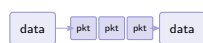


Data Transmission

IGCSE Computer Science • Topic 2

IGCSE Computer Science



Data Transmission

What we will cover

- 1 Packets & packet switching
- 2 Serial, parallel & duplex
- 3 USB
- 4 Error detection
- 5 Encryption
- 6 Recap

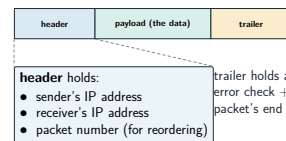


1 Packets

Data Transmission

└ Packets

Packets



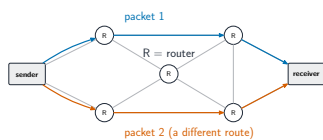
trailer holds an error check + the packet's end marker

- the sender's IP address 地址 (where the packet came from),

Data Transmission

└ Packets

Packet switching



- **routers** 路由器 read each header and pick the best route
- each packet may take its **own** path
- so packets may **arrive out of order**
- the **packet numbers** put them back in order

Different routes means a busy or broken link can be avoided, and many users share one connection.

2 Transmission methods

Serial vs parallel



serial: one bit at a time, one wire

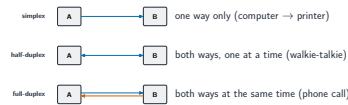


parallel: several bits at once, several wires

	serial 串行	parallel 并行
bits	one at a time	several at once
wires	one	many
distance	long	short only
cost	cheaper	dearer

Over long parallel wires the bits arrive at slightly different times – which is why long links go **serial** (USB, the S is serial).

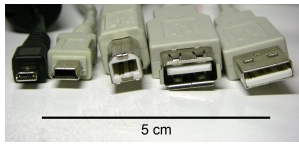
Direction: the three duplexes



- **simplex** 单工: one way only (PC → printer)
- **half-duplex** 半双工: both ways, one at a time (walkie-talkie)
- **full-duplex** 全双工: both ways at once (phone call)

Choose by **distance**, **speed**, **cost**, and whether data must flow both ways at **once**.

USB



The **universal serial bus** 通用串行总线 is one standard **interface** 接口:

- one connector for many devices
- auto-detected; driver loaded
- carries power; fits only one way

But: limited cable length, and older versions are slower.

3

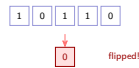
Error detection

Why check for errors?

Interference 干扰 in transit can cause:

- **data loss** – bits do not arrive
- **data gain** – extra bits appear
- **data change** – bits are flipped

So the receiver checks the data arrived correctly, using one of several methods.



Worked example – the parity block

Even parity. One bit flipped in transit – find it.

	b1	b2	b3	b4	b5	par
by1	1	0	1	1	0	1
by2	0	1	1	0	1	1
by3	1	1	1	1	0	1
by4	0	0	1	1	0	0
par	0	0	1	1	1	

One parity bit only shows that an error happened. A parity **block** pinpoints it: the bad row × the bad column = **byte 3, bit b3**.

Four more checks

checksum 校验和
a value from the data; re-computed and compared

echo check 回送校验
receiver sends the data back to compare

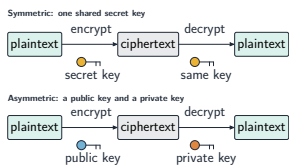
ARQ 自动重传
ack/timeout; re-send if none arrives

check digit 校验码
an extra digit on a typed number (barcodes, ISBN)

A **check digit** catches a mistyped, swapped (**transposition**), missing or extra digit.

4 Encryption

Encryption



- **symmetric** 对称: one **shared** key encrypts and decrypts
- **asymmetric** 非对称: a **public key** 公钥 encrypts, a **private key** 私钥 decrypts

Encryption does **not** stop interception – it stops the data being **understood**. Asymmetric never shares a secret key.

5 Recap

Topic 2 – key takeaways

1 Packets

header (addresses, number) + payload + trailer

3 Errors

parity block locates the bit; checksum, echo, ARQ

2 Serial/parallel

serial one bit, long distance; parallel many, short

4 Encryption

symmetric one key; asymmetric public + private

Check yourself

- 1 What puts out-of-order packets back in order?
- 2 Walkie-talkie: which duplex?
- 3 What does a parity block locate that one bit cannot?
- 4 Which key decrypts in asymmetric encryption?

pkt pkt pkt

Answers 1. the packet numbers 2. half-duplex 3. the exact wrong bit 4. the private key