

Microprocessor & Interfacing

Lecture 28

8259

Programmable Interrupt Controller-- 1



PARUL BANSAL
ASST PROFESSOR
ECS DEPARTMENT
DRONACHARYA COLLEGE OF ENGINEERING

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Introduction



- An interrupt is an event which informs the
- CPU that its service (action) is needed.
- Sources of interrupts:
 - internal fault (e.g.. divide by zero, overflow)
 - Software
 - external hardware : maskable, nonmaskable
 - reset

Processing Interrupts



- When an interrupt is executed, the *microprocessor*:
 - finishes executing its current instruction (if any).
 - saves (PUSH) the flag register, IP and CS register in the stack.
 - goes to a fixed memory location.
 - reads the address of the associated ISR.
 - Jumps to that address and executes the ISR.
 - gets (PULL) the flag register, CS:IP register from the stack.
 - continues executing the previous job (if any).

8086/88 Hardware Interrupt Pins



- **INTR: Interrupt Request.**
 - Input signal into the CPU
 - If it is activated, the CPU will finish the current instruction and respond with the interrupt acknowledge operation
 - Can be masked (ignored) thru instructions CLI and STI
- **NMI: NonMaskable interrupt.**
 - Input signal
 - Cannot be masked or unmasked thru CLI and STI
 - Examples of use: power frailer. Memory error
- **INTA: Interrupt Acknowledge.**
 - Output signal

Interrupt Flag



- IF (Interrupt Enable Flag) D9: used to mask any hardware interrupt that may come in from the INTR pin.
- When IF=0, all hardware interrupt requests through INTR are masked.
- This has no effect on interrupts coming from the NMI pin or “INT nn” instructions.
- CLI sets IF to 0, STI sets IF to 1.

INT n and ISR



- *n is multiplied by 4*
- In the address “ $4n$ ” *the offset address the ISR is found.*
- Example: Intel has set aside INT 2 for the NMI interrupt.
- Whenever the NMI pin is activated, the CPU jumps to physical memory location 00008 to fetch the CS:IP of the interrupt service routine associated with the NMI.

