. CIDR
E. Host bits

10. Which term means: “Marks network vs host bits”?

A. Gateway
B. Broadcast address
C. Subnet mask
D. Router
E. Best effort

11. Which term means: “Prefix length notation like /26”?

A. Packet switching
B. DHCP
C. IPv6
D. CIDR
E. IPv4

12. Which term means: “Device linking networks”?

A. Host bits
B. Private IP
C. Best effort
D. Subnet mask
E. Gateway

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13. Which term means: “Dynamic Host Configuration Protocol”?

A. Broadcast address
B. DHCP
C. Router
D. IPv6
E. CIDR

14. Which term means: “Non-routable on public Internet”?

A. Gateway
B. Packet switching
C. Host bits
D. IPv4
E. Private IP

15. Which term means: “Forwards packets between networks”?

A. Broadcast address
B. Router
C. Subnet mask
D. DHCP
E. Best effort

16. Which term means: “Data sent as packets hop by hop”?

A. Packet switching
B. Private IP
C. IPv4
D. IPv6
E. CIDR

17. Which term means: “IP tries but does not guarantee delivery”?

A. Router
B. Subnet mask
C. Gateway
D. Best effort
E. Host bits

18. Which term means: “Larger address space successor”?

A. IPv6
B. DHCP
C. Broadcast address
D. Packet switching
E. CIDR

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19. Which term means: “Bits identifying hosts in a subnet”?

A. Private IP
B. Best effort
C. Host bits
D. IPv4
E. Gateway

20. Which term means: “All-hosts address in a subnet”?

A. IPv6
B. Router
C. DHCP
D. Subnet mask
E. Broadcast address

Structured Questions

1. Explain gateway and need for IP. *(2 marks)*

> Joins LANs; uniform addressing beyond MAC.

2. Given 192.168.10.0/24 borrow 2 bits: mask, subnet count, hosts. *(3 marks)*

> 255.255.255.192; 4; 62.

3. List first subnet net, usable range, broadcast. *(3 marks)*

> 192.168.10.0; 192.168.10.1–192.168.10.62; 192.168.10.63

4. DHCP and private IP roles. *(2 marks)*

> Dynamic config; non-public ranges.

5. Routing, packet switching, best effort. *(3 marks)*

> Path selection; hop forwarding; no hard guarantee.

Summary

- Gateways interconnect networks.
- IPv4 + masks + CIDR.
- Worked /24→/26 example.
- DHCP and private addresses.
- Routers forward packets best-effort.

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MCQ answer key – 6.7

1. **D** – 192 = 2 borrowed bits.
2. **A** – 2^6−2=62.
3. **B** – 2^2=4.
4. **C** – Base block.
5. **A** – Dynamic IP.
6. **D** – Routing.
7. **E** – Not public-routed.
8. **C** – 2^12−2.
9. **B** – IPv4 – 32-bit Internet address.
10. **C** – Subnet mask – Marks network vs host bits.
11. **D** – CIDR – Prefix length notation like /26.
12. **E** – Gateway – Device linking networks.
13. **B** – DHCP – Dynamic Host Configuration Protocol.
14. **E** – Private IP – Non-routable on public Internet.
15. **B** – Router – Forwards packets between networks.
16. **A** – Packet switching – Data sent as packets hop by hop.
17. **D** – Best effort – IP tries but does not guarantee delivery.
18. **A** – IPv6 – Larger address space successor.
19. **C** – Host bits – Bits identifying hosts in a subnet.
20. **E** – Broadcast address – All-hosts address in a subnet.

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Grade 12 A/L ICT · Lesson 6

6.8 Transport Protocols: TCP and UDP

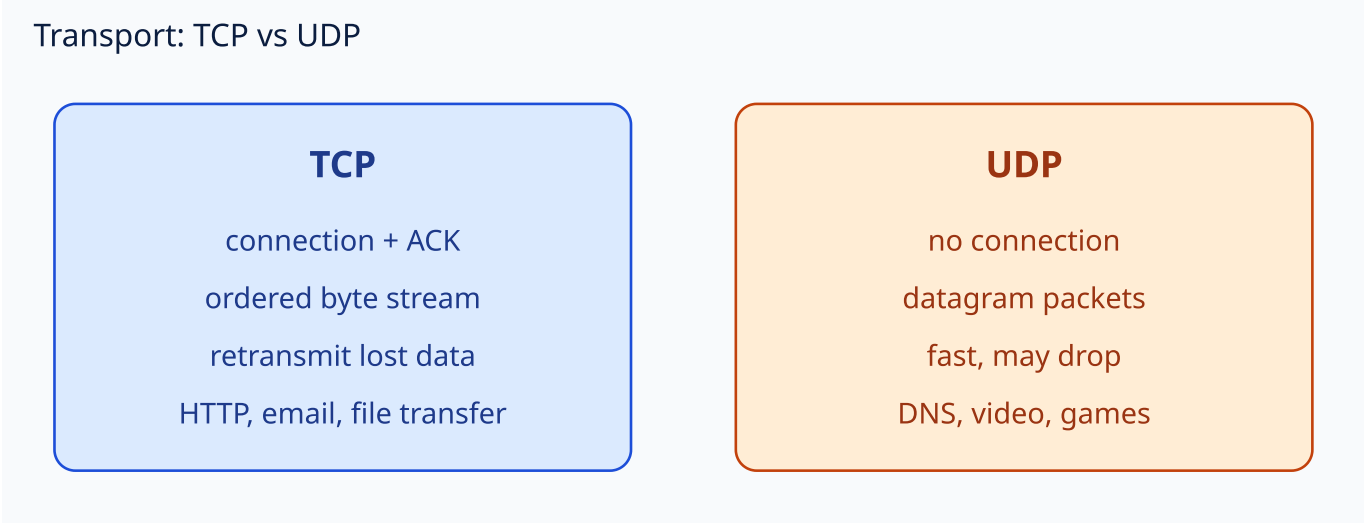
Syllabus 6.8. IP delivers to a host; **transport** delivers to an **application process** using **ports**. **UDP** is simple; **TCP** is connection-oriented and reliable.

