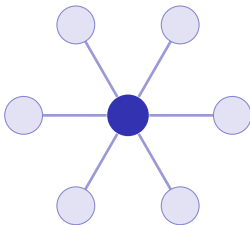


Communication

AS Computer Science ■ Topic 2

A-Level Computer Science



What we will cover

- 1 Networks: types & models
- 2 Topologies & cloud
- 3 Hardware & routing
- 4 Ethernet & streaming
- 5 Internet, IP & DNS
- 6 Recap



Why use a network?

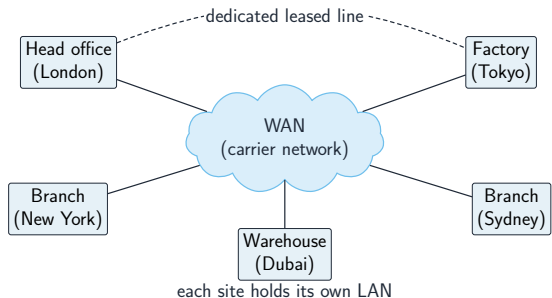
A **network** 网络 connects devices to communicate and share:

- share resources (printers, files, internet)
- central management & backup
- communication & remote access



ethernet rj45

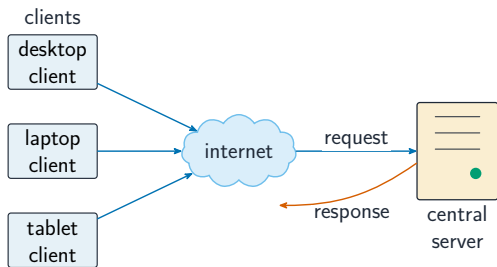
LAN vs WAN



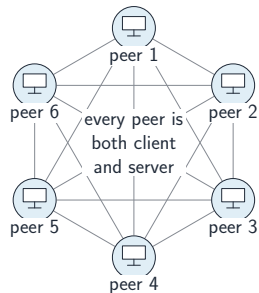
- **LAN** 局域网 – small area, one owner, fast, low **latency** 延迟
- **WAN** 广域网 – large area, telecom links, slower; joins LANs

The internet is the largest WAN.

Client-server and peer-to-peer



client-server 客户端-服务器: *central*



peer-to-peer 对等网络: *equal peers*

Server: easy to manage but a single point of failure. P2P: robust but harder to secure.

Thin vs thick clients

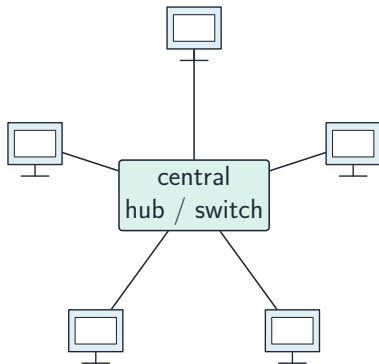
thin client 瘦客户端

little local processing/storage
relies on a powerful server
(web terminal, remote desktop)

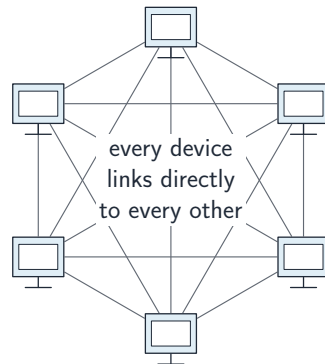
thick client 胖客户端

strong local processing/storage
runs full applications itself
(a normal desktop PC)

Network topologies (1)



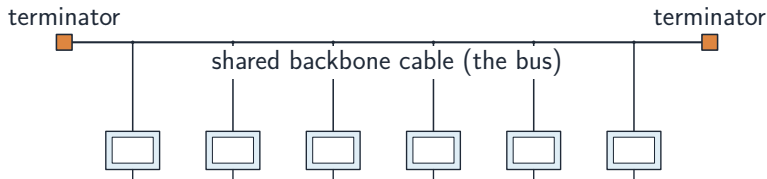
star 星形: a central switch (most common)



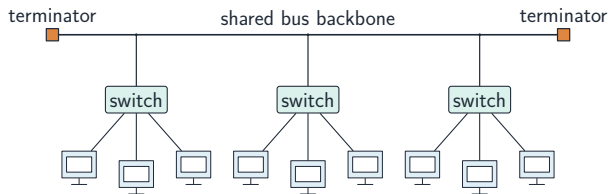
mesh 网状: many paths, **fault-tolerant** 容错

In a star one cable fault affects one device – but the switch is a single point of failure.

Network topologies (2)



bus 总线: one shared cable – cheap, but one break stops everyone



each cluster is a star

Cloud computing and wired vs wireless

Cloud computing 云计算: services over the internet, hosted by a third party.

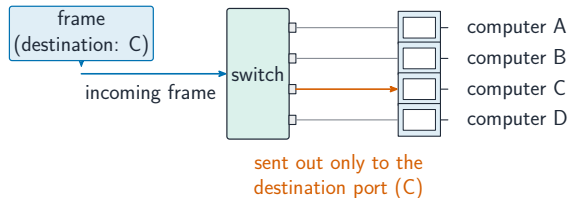
- + **scalability** 可扩展性, low cost, anywhere
- – needs internet; data held by others

wired: faster, safer, lower latency

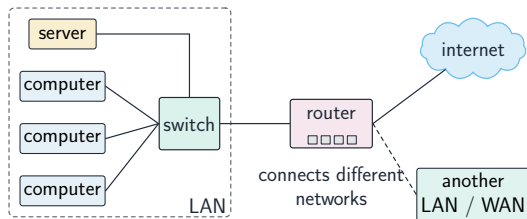
wireless: mobile, no cables, but slower

LAN hardware

- **NIC** 网络接口卡 – sends/receives; unique **MAC address** MAC 地址
- **switch** 交换机 – forwards a frame to the right port only
- **hub** 集线器 – copies to all ports (obsolete)
- **WAP** 无线接入点 – joins wireless clients to a wired LAN



