IGCSE 02 Data transmission

Data Packets:
1. **packet header:**
IP address of the **sending station**
IP address of **receiving station**
the sequence **number of the packet**
packet size
2. **payload**: the actual data
3. **packet trailer:**
cyclic redundancy check (CRC)
a way of identifying the **end of the data packet**

Routers: used to control the path a data packet takes from sending station to receiving station

Packet Switching:
each data packet can take a **different route**;
each route taken is **independent of each other**.

Benefits of packet switching:
1. There is no need to tie up a **single communication line**.
2. It is possible to **overcome failed**, busy or faulty lines by simply rerouting packets.
3. It is relatively **easy to expand** package usage.
4. A **high data transmission rate** is possible.

Drawbacks of packet switching:
1. Packets **can be lost** and need to be re-sent.
2. The method doesn't work well with **real-time streaming** (for example, a live sporting event being transmitted over the internet).
3. There is a **delay** at the destination whilst the packets are being reordered.

Simplex: data can be sent in **one direction only**. (from computer to **printer**)
Half-duplex: data can be sent in **both directions by not at the same time** (**walkie-talkie**)
Full-duplex: data can be sent in **both directions at the same time** (**broadband internet connect**)
Serial data transmission: data is sent **one bit at a time over a single wire/channel.**
1. Less risk of **external interference** than with parallel.
2. More reliable transmission over **longer distances**.
3. Transmitted bits won't have the risk of being skewed.
4. Used if the amount of data being sent is relatively small, since transmission rate is **slower than parallel**.
5. Used to send data over long distances.
6. **Less expensive** than parallel due to fewer hardware requirements.

Parallel data transmission: **several bits of data** are sent down **several channels/wires** all at the same time
1. **Faster** rate of data transmission than serial, which makes it the preferred method where speed is important (such as internal connections in a computer).
2. Works well over **shorter distances**.
3. Due to several wires/channels being used, data can become skewed over long distances (no longer synchronised).
4. Easier to program input/output operations when parallel used. Preferred method when **sending large amounts of data**.
5. The most appropriate transmission method if data is **time sensitive**.
6. Requires more hardware, making it more **expensive** to implement than serial ports.

Parity checking: check whether data has been change or corrupted following data transmission

0	1	1	0	1	1	0	0

Even parity checking: an even number of 1-bits in the byte

1	1	1	0	1	1	0	0

Odd parity checking: an odd number of 1-bits in the byte

If **two of the bits change value** following data transmission, it may be impossible to locate the error using parity checking.

Checksum: check if data has been changed or corrupted following data transmission. (**send at the end of block data**)

Process:
1. calculated from the block of data
2. the calculation is done using an agreed algorithm
3. transmitted with the block of data
4. at the receiving end, the checksum is recalculated by the computer using the block of data
5. the re-calculated checksum is then compared to the checksum sent with the data block
6. if the two checksums are the same is correct

USB(Universal serial bus): a form of serial data transmission. Allow both half-duplex and full-duplex data transmission.
Process:
1. The computer automatically **detects that a device is present**.
2. The device is automatically recognized, and the appropriate **device driver software is loaded up**
3. Look for the device driver that **matches the device**.

Benefits:
1. Devices **automatically detected**. device driver automatically loaded up
2. become an **industry standard**
3. support **different data transmission rates**
4. no need external **power source**
5. **backward compatible**(old version still supported)

Drawbacks:
1. only support **maximum cable length** of 5m
2. early standard(v1) may not always supported
3. Even the latest version 3 (V3) and version 4 (V4) USB-C systems have a data transfer rate which is slow compared with, for example, Ethernet connections.

ARQs (Automatic Repeat Requests): a third way used to check data transmission
Process:
1. Uses acknowledgement / request and time-out
2. Error control protocol
3. Check performed on receiving data // error is detected by e.g. parity check, check sum
4. If error detected, request is sent to resend data // negative acknowledgement is used
5. Resend request is repeated till data is sent correctly / requests time out / limit is reached
6. Send acknowledgement that data is received // positive acknowledgement is used
7. If acknowledgement not received in set time data is resent

Echo check : when data is sent to another device, this data is sent back again to the sender.

Process:
1. a copy of data is sent back to the sender
2. returned data compare with the original data by the sender
3. if no difference, send without error
4. if difference, error occurred.

Check digits : calculated from all the other digits in the code.

Process:
1. A digit that is calculated from the data // uses modulo to calculate digit // valid description of modulo
2. It is appended / added to the data
3. Digit is recalculated when data is entered
4. Digits are compared to check for error

plaintext: the origin data
ciphertext: the encryption data

Symmetric encryption: use an encryption key. **The same key** is used to encrypt and decrypt the encoded message.
Drawback: keeping the encryption key a secret.

Asymmetric encryption: use **two keys called public key and private key**.
public key: made available to everybody
private key: only known to the computer user

Matching pairs (private and public keys) are generated by an **encryption algorithm.**

Increase the length of the key can make encryption more secure