1. Process to process

Many apps share one IP. **Port numbers** multiplex conversations (e.g. 80/443 web, 53 DNS).

2. UDP and TCP

UDP: connectionless, low overhead, unreliable – DNS, some streaming. **TCP**: connection-oriented, reliable, ordered – HTTP, email, file transfer.



TCP reliable stream vs UDP datagrams

💡 IP = host; port = process/app endpoint.

🧱 **Worked example: DNS query → often UDP/53 (one packet). Web download → TCP/80 or 443 (ordered, retransmitted).**
UDP = fast, no connection. TCP = reliable byte stream.

🚀 **Beyond the syllabus (2026 update)** *Not required for the exam – read for interest.* QUIC/HTTP3 over UDP is beyond the syllabus.

Key Words

Transport layer – Process-to-process delivery.

Port – Number identifying an endpoint.

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Multiplexing – Many apps sharing one IP.	**UDP** – Unreliable datagram transport.
TCP – Reliable connection-oriented transport.	**Datagram** – Independent UDP packet.
Connection – TCP session setup.	**Reliable delivery** – TCP retransmits lost data.
HTTP – Often uses TCP ports 80/443.	**DNS** – Often uses UDP port 53.
Endpoint – IP + port pair.	**Overhead** – Extra header/control cost.

Sample Q&A

1. Why ports?

> **Answer:** Many processes share one IP.

2. UDP properties?

> **Answer:** Connectionless, low overhead, unreliable.

3. TCP properties?

> **Answer:** Connection-oriented, reliable, ordered.

4. UDP app example?

> **Answer:** DNS (often).

5. TCP app example?

> **Answer:** HTTP / email.

6. IP alone enough?

> **Answer:** No – need ports for apps.

MCQ

1. Ports identify

A. chair heights
B. fiber brands
C. cable colours
D. application endpoints on a host
E. font names

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2. UDP is

A. connectionless datagram service
B. always a topology
C. a hub flood
D. a MAC type
E. a subnet mask

3. TCP is

A. always wireless only
B. a hub flood
C. a bus cable
D. reliable connection-oriented byte stream
E. a parity bit

4. DNS commonly uses

A. only VGA
B. only PSTN voice
C. only USB power
D. only HDMI
E. UDP (often port 53)

5. Web HTTP commonly uses

A. only ALOHA
B. only coax colours
C. only parity
D. only hubs
E. TCP

6. Multiplexing means

A. boiling water
B. deleting MAC
C. painting switches
D. sharing one IP among apps via ports
E. cutting fiber

7. Without ports

A. gravity fails
B. host cannot tell which app gets the data
C. light stops
D. screens invent pixels
E. cables vanish

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8. TCP retransmission helps

A. set wallpapers
B. rename folders
C. brew tea
D. recover lost segments
E. change cable paint

9. Which term means: “Process-to-process delivery”?

A. Datagram
B. Multiplexing
C. Transport layer
D. Reliable delivery
E. Endpoint

10. Which term means: “Number identifying an endpoint”?

A. Connection
B. Port
C. UDP
D. HTTP
E. Overhead

11. Which term means: “Many apps sharing one IP”?

A. Reliable delivery
B. DNS
C. Multiplexing
D. Transport layer
E. TCP

12. Which term means: “Unreliable datagram transport”?

A. UDP
B. HTTP
C. Datagram
D. Endpoint
E. Port

13. Which term means: “Reliable connection-oriented transport”?

A. DNS
B. TCP
C. Multiplexing
D. Connection
E. Overhead

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14. Which term means: “Independent UDP packet”?

A. Datagram
B. Reliable delivery
C. Transport layer
D. UDP
E. Endpoint

15. Which term means: “TCP session setup”?

A. HTTP
B. TCP
C. Connection
D. Overhead
E. Port

16. Which term means: “TCP retransmits lost data”?

A. Multiplexing
B. Datagram
C. DNS
D. Transport layer
E. Reliable delivery

17. Which term means: “Often uses TCP ports 80/443”?

A. Port
B. Connection
C. HTTP
D. Endpoint
E. UDP

18. Which term means: “Often uses UDP port 53”?

A. Overhead
B. DNS
C. TCP
D. Reliable delivery
E. Multiplexing

19. Which term means: “IP + port pair”?

A. Endpoint
B. Transport layer
C. Datagram
D. HTTP
E. UDP

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20. Which term means: “Extra header/control cost”?

A. Port
B. Connection
C. DNS
D. TCP
E. Overhead

Structured Questions

1. Explain process-to-process delivery. *(2 marks)*

> IP to host; ports to apps.

2. Define multiplexing with ports. *(2 marks)*

> Apps distinguished by port numbers.

3. UDP: properties + apps. *(2 marks)*

> Connectionless/unreliable; DNS, streaming.

4. TCP: properties + apps. *(2 marks)*

> Reliable connection; HTTP, email.

5. Why both UDP and TCP? *(2 marks)*

> Trade simplicity vs reliability.

Summary

- Ports select applications.
- UDP = simple datagrams.
- TCP = reliable streams.
- DNS often UDP; web often TCP.
- Transport sits above IP.

MCQ answer key – 6.8

1. **D** – App endpoints.
2. **A** – Datagram.
3. **D** – Reliable stream.
4. **E** – UDP 53.
5. **E** – TCP.
6. **D** – Many apps.
7. **B** – Which app?

