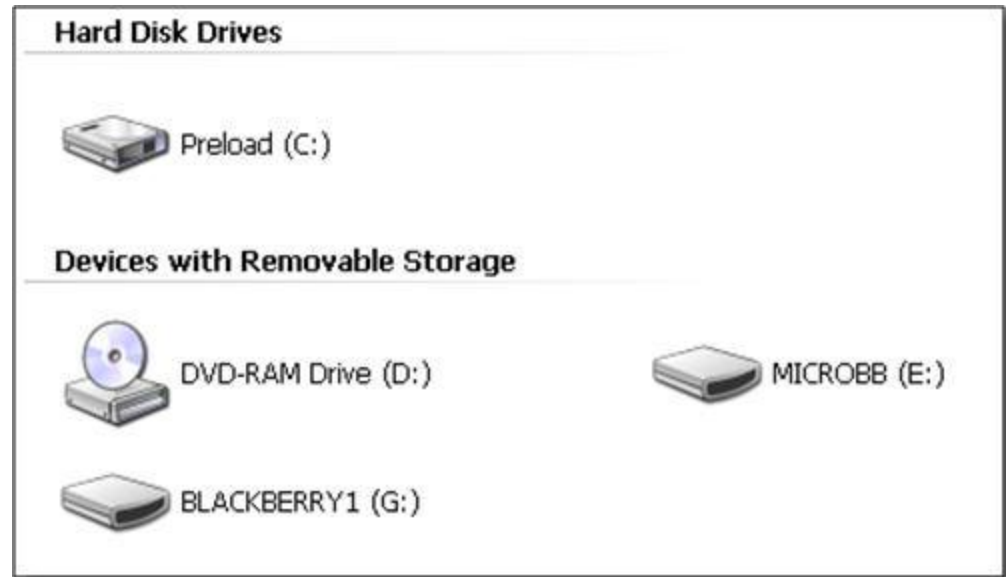


8086 I/O Interfacing

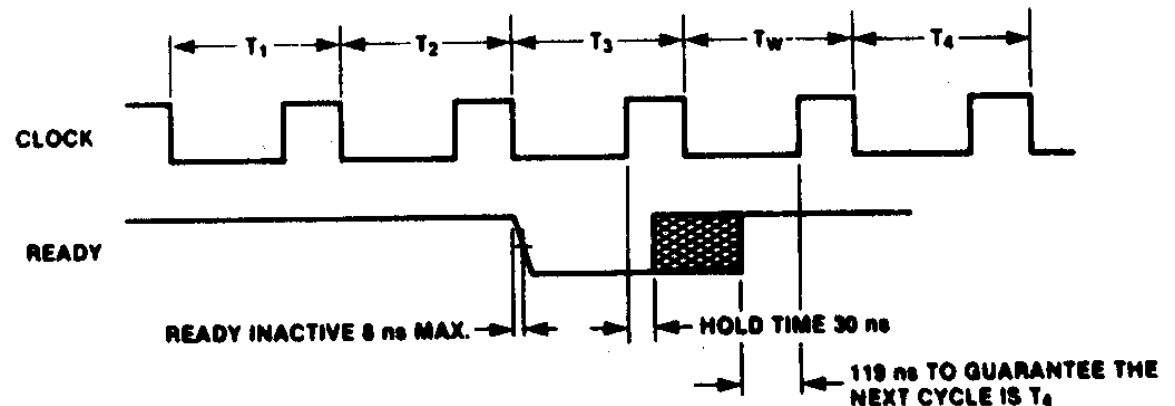
Input output devices

- I/O devices serve two main purposes
 - To communicate with outside world
 - To store data