8259



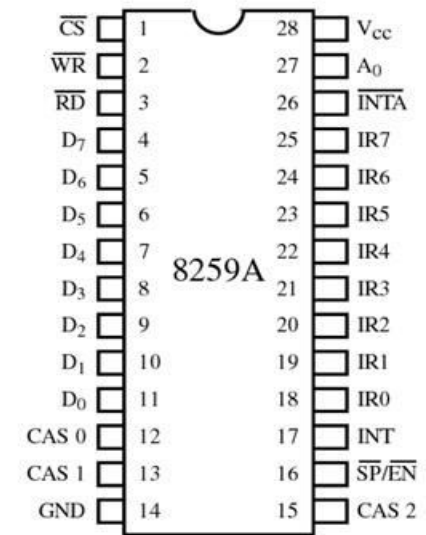
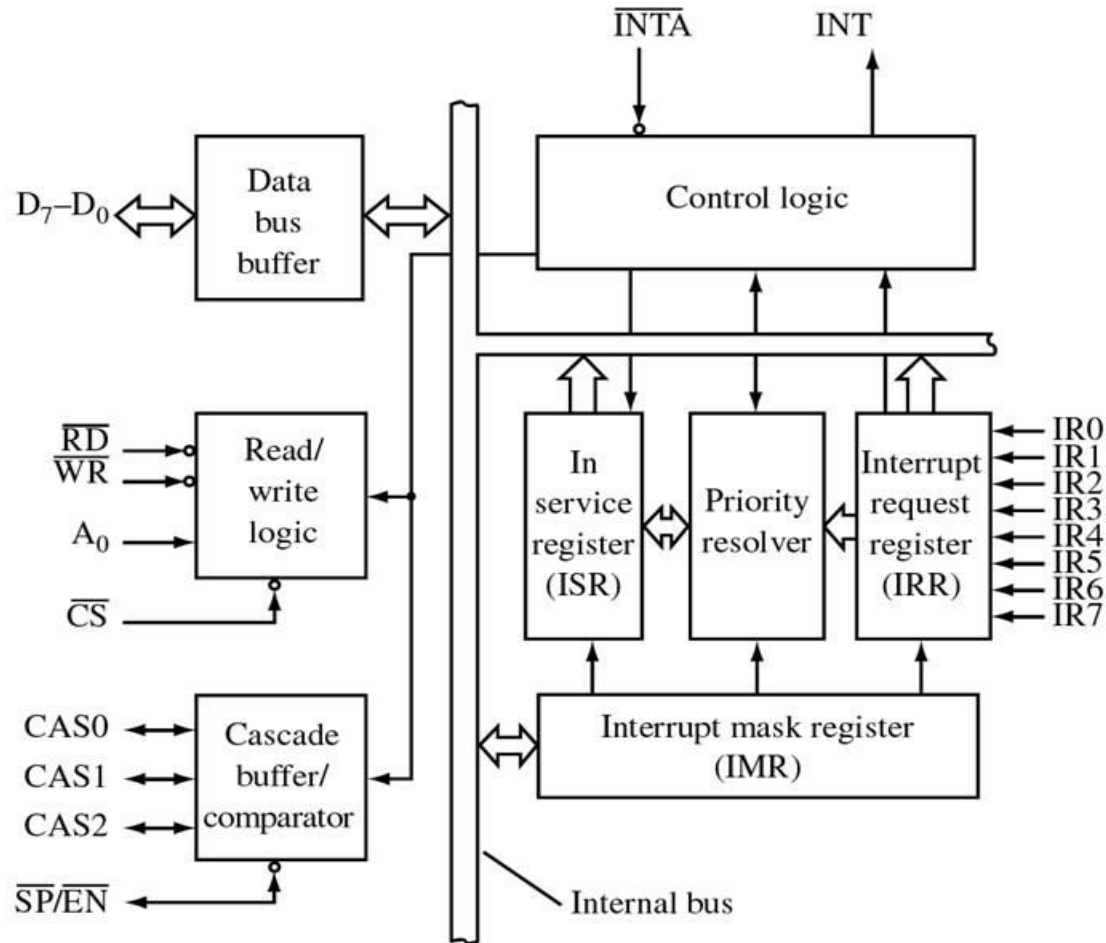
- 8259 is Programmable Interrupt Controller (PIC)
- It is a tool for managing the interrupt requests.
- 8259 is a very flexible peripheral controller chip:
 - PIC can deal with up to 64 interrupt inputs
 - interrupts can be masked
 - various priority schemes can also programmed.
- Originally (in PC XT) it is available as a separate IC
- Later the functionality of (two PICs) is in the motherboards chipset.
- In some of the modern processors, the functionality of the PIC is built in.

