MODULE E · OCR J277 1.3.1, 1.3.2 · CAMBRIDGE 0478 3.4, 5.1.3

Networks

LANs and WANs, **performance**, **client-server**, **hardware**, **star and mesh**, **wired and wireless**, **IP and MAC**, **protocols** and **layers**. **Cambridge 0478: you only need cards 04, 07 and 09**, without the GCSE-only rows. There is no E8. Spec versions as checked in November 2026.

01 LANs and WANs (E1) GCSE only

LAN Small geographical area (home, school, one site). Hardware owned by the organisation.

WAN Large geographical area, linking LANs. Links leased from third parties (cables, phone lines, satellite).

Examples LAN: office network. WAN: the internet (the largest WAN), a bank linking its branches.

02 Network performance (E2) GCSE only

Bandwidth Amount of data transferred in a given time (Mbps).

Devices More devices share the bandwidth: 100 Mbps ÷ 4 = 25 Mbps; ÷ 5 = 20 Mbps each.

Media Wired faster and more reliable; fibre optic has the highest bandwidth.

Wireless Weakens with distance and walls; interference.

Other Heavy traffic (streaming, backups); a slow server or switch is a bottleneck.

03 Client-server and P2P (E3) GCSE only

Client-server Server provides services (web, file, print); clients request them.

Pros, cons Central backups, security, accounts, updates. Costly; specialist staff; server fails, clients lose access.

Peer-to-peer No server; all equal; each is client and server.

Pros, cons Cheap, easy, no single server to fail. No central backup or security; peers slow down.

04 Network hardware (E4) · both boards

NIC Needed to access a network; wired or wireless. IGCSE only given a MAC address at manufacture.

Router Sends data to a specific destination; connects a LAN to the internet. IGCSE only can assign IP addresses.

Switch GCSE only Connects devices within a LAN; uses MAC addresses to send only to the right device.

WAP GCSE only Lets wireless devices join a wired network by radio waves.

Media GCSE only Copper (Ethernet) cable, fibre optic, radio waves.

05 Star and mesh (E5) GCSE only

Star All devices connect to a central switch.

Star +/- One cable failing affects only that device; easy to add. Switch fails: whole network fails; lots of cable.

Mesh Devices linked directly; full mesh: every one to every other.

Mesh +/- Many routes, no single point of failure, rerouting. Lots of cabling: expensive, complex.

Cables Full mesh: n(n - 1) ÷ 2. 5 devices: 10; 6 devices: 15.

06 Wired and wireless (E6) GCSE only

Ethernet Cables. Faster, reliable, harder to intercept. Cost, installation, no mobility.

Wi-Fi Radio waves via a WAP. Mobility, no cables, easy to add. Slower, interference, limited range: encrypt.

Bluetooth Short range (about 10 m) between two devices. Low power, easy pairing, low bandwidth.

Scenario Recommend one or more, justified from the scenario.

07 IP and MAC addresses (E7) · both boards

IP Identifies a device so data reaches the right destination.

IPv4 32 bits; 4 denary numbers 0-255. 192.0.2.45 valid; 192.0.2.256 not (256 > 255).

IPv6 128 bits; 8 groups of 4 hex digits. Made because IPv4 addresses are running out.

MAC 48 bits; 12 hex digits in 6 pairs, e.g. 6E-14-AB-90-2C-F7. Unique to the NIC; used within a LAN.

IGCSE only MAC = manufacturer code + serial code, set at manufacture. IP static (stays the same) or dynamic (assigned on connecting).

09 Protocols and standards (E9) · both boards

Protocol A set of rules for transferring data.

HTTP Browser requests a web page; web server sends the HTML and files. Plain text.

HTTPS Same, but encrypted (SSL/TLS): logins, payments. https:// and a padlock.

GCSE only Standard: rules so hardware and software from different makers work together. TCP splits into packets, reorders, checks; IP addresses and routes. FTP transfers files.

10 Email protocols (E10) GCSE only

SMTP Sends email: client to server, server to server.

POP Downloads to one device; usually deletes from server; offline; not synced.

IMAP Email stays on the server; every device synced. Needs server storage and a connection.

11 Layers (E11) GCSE only

Layer A division of network communication with one job and its own protocols.

Passing Data goes down the layers to send, up to receive. Example: 4-layer TCP/IP model (names not needed).

Benefits Manageable parts, developed separately; change one layer without affecting others; standards let makers work together; easier to fix problems.

01
LAN or WAN: the **size of the area** and **who owns the links**, not the number of devices.

02
Switch: within a LAN, MAC addresses. **Router**: between networks, IP addresses.

03
IPv4 numbers are **denary, 0-255**. IPv6 and MAC addresses are **hexadecimal**.

04
SMTP sends; POP and IMAP receive. HTTPS **encrypts**; it does not stop interception.