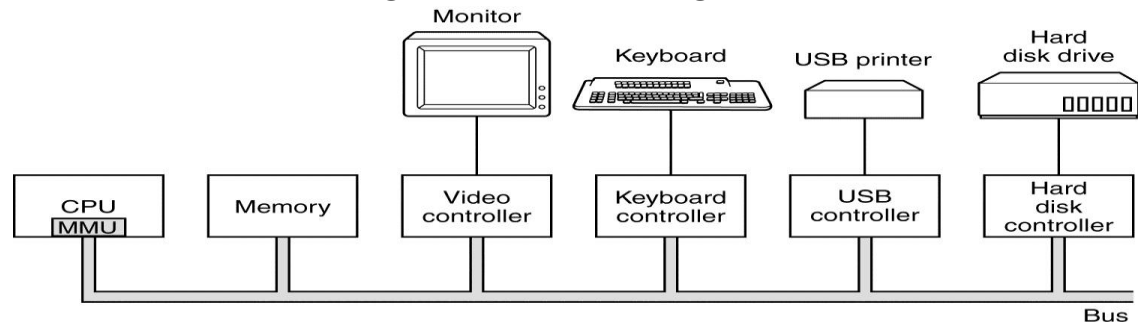
READY signal

- Few I/O devices & memory are usually slower than the microprocessor.
 - The processor issues a command or data to the device, if the device is not ready, it makes the READY input to μP low.
 - So One or more T states called wait states (T_w) are inserted between T_3 and T_4 of bus cycle to lengthen it.
 - The I/O device finishes its task and indicates a ready condition by making READY pin High, and the cycle continues.



I/O controllers

- I/O controller acts as an interface between the systems bus and I/O device
 - Relieves the processor of low-level details like:
 - Takes care of electrical interface i.e. voltage , speed & protocol translation.
 - Buffering
 - Error detection & correction.
 - Addressing.
 - Providing low level control signals according to the I/O device needs.

