

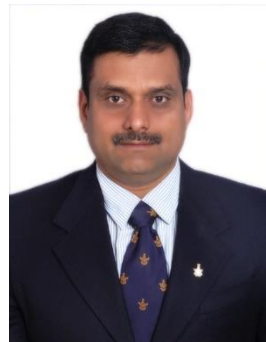


Microprocessors and Interfaces: 2021-22

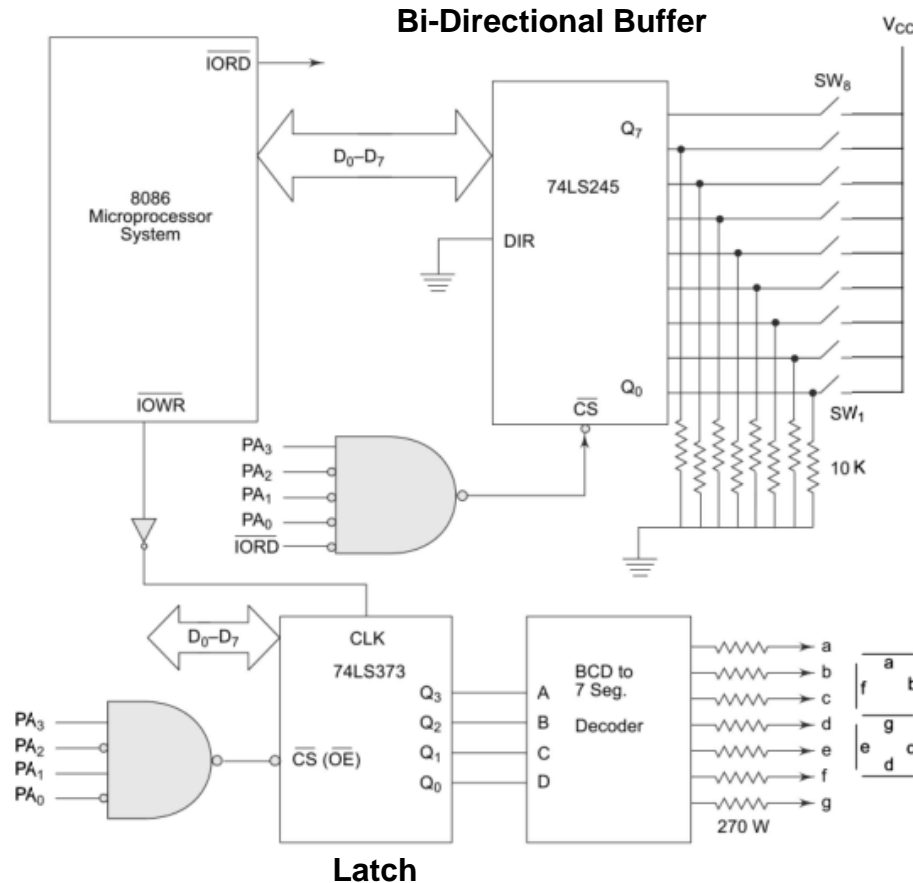
Lecture 31 :