Routers

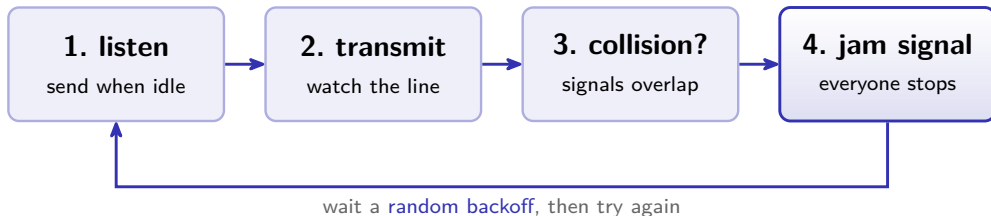


A **router** 路由器 connects **different networks**:

- forwards **packets** 数据包 by IP (routing table)
- **NAT** 网络地址转换, **DHCP** 动态主机配置协议, **firewall** 防火墙

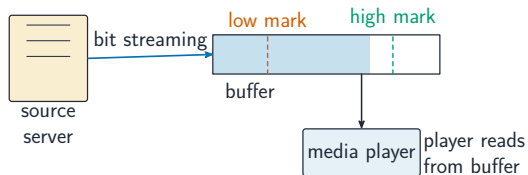
Ethernet and CSMA/CD

On shared media a **collision** 冲突 can happen – **CSMA/CD** 载波侦听多路访问:



Modern **full-duplex** 全双工 switches avoid collisions altogether.

Bit streaming



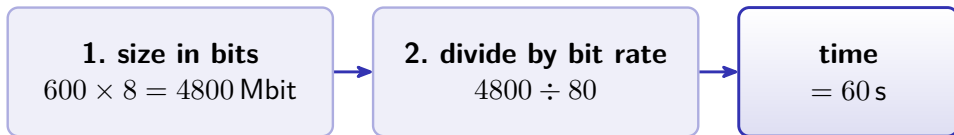
Bit streaming 流式传输: play media as it arrives.

- **real-time** (live): low latency, no rewind
- **on-demand**: **buffer** 缓冲 ahead, can pause

Uses **lossy** 有损 compression to fit the bandwidth.

Worked example: how long to download?

A 600 MB video over an 80 Mbit/s connection – how many seconds?



File sizes are in **bytes** (MB); connection speeds are in **bits** per second (Mbit/s).
Multiply by 8 first – forgetting it is the classic exam slip.

Internet vs World Wide Web

Internet 互联网

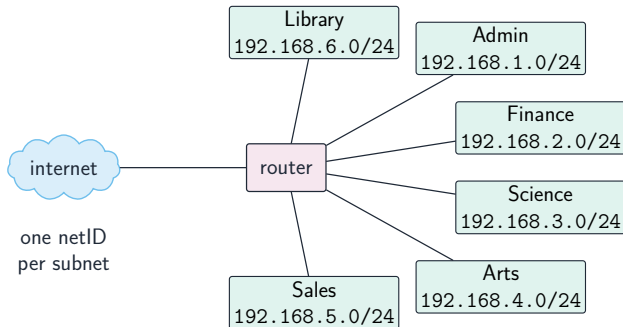
the global network of
networks (TCP/IP)

World Wide Web 万维网

one **service** on it:
linked pages via HTTP

Email and file transfer are other internet services – not part of the Web.

IP addresses and subnetting



- **IPv4** IPv4: 32-bit (192.168.1.10)
- **IPv6** IPv6: 128-bit, far more addresses
- **subnet** 子网: split by a **subnet mask** 子网掩码 (255.255.255.0)

Address kinds

private vs public

private: inside a LAN; public: globally routable (from **ISP** 互联网服务提供商)

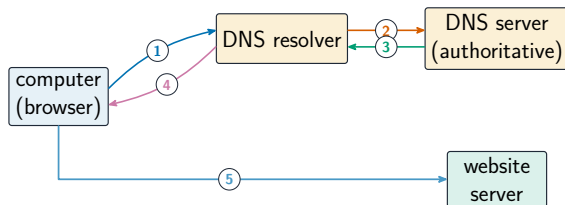
static vs dynamic

static: fixed (servers); dynamic: from **DHCP** 动态主机配置协议, may change

NAT protection

devices behind NAT are not directly reachable from the internet

URL and DNS



- 1 computer asks the resolver for the IP 2 resolver queries a DNS server
3 server returns the IP address 4 resolver passes the IP back to the computer
5 browser connects to that IP and requests the page

A **URL** 统一资源定位符 names a resource: `protocol://domain/path`.

DNS 域名系统 turns the **domain name** into an **IP address** before the browser connects.

Topic 2 – key takeaways

1 Types

LAN vs WAN; client-server vs peer-to-peer

2 Topologies

bus, star, mesh, hybrid

3 Hardware

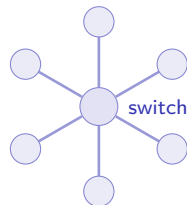
switch forwards by MAC; router by IP

4 Internet

Web is a service on it; DNS maps name to IP

Check yourself

- 1 Which device forwards frames by MAC address?
- 2 In a star topology, what fails if the switch fails?
- 3 What does DNS convert?
- 4 Internet or Web: which is the service?



Answers 1. a switch 2. the whole network 3. domain name → IP address 4. the Web