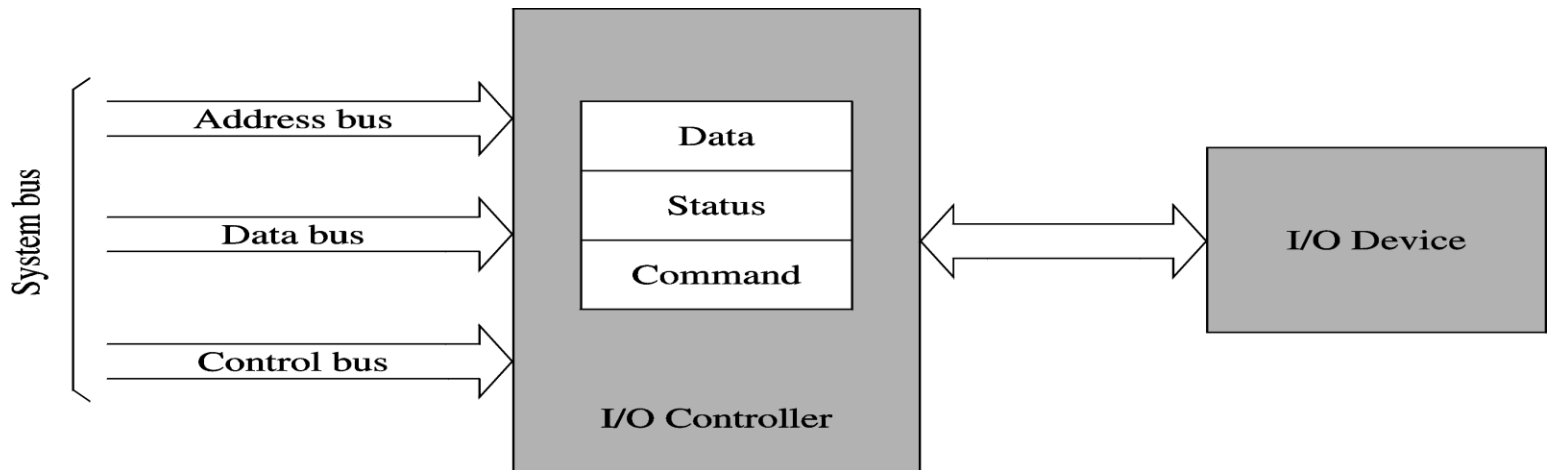


Micro processor & assembly language

I/O Controller

I/O controllers have three types of registers

1. Data
2. Command
 1. Mode of operation (protocol)
3. Status
 1. Device ready
 2. Operation Complete



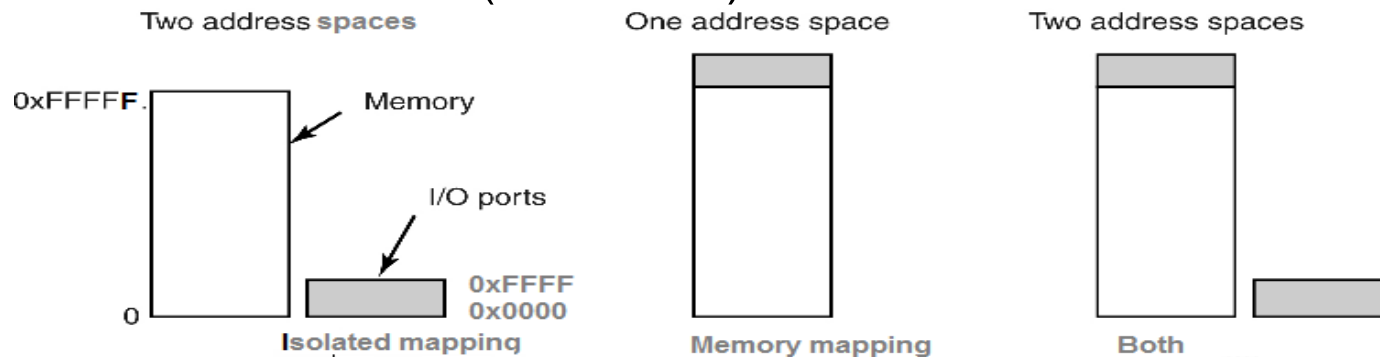
Addressing I/O Devices

– Memory-mapped I/O

- I/O is given address from memory address space.
- Memory read & memory write control signals are used. Reading and writing are done with the memory related instructions.

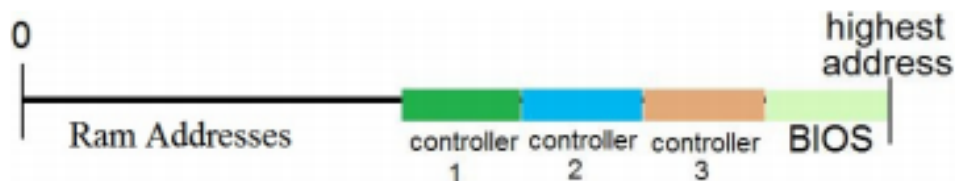
– Isolated I/O

- I/O is given address from separate address space.
- I/O read & I/O write control signals are used.
- Reading and writing are done with the I/O related instructions (IN & OUT).



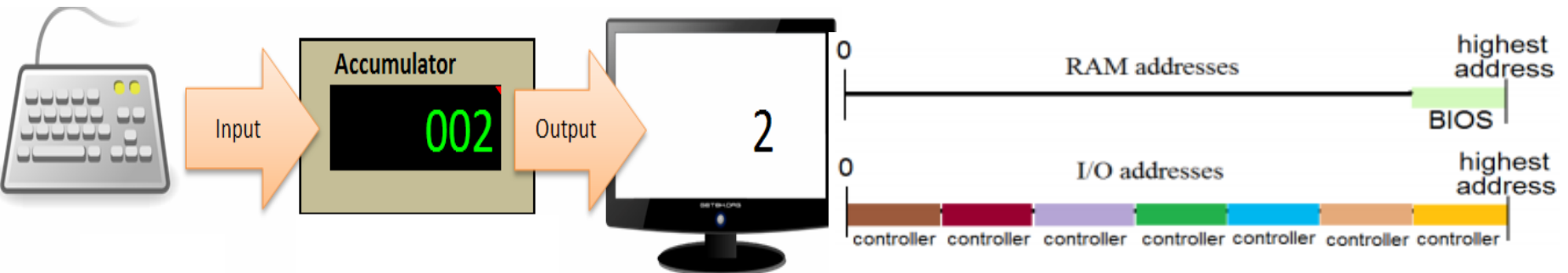
Memory mapped I/O

- Advantages:
 - Data can be transferred from I/O to any register & vice versa.
 - Vast set of memory instructions can be used for I/O operations.
- Disadvantages:
 - More address lines require more decoding circuitry
 - Instructions execute slower than I/O instructions.
 - A part of memory address space is lost in mapping I/O device controllers.