Programmable Interrupt Controller 8259A

By Dr. Sanjay Vidhyadharan

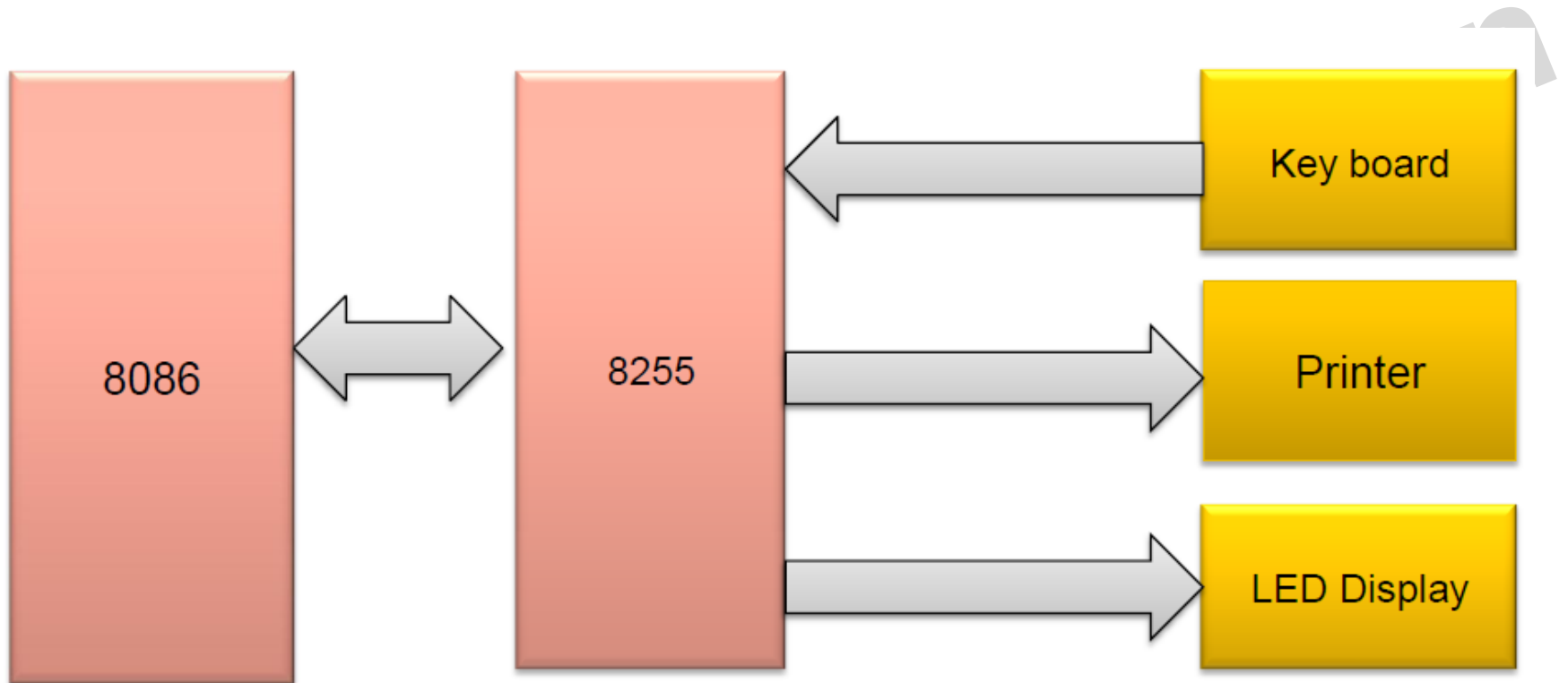


Input & Output Interface

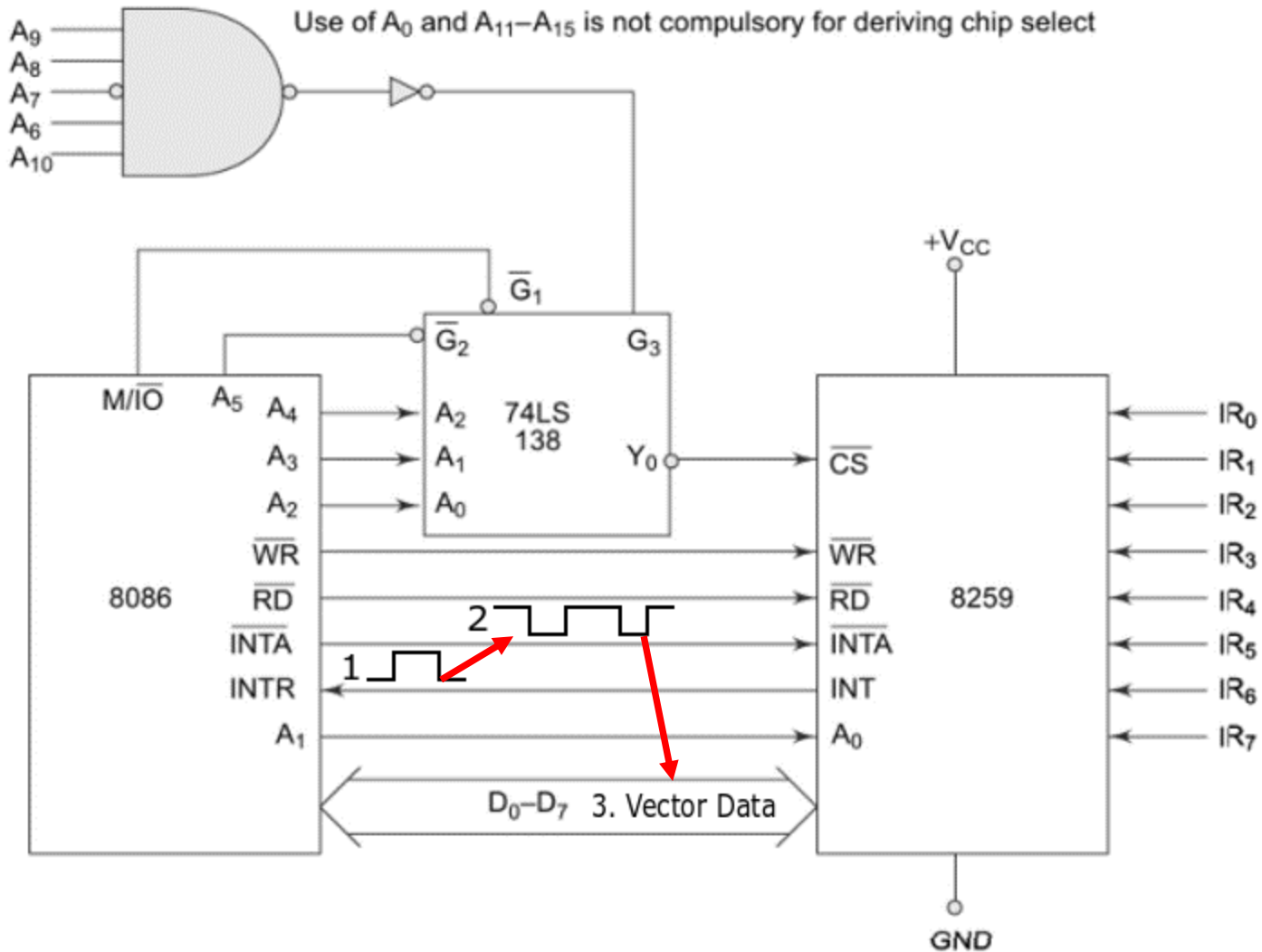


64K I/P & 64K O/P