Pin Description

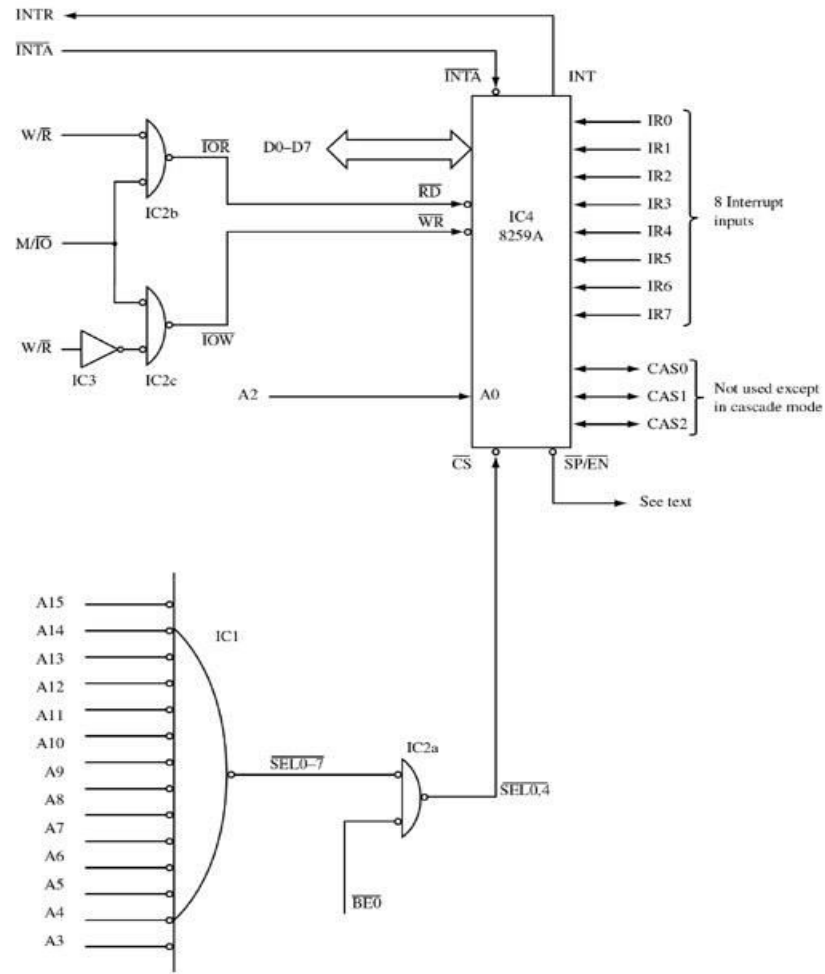


- 8-bit bi-directional data bus, one address line is needed, PIC has two control registers to be programmed, you can think of them as two output ports or two memory location.
- The direction of data flow is controlled by RD and WR.
- CS is as usual connected to the output of the address decoder.
- Interrupt requests are output on INT which is connected to the INTR of the processor. Int. acknowledgment is received by INTA.
- IR0-IR7 allow 8 separate interrupt requests to be inputted to the PIC.
- sp/en=1 for master , sp/en=0 for slave.
- CAS0-3 inputs/outputs are used when more than one PIC to cascaded.

