A-LEVEL COMPUTER SCIENCE • EXERCISE SHEET

2.1.1 Network types, client-server and peer-to-peer models, and topologies

Name: _____ Class: _____ Date: _____ **Total: 34 marks**

KEY WORDS router 路由器 • ip address IP 地址 • star 星形 • peer-to-peer 对等网络 • mesh 网状

Objective

Build the skills to answer the **networks** 网络 questions that sheet 2.1 only names. That sheet defines a **LAN** 局域网 and a **WAN** 广域网, lists the topologies and contrasts the two models; this sheet is about the questions that ask you to **justify** a choice for a given situation, to say **how a packet actually travels** in each topology, and to describe the hardware a LAN is built from. It also covers **thin** and **thick clients**, which sheet 2.1 does not.

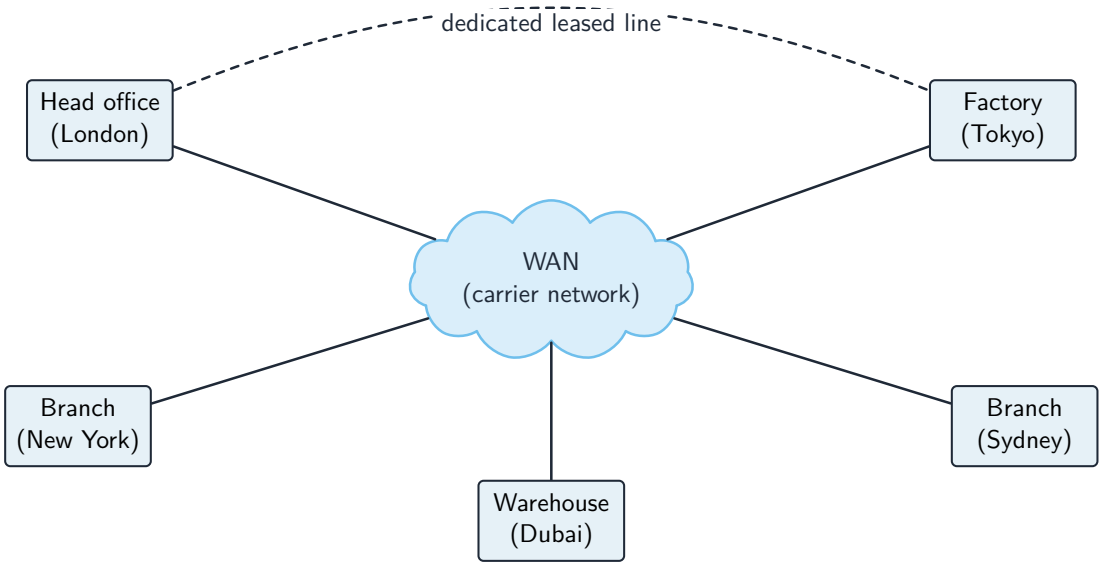
You must be able to:

- show understanding of the characteristics of a LAN and a WAN, and justify which one a situation needs
- explain the **client-server** 客户端-服务器 and **peer-to-peer** 对等网络 models, their benefits and drawbacks, and justify the use of a model for a given situation
- show understanding of **thin-client** 瘦客户端 and **thick-client** 胖客户端 and the differences between them
- show understanding of the **bus**, **star**, **mesh** and **hybrid** topologies, how packets are transmitted between two hosts in each, and justify a topology for a given situation
- describe the hardware used to support a LAN, and the role and function of a **router** 路由器

1 Worked examples

Study these first. Each one shows a **method** that a question later on this sheet needs.