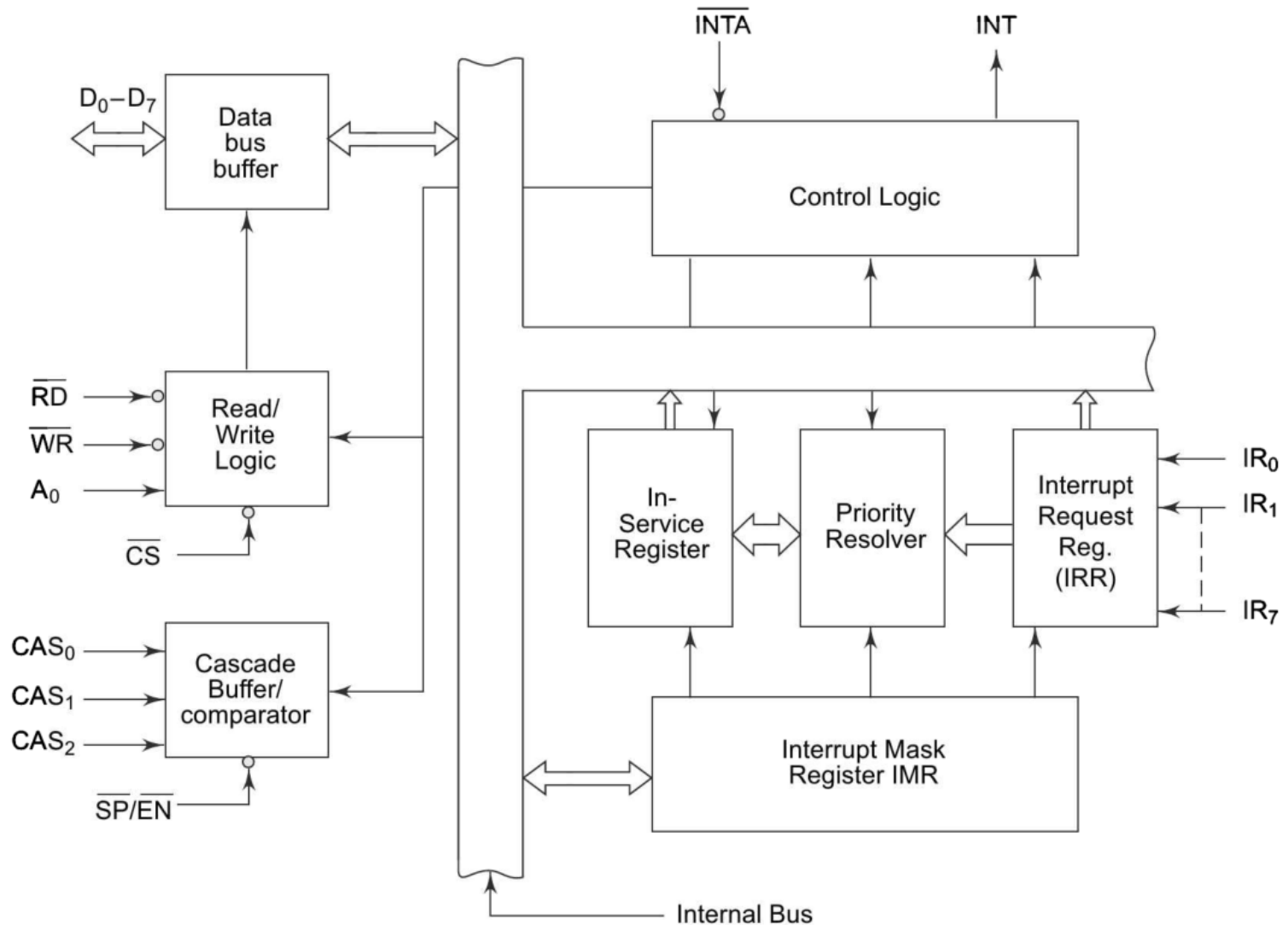
Input & Output Interface



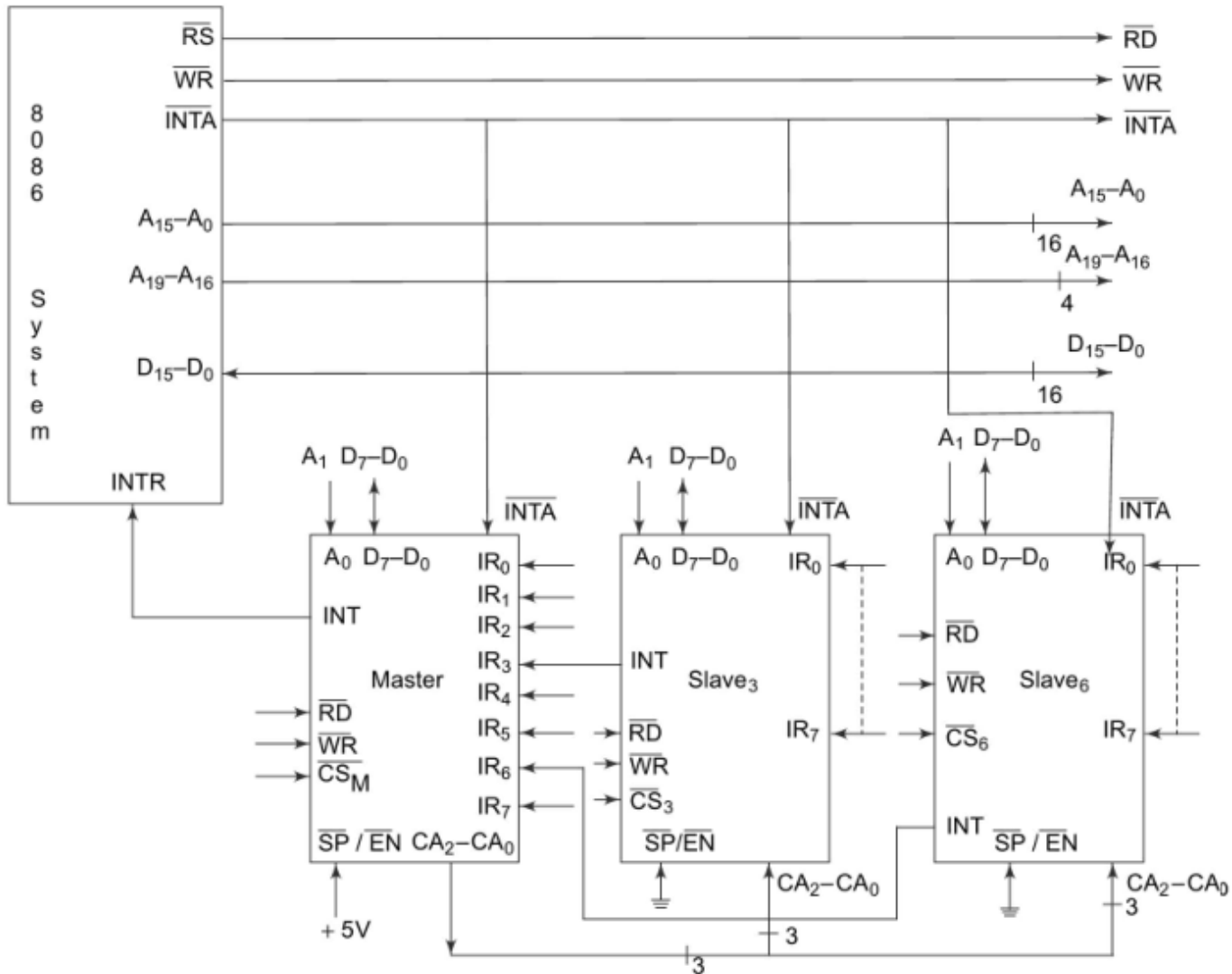
Interface with 8259A



8259A Block Diagram



Cascaded 8259A



Max 64

Addressing 8259A

➤ Only Two Addresses per 8259A.