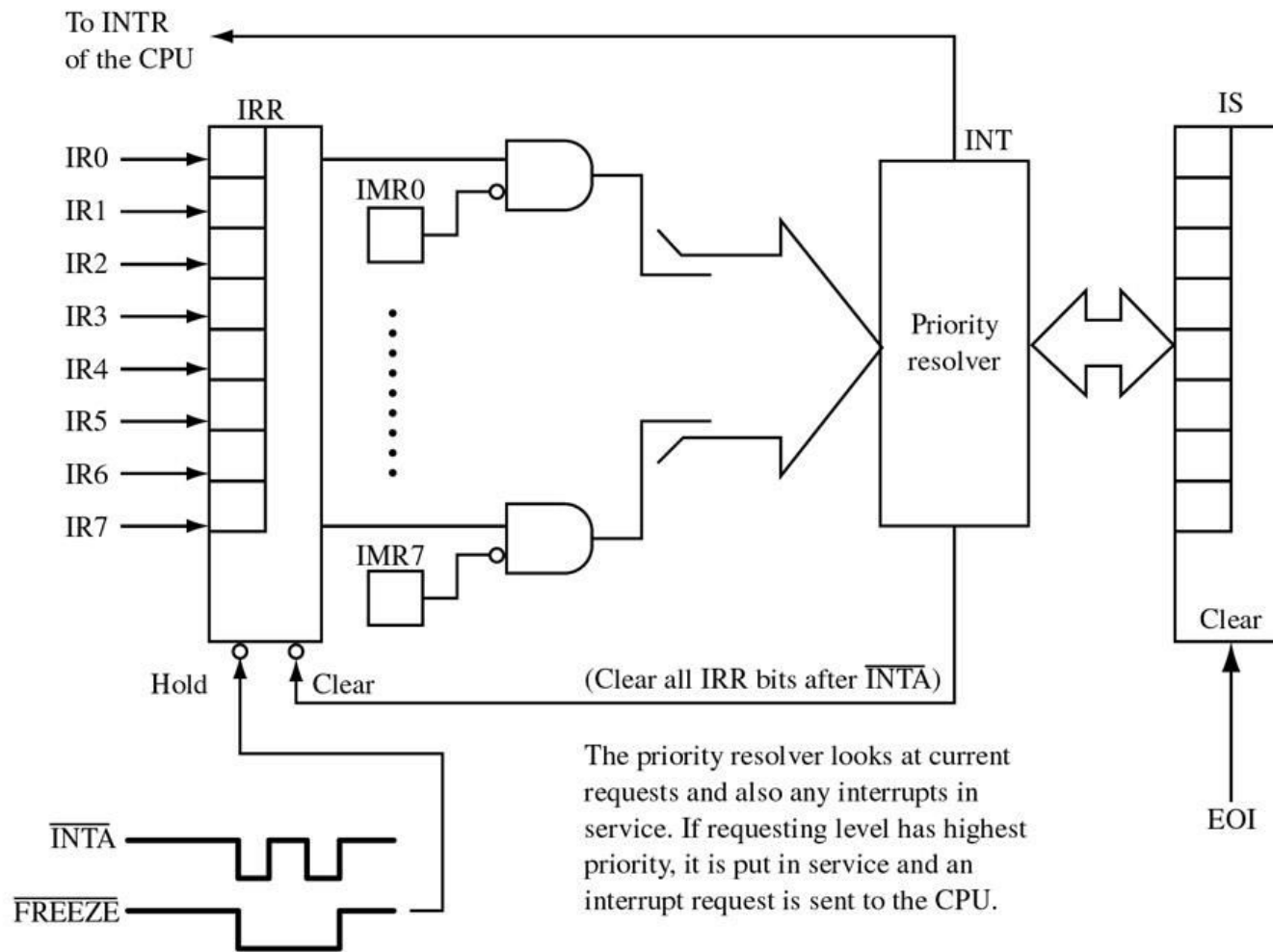
Block Diagram



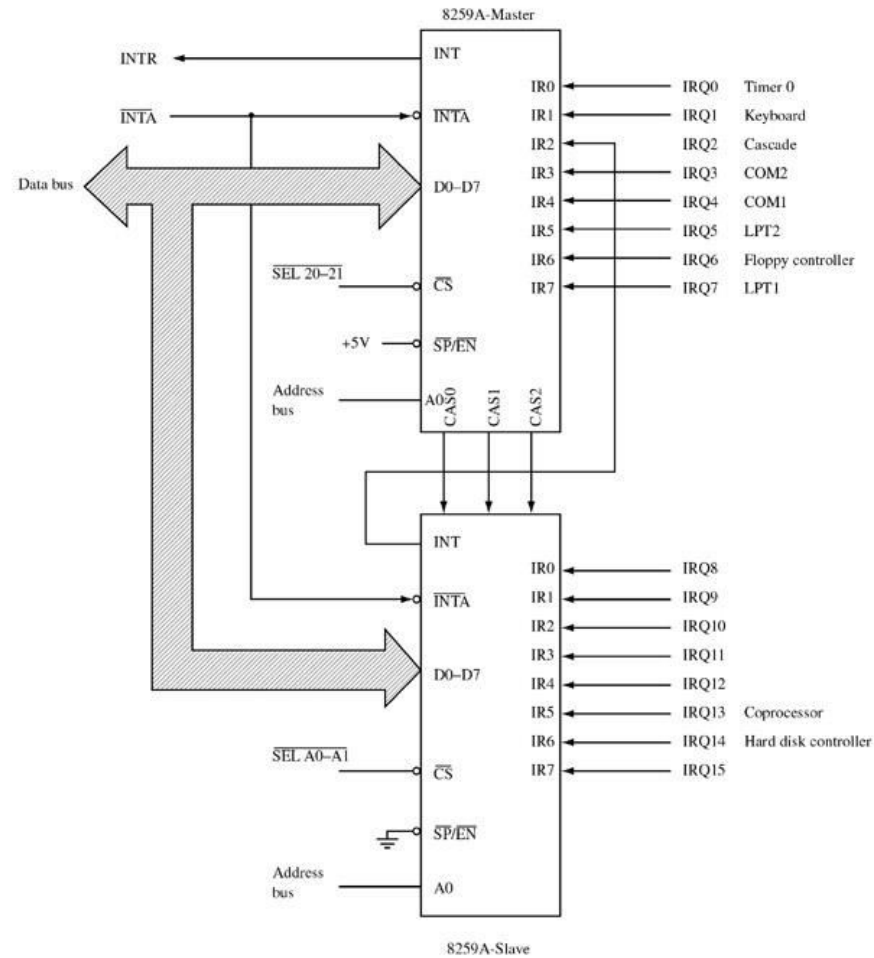
Interfacing the PIC to 386 and 486



All interrupt requests pass through Interrupt Request Register & Interrupt Mask Register



Two Cascaded PICs



Operation



- PIC is to be initialized and programmed to control its operation.
- The operation in simple words:
 - When an interrupt occurs , the PIC determines the highest priority, activates the processor via its INTR input, and sends the type number onto the data bus when the processor acknowledges the interrupt.
- Priority:
 - What is used in PC is *fully nested mode*. That is the lowest numbered IRQ input has highest priority. Lower priority interrupts will not be forwarded to the processor until the higher priority interrupts have been serviced.