■ Justifying LAN or WAN



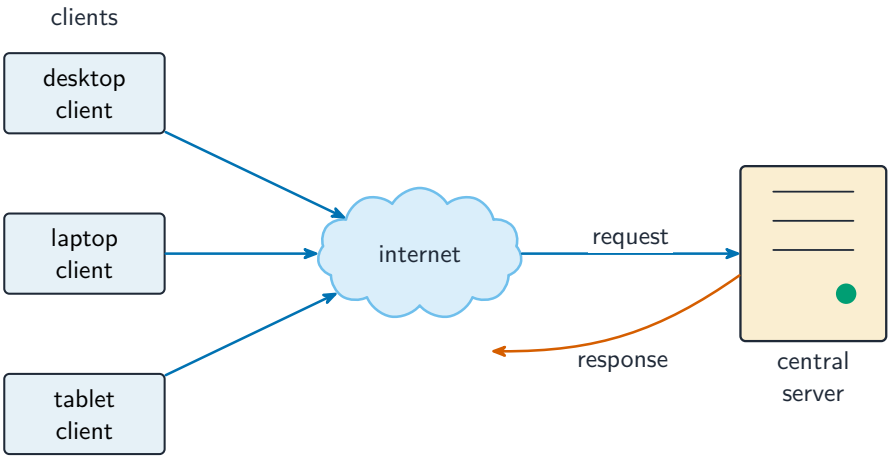
each site holds its own LAN

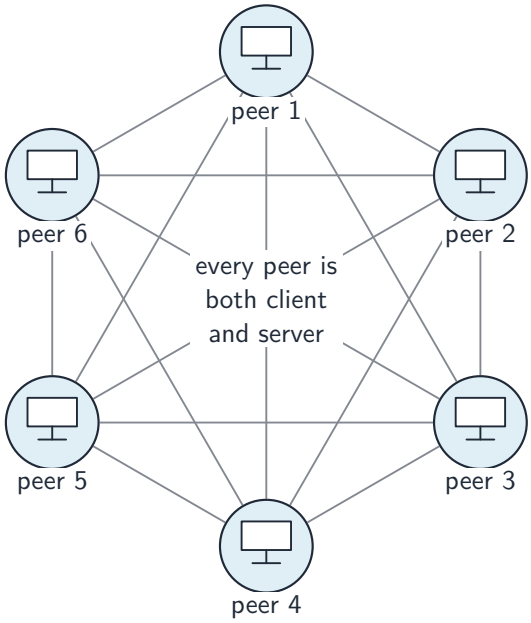
A "state whether this is a LAN or a WAN, and justify your answer" question is marked on the **justification**, not the name. Two things decide it:

- **the area covered** – one site or building is a LAN; separate towns, countries or continents need a WAN.
- **who owns the links** – a LAN's switches and cabling belong to the organisation; a WAN uses a third party's infrastructure (leased lines, the **PSTN**, the internet).

Worked example. *A school connects the computers in one building. A company connects its offices in two cities.* The school has a **LAN**: one site, and the school owns the cabling. The company needs a **WAN**: the sites are far apart, so the link must be leased from a telecommunications company. A WAN also has lower data rates and higher **latency** 延迟 than a LAN, because the signal travels much further through equipment the organisation does not control.

■ Choosing between the two models





	client-server	peer-to-peer
roles	servers provide, clients request	every node is both
files	stored and backed up centrally	spread across the peers
security	managed once, on the server	each machine secured separately
weakness	the server is a single point of failure	a file is unavailable when its owner's machine is off

Justifying a model. A school or business wants **client-server**: one login works on any machine, files are backed up in one place, and software and security are managed once – at the cost of the server itself, a technician, and that single point of failure. A few friends sharing files want **peer-to-peer**: nothing to buy, quick to set up, each user keeps control of their own machine.

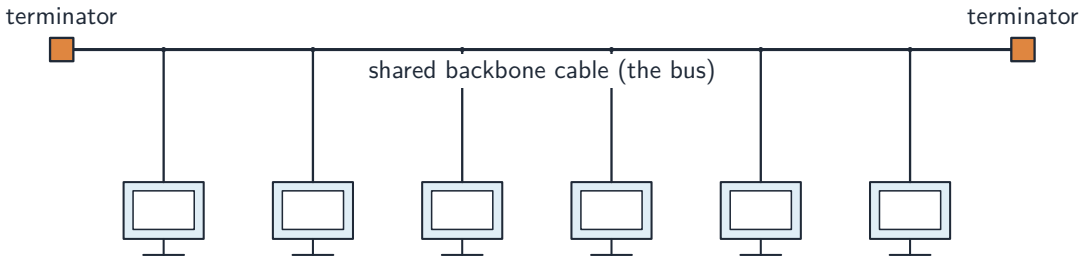
- An online game played in a browser against other people is **client-server**: the browser is the client, and the shared world runs on the company's server, which is what keeps every player's view consistent.