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8. **D** – Reliability.
9. **C** – Transport layer – Process-to-process delivery.
10. **B** – Port – Number identifying an endpoint.
11. **C** – Multiplexing – Many apps sharing one IP.
12. **A** – UDP – Unreliable datagram transport.
13. **B** – TCP – Reliable connection-oriented transport.
14. **A** – Datagram – Independent UDP packet.
15. **C** – Connection – TCP session setup.
16. **E** – Reliable delivery – TCP retransmits lost data.
17. **C** – HTTP – Often uses TCP ports 80/443.
18. **B** – DNS – Often uses UDP port 53.
19. **A** – Endpoint – IP + port pair.
20. **E** – Overhead – Extra header/control cost.

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6.9 DNS, HTTP and the Client–Server Model

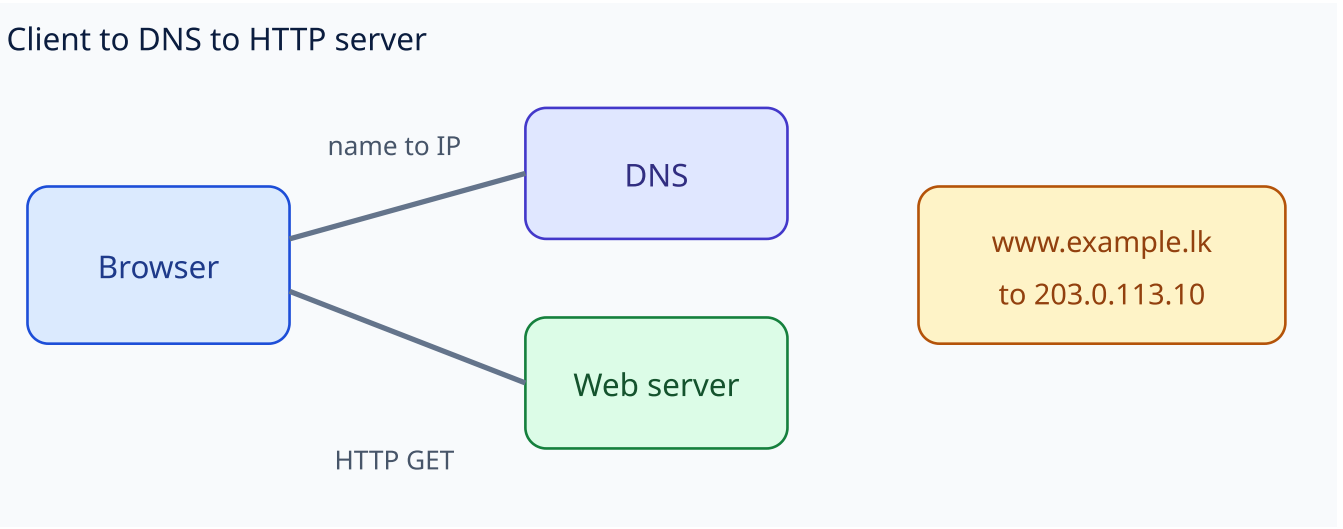
Syllabus 6.9. People prefer names to numbers. **DNS** maps **hierarchical** names to IPs. **HTTP** uses a **client–server** model (e.g. a simple **GET** request and response).

1. Why DNS?

IPs are hard to remember. **DNS** gives human-friendly **hierarchical** names; each **domain** manages names under it; **TLDs** like .lk, .com sit near the top.

2. HTTP and client–server

A **client** (browser) sends an HTTP **GET** for a resource; a **server** responds with status and content. DNS and HTTP both illustrate client–server.



Client uses DNS then HTTP GET

💡 Example: resolve www.school.lk then GET /index.html.

🧱 **Worked example: Browser: DNS resolves name → TCP connect → HTTP GET /index.html → 200 OK + body.**
Client requests; server responds (client–server).

🚀 **Beyond the syllabus (2026 update)** *Not required for the exam – read for interest.* DoH/DoT encrypt DNS; HTTP/3 uses QUIC – interest only.

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Key Words

DNS – Maps names to IP addresses.	**Domain** – Managed name subtree.
TLD – Top-level domain (.lk, .com).	**Hierarchical name** – Name split by dots into levels.
HTTP – Web application protocol.	**GET request** – Ask server for a resource.
Client – Requests a service.	**Server** – Provides a service.
Resolver – Client-side DNS lookup helper.	**URL** – Web resource locator.
Response – Server reply (status + body).	**Host name** – Name of a machine in DNS.

Sample Q&A

1. Why DNS?

> **Answer:** Human-friendly names instead of raw IPs.

2. Hierarchical DNS means?

> **Answer:** Names managed in a tree of domains.

3. What is a TLD?

> **Answer:** Top-level domain such as .lk or .com.

4. HTTP GET does what?

> **Answer:** Requests a resource from a server.

5. Client–server?

> **Answer:** Client requests; server responds.

6. DNS and HTTP both use?

> **Answer:** Client–server pattern.

