Grade 12 A/L ICT · Lesson 6

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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