

Exercise walk-through

Networks including the internet ■ 2.1

eXercise

You must be able to

- compare a **LAN** 局域网 and a **WAN** 广域网, and the **client-server** and **peer-to-peer** models
- describe the **bus**, **star** and **mesh** topologies
- explain **IP addresses** (IPv4 / IPv6, public / private, static / dynamic)
- explain how a **URL**, the **DNS** and the difference between the **internet** and the **WWW** work

Method — Network types and topologies

A **LAN** (local area network) covers a **small area** (one site), is owned by the organisation, and is fast. A **WAN** (wide area network) covers a **large area** using telecom links — the internet is the biggest WAN. A WAN joins LANs together.

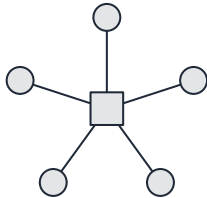
The **topology** 拓扑 is how the devices are linked:

- **bus** — one shared cable: cheap, but the whole LAN fails if the cable does. Only one device can send at a time, so devices must **detect and manage collisions** 冲突 — if two send at once, they stop, wait a random time, and resend.
- **star** — each device to a central switch: one device failing doesn't affect others (most common).
- **mesh** — every device linked to others: very **fault-tolerant** (traffic reroutes), but lots of cabling.

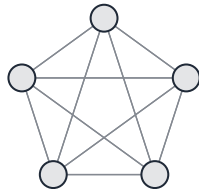
Method — Network types and topologies



Bus



Star



Mesh

Method — Network hardware

- a **router** 路由器 joins different networks and sends (routes) data between them — it connects a LAN to the internet.
- a **switch** 交换机 connects devices **inside** one LAN and sends each message only to the device it is addressed to.
- a **network interface card (NIC)** gives a device its fixed physical **MAC address** 物理地址 and connects it to the network.

Method — Client–server vs peer-to-peer

	client–server	peer-to-peer
Roles	servers 服务器 provide; clients 客户端 request	every node is both client and server
Control	central, easy to manage and back up	no central control
Weakness	server is a single point of failure	harder to secure / keep consistent

Method — IP addresses

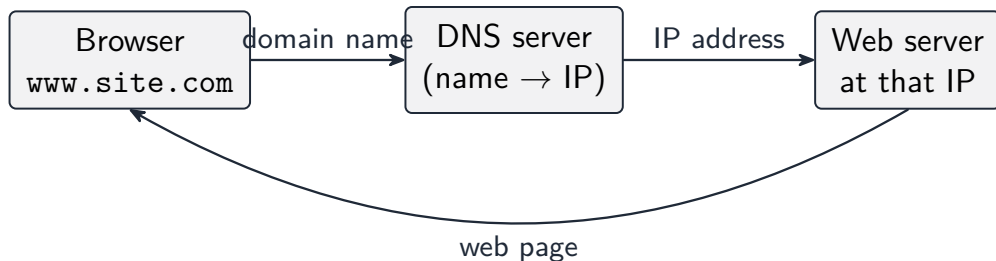
Every device on a network has an **IP address**.

- **IPv4** — four numbers 0–255, e.g. 192.168.0.5. **IPv6** — much longer (hex), created because IPv4 addresses ran out.
- **public** = unique across the whole internet; **private** = used only inside a LAN (not reachable directly from outside → safer).
- **static** = fixed; **dynamic** = assigned when the device joins and may change.

Method — Finding a web page: URL and DNS

The **internet** is the global network of hardware; the **World Wide Web (WWW)** is the pages and resources carried on it. To open a page, the browser turns the **URL**'s domain name into an IP address using the **DNS** (Domain Name Service):

Method — Finding a web page: URL and DNS



Practice 2.1 ■ 2 marks

State **two** benefits of connecting computers in a network.

Solution 2.1

Worked steps

Any two of: share resources (printers, files); share/access the same data; central management and backup; communication; remote access **B1** **B1**.

Practice 2.2 ■ 2 marks

State **two** differences between a LAN and a WAN.

Solution 2.2

Worked steps

Any two differences, e.g.: LAN covers a small area / WAN a large area; LAN owned by the organisation / WAN uses telecom links; LAN faster, lower latency / WAN slower **B1** **B1**.

Practice 2.3 ■ 2 marks

Name the topology in which every device connects to a central switch, and give one advantage of it.

Solution 2.3

Method: Network types and topologies

Worked steps

Star **B1**; advantage e.g. one device (or its cable) failing does not affect the others **B1**.

Practice 2.4 ■ 1 mark

State the difference between a **public** and a **private** IP address.

Solution 2.4

Method: IP addresses

Worked steps

A public IP is unique across the whole internet; a private IP is used only inside a local network **B1**.

Exam-style 3.1 ■ 2 marks

- (a) Describe the **client–server** model of a network.
- (b) Give one advantage **and** one disadvantage of client–server compared with peer-to-peer.

Solution 3.1

Method: Client-server vs peer-to-peer

Worked steps

- (a) Powerful **servers** provide services (files, web pages); **client** machines request those services **B1 B1**.
- (b) Advantage e.g. central management / easier backup and security **B1**. Disadvantage e.g. the server is a single point of failure / cost of the server **B1**.

