Lecture – 21

Communication Methods

Intrasystem Communication:

- Occurs within a single computer system.
- Implemented by *bus*.
- Transmission is parallel.

Intersystem Communication:

- Involves communication over much longer distances.
- Realized by a variety of physical media.
- Transmission is serial.

Buses

- Reading Assignment

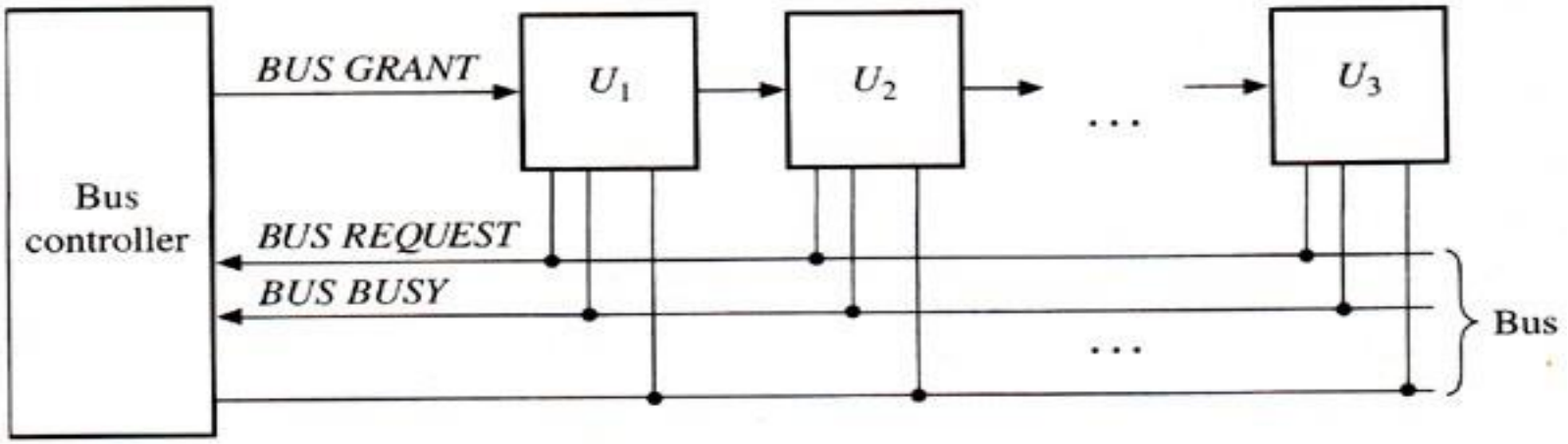
Bus Arbitration

Several master or slave units connected to a shared bus may request access to the bus at the same time. A selection mechanism called ***bus arbitration*** is required to enable the current master called ***bus controller*** to decide among such competing requests.

Three arbitration scheme:

1. Daisy Chaining
2. Polling
3. Independent Requesting

Daisy Chaining



Daisy Chaining

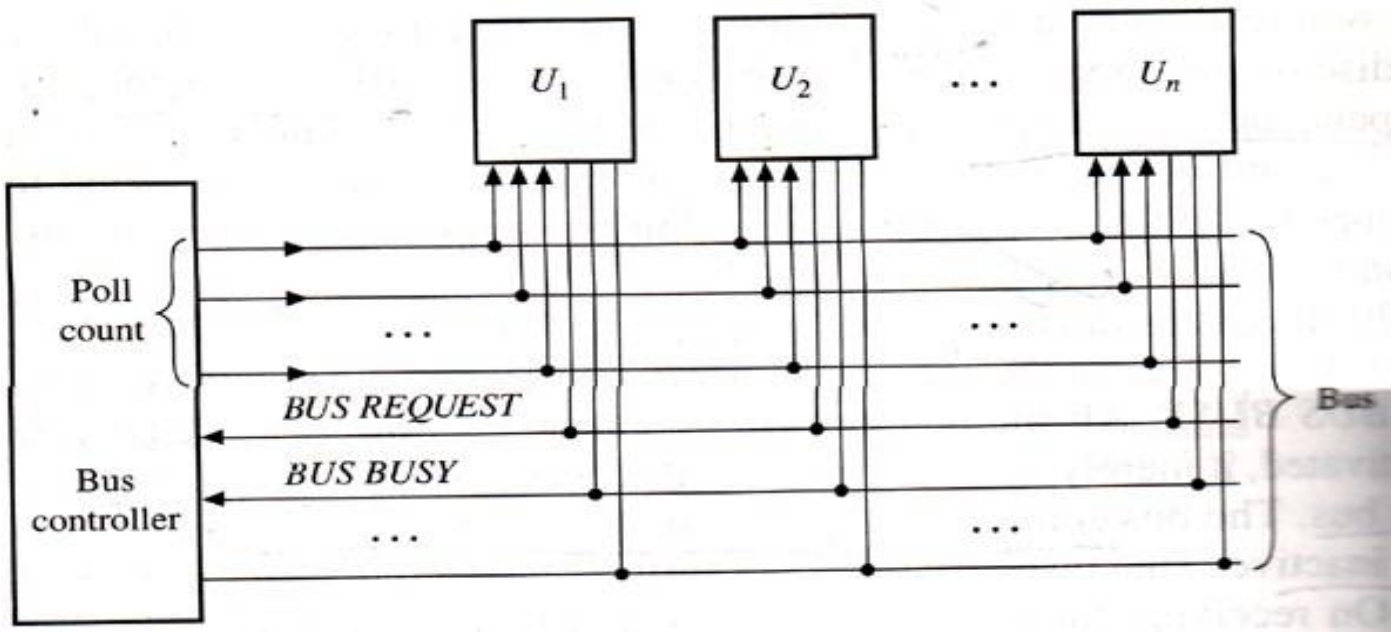
Advantages:

- It requires very few control lines.
- Its arbitration scheme is very simple and fixed.
- It can be used with unlimited number of bus units.

Disadvantages:

- A unit's priority cannot be changed under program control.
- A high-priority unit can lock out a low-priority device.
- If a unit U_i is unable to propagate the *BUS GRANT* signal, then no U_j where $j>i$ can gain access to the bus.

Polling



Polling

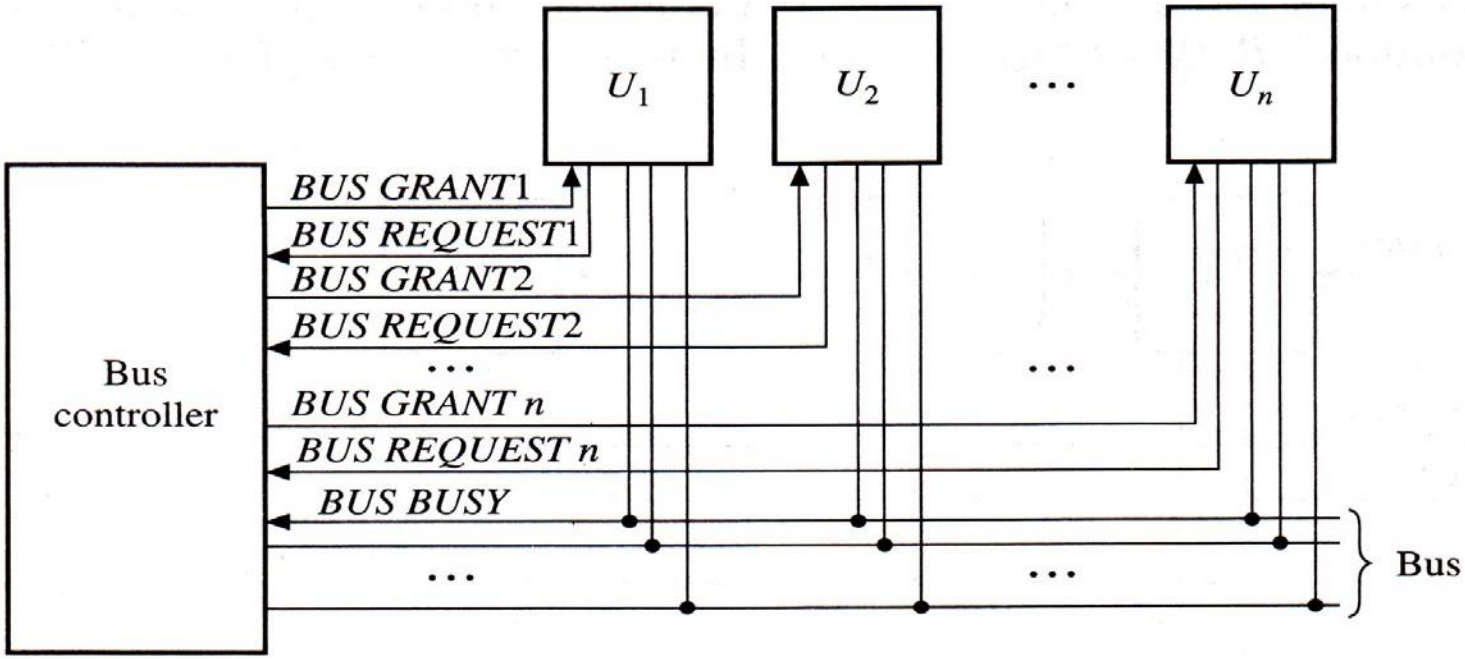
Advantages:

- The selection priority can be altered under software control.
- A failure in one unit does not affect the other units.

Disadvantages:

- It requires more control line.
- The number of units that can share the bus is limited by the addressing capability of the poll-count lines.

Independent Requesting



Independent Requesting

Advantages:

- The bus controller can respond rapidly to requests for bus access.
- The bus controller unit determines priority, which is programmable.

Disadvantages:

- It requires *n* BUS REQUEST and *n* BUS GRANT lines for *n* units. In contrast, daisy chaining requires two such lines, while polling requires approximately $log_2 n$ lines.

IO Control Methods

Three control methods:

- Programmed IO
- Direct Memory Access (DMA)
- Interrupt

Programmed IO

- Programmed IO requires that all IO operations be executed under the direct control of the CPU.

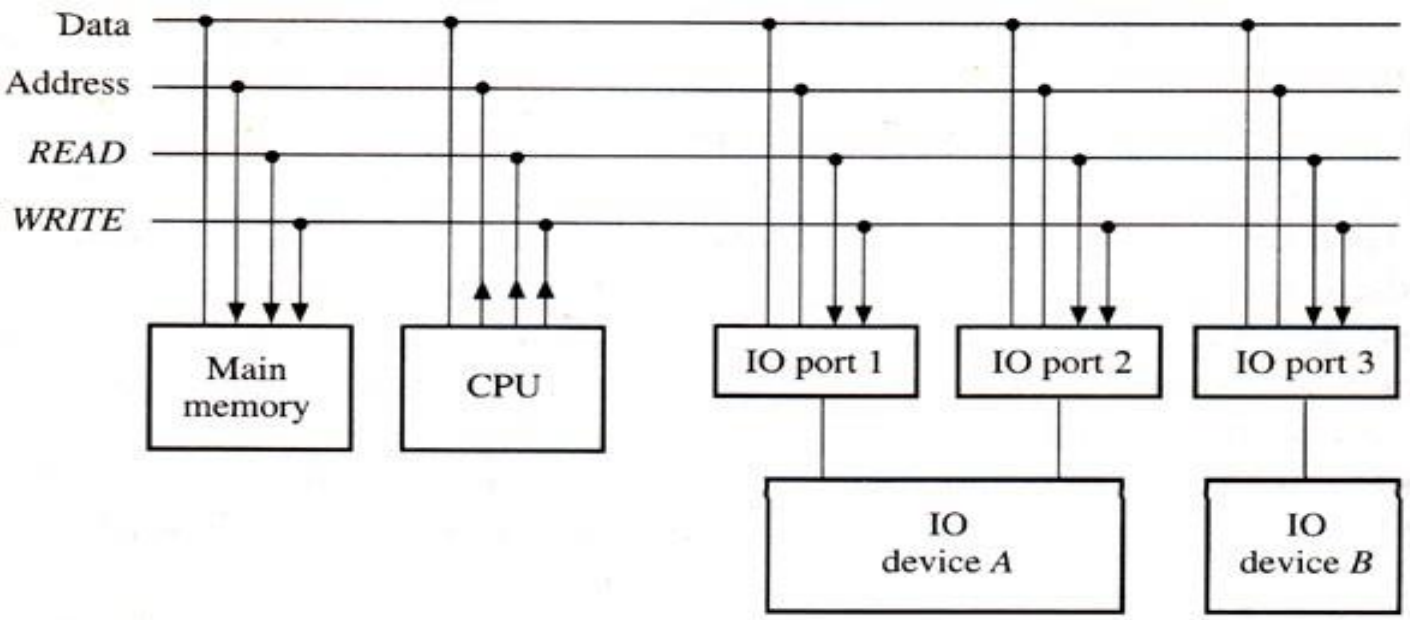
- Every data-transfer operation involving an IO device requires the execution of an instruction by the CPU.

- The transfer is between two programmable registers: one is a CPU register and the other attached to the IO device.

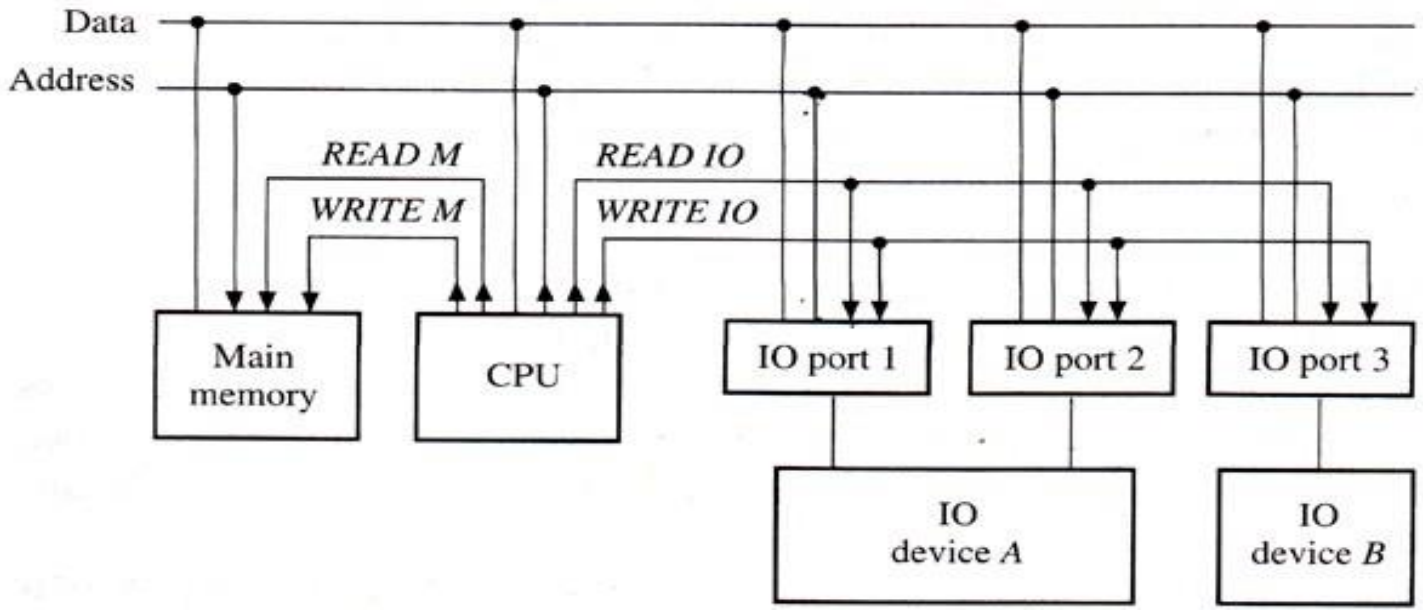
- The IO device doesn’t have direct access to main memory.

- A data transfer from an IO device to M requires the CPU to execute several instructions.

Memory-mapped IO



IO-mapped IO


Data
Address
READ M
WRITE M
READ IO
WRITE IO
Main memory
CPU
IO port 1
IO port 2
IO port 3
IO device A
IO device B

Programmed IO

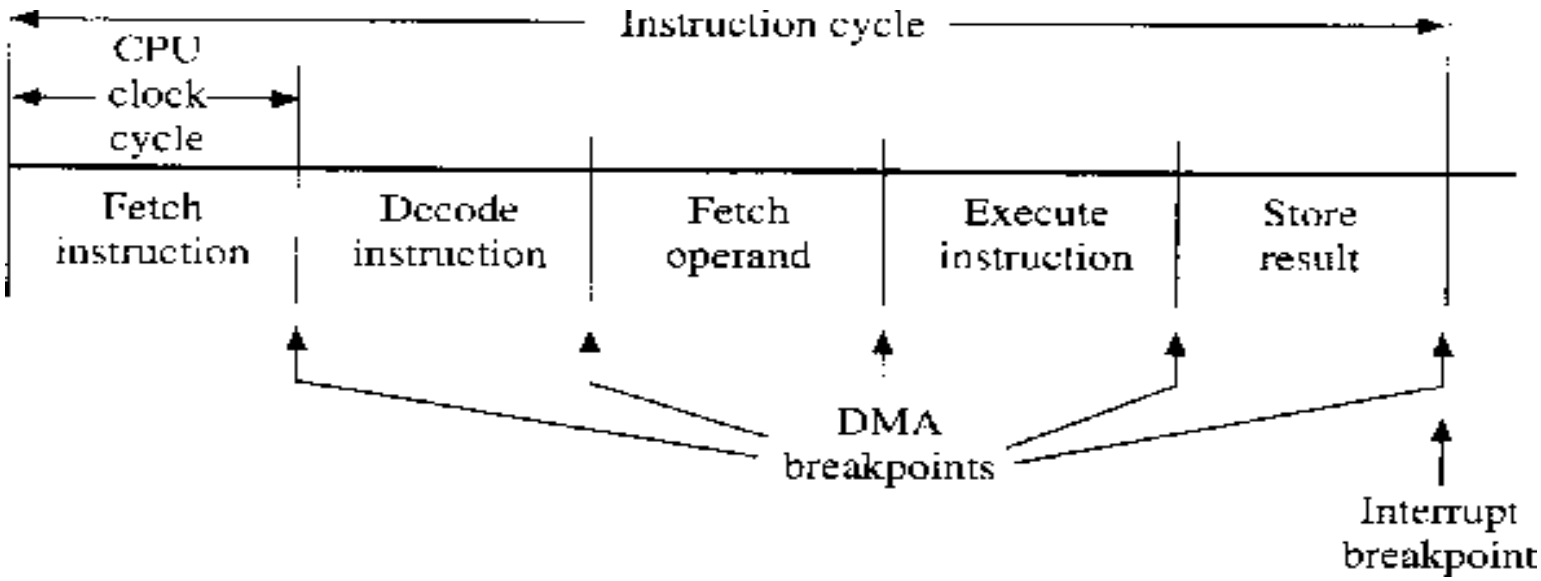
Advantages:

- No special hardware needed.
- The scheme is very simple.

Disadvantages:

- The speed with which the CPU can test and service IO devices limits IO data transfer rates.
- The time that the CPU spends testing IO device status and executing IO data transfers can often be better spent on other tasks.

DMA and Interrupt Breakpoints



Direct Memory Access (DMA)

- A DMA request by an IO device only requires the CPU to grant control of the memory (system) bus to the requesting device.

- The DMA controller is provided with an interrupt capability, in which case it sends an interrupt to the CPU to signal the end of the IO data transfer.

Interrupt

- An interrupt asks the CPU to begin executing an interrupt service program.
- The interrupt program performs tasks such as initiating an IO operation or responding to an error encountered by the IO device.
- The CPU responds to interrupts only between instruction cycles.

Interrupt

- The CPU responds to an interrupt request by a transfer of control to an interrupt handler like subroutine call. The following steps are taken:

1. The CPU identifies the source of the interrupt.
2. The CPU obtains the memory address of the required interrupt handler.
3. The PC and other CPU status information are saved.
4. The PC is loaded with the address of the interrupt handler. Execution proceeds until a return instruction is encountered.