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MCQ

1. DNS maps

A. cables to colours
B. fonts to sizes
C. names to IP addresses
D. inks to printers only
E. chairs to heights

2. A TLD is

A. a top-level domain
B. a bus cable
C. a parity bit
D. a hub flood
E. a modem tone

3. HTTP GET is sent by

A. only the hub
B. only the PSTN
C. the client (e.g. browser)
D. only the fiber
E. only the GPU

4. In client–server

A. cables request lunch
B. client requests and server replies
C. switches invent DNS
D. both stay silent
E. modems paint frames

5. Domains manage

A. only mouse DPI
B. only chair colour
C. only copper atoms
D. only GUI themes
E. names under their part of the tree

6. IPs are hard to remember so we use

A. only parity
B. only baud
C. DNS names
D. random voltages only
E. only MAC paint

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7. A simple web fetch needs

A. only a ruler
B. only a hammer
C. only a kettle
D. name resolution then HTTP
E. only a stapler

8. Hierarchical means

A. one letter total
B. circular only
C. flat forever
D. random soup
E. organised in levels

9. Which term means: “Maps names to IP addresses”?

A. Server
B. TLD
C. GET request
D. DNS
E. Response

10. Which term means: “Managed name subtree”?

A. Resolver
B. Domain
C. Hierarchical name
D. Host name
E. Client

11. Which term means: “Top-level domain (.lk, .com)”?

A. TLD
B. URL
C. DNS
D. Server
E. HTTP

12. Which term means: “Name split by dots into levels”?

A. Domain
B. GET request
C. Resolver
D. Hierarchical name
E. Response

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13. Which term means: “Web application protocol”?

A. URL
B. Host name
C. HTTP
D. Client
E. TLD

14. Which term means: “Ask server for a resource”?

A. Hierarchical name
B. GET request
C. Server
D. DNS
E. Response

15. Which term means: “Requests a service”?

A. Client
B. Resolver
C. Host name
D. HTTP
E. Domain

16. Which term means: “Provides a service”?

A. Server
B. URL
C. GET request
D. DNS
E. TLD

17. Which term means: “Client-side DNS lookup helper”?

A. Domain
B. Resolver
C. Response
D. Client
E. Hierarchical name

18. Which term means: “Web resource locator”?

A. Server
B. TLD
C. HTTP
D. URL
E. Host name

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19. Which term means: “Server reply (status + body)”?

A. DNS
B. GET request
C. Hierarchical name
D. Resolver
E. Response

20. Which term means: “Name of a machine in DNS”?

A. HTTP
B. URL
C. Domain
D. Client
E. Host name

Structured Questions

1. Need for DNS. *(2 marks)*

> Memorable names mapped to IPs.

2. Hierarchical + TLD idea. *(2 marks)*

> Tree of domains; .lk/.com at top.

3. Describe HTTP GET + response. *(2 marks)*

> Client asks for URL; server returns status/body.

4. Client–server with DNS and HTTP. *(2 marks)*

> Both use requesting clients and answering servers.

5. Why not hard-code IPs in bookmarks only? *(2 marks)*

> IPs change; names stay stable via DNS.

Summary

- DNS maps names to IPs.
- Hierarchical domains and TLDs.
- HTTP GET is client→server.
- Client–server model.
- DNS + HTTP work together for the web.

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MCQ answer key – 6.9

1. **C** – Name→IP.
2. **A** – Top domain.
3. **C** – Client.
4. **B** – Request/reply.
5. **E** – Subtree names.
6. **C** – Names.
7. **D** – DNS then HTTP.
8. **E** – Levels.
9. **D** – DNS – Maps names to IP addresses.
10. **B** – Domain – Managed name subtree.
11. **A** – TLD – Top-level domain (.lk, .com).
12. **D** – Hierarchical name – Name split by dots into levels.
13. **C** – HTTP – Web application protocol.
14. **B** – GET request – Ask server for a resource.
15. **A** – Client – Requests a service.
16. **A** – Server – Provides a service.
17. **B** – Resolver – Client-side DNS lookup helper.
18. **D** – URL – Web resource locator.
19. **E** – Response – Server reply (status + body).
20. **E** – Host name – Name of a machine in DNS.

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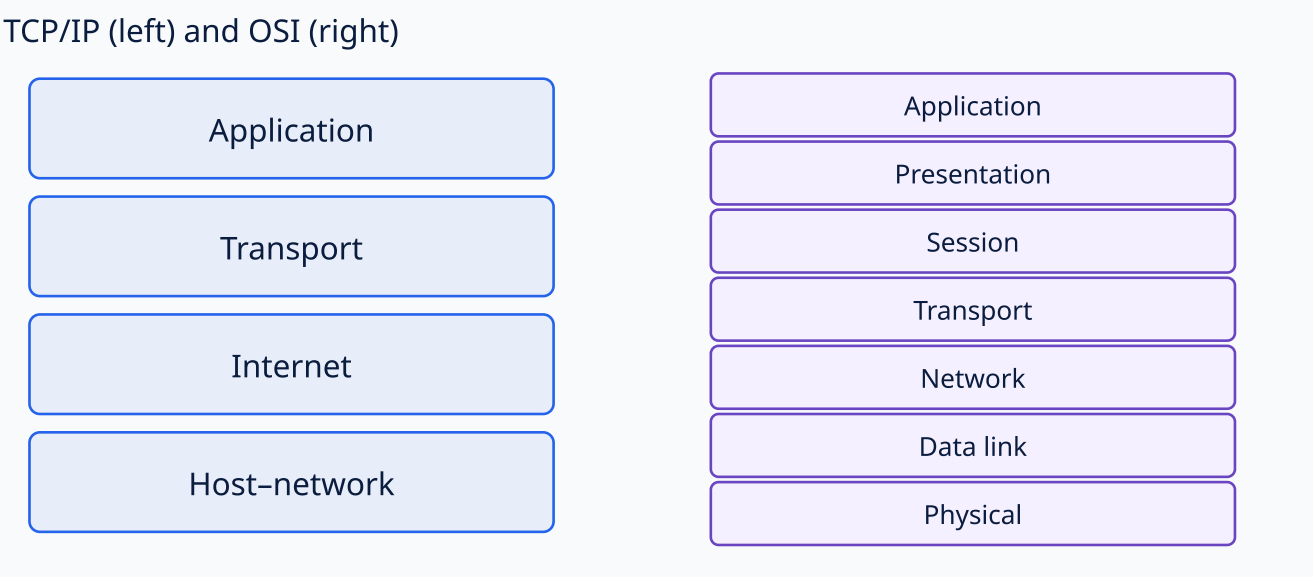
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6.10 OSI and TCP/IP Reference Models

Syllabus 6.10. TCP/IP (application, transport, internet, host-to-network) and **OSI** (7 layers) describe network architecture. You name **bits**, **frames** and **packets** and follow data flow down and up the stack.