- **INITIALIZATION COMMAND WORDS (ICWS)**

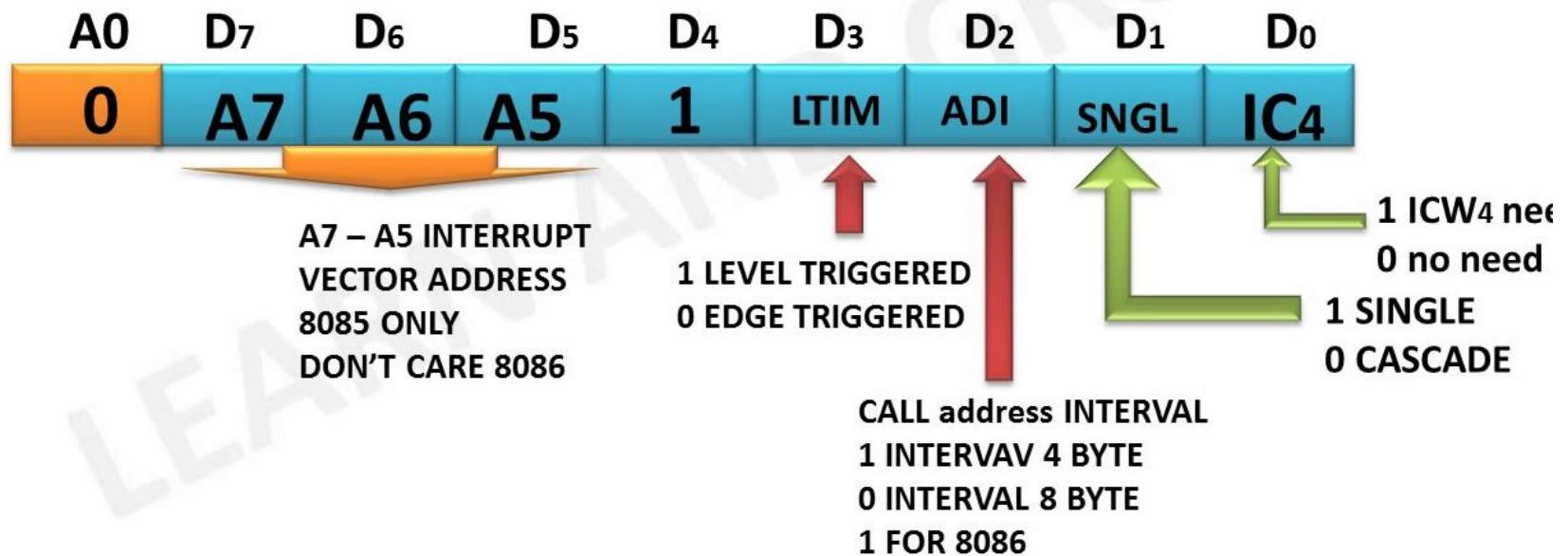
ICW 1, ICW 2, ICW 3, & IC4

- **Operation Command Words (OCWs):**
OCW 1, OCW 2 & ICW 3

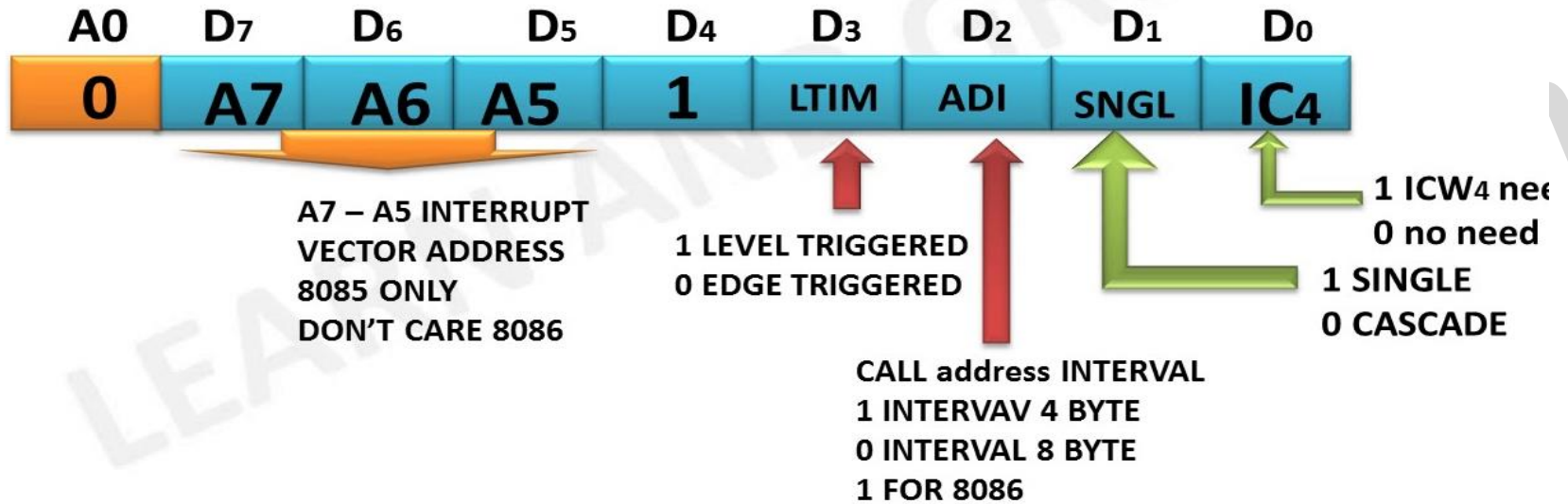
8259A ICWs

ICW1 : Mandatory

ICWs 1 (INITIALIZATION COMMAND WORD)



8259A ICWs



WAP to initialize Single 8259 as follows

Edge triggered,

Single,

Auto EOI Mode,

Buffered Mode,

Mask IR3, IR4, IR5, IR6,

Vector number of IR0 is 40H.

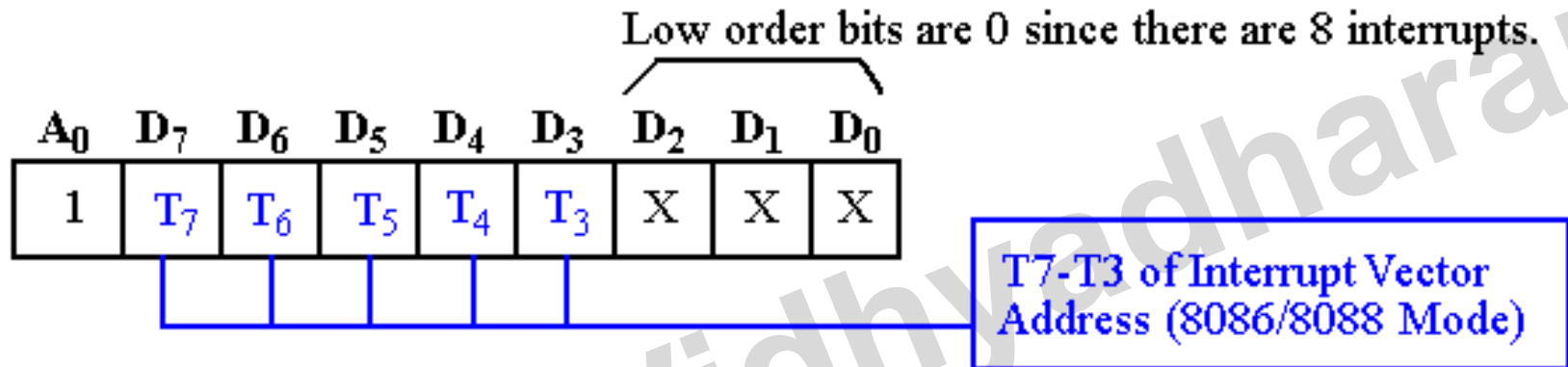
Assume 8259 is at Port Address 80H.

```

Start: MOV AL, 17H
      OUT 80H, AL
  
```

8259A ICWs

ICW2 : Mandatory



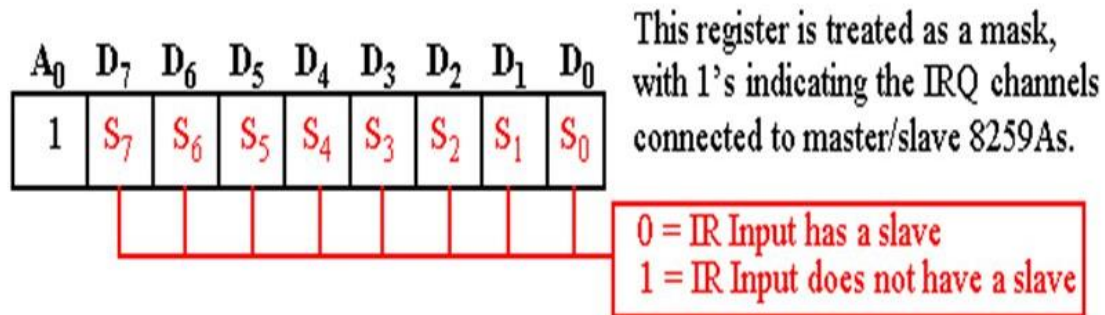
WAP to initialize Single 8259 as follows
Edge triggered,
Single,
Auto EOI Mode,
Buffered Mode,
Mask IR3, IR4, IR5, IR6,
Vector number of IR0 is 40H.
Assume 8259 is at Port Address 80H.

```
Start: MOV AL, 17H
      OUT 80H, AL

      MOV AL, 40H
      OUT 82H, AL
```

