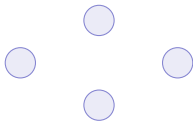


Computer Systems & Networks

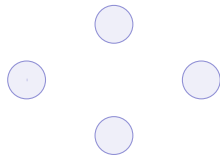
AP Computer Science Principles ■ Unit 4

AP Computer Science Principles

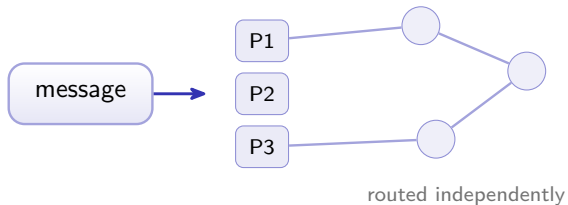


What we will cover

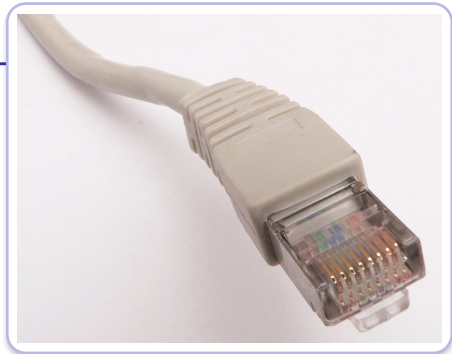
- 1 The Internet
- 2 Fault tolerance
- 3 Parallel & distributed computing



Data travels as packets

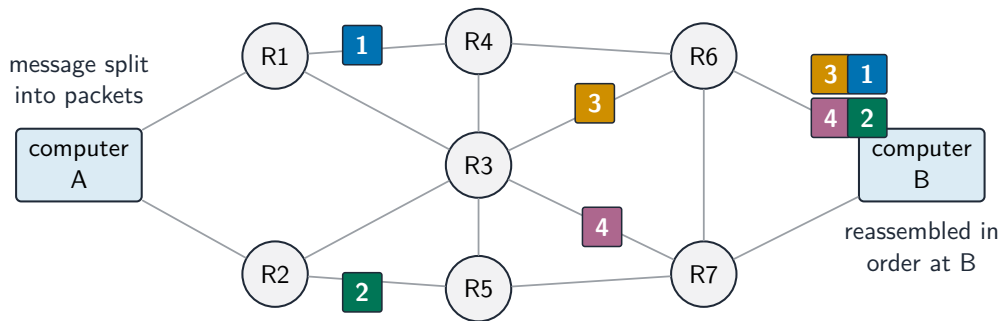


The **Internet** 互联网 is a network of networks cooperating through shared **protocols** 协议. Data splits into **packets** 数据包, each addressed by an **IP address** 网际协议地址 and reassembled in order. The **World Wide Web** 万维网 is one service on top.



Packets carry data across networks

Data travels as packets



Fault tolerance

Fault tolerant 容错的

redundancy 冗余: extra paths/copies, a backup takes over

Single failure

one part
ure stop

The Internet is fault tolerant because many routes mean a broken link is bypassed. Redundancy costs money, so designers weigh it against reliability.



Routers forward packets toward their destination

Parallel & distributed computing

Sequential 顺序计算

one step at a time

Parallel 并行计算

several **processors** 处理器,
one machine

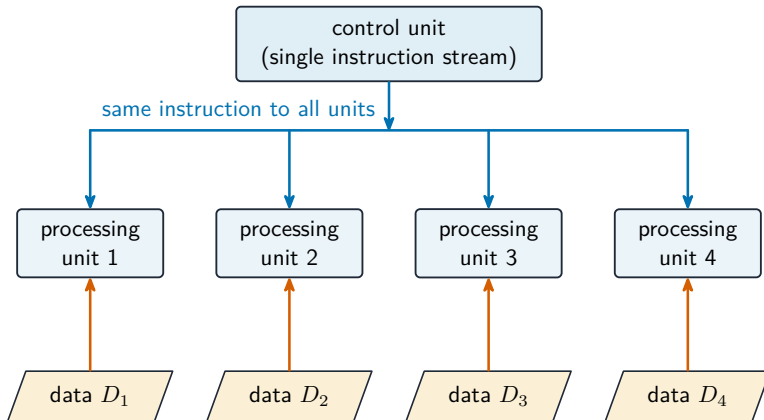
Distributed

Speedup 加速比 = $\frac{\text{one-processor time}}{\text{many-processor time}}$. The **sequential part** caps it – a 100 s task with 20 s sequential can never beat 5×



Distributed systems run across many machines

Parallel & distributed computing



Key points

The **Internet** routes independent **packets** via protocols

Redundancy makes a system **fault tolerant**

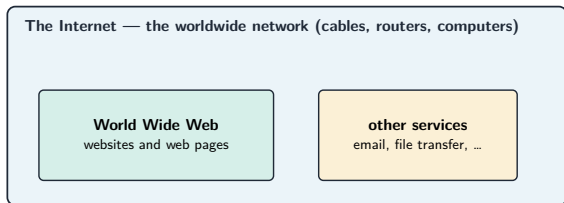
Parallel = one machine;
distributed = many

The **sequential part**
caps parallel speedup

The Internet is not the Web

The **Internet** 互联网 is the **network of networks** – the wires, routers and protocols. The **World Wide Web** 万维网 is **one service running on top** of it.

Email, video calls and games also ride the Internet **without** touching the Web.



one is the road, the other is one kind of traffic

Worked example – the limit of parallelism

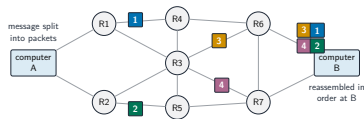
A 40 s sequential part + a 60 s parallelizable part

On one processor: $40 + 60 = 100$ s. Spread the parallel part over 3 processors: $\frac{60}{3} = 20$ s, so the total is $40 + 20 = 60$ s and the speedup is $\frac{100}{60} \approx 1.67$.

The 40 s sequential part is a **floor**: even with **infinitely many** processors the task can **never** finish in under 40 s.

Check yourself

- 1 Is the Web the same thing as the Internet?
- 2 A 40 s sequential part: can 1000 processors beat 40 s?
- 3 Why does packet switching make the Internet fault tolerant?
- 4 What is redundancy in a network?



Answers 1. no – the Web is one service on the Internet 2. no – it is a floor 3. packets reroute around a failure 4. more than one path between two points