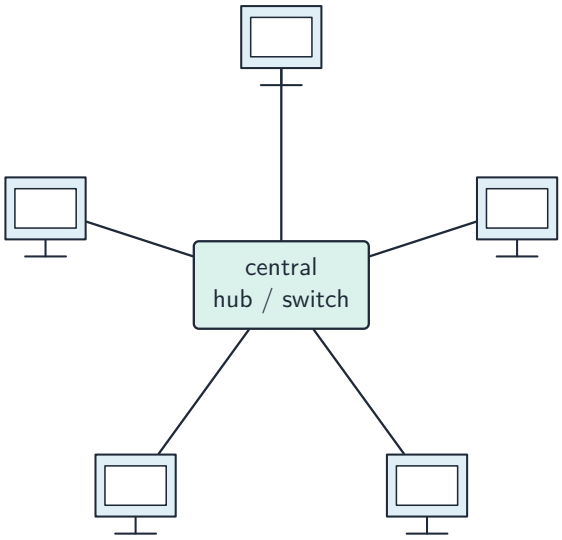
Thin and thick clients

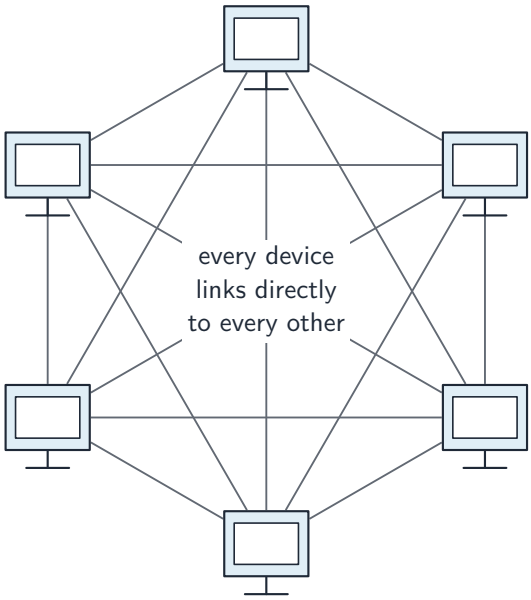
	thin client	thick client
processing	almost all on the server	on the client itself
storage	almost all on the server	on the client itself
needs the network	always	only to reach shared resources
cost of the client	low	high

- In a **thin-client** model the server processes the data and stores it; the client only sends input and displays output. Cheap terminals, one place to back up and update – but nothing works if the network or server fails.
- In a **thick-client** model the client runs the software and stores its own files, so it still works offline and loads the server less – but every client must be bought, updated and secured.
- A school computer room suits thin clients; a video editor needs a thick client.

How a packet travels in each topology





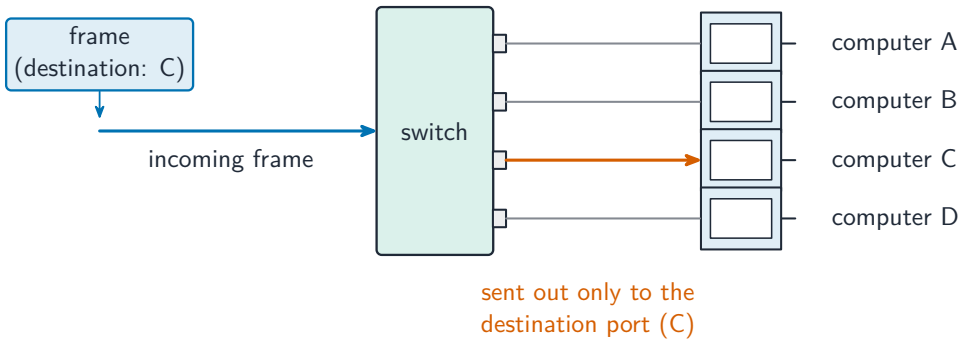


This is the part most often lost. Say what happens to the **packet**, not just what the diagram looks like.

