

Exceptions and Interrupts

(continued)

November 17

CSC201 Section 002

Fall, 2000

Device Priorities

- Some devices are
 - More important than others
 - Or, need attention more quickly
- Low-priority interrupts should not be able to interrupt ISRs for high-priority interrupts
- The Pentium only has one interrupt request line; how indicate priority?
 - The Interrupt Controller does this for the CPU

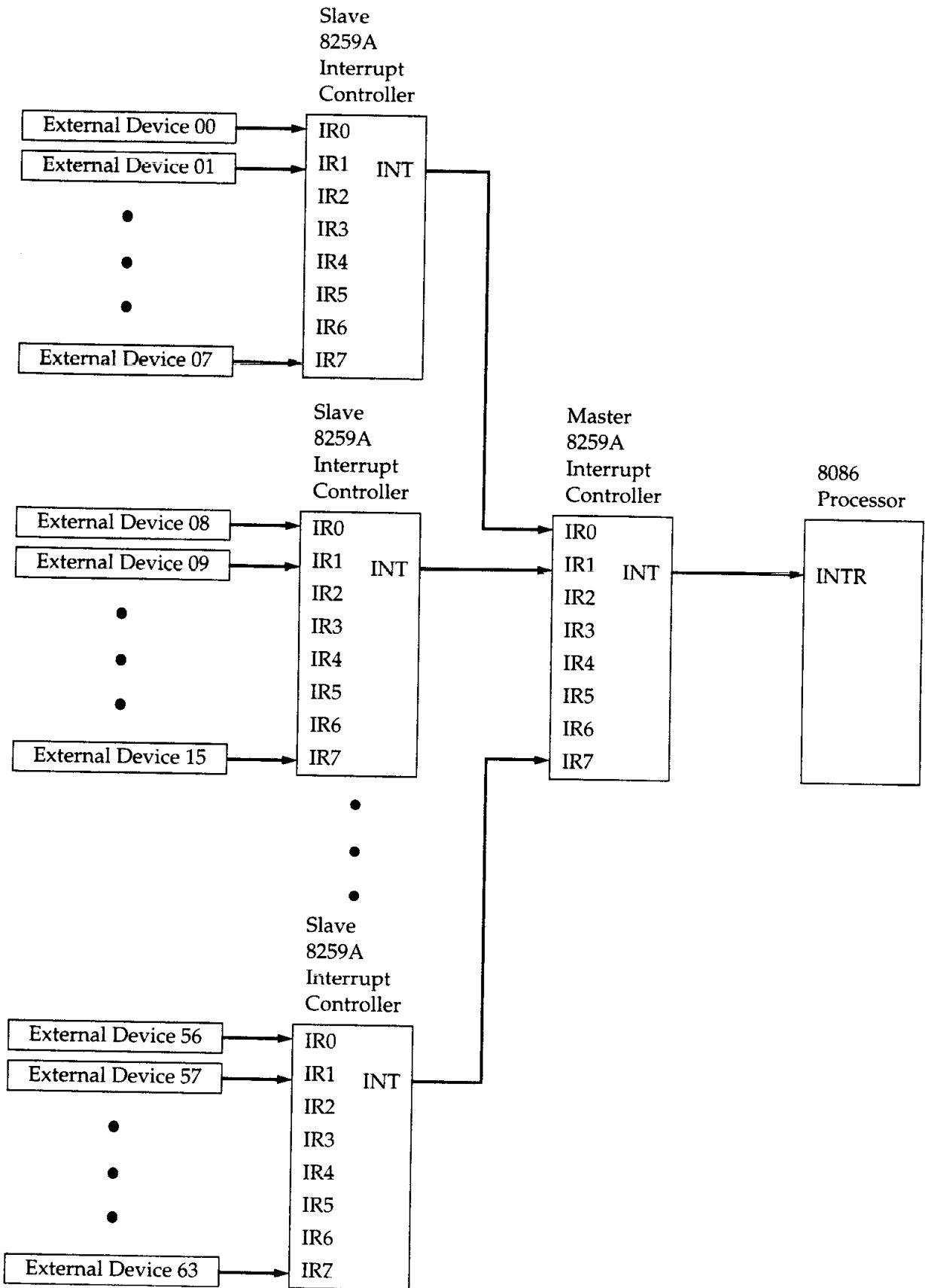


Figure 6.9 Use of the 82C59A Interrupt Controller.

How Priorities Can Be Accomplished

- 1. Can disable interrupts for any specific device
- 2. There are 16 interrupt request lines (signals)
 - IRQ0 priority > IRQ1 priority >
- 3. Can disable interrupts on any individual interrupt request line

Example Interrupt Process

1. A program is executing
2. The user presses a key on the keyboard
3. The keyboard generates an interrupt request signal to the Interrupt Controller, using IRQ1
4. The Interrupt Controller generates an interrupt request to the processor, and waits for an acknowledgment
5. When the CPU finishes the current instruction and fetches the next one, it checks whether there is any interrupt pending
6. The CPU
 - acknowledges the interrupt
 - saves task state
 - clears (disables) the interrupt flag

Example Interrupt Process

7. The Interrupt Controller sends the appropriate interrupt vector for the keyboard ISR to the processor
8. The CPU reads the ISR address from the interrupt descriptor table (IDT)
9. The CPU forces a "jump" to that address
10. The keyboard ISR is now executing, and does whatever processing is needed
11. The "iret" instruction is executed by the ISR
 - restores the task state
 - returns to the program that was interrupted

Memory Privilege Levels

- The Pentium has 4 memory privilege levels: 0 (highest) to 3(lowest)
 - The operating system runs at level 0, application processes at level 3
 - Other levels for device drivers etc.
- "Privileged memory" = areas that should not be read or written directly by user programs
- Sections (segments) of memory are protected by privilege level
 - A memory reference (read or write) first compares the required privilege level at the address to the process's privilege level
 - If the process's priority isn't high enough, an exception is generated

Instruction Privilege Levels

- Instructions are also protected by privilege level
- Some instructions are designed to specifically modify operating system data structures
 - Should not be executed by user processes; could overwrite the operating system!
- When an instruction is fetched, the required privilege level is compared to the process's privilege level
 - If not high enough, an exception is generated