

## 5 Computer Organisation and Architecture

### 5.25 Internal Computer Hardware

- **External components** include input/output and storage devices.
- **Internal components** are those within the CPU.
  - Processor
  - Main memory
  - Address/control/data bus
  - I/O controllers

#### The Processor

The processor **responds to and processes the instructions** that drive the computer. It contains

- The **control unit** coordinate s and controls all operations carried out by the computer. It operates by repeating the **fetch-decode-execute cycle**.
- ALU performs operations on data, such as **arithmetic operations** and **logical operations** and **shift operations**.
- Registers are **special memory cells** that operate at very high speeds. All arithmetic and logical operations take place within Registers.

#### Buses

Each bus is a **shared transmission medium**, only one device can transmit at a time..

- **Control bus**, a bidirectional bus to **transmit command** between components, and ensure the access to and use of the data and address buses by different components **does not lead to conflict**.

The control bus is made of **control lines**, including

- Memory read/write
  - Interrupt request
  - Bus request/grant
  - Clock
  - Reset
- **Data bus**, a bidirectional bus for **moving data and instructions** between components. The width of the data bus is a key factor in determining **overall system performance**.

- **Address bus** - specify an address to access a particular memory location.

The memory is divided into **words** handled as a unit by the processor, each word in memory has its own address. The width of the address bus determines the **maximum possible memory capacity** of the system.

## I/O Controller

An I/O controller is a device which **interfaces between and I/O device and the processor**. Each device has a **separate controller** which connects to the control bus.

The controller consists of

- An interface that allows connection of the controller **to the system bus**.
- A set of data, command, and status **registers**.
- An interface that enables connection of the controller **to the cable** connecting the device to the computer.

An **interface** is a standardised form of connection defining things such as signal, voltage levels, etc.

- The **von Neumann architecture** - a shared memory and bus is used for both data and instructions.
- The **stored program concept** - a program **must be in main memory** to be executed, and instructions are fetched from memory one at a time.
- The **Harvard architecture** - physically separate memories for instructions and data. It is used in **embedded systems** as instruction can use a read-only memory.

Harvard architecture is faster than von Neumann because data and instructions can be **fetched in parallel**.