8259A ICWs

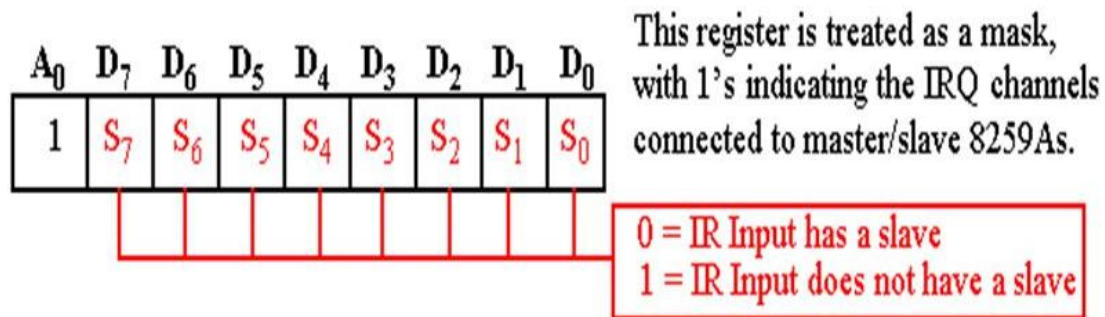
ICW3 : Dependant on ICW 1 (**Mandatory if Cascade selected in ICW1**)



WAP to initialize Single 8259 as follows
Edge triggered,
Single,
Auto EOI Mode,
Buffered Mode,
Mask IR3, IR4, IR5, IR6,
Vector number of IR0 is 40H.
Assume 8259 is at Port Address 80H.

8259A ICWs

ICW3 : Dependant on ICW 1 (**Mandatory if Cascade selected in ICW1**)



WAP to initialize Single 8259 as follows

Edge triggered,

Single,

Auto EOI Mode,

Buffered Mode,

Mask IR3, IR4, IR5, IR6,

Vector number of IR0 is 40H.

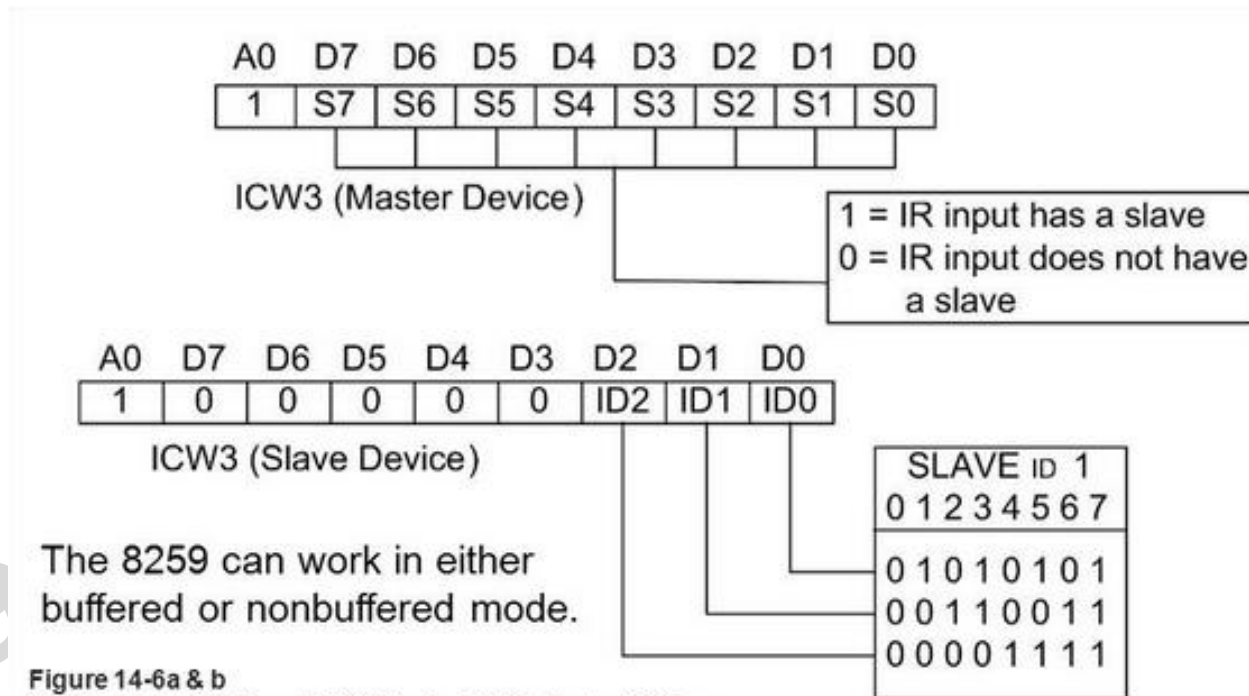
Assume 8259 is at Port Address 80H.

```
Start: MOV AL, 17H
      OUT 80H, AL
```

```
      MOV AL, 40H
      OUT 82H, AL
```

8259 ICWs

ICW3 : Dependant on ICW 1 (**Mandatory if Cascade selected in ICW1**)

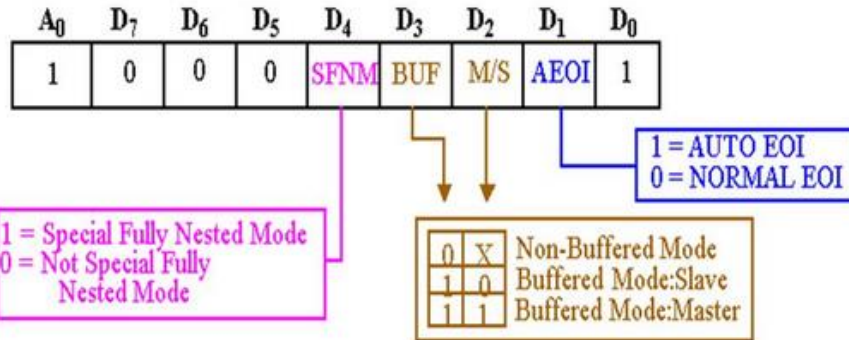


The 8259 can work in either buffered or nonbuffered mode.

Figure 14-6a & b
ICW Formats (ICW3 and CW4) for the 8259 - Master & Slave

8259 ICWs

ICW4 : Dependant on ICW 1 (**Mandatory if 8086 used**)



SFNM :1 for Fully nested Cascade: 0/1 SFNM :0 for Single

D₀-0 for 8085
D₀-1 for 8086

Normal EOI- D₁-0
ISR has EOI
Auto EOI : D₁-1

After sending vector ISR register set 0

WAP to initialize Single 8259 as follows
Edge triggered,
Single,
Auto EOI Mode,
Buffered Mode,
Mask IR3, IR4, IR5, IR6,
Vector number of IR0 is 40H.
Assume 8259 is at Port Address 80H.