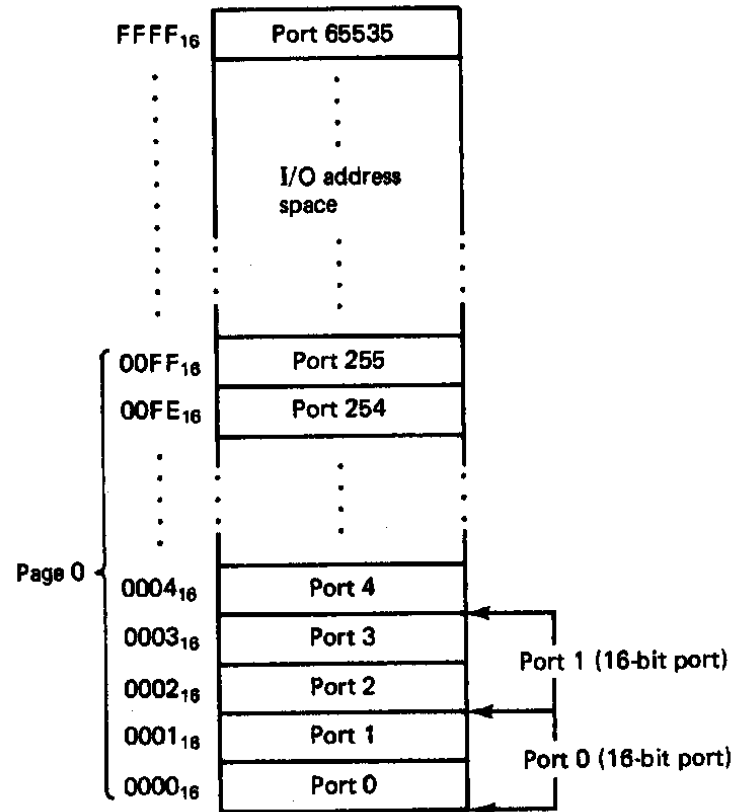
ISOLATED mapped I/O

- Advantages:
 - Less address lines require less decoding circuitry.
 - Instructions execute faster than memory instructions.
 - A part of memory address space is not lost in mapping I/O device controllers.
- Disadvantages:
 - Data can be transferred only from I/O to accumulator & vice versa.
 - Few instructions can be used for I/O operations.



