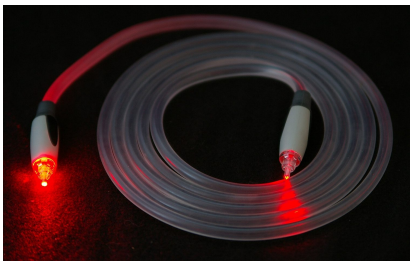
Data Transmission

IGCSE Computer Science ▪ Topic 2

IGCSE Computer Science

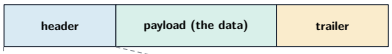
What we will cover

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



1 Packets

Packets

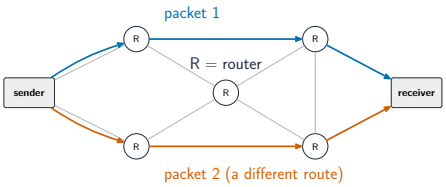


header holds:
- sender's IP address
- receiver's IP address
- packet number (for reordering)

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

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

Packet switching



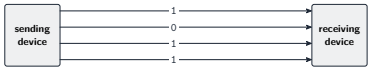
- **routers** 路由器 read each header and pick the best route
- each packet may take its own path
- so packets may arrive out of order
- the packet numbers put them back in order

> 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

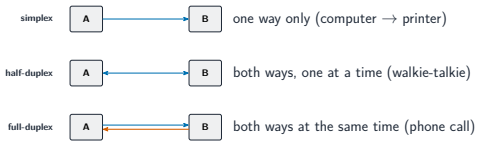


parallel: several bits at once, several wires

	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).

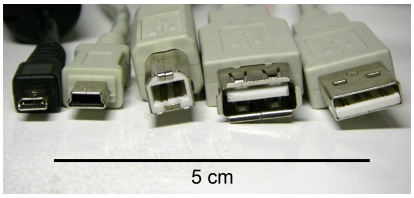
Direction: the three duplexes



- **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.

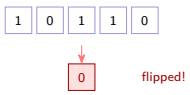
3 Error detection

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	row odd
by4	0	0	1	1	0	0	
par	0	0	1	1	1		col b3 odd

One parity bit only shows that an error happened. A parity block pinpoints it: the bad row $\times$ 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

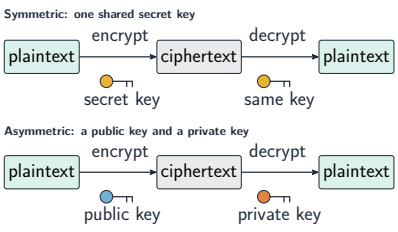
ARQ 自动重传
ack/timeout; re-send if none arrives

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

2 Serial/parallel

serial one bit, long distance; parallel many, short

3 Errors

parity block locates the bit; checksum, echo, ARQ

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?

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