Input / Output

November 27

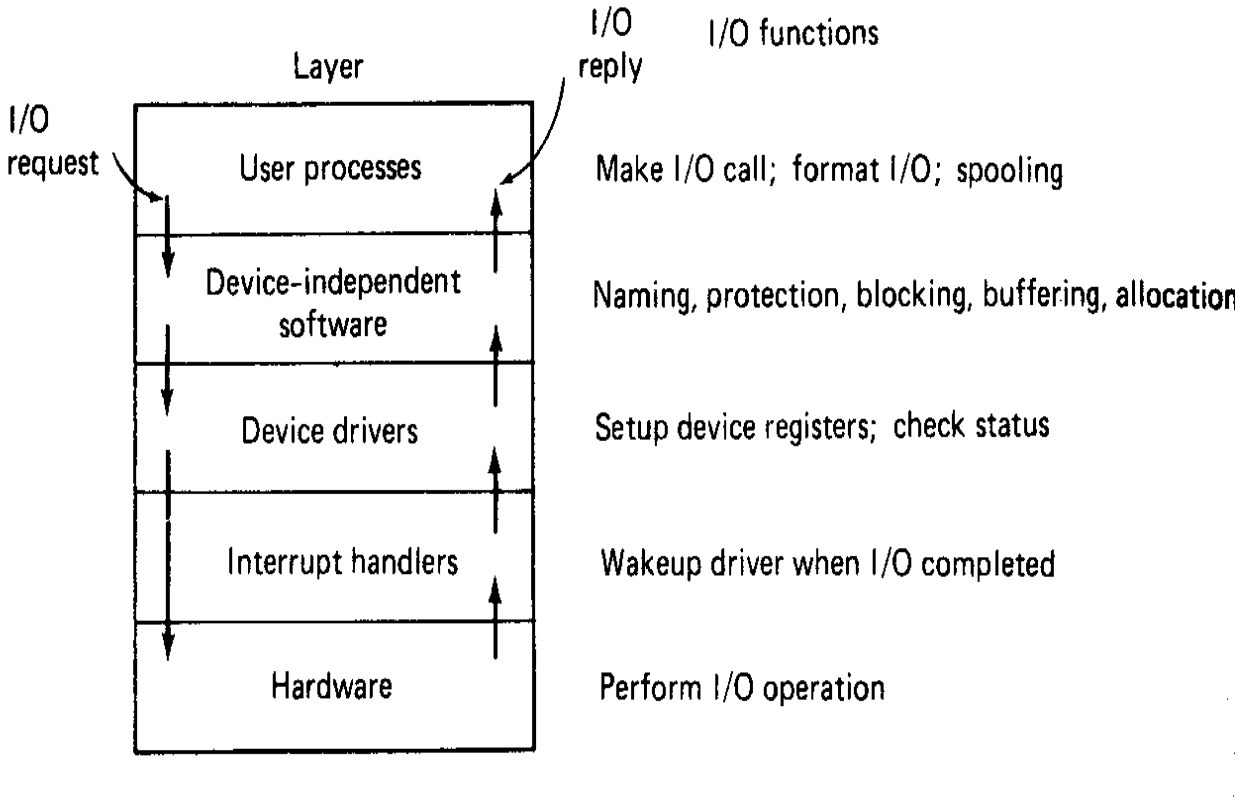
CSC201 Section 002

Fall, 2000

Why Study?

- Device drivers are an essential part of operating systems
- Drivers impact performance of I/O
- Drivers impact what devices can be used

Levels



Levels

- Hardware
  - Devices
  - Controllers
  - Buses
- Operating system
  - Device drivers
  - File Management
- Application programs
  - I/O procedure calls