1. TCP/IP model

Application – apps (HTTP, DNS). **Transport** – TCP/UDP. **Internet** – IP routing. **Host-to-network** – link/physical technologies.



TCP/IP beside OSI

2. OSI seven layers

Application, Presentation, Session, Transport, Network, Data link, Physical – from user apps down to bits on the wire.

3. Data units

Bit on the physical medium; **frame** at data link; **packet** (IP) at network/internet. Headers are added going down and removed going up.

> 🧱 **Worked example: Data path: Application → Transport (TCP segment) → Network (IP packet) → Data link (frame) → Physical (bits).**
> OSI has 7 layers; TCP/IP is often taught as 4.

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🚀 **Beyond the syllabus (2026 update)** *Not required for the exam – read for interest.* Real stacks blur layers; exam still wants the named models and PDUs.

Key Words

TCP/IP model – Four-layer Internet model.	**OSI model** – Seven-layer reference model.
Application layer – Network apps and services.	**Transport layer** – End-to-end process delivery.
Internet / Network – Routing of packets.	**Data link** – Frames on a link/LAN.
Physical – Bits on the medium.	**Packet** – Network-layer data unit.
Frame – Data-link data unit.	**Bit** – Physical-layer symbol/unit.
Encapsulation – Adding headers down the stack.	**Presentation / Session** – OSI layers above transport.

Sample Q&A

1. TCP/IP four layers?

> **Answer:** Application, transport, internet, host-to-network.

2. OSI has how many layers?

> **Answer:** Seven.

3. PDU at data link?

> **Answer:** Frame.

4. PDU at network/IP?

> **Answer:** Packet.

5. Physical layer deals with?

> **Answer:** Bits on the medium.

6. Encapsulation direction?

> **Answer:** Headers added going down the stack.

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MCQ

1. TCP/IP has

A. 12
B. 1 only
C. 0
D. 7 only
E. 4 layers

2. OSI has

A. 11
B. 4 only
C. 7 layers
D. 2
E. 9

3. A frame is used at

A. only parity tea
B. data link
C. only DNS text
D. only HTTP verbs
E. only GUI

4. A packet is used at

A. only icons
B. only mouse clicks
C. network / internet layer
D. only fonts
E. only physical copper paint

5. Bits belong mainly to

A. the physical layer
B. only presentation slides
C. only application essays
D. only transport poems
E. only session jokes

6. Going down the stack we

A. delete the universe
B. invent gravity
C. add headers (encapsulation)
D. boil the switch
E. paint the chair

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7. HTTP sits near

A. only the hub LED
B. the application layer
C. only the PSTN tone
D. only the fiber core
E. only the fan

8. IP sits at

A. only physical pins
B. only session chairs
C. only data-link paint
D. only presentation fonts
E. internet / network layer

9. Which term means: “Four-layer Internet model”?

A. TCP/IP model
B. Encapsulation
C. Data link
D. Application layer
E. Packet

10. Which term means: “Seven-layer reference model”?

A. OSI model
B. Transport layer
C. Physical
D. Frame
E. Presentation / Session

11. Which term means: “Network apps and services”?

A. Internet / Network
B. TCP/IP model
C. Packet
D. Application layer
E. Bit

12. Which term means: “End-to-end process delivery”?

A. Encapsulation
B. OSI model
C. Transport layer
D. Frame
E. Data link

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13. Which term means: “Routing of packets”?

A. Application layer
B. Internet / Network
C. Physical
D. Presentation / Session
E. Bit

14. Which term means: “Frames on a link/LAN”?

A. Packet
B. Data link
C. Transport layer
D. Encapsulation
E. TCP/IP model

15. Which term means: “Bits on the medium”?

A. Presentation / Session
B. OSI model
C. Frame
D. Physical
E. Internet / Network

16. Which term means: “Network-layer data unit”?

A. Packet
B. Application layer
C. Data link
D. TCP/IP model
E. Bit

17. Which term means: “Data-link data unit”?

A. Transport layer
B. Encapsulation
C. OSI model
D. Physical
E. Frame

18. Which term means: “Physical-layer symbol/unit”?

A. Application layer
B. Presentation / Session
C. Internet / Network
D. Bit
E. Packet

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19. Which term means: “Adding headers down the stack”?

A. Transport layer
B. Data link
C. Frame
D. TCP/IP model
E. Encapsulation

20. Which term means: “OSI layers above transport”?

A. Physical
B. OSI model
C. Bit
D. Presentation / Session
E. Internet / Network

Structured Questions

1. List TCP/IP layers with one role each. *(2 marks)*

> App/transport/internet/host-network + roles.

2. List OSI seven layers in order. *(2 marks)*

> App…Physical top to bottom (or reverse).

3. Define bit, frame, packet. *(3 marks)*

> Physical; data link; network.

4. Describe data flow sender→receiver. *(3 marks)*

> Down stack with headers; across; up stripping headers.

5. Map HTTP and IP onto the models. *(2 marks)*

> HTTP application; IP internet/network.

Summary

- TCP/IP has four layers.
- OSI has seven layers.
- Bit, frame, packet PDUs.
- Encapsulation down the stack.
- Models organise network functions.