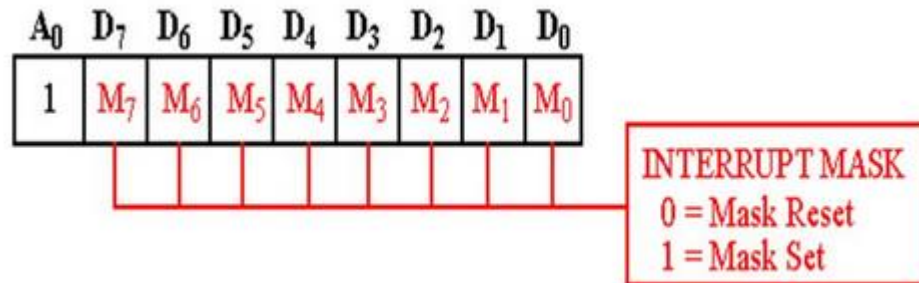
```
Start: MOV AL, 17H
      OUT 80H, AL

      MOV AL, 40H
      OUT 82H, AL

      MOV AL, 0FH
      OUT 82H, AL
```

8259 OCWs

OCW1 : Non-Mandatory



WAP to initialize Single 8259 as follows
Edge triggered,
Single,
Auto EOI Mode,
Buffered Mode,
Mask IR3, IR4, IR5, IR6,
Vector number of IR0 is 40H.
Assume 8259 is at Port Address 80H.

```
Start: MOV AL, 17H
      OUT 80H, AL

      MOV AL, 40H
      OUT 82H, AL

      MOV AL, 0FH
      OUT 82H, AL

      MOV AL, 78H
      OUT 82H, AL

      INT 03H

Code ENDS

      END Start
```

Problem

Q 2) WAP to initialize Cascaded 8259.

One Master, two slaves connected on IR2 and IR3 of master.

master: Port address 80H. Vector Number of IR6 is 46H. Edge triggered. AEOI Mode.

SFNM. Keyboard Interrupt connected on IR4.

Slave2: Port address 84H. Vector Number of IR0 is 50H. Level triggered.

Normal EOI Mode. Printer Interrupt on IR0. Card Reader Interrupt on IR1.

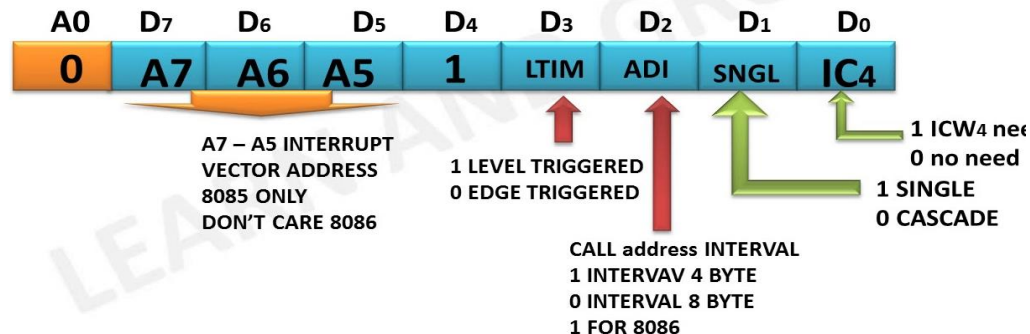
Slave3: Port address 90H. Vector Number of IR6 is 76H. Edge triggered. AEOI Mode.

External Interrupts connected on IR0, IR1, IR2 and IR7.

For all the above 8259's, mask the unwanted interrupts.

```

Start: MOV AL, 15H // MASTER 8259
      OUT 80H, AL // ICW1 = 0001 0101 = 15H
      MOV AL, 40H
      OUT 82H, AL // ICW2 = 0100 0000 = 40H
      MOV AL, 0CH
      OUT 82H, AL // ICW3 = 0000 1100 = 0CH
      MOV AL, 1FH
      OUT 82H, AL // ICW4 = 0001 1111 = 1FH
      MOV AL, E3H
      OUT 82H, AL // OCW1 = 1110 0011 = E3H
    
```

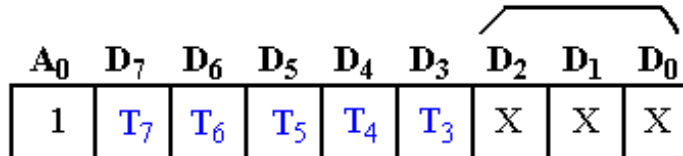


Problem

Q 2) WAP to initialize Cascaded 8259.
One Master, two slaves connected on IR2 and IR3 of master.
Master: Port address 80H. Vector Number of IR6 is 46H. Edge triggered. AEOI Mode.
SFNM. Keyboard Interrupt connected on IR4.
Slave2: Port address 84H. Vector Number of IR0 is 50H. Level triggered.
Normal EOI Mode. Printer Interrupt on IR0. Card Reader Interrupt on IR1.
Slave3: Port address 90H. Vector Number of IR6 is 76H. Edge triggered. AEOI Mode.
External Interrupts connected on IR0, IR1, IR2 and IR7.
For all the above 8259's, mask the unwanted interrupts.

```
Start: MOV AL, 11H // MASTER 8259
      OUT 80H, AL // ICW1 = 0001 0001 = 11H
      MOV AL, 40H // ICW2 = 0100 0000 = 40H
      OUT 82H, AL // ICW3 = 0000 1100 = 0CH
      MOV AL, 0CH // ICW3 = 0000 1100 = 0CH
      OUT 82H, AL // ICW4 = 0001 1111 = 1FH
      MOV AL, 1FH // ICW4 = 0001 1111 = 1FH
      OUT 82H, AL // OCW1 = 1110 0011 = E3H
      MOV AL, E3H // OCW1 = 1110 0011 = E3H
      OUT 82H, AL
```

Low order bits are 0 since there are 8 interrupts.



T7-T3 of Interrupt Vector
Address (8086/8088 Mode)

Problem

Q 2) WAP to initialize Cascaded 8259.

One Master, two slaves connected on IR2 and IR3 of master.

Master: Port address 80H. Vector Number of IR6 is 46H. Edge triggered. AEOI Mode.
SFNM. Keyboard Interrupt connected on IR4.

Slave2: Port address 84H. Vector Number of IR0 is 50H. Level triggered.

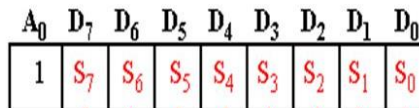
Normal EOI Mode. Printer Interrupt on IR0. Card Reader Interrupt on IR1.

Slave3: Port address 90H. Vector Number of IR6 is 76H. Edge triggered. AEOI Mode.

External Interrupts connected on IR0, IR1, IR2 and IR7.

