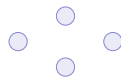


Computer Systems & Networks

AP Computer Science Principles • Unit 4

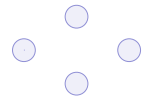
AP Computer Science Principles



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What we will cover

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



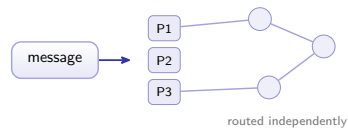
1

The Internet

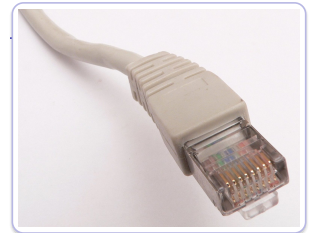
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└ The Internet

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

2

Fault tolerance

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└ Fault tolerance

Fault tolerance

Fault tolerant 容错的
redundancy 冗余: extra paths/copies, a backup takes over

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

3 Parallel & distributed

Parallel & distributed computing

Sequential 顺序计算
one step at a time

Parallel 并行计算
several **proces-**
sors 处理器,
one machine

Distributed 分布式计算
many **sepa-**
rate machines



Distributed systems run across many machines

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

Key points

The **Internet** routes indepen-
dent **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.

The Internet — the worldwide network (cables, routers, computers)

World Wide Web
websites and web pages

other services
email, file transfer, ...

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 Inter-
net?
- 2 A 40 s sequential part: can 1000 proces-
sors beat 40 s?
- 3 Why does packet switching make the In-
ternet 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