COMMUNICATION METHODS

Serial and Parallel transmission

Bits are sent on the wires by varying the voltage: high voltage → 1, low voltage → 0. Usually a little voltage is always kept on the wire to allow the devices to detect a broken cable.

- Serial: bits are sent one at the time over a single wire
  - e.g. USB (Universal Serial Bus), LAN Network
- Parallel: bits are sent simultaneously over many parallel wires
  - e.g. bus systems inside motherboard, connection to printers before USB

Parallel is potentially faster, but it can only be used over short distances, require multiple wires (more expensive) and, since bits may travel at different speeds, data skew might occur.

Bandwidth, Bit Rate and Baud Rate

Bandwidth: a measure of the capacity of the channel down which data is being. Measured in Hertz (range of signal frequencies it can transmit).

Bit Rate: the rate at which data is actually being transmitted, measured in bits per second.

$$Bit\ Rate \propto Bandwidth$$

For a given bit rate of W bps, you need a Tx frequency of 2W Hz

Baud rate: rate at which the signal changes from on electrical state to another.

$$Bit\ rate = Baud\ Rate * N° of\ bits\ per\ signal\ wave$$

Latency

Time delay that occurs when transmitting data between devices, e.g. time between Tx sending the signal and Rx responding to the signal.

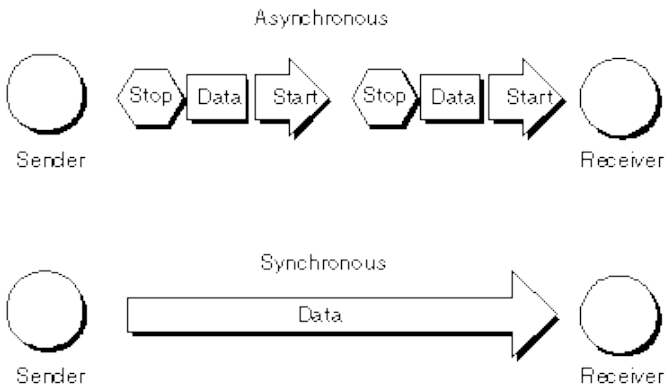
There are three general causes of latency when communicating data

1. *Propagation* - time taken for logic circuits to transmit the data
2. *Transmission* - time taken to pass through a communication medium (Fibre Optic less than Copper)
3. *Processing* - time taken to pass around a network (# Devices / route)

Serial transmission

There are two types of serial transmission:

- Asynchronous: data is transmitted between two devices that do not share a common clock, clocks need to be synchronized for the duration of the transmission.
  - A *start bit* (0 or 1) alerts the receiver and forces it to synchronise its clock, then the character is transmitted with a *parity bit,* which enables checking. A *stop bit* (opposite to the start one) is sent at the end.
  - 1 character at a time, start, parity & stop bits sent with each character
  - Both Tx and Rx must agree parity is odd or even, in the MSB or LSB



- Synchronous: data is transmitted where the pulse of the clock of the sending and receiving device are in time with each other. The devices may share a common clock. Blocks of data are sent in timed sequences. Faster due to lack of control bits.

Communication protocol:

A protocol is a *set of rules* for data & information exchange between a computer and another device to enable successful communication. It covers standards for: physical connectors, cabling, mode of transmission, speed, data format, error detection and correction. Examples of communications protocols: TCP/IP, HTTP and FTP.

Signalling methods

- Baseband: the whole bandwidth is dedicated to one channel
  - Bit Rate = Baud Rate * N° bits encoded per state change
  - E.g. LANs: Fast and Cheap for the connected channel, sharing needs to be managed (CSMA/CD)

- Broadband: bandwidth is divided between multiple channels
  - Data are placed on a modulated carrier, therefore multiple frequency carriers result in multiple channels
  - Bit Rate = Baud Rate * N° bits encoded per state change * N° of channels
  - E.g. WANs: flexible and efficient use of the bandwidth