For all the above 8259's, mask the unwanted interrupts.

```
Start: MOV AL, 11H // MASTER 8259
      OUT 80H, AL // ICW1 = 0001 0001 = 11H
      MOV AL, 40H
      OUT 82H, AL // ICW2 = 0100 0000 = 40H
      MOV AL, 0CH
      OUT 82H, AL // ICW3 = 0000 1100 = 0CH
      MOV AL, 1FH
      OUT 82H, AL // ICW4 = 0001 1111 = 1FH
      MOV AL, E3H
      OUT 82H, AL // OCW1 = 1110 0011 = E3H
```



This register is treated as a mask, with 1's indicating the IRQ channels connected to master/slave 8259As.

0 = IR Input has a slave
1 = IR Input does not have a slave

Problem

Q 2) WAP to initialize Cascaded 8259.

One Master, two slaves connected on IR2 and IR3 of master.

Master: Port address 80H. Vector Number of IR6 is 46H. Edge triggered. AEOI Mode.

SFNM. Keyboard Interrupt connected on IR4.

Slave2: Port address 84H. Vector Number of IR0 is 50H. Level triggered.

Normal EOI Mode. Printer Interrupt on IR0. Card Reader Interrupt on IR1.

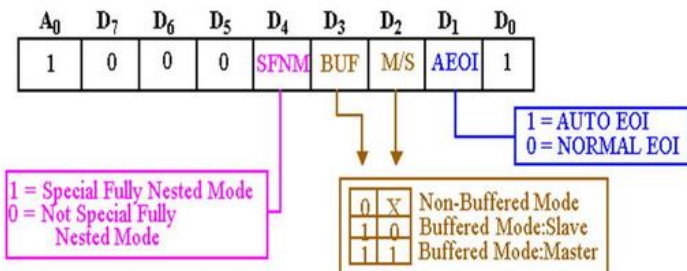
Slave3: Port address 90H. Vector Number of IR6 is 76H. Edge triggered. AEOI Mode.

External Interrupts connected on IR0, IR1, IR2 and IR7.

For all the above 8259's, mask the unwanted interrupts.

```

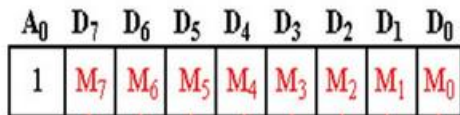
Start: MOV AL, 11H      // MASTER 8259
      OUT 80H, AL      // ICW1 = 0001 0001 = 11H
      MOV AL, 40H
      OUT 82H, AL      // ICW2 = 0100 0000 = 40H
      MOV AL, 0CH
      OUT 82H, AL      // ICW3 = 0000 1100 = 0CH
      MOV AL, 1FH
      OUT 82H, AL      // ICW4 = 0001 1111 = 1FH
      MOV AL, E3H
      OUT 82H, AL      // OCW1 = 1110 0011 = E3H
    
```



Problem

- Q 2) WAP to initialize Cascaded 8259.
One Master, two slaves connected on **IR2 and IR3 of master.**
Master: Port address 80H. Vector Number of IR6 is 46H. Edge triggered. AEOI Mode.
SFNM. **Keyboard Interrupt connected on IR4.**
Slave2: Port address 84H. Vector Number of IR0 is 50H. Level triggered.
Normal EOI Mode. Printer Interrupt on IR0. Card Reader Interrupt on IR1.
Slave3: Port address 90H. Vector Number of IR6 is 76H. Edge triggered. AEOI Mode.
External Interrupts connected on IR0, IR1, IR2 and IR7.
For all the above 8259's, mask the unwanted interrupts.

```
Start: MOV AL, 11H // MASTER 8259
      OUT 80H, AL // ICW1 = 0001 0001 = 11H
      MOV AL, 40H
      OUT 82H, AL // ICW2 = 0100 0000 = 40H
      MOV AL, 0CH
      OUT 82H, AL // ICW3 = 0000 1100 = 0CH
      MOV AL, 1FH
      OUT 82H, AL // ICW4 = 0001 1111 = 1FH
      MOV AL, E3H
      OUT 82H, AL // OCW1 = 1110 0011 = E3H
```



INTERRUPT MASK
0 = Mask Reset
1 = Mask Set

Problem

Q 2) WAP to initialize Cascaded 8259.

One Master, two slaves connected on IR2 and IR3 of master.

Master: Port address 80H. Vector Number of IR6 is 46H. Edge triggered. AEOI Mode. SFNM. Keyboard Interrupt connected on IR4.

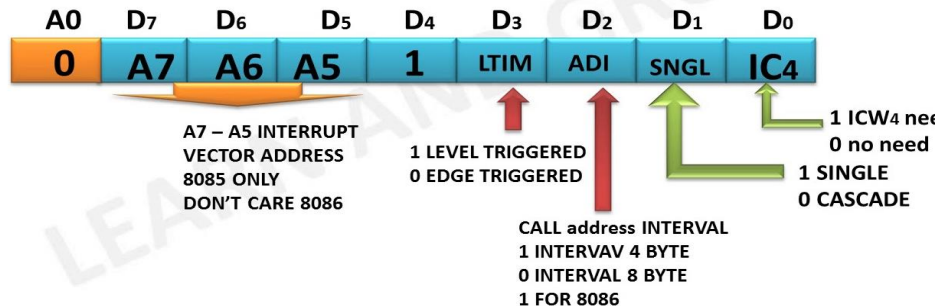
Slave2: Port address 84H. Vector Number of IR0 is 50H. Level triggered. Normal EOI Mode. Printer Interrupt on IR0. Card Reader Interrupt on IR1.

Slave3: Port address 90H. Vector Number of IR6 is 76H. Edge triggered. AEOI Mode. External Interrupts connected on IR0, IR1, IR2 and IR7.

For all the above 8259's, mask the unwanted interrupts.

```

MOV AL, 1DH // SLAVE at IR2
OUT 84H, AL // ICW1 = 0001 1101 = 1DH
MOV AL, 50H // ICW2 = 0101 0000 = 50H
OUT 86H, AL // ICW3 = 0000 0010 = 02H
MOV AL, 02H // ICW4 = 0000 1001 = 09H
OUT 86H, AL // ICW4 = 0000 1001 = 09H
MOV AL, 09H // ICW4 = 0000 1001 = 09H
OUT 86H, AL // ICW4 = 0000 1001 = 09H
MOV AL, FCH // OCW1 = 1111 1100 = FCH
OUT 86H, AL // OCW1 = 1111 1100 = FCH
    
```



Problem

Q 2) WAP to initialize Cascaded 8259.

One Master, two slaves connected on IR2 and IR3 of master.

Master: Port address 80H. Vector Number of IR6 is 46H. Edge triggered. AEOI Mode.

SFNM. Keyboard Interrupt connected on IR4.

Slave2: Port address 84H. Vector Number of IR0 is 50H. Level triggered.

Normal EOI Mode. Printer Interrupt on IR0. Card Reader Interrupt on IR1.

Slave3: Port address 90H. Vector Number of IR6 is 76H. Edge triggered. AEOI Mode.