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MCQ answer key – 6.10

1. **E** – Four.
2. **C** – Seven.
3. **B** – Data link.
4. **C** – Network.
5. **A** – Physical.
6. **C** – Encapsulate.
7. **B** – Application.
8. **E** – Internet layer.
9. **A** – TCP/IP model – Four-layer Internet model.
10. **A** – OSI model – Seven-layer reference model.
11. **D** – Application layer – Network apps and services.
12. **C** – Transport layer – End-to-end process delivery.
13. **B** – Internet / Network – Routing of packets.
14. **B** – Data link – Frames on a link/LAN.
15. **D** – Physical – Bits on the medium.
16. **A** – Packet – Network-layer data unit.
17. **E** – Frame – Data-link data unit.
18. **D** – Bit – Physical-layer symbol/unit.
19. **E** – Encapsulation – Adding headers down the stack.
20. **D** – Presentation / Session – OSI layers above transport.

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6.11 Network Security: Threats and Protection

Syllabus 6.11. The open Internet lacks built-in confidentiality. **Public/private keys** support **encryption** and **digital signatures**. You list **threats** (viruses, Trojans, malware, phishing) and **protection** (firewalls, antivirus, awareness).

1. Confidentiality and keys

Encryption hides content; **digital signatures** help authenticate the sender. **Public** key encrypts / verifies; matching **private** key decrypts / signs (basic idea).

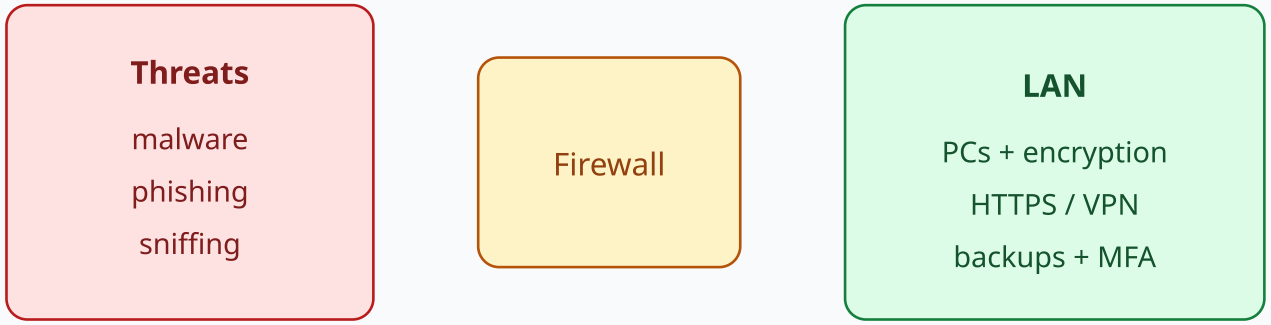
2. Threats

- **Virus** – spreads by infecting files/programs.
- **Trojan** – looks useful, hides harm.
- **Malware** – broad term for bad software.
- **Phishing** – tricks people into giving secrets.

3. Protection

Firewalls filter traffic; **antivirus** detects malware; **education** and good passwords/updates stop many attacks.

Threats, firewall and protected LAN



Firewall between threats and LAN

🧱 **Worked example: Phishing link to a fake bank. Defence: check URL, use HTTPS, MFA, never email passwords.**
Firewall + encryption + user caution reduce risk.

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🚀 **Beyond the syllabus (2026 update)** *Not required for the exam – read for interest.* Passkeys and zero-trust are modern trends; syllabus wants keys, threats and basic defences.

Key Words

Encryption – Scrambling data for confidentiality.	**Digital signature** – Proves origin/integrity with keys.
Public key – Shared key for encrypt/verify.	**Private key** – Secret key for decrypt/sign.
Virus – Self-spreading infection of programs.	**Trojan** – Malware disguised as useful software.
Malware – Malicious software (general).	**Phishing** – Social engineering for secrets.
Firewall – Filters network traffic.	**Antivirus** – Detects/removes malware.
Authentication – Confirming identity.	**Confidentiality** – Keeping data private.

Sample Q&A

1. Why encrypt?

> **Answer:** Confidentiality on an open network.

2. Public vs private key (one line).

> **Answer:** Public shared; private kept secret.

3. Phishing?

> **Answer:** Tricking users into revealing secrets.

4. Firewall role?

> **Answer:** Filter allowed/denied traffic.

5. Trojan vs virus (brief).

> **Answer:** Trojan disguises; virus spreads by infection.

6. Name three protections.

> **Answer:** Firewall, antivirus, user awareness.

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MCQ

1. Encryption mainly provides

A. confidentiality
B. chair height
C. mouse DPI
D. font size
E. cable colour

2. A private key should be

A. emailed to strangers
B. printed on buses
C. painted on walls
D. kept secret
E. posted publicly

3. Phishing attacks

A. only hub LEDs
B. trick people
C. only fan noise
D. only fiber photons
E. only copper atoms

4. A firewall

A. irons shirts
B. draws cartoons
C. filters network traffic
D. boils water
E. cuts paper

5. Malware means

A. marble statues
B. malicious software
C. maths homework
D. milk cartons
E. musical software only

6. Digital signatures help with

A. folding chairs
B. warming GPUs
C. painting MAC
D. making tea
E. authentication / integrity

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7. Antivirus software

A. brews coffee
B. detects malware
C. builds buses
D. tunes guitars
E. assigns IPv6 only

8. The open Internet alone does not guarantee

A. confidentiality and authentication
B. that chairs have legs
C. that light travels
D. that paper is dry
E. that copper exists

9. Which term means: “Scrambling data for confidentiality”?

A. Public key
B. Phishing
C. Encryption
D. Authentication
E. Trojan

10. Which term means: “Proves origin/integrity with keys”?

A. Digital signature
B. Malware
C. Private key
D. Confidentiality
E. Firewall

11. Which term means: “Shared key for encrypt/verify”?

A. Encryption
B. Virus
C. Antivirus
D. Phishing
E. Public key

12. Which term means: “Secret key for decrypt/sign”?

A. Digital signature
B. Firewall
C. Trojan
D. Private key
E. Authentication

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13. Which term means: “Self-spreading infection of programs”?

