AQA Computer Science A-Level

4.9.1 Communication

Intermediate Notes

Specification:

4.9.1.1 Communication methods:

Define serial and parallel transmission methods and discuss the advantages of serial over parallel transmission.

Define and compare synchronous and asynchronous data transmission.

Describe the purpose of start and stop bits in asynchronous data transmission.

4.9.1.2 Communication basics:

Define:

- baud rate
- bit rate
- bandwidth
- latency
- protocol

Differentiate between baud rate and bit rate.

Understand the relationship between bit rate and bandwidth.

Communication basics

Before understanding different methods of communication, it helps to understand some key concepts in communication.

Symbol
A symbol is a pattern of 1s and 0s represented by a signal. For example, a symbol of four bits might be 1101.

Baud rate
A communication system's Baud rate is the number of times the signal changes over the medium per second. 1 Baud (or 1Bd) is equal to 1 symbol change per second.

Bit rate
A communication medium's bit rate refers to the number of bits that are transmitted over the medium per second. This is often measured in bits per second (bps).

Bandwidth
Bandwidth, expressed in Hertz, relates to the range of frequencies that a communication medium is capable of transmitting. There is a direct relationship between bandwidth and bit rate. Higher bandwidth results in a higher bit rate.

Latency
Latency in a communication medium, often measured in milliseconds, is the difference in time between an action being triggered and it being noticed. For example, if you press the "R" key on your keyboard and the letter R appears on screen 26ms later, the latency in the link between your keyboard and the application you are using is 26ms.

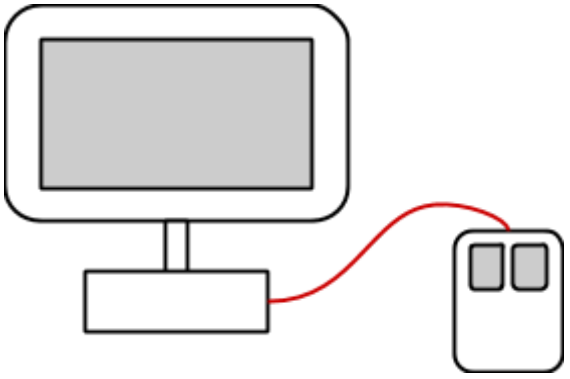
Protocol
A protocol is a set of rules relating to communication between devices. International organisations decide upon and publish protocols which allow devices made by different manufacturers in opposite ends of the world to communicate seamlessly.

Serial and parallel data transmission

Computers can transmit data between their different components in two ways: serially or in parallel.

Serial data transmission

In serial data transmission, data is sent one bit at a time over one wire.



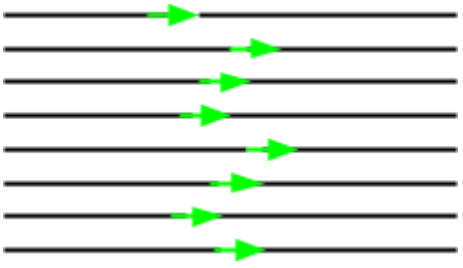
Serial data transmission is frequently used for transmitting data over medium to long distances (in terms of computers), such as from wired peripherals like mice and keyboards to your computer.

Parallel data transmission

Parallel data transmission uses multiple parallel wires in order to send multiple bits between components in a computer at the same time.

The more wires that a parallel communication medium uses, the more data can be transferred simultaneously.

Each of the wires that forms part of a parallel communication medium will have slightly different electrical properties, meaning that the time taken for one bit to be transferred will differ slightly from line to line. This means that bits sent together may not be received together, a problem referred to as skew.



Skew is worst over long distances and can cause corruption of data. Furthermore, parallel communication mediums are more expensive than their serial counterparts because of their use of multiple wires. For these reasons, parallel data transmission is most often used over short distances, such as between parts of the processor.

The advantages of serial over parallel

Serial data transmission doesn't suffer from skew making it a more reliable communication method, especially over long distances. Serial communication mediums, which use just one wire, are cheaper to install than parallel mediums which use more than one wire.

Synchronous and asynchronous data transmission

Synchronous transmission

When data is transmitted using synchronous transmission, a clock signal (which is shared by both the sender and the receiver) is used to time when signals are sent. Synchronous data transmission is used within the busses of a computer's processor in the fetch-execute cycle.

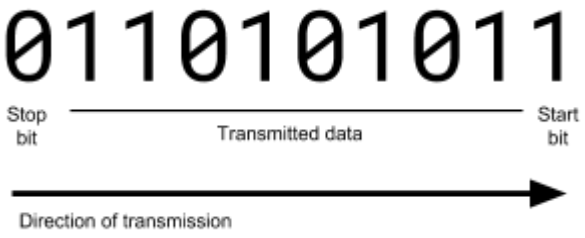
Synoptic Link

The **fetch-execute cycle** is covered in detail in the notes for **structure and role of the processor and its components** under **fundamentals of computer organisation and architecture.**

The signals, which are sent at regular intervals, will be received in the same order that they were sent. This makes synchronous data transmission suitable for transmitting information in real-time systems where its important that data is received correctly so as not to delay a response.

Asynchronous transmission

In asynchronous data transmission, the requirement for a shared clock signal is done away with by using start and stop bits to indicate when a transmission starts and finishes.



The start bit can be either a 0 or a 1 and the stop bit is always the opposite of the start bit.

The main advantage of asynchronous data transmission is that the sender and receiver need only synchronise their clock for the duration of data transmission.