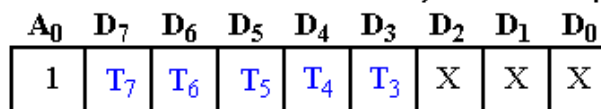
External Interrupts connected on IR0, IR1, IR2 and IR7.

For all the above 8259's, mask the unwanted interrupts.

```

MOV AL, 1DH      // SLAVE at IR2
OUT 84H, AL      // ICW1 = 0001 1101 = 1DH
MOV AL, 50H
OUT 86H, AL      // ICW2 = 0101 0000 = 50H
MOV AL, 02H
OUT 86H, AL      // ICW3 = 0000 0010 = 02H
MOV AL, 09H
OUT 86H, AL      // ICW4 = 0000 1001 = 09H
MOV AL, FCH
OUT 86H, AL      // OCW1 = 1111 1100 = FCH
    
```

Low order bits are 0 since there are 8 interrupts.



T7-T3 of Interrupt Vector Address (8086/8088 Mode)

Problem

Q 2) WAP to initialize Cascaded 8259.

One Master, two slaves connected on IR2 and IR3 of master.

Master: Port address 80H. Vector Number of IR6 is 46H. Edge triggered. AEOI Mode.

SFNM. Keyboard Interrupt connected on IR4.

Slave2: Port address 84H. Vector Number of IR0 is 50H. Level triggered.

Normal EOI Mode. Printer Interrupt on IR0. Card Reader Interrupt on IR1.

Slave3: Port address 90H. Vector Number of IR6 is 76H. Edge triggered. AEOI Mode.

External Interrupts connected on IR0, IR1, IR2 and IR7.

For all the above 8259's, mask the unwanted interrupts.

```

MOV AL, 1DH // SLAVE at IR2
OUT 84H, AL // ICW1 = 0001 1101 = 1DH
MOV AL, 50H
OUT 86H, AL // ICW2 = 0101 0000 = 50H
MOV AL, 02H
OUT 86H, AL // ICW3 = 0000 0010 = 02H
MOV AL, 09H
OUT 86H, AL // ICW4 = 0000 1001 = 09H
MOV AL, FCH
OUT 86H, AL // OCW1 = 1111 1100 = FCH
    
```

A0	D7	D6	D5	D4	D3	D2	D1	D0
1	0	0	0	0	0	ID2	ID1	ID0

ICW3 (Slave Device)

The 8259 can work in either buffered or nonbuffered mode.

SLAVE ID 1							
0	1	2	3	4	5	6	7
0	1	0	1	0	1	0	1
0	0	1	1	0	0	1	1
0	0	0	0	1	1	1	1

Figure 14-6a & b
ICW Formats (ICW3 and CW4) for the 8259 - Master & Slave

Problem

Q 2) WAP to initialize Cascaded 8259.

One Master, two slaves connected on IR2 and IR3 of master.

Master: Port address 80H. Vector Number of IR6 is 46H. Edge triggered. AEOI Mode.

SFNM. Keyboard Interrupt connected on IR4.

Slave2: Port address 84H. Vector Number of IR0 is 50H. Level triggered.

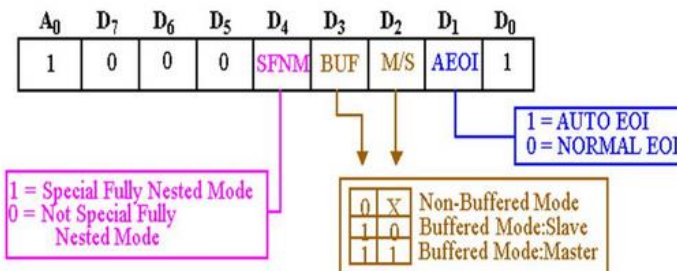
Normal EOI Mode. Printer Interrupt on IR0. Card Reader Interrupt on IR1.

Slave3: Port address 90H. Vector Number of IR6 is 76H. Edge triggered. AEOI Mode.

External Interrupts connected on IR0, IR1, IR2 and IR7.

For all the above 8259's, mask the unwanted interrupts.

```
MOV AL, 1DH // SLAVE at IR2
OUT 84H, AL // ICW1 = 0001 1101 = 1DH
MOV AL, 50H
OUT 86H, AL // ICW2 = 0101 0000 = 50H
MOV AL, 02H
OUT 86H, AL // ICW3 = 0000 0010 = 02H
MOV AL, 09H
OUT 86H, AL // ICW4 = 0000 1001 = 09H
MOV AL, FCH
OUT 86H, AL // OCW1 = 1111 1100 = FCH
```



Problem

Q 2) WAP to initialize Cascaded 8259.
One Master, two slaves connected on IR2 and IR3 of master.
Master: Port address 80H. Vector Number of IR6 is 46H. Edge triggered. AEOI Mode.
SFNM. Keyboard Interrupt connected on IR4.
Slave2: Port address 84H. Vector Number of IR0 is 50H. Level triggered.
Normal EOI Mode. Printer **Interrupt on IR0. Card Reader Interrupt on IR1.**
Slave3: Port address 90H. Vector Number of IR6 is 76H. Edge triggered. AEOI Mode.
External Interrupts connected on IR0, IR1, IR2 and IR7.
For all the above 8259's, mask the unwanted interrupts.

```
MOV AL, 1DH // SLAVE at IR2
OUT 84H, AL // ICW1 = 0001 1101 = 1DH
MOV AL, 50H
OUT 86H, AL // ICW2 = 0101 0000 = 50H
MOV AL, 02H
OUT 86H, AL // ICW3 = 0000 0010 = 02H
MOV AL, 09H
OUT 86H, AL // ICW4 = 0000 1001 = 09H
MOV AL, FCH
OUT 86H, AL // OCW1 = 1111 1100 = FCH
```

Problem

- Q 2) WAP to initialize Cascaded 8259.
One Master, two slaves connected on IR2 and IR3 of master.
Master: Port address 80H. Vector Number of IR6 is 46H. Edge triggered. AEOI Mode.
SFNM. Keyboard Interrupt connected on IR4.
Slave2: Port address 84H. Vector Number of IR0 is 50H. Level triggered.
Normal EOI Mode. Printer Interrupt on IR0. Card Reader Interrupt on IR1.
Slave3: Port address 90H. Vector Number of IR6 is 76H. Edge triggered. AEOI Mode.
External Interrupts connected on IR0, IR1, IR2 and IR7.
For all the above 8259's, mask the unwanted interrupts.

```
MOV    AL, 15H      // SLAVE at IR3
OUT    90H, AL      // ICW1 = 0001 0101 = 15H
MOV    AL, 70H
OUT    92H, AL      // ICW2 = 0111 0000 = 70H
MOV    AL, 03H
OUT    92H, AL      // ICW3 = 0000 0011 = 03H
MOV    AL, 0BH
OUT    92H, AL      // ICW4 = 0000 1011 = 0BH
MOV    AL, 78H
OUT    92H, AL      // OCW1 = 0111 1000 = 78H
```

INT 03H

Code ENDS
END Start



Thank You