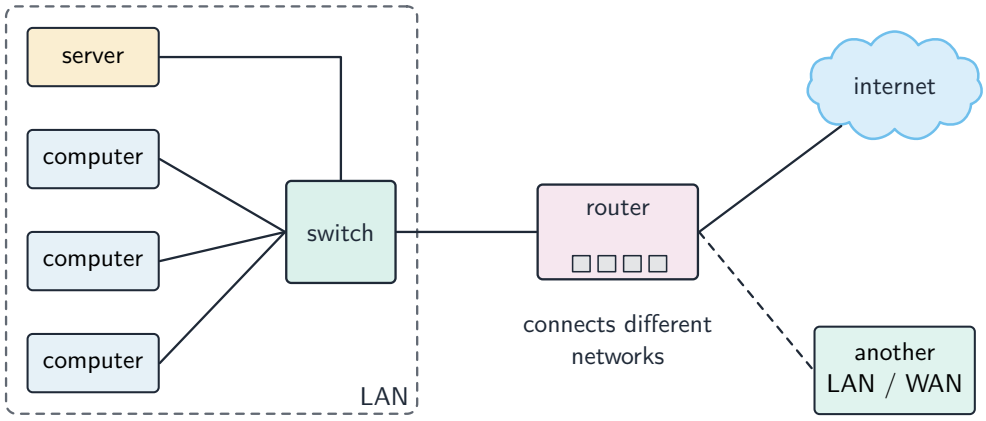
- **Bus** – the sender puts the packet on the one shared cable; **every** device sees it, and only the device whose address matches accepts it. Only one device may transmit at a time, so collisions are possible.
- **Star** – the sender passes the packet to the central **switch** 交换机, which reads the destination address and forwards it **only** down that device's cable. Two other devices can talk at the same moment.
- **Mesh** – the packet is passed from node to node along one of **several possible routes**; if a link fails, another route is used.
- **Hybrid** – a mix, for example a star in each office with mesh links between the offices.

Justifying a topology. A classroom or office wants a **star**: one failed cable affects one device, adding a device is easy, and a switch means no collisions. Where reliability matters most – a hospital, an internet backbone – use a **mesh**, because traffic reroutes around a failure. A **bus** only where cost matters and few devices share the cable.

■ The hardware a LAN is built from



- **NIC** – lets a device send and receive on the network, and carries its unique **MAC address** MAC 地址. A wireless device has a **WNIC**, which converts data to radio signals and back, follows the wireless protocol, and connects the device to an access point.
- **switch** – forwards each frame only to the port for the destination MAC address (a **hub** copies it to every port, which is why hubs are obsolete).
- **wireless access point (WAP)** – lets wireless clients join the wired LAN.
- **server**, **cabling**, **bridge** (joins two LAN segments), **repeater** (retransmits a weakened signal to extend a cable's reach).



A **router** joins **different** networks. It reads each packet's destination **IP address** and forwards it using a **routing table**, hands out private addresses by DHCP, and performs network address translation so many private addresses share one public one.

- The distinction the scheme wants: a **switch** sends data to a device **within** one LAN using its MAC address; a **router** sends data **between networks** using its IP address. A router does **not** find the IP address for a URL – that is DNS – and it does not store web pages.

2 Practice

Now use the methods above.

2.1 A company has one office building. It is deciding between a client-server and a peer-to-peer network. State which model it should choose, and give **two** reasons. [3]

2.2 State **two** differences between a **thin client** and a **thick client**. [2]

2.3 Describe how a packet reaches its destination in a **star** topology. [2]

2.4 State the role of a **bridge** and the role of a **repeater** in a LAN. [2]

2.5 State **one** difference between a switch and a router. [2]

3 Exam-style questions

3.1 A university has two campuses, five kilometres apart. Each campus has several computer rooms.

(a) State the type of network used **within** one campus, and the type used **between** the two campuses. [2]

(b) Justify your answer to part (a), referring to the area covered **and** to who owns the links. [3]

3.2 A hospital is choosing a topology for the network that links its critical servers.

(a) State which topology it should choose. [1]

(b) Explain, by describing how a packet travels, why this topology suits the hospital. [3]

(c) State **one** drawback of this topology. [1]

3.3 A design company replaces its desktop computers with thin clients.

(a) Describe how the processing and storage are shared between the client and the server after the change. [2]

(b) Give **one** benefit and **one** drawback of the change for the company. [2]

3.4 A small office LAN has six computers, a printer and a connection to the internet.

(a) Name **three** items of hardware the LAN needs, and state the function of each. [6]

(b) Describe the role and function of the **router**. [3]