A. Antivirus
B. Confidentiality
C. Public key
D. Malware
E. Virus

14. Which term means: “Malware disguised as useful software”?

A. Private key
B. Phishing
C. Authentication
D. Trojan
E. Encryption

15. Which term means: “Malicious software (general)”?

A. Virus
B. Firewall
C. Confidentiality
D. Malware
E. Digital signature

16. Which term means: “Social engineering for secrets”?

A. Phishing
B. Antivirus
C. Public key
D. Encryption
E. Trojan

17. Which term means: “Filters network traffic”?

A. Malware
B. Firewall
C. Authentication
D. Private key
E. Digital signature

18. Which term means: “Detects/removes malware”?

A. Confidentiality
B. Virus
C. Public key
D. Phishing
E. Antivirus

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19. Which term means: “Confirming identity”?

A. Firewall
B. Trojan
C. Authentication
D. Private key
E. Encryption

20. Which term means: “Keeping data private”?

A. Antivirus
B. Digital signature
C. Confidentiality
D. Virus
E. Malware

Structured Questions

1. Need for confidentiality and authentication. *(2 marks)*

> Internet does not provide them by default.

2. Public/private keys for encrypt and sign. *(2 marks)*

> Public encrypt/verify; private decrypt/sign.

3. Four threats with one line each. *(4 marks)*

> Virus; Trojan; malware; phishing.

4. Three protections. *(3 marks)*

> Firewall; antivirus; awareness/practices.

5. One school-lab safe practice. *(2 marks)*

> Strong passwords / do not open unknown links.

Summary

- Keys enable secrecy and signatures.
- Threats: virus, Trojan, malware, phishing.
- Firewalls filter traffic.
- Antivirus + updates.
- Awareness stops many attacks.

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MCQ answer key – 6.11

1. **A** – Privacy of content.
2. **D** – Secret.
3. **B** – People.
4. **C** – Filters.
5. **B** – Bad software.
6. **E** – Auth/integrity.
7. **B** – Detect malware.
8. **A** – No built-in secrecy.
9. **C** – Encryption – Scrambling data for confidentiality.
10. **A** – Digital signature – Proves origin/integrity with keys.
11. **E** – Public key – Shared key for encrypt/verify.
12. **D** – Private key – Secret key for decrypt/sign.
13. **E** – Virus – Self-spreading infection of programs.
14. **D** – Trojan – Malware disguised as useful software.
15. **D** – Malware – Malicious software (general).
16. **A** – Phishing – Social engineering for secrets.
17. **B** – Firewall – Filters network traffic.
18. **E** – Antivirus – Detects/removes malware.
19. **C** – Authentication – Confirming identity.
20. **C** – Confidentiality – Keeping data private.

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Grade 12 A/L ICT · Lesson 6

6.12 ISPs, Home Networks and NAT

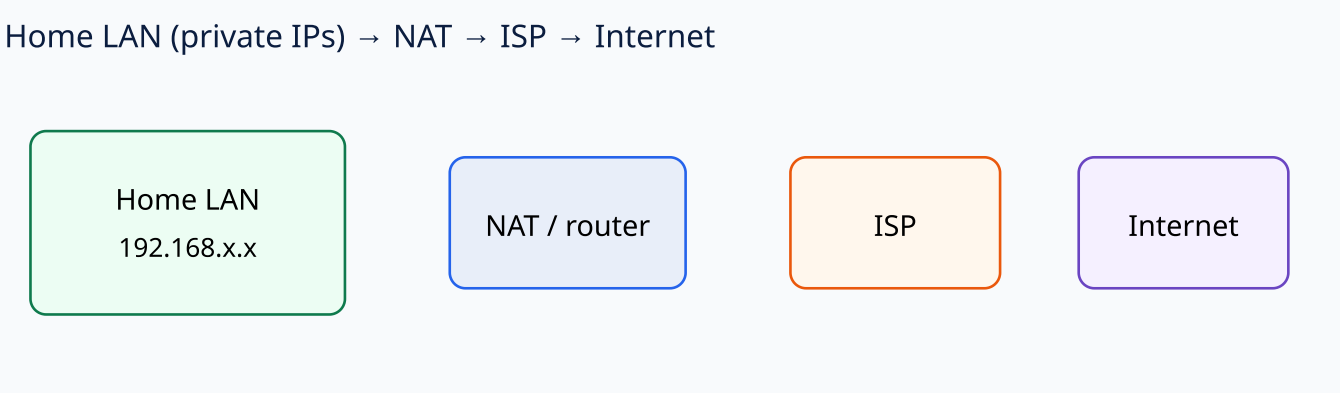
Syllabus 6.12. An **ISP** connects you to the Internet. Homes use **modems** and **DSL/ADSL**, often a **private-IP LAN** with **NAT** (and sometimes **proxies**) so many devices share one public address.

1. ISP role

An **Internet Service Provider** gives connectivity, often with a public IP (or CGNAT) and DNS defaults.

2. Connecting home

Dial-up modems used phone lines; **DSL/ADSL** send data at higher speed on the same copper with voice filters – always-on and faster than dial-up.



Home LAN → NAT → ISP → Internet

3. NAT and proxies

NAT translates many private addresses to one (or few) public addresses. A **proxy** can forward/filter application requests on behalf of clients.

🧱 **Worked example: LAN 192.168.1.0/24 behind one public WAN IP. NAT rewrites private sources so many hosts share one public address.**
NAT hides private addresses; ISP routes the public IP.