Types of Input/Output

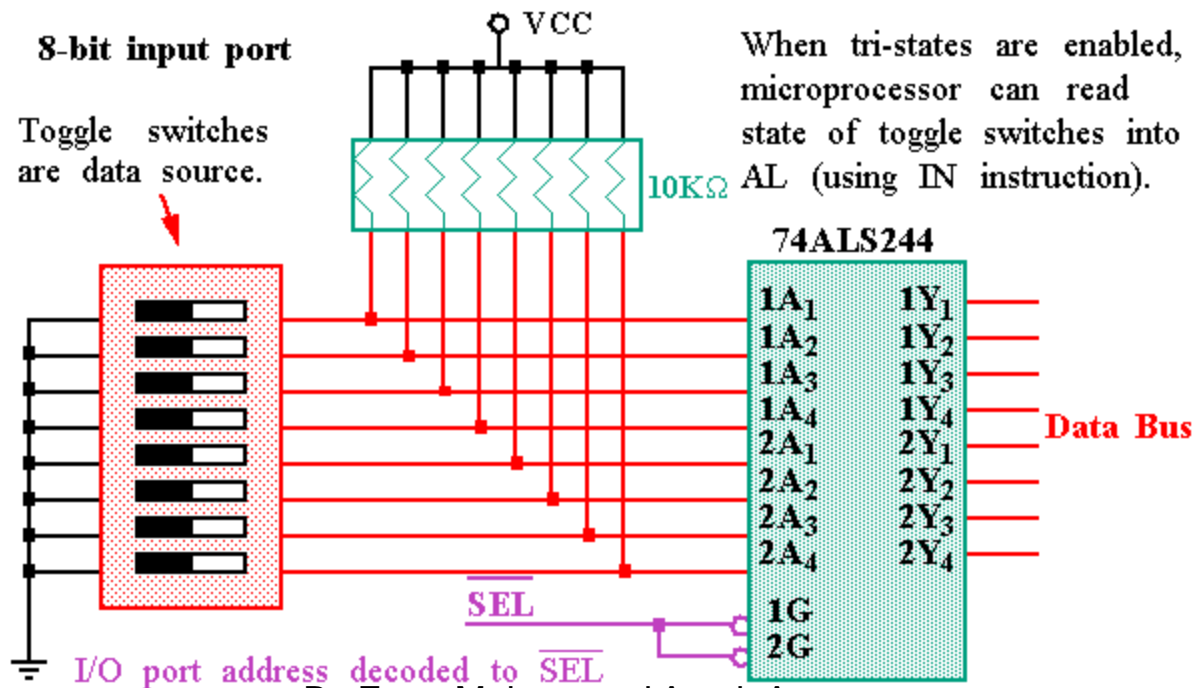
- Isolated input/output



Isolated I/O ports

Simplest input controller

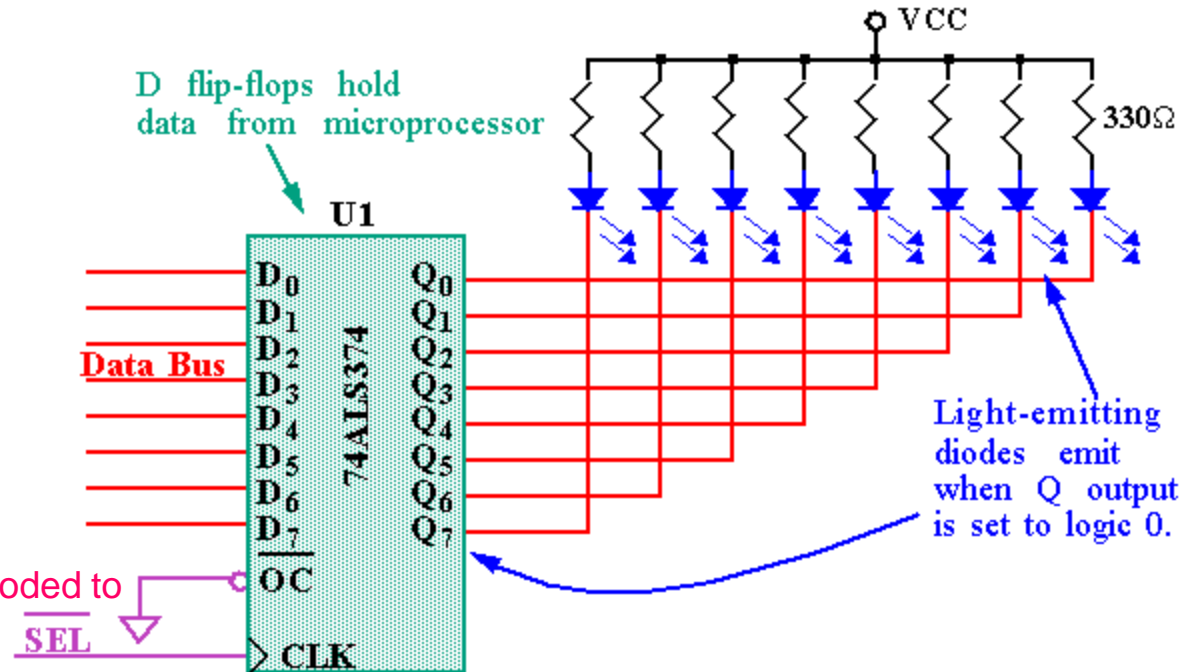
- The basic input controller (to the microprocessor) is a set of tri-state buffers.



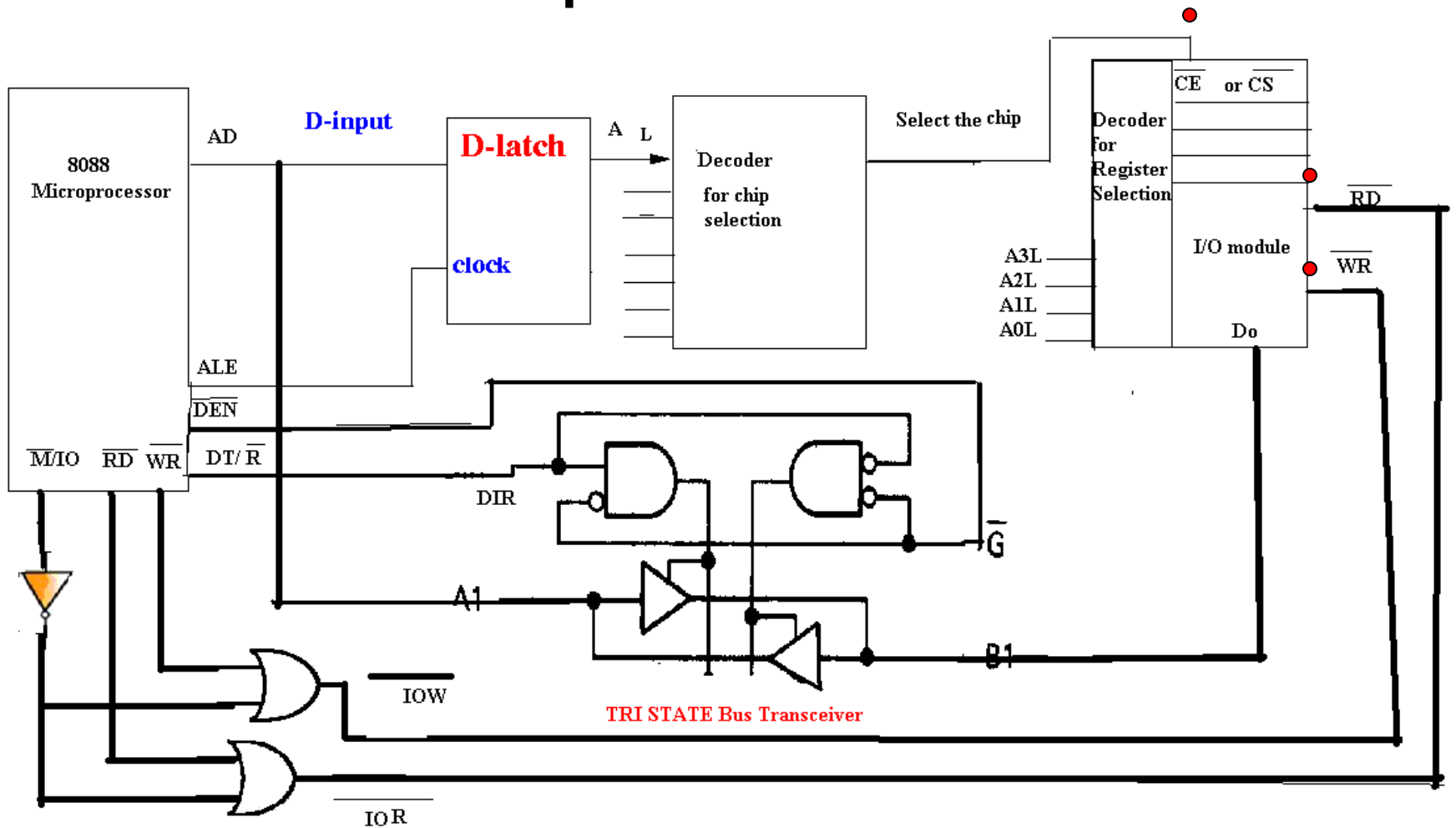
When tri-states are enabled, microprocessor can read state of toggle switches into AL (using IN instruction).