Hardware Example

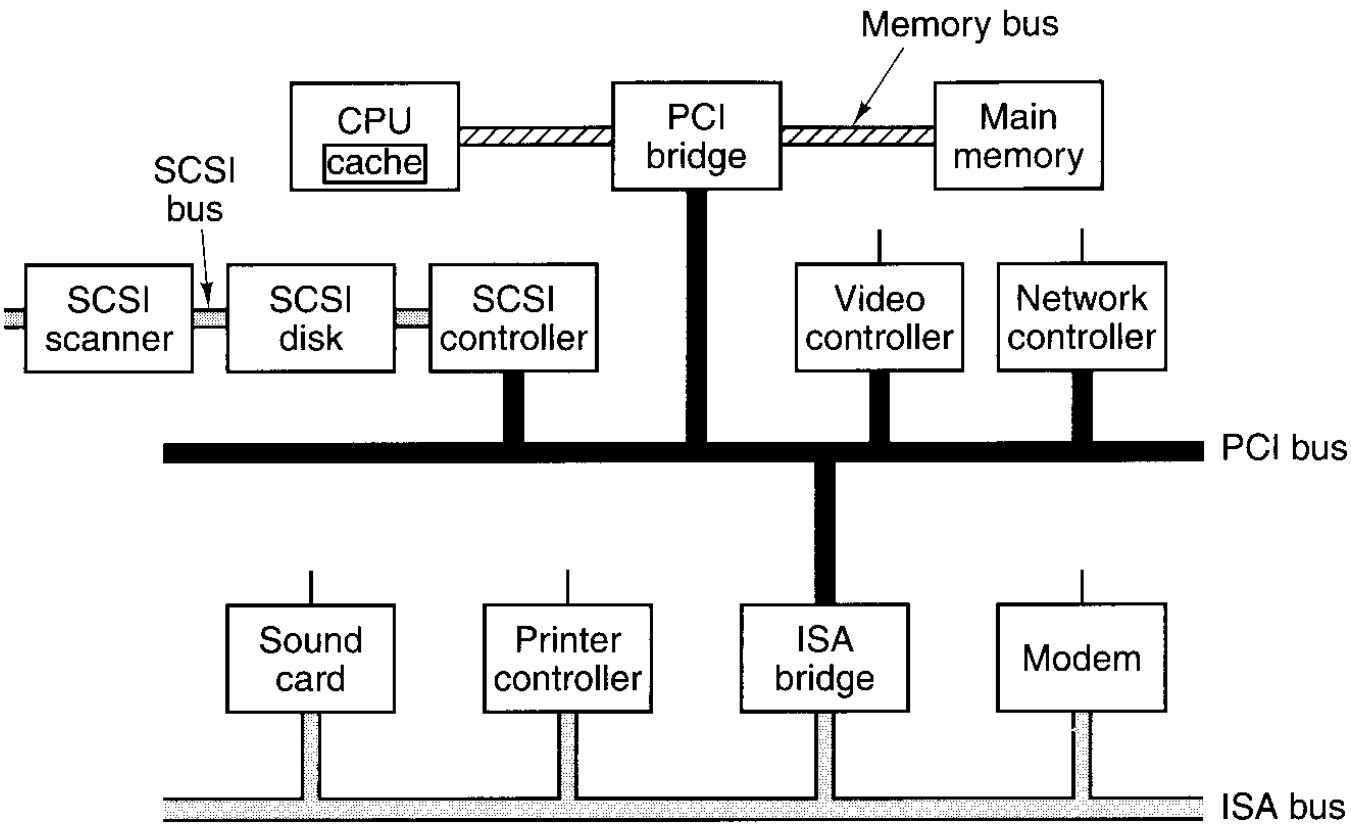


Figure 2-30. A typical modern PC with a PCI bus and an ISA bus. The modem and sound card are ISA devices; the SCSI controller is a PCI device.

Types of devices

- User interface (printer, keyboard, display, mouse, ...)
- Storage (hard drive, floppy drive, CD-ROM, DVD-ROM, ...)
- Communication (serial and parallel interface, high-speed interface, local area network, ...)
- Other (timers, ...)

Keyboards

- Pass the entire sequence of key presses and releases to the interrupt service routine
- Key press and key release: pass the event and key number to the CPU (called a scan code)
  - translating to an ASCII code: table lookup
- Example: capital-A

Keyboards

- "Cooked" mode
  - The operating system buffers characters and passes them to the application program only when end-of-line is detected
  - Also processes back space and line-kill characters
  - No buffering: "raw" mode
- Echoing characters
  - The operating system or user program can output characters to the display as they are typed

The ASCII (Text) Terminal

- Maps characters into pixels on the screen
  - fixed number of lines; as new lines appear, old ones scroll off
  - cursor position maintained by software
- Characters are stored in a memory
  - one byte for each character
  - one byte for each character's attributes (color, highlight, underline, ...)
- Example: 25x80 screen requires 2000 bytes for characters + 2000 bytes for attributes

Bit-Map Terminals

- 3 bytes per Pixel: R, G, and B
- Large chunk of memory needed to store contents of screen
  - 3 bytes * 1024 * 768 = 2,359,296 bytes of memory
- Graphics card has a co-processor for handling common graphics operations
  - line drawing, filled shape drawing, scrolling, etc.

Mouse

- Usually sends a 3-byte code
  - x movement since last update
  - y movement since last update
  - state of the buttons

Printers

- Simplest: output a series of characters to be printed
- Printer is controlled by its own processor
  - Page description language: HP's PCL, Adobe's Postscript
  - With