Exam-style 3.2 ■ 1 mark

- (a) State the format of an **IPv4** address.
- (b) Give one reason **IPv6** was introduced.
- (c) State the difference between a **static** and a **dynamic** IP address.

Solution 3.2

Method: IP addresses

Worked steps

- (a) Four numbers 0–255 separated by dots, e.g. 192.168.0.5 **B1**.
- (b) IPv4 addresses ran out / IPv6 gives many more addresses **B1**.
- (c) Static = fixed and does not change; dynamic = assigned when the device joins and can change **B1** **B1**.

Exam-style 3.3 ■ 3 marks

Describe how the **DNS** is used when a user types a URL into a browser.

Solution 3.3

Worked steps

The browser takes the domain name from the URL **B1** and sends it to a DNS server, which looks it up and returns the matching IP address **B1**; the browser then connects to the web server at that IP to fetch the page **B1**.

Exam-style 3.4 ■ 2 marks

- (a) State the difference between the **internet** and the **World Wide Web**.
- (b) Give one advantage **and** one disadvantage of a wireless connection compared with a wired one.

Solution 3.4

Method: Finding a web page: URL and DNS

Worked steps

- (a) The internet is the global **network of hardware**; the WWW is the **pages and resources** carried over it **B1 B1**.
- (b) Advantage e.g. mobility / no cabling **B1**. Disadvantage e.g. slower / less secure / more interference **B1**.

Exam-style 3.5 ■ 1 mark

A company has offices in two cities, each with a star-topology LAN.

- (a) Name the type of network that connects the two offices together.
- (b) State one benefit of using a mesh topology for the links between the key servers.

Solution 3.5

Method: Network types and topologies

Worked steps

- (a) A **WAN** (wide area network) **B1**.
- (b) Many paths, so if one link fails the traffic reroutes — high fault tolerance **B1**.

Exam-style 3.6 ■ 1 mark

A home has a router and several devices connected to a switch.

- (a) State the role of the **router**.
- (b) State **one** difference between a **switch** and a **router**.

Solution 3.6

Method: Network hardware

Worked steps

- (a) It joins the home LAN to the internet and routes data between the two networks **B1**.
- (b) A switch sends data only to devices **within** the same LAN; a router sends data **between different networks** (e.g. the LAN and the internet) **B1 B1**.

Exam-style 3.7 ■ 2 marks

A LAN uses a single shared cable (a bus). Describe how the network deals with a **collision** when two devices send data at the same time.

Solution 3.7

Method: Network types and topologies

Worked steps

The two devices detect that they sent at the same time, stop transmitting **B1**, then each waits a **random** length of time before resending, so they are unlikely to collide again **B1**.

Exam-style 3.8 ■ 3 marks

A college streams recorded lectures to students and also runs live question-and-answer sessions.

(a) **Complete** the table by describing each type of IP address.

type of IP address	description
public	
private	
static	

Exam-style 3.8 ■ 3 marks

- (b) Consider the address 2001:0db8:0000:0000:0000:ff00:0042:8329. **Identify** which version of IP this is, and **give** one advantage of it over the other version besides the number of addresses available.
- (c) **Describe** the difference between **real-time** and **on-demand** bit streaming, giving one example of each.
- (d) **Explain** why a high **bit rate** and a large enough **buffer** both matter when streaming video.
- (e) A student watching an on-demand lecture sees the video pause repeatedly to reload. **Explain**, in terms of the buffer, why this happens, and **give** one change that would reduce it.

Solution 3.8

Method: IP addresses

Worked steps

- (a) **Public** — unique across the whole internet, assigned by an ISP, and routable on it **B1**. **Private** — used only inside a LAN, not routable on the internet, so the same range can be reused in every building **B1**. **Static** — the same address every time the device connects, rather than one allocated afresh by DHCP **B1**.
- (b) **IPv6** — eight groups of four hexadecimal digits separated by colons **B1**. Any one of: it has a simpler header so routers process packets faster; it has built-in support for encryption and authentication; it removes the need for network address translation **B1**.

Solution 3.8

(c) **Real-time**: the event is broadcast as it happens, encoded and sent immediately, and cannot be paused or rewind past the live point **B1** — for example the live question-and-answer session **B1**. **On-demand**: the file already exists on a server and is streamed when the user asks for it, so it can be paused, rewind and replayed **B1** — for example a recorded lecture **B1**.

(d) The **bit rate** must be at least as large as the rate at which the video consumes data, or the stream cannot keep up whatever else is done **B1**; a higher bit rate also allows a higher resolution **B1**. The **buffer** stores data ahead of the play position **B1**, so short dips in the connection speed are covered by data already downloaded and playback continues smoothly **B1**.

(e) The data arrives more slowly than it is played, so the buffer **empties**, and playback must stop until it refills **B1**. Any one of: choose a lower-resolution stream so the

Solution 3.8

required bit rate falls; use a wired connection or move closer to the router; allow a larger buffer before playback starts **B1** **B1**.