🚀 **Beyond the syllabus (2026 update)** *Not required for the exam – read for interest.* Fiber ONTs replaced many ADSL boxes; NAT ideas remain.

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Key Words

ISP – Internet Service Provider.	**Modem** – Modulates for the access link.
DSL / ADSL – Digital Subscriber Line family.	**Dial-up** – Internet via telephone call.
Home LAN – Private network at home.	**NAT** – Network Address Translation.
Proxy – Intermediate request forwarder.	**Private IP** – Address used inside the LAN.
Public IP – Globally routable address.	**Always-on** – Link stays connected (DSL).
Customer router – Home gateway doing NAT/Wi-Fi.	**Access network** – Link from home to ISP.

Sample Q&A

1. What is an ISP?

> **Answer:** Organisation that connects customers to the Internet.

2. ADSL advantage over dial-up?

> **Answer:** Faster, always-on, can share line with voice.

3. NAT role?

> **Answer:** Maps private LAN IPs to public IP(s).

4. Proxy role?

> **Answer:** Forwards/filters client requests.

5. Why private IPs at home?

> **Answer:** Many devices share scarce public addresses via NAT.

6. Modem on access link?

> **Answer:** Fits digital data to the ISP access technology.

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MCQ

1. An ISP provides

A. Internet connectivity
B. only paint
C. only pencils
D. only chairs
E. only lunch

2. ADSL is typically

A. only USB power
B. faster and always-on vs dial-up
C. slower than smoke signals
D. only satellite paint
E. only parity

3. NAT translates

A. private addresses to public
B. chairs to desks
C. songs to notes
D. tea to coffee only
E. fonts to colours

4. A home LAN often uses

A. only DNS as IP
B. only HTTP as IP
C. only public IPv4 for every bulb
D. private IP addresses
E. only MAC as IP

5. A proxy can

A. forward or filter application requests
B. grow fiber trees
C. iron cables
D. boil switches
E. invent gravity

6. Dial-up uses

A. only DisplayPort
B. only HDMI
C. only Wi-Fi mist
D. only VGA
E. a telephone call path

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7. Many devices share one public IP using

A. only ALOHA fruit
B. only bus paint
C. only hubs without cables
D. NAT
E. only parity

8. The path home→Internet is

A. MAC → tea → proxy
B. Internet → lunch → LAN
C. GPU → fan → ISP
D. DNS → chair → modem
E. LAN → NAT/router → ISP → Internet

9. Which term means: “Internet Service Provider”?

A. Customer router
B. NAT
C. ISP
D. Private IP
E. DSL / ADSL

10. Which term means: “Modulates for the access link”?

A. Access network
B. Modem
C. Public IP
D. Proxy
E. Dial-up

11. Which term means: “Digital Subscriber Line family”?

A. Private IP
B. Home LAN
C. DSL / ADSL
D. ISP
E. Always-on

12. Which term means: “Internet via telephone call”?

A. Modem
B. Public IP
C. NAT
D. Customer router
E. Dial-up

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13. Which term means: “Private network at home”?

A. Always-on
B. Home LAN
C. Proxy
D. DSL / ADSL
E. Access network

14. Which term means: “Network Address Translation”?

A. Private IP
B. NAT
C. Dial-up
D. Customer router
E. ISP

15. Which term means: “Intermediate request forwarder”?

A. Access network
B. Public IP
C. Home LAN
D. Proxy
E. Modem

16. Which term means: “Address used inside the LAN”?

A. Private IP
B. Always-on
C. DSL / ADSL
D. NAT
E. ISP

17. Which term means: “Globally routable address”?

A. Customer router
B. Dial-up
C. Public IP
D. Modem
E. Proxy

18. Which term means: “Link stays connected (DSL)”?

A. Private IP
B. Home LAN
C. Access network
D. DSL / ADSL
E. Always-on

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19. Which term means: “Home gateway doing NAT/Wi-Fi”?

A. Public IP
B. ISP
C. Customer router
D. Dial-up
E. NAT

20. Which term means: “Link from home to ISP”?

A. Home LAN
B. Proxy
C. Always-on
D. Access network
E. Modem

Structured Questions

1. Role of an ISP. *(2 marks)*

> Connects customers to the wider Internet.

2. Modems and dial-up vs DSL/ADSL. *(2 marks)*

> Dial-up call; DSL faster always-on on copper.

3. Home private LAN + NAT. *(2 marks)*

> Many private hosts share public IP(s).

4. Proxy in a private LAN. *(2 marks)*

> Intermediate forward/filter of requests.

5. Sketch home → ISP → Internet. *(2 marks)*

> LAN, NAT router, ISP, Internet labelled.

Summary

- ISPs provide Internet access.
- DSL/ADSL beat dial-up speed.
- Home LANs use private IPs.
- NAT shares public addresses.
- Proxies can filter/forward apps.

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MCQ answer key – 6.12

1. **A** – Connectivity.
2. **B** – Faster/always-on.
3. **A** – Address translate.
4. **D** – Private IPs.
5. **A** – Forward/filter.
6. **E** – Phone path.
7. **D** – NAT.
8. **E** – Via ISP.
9. **C** – ISP – Internet Service Provider.
10. **B** – Modem – Modulates for the access link.
11. **C** – DSL / ADSL – Digital Subscriber Line family.
12. **E** – Dial-up – Internet via telephone call.
13. **B** – Home LAN – Private network at home.
14. **B** – NAT – Network Address Translation.
15. **D** – Proxy – Intermediate request forwarder.
16. **A** – Private IP – Address used inside the LAN.
17. **C** – Public IP – Globally routable address.
18. **E** – Always-on – Link stays connected (DSL).
19. **C** – Customer router – Home gateway doing NAT/Wi-Fi.
20. **D** – Access network – Link from home to ISP.

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