Simplest Output controller

- The basic output controller (from the microprocessor) is a set of latches.

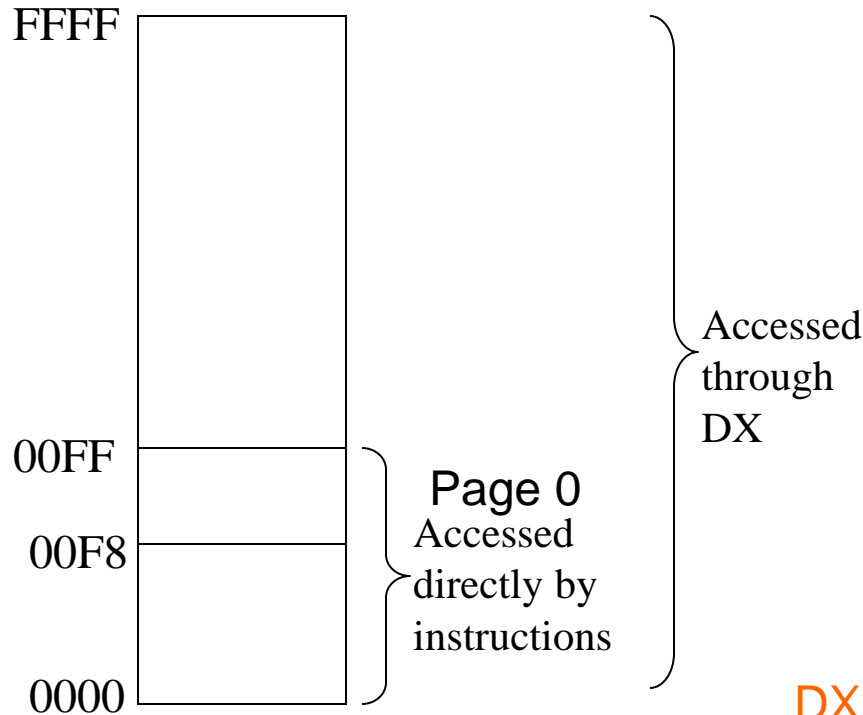


I/O Module Interfacing with processor



8088 Port Addressing Space (isolated address mapping)

□ Addressing Space



□ Accessing directly by instructions

```
IN  AL, 80H
IN  AX, 6H
OUT 3CH, AL
OUT 0A0H, AX
```

Port address on page # 0

□ Accessing through DX

```
IN  AL, DX*
IN  AX, DX
OUT DX, AL
OUT DX, AX
```

DX contains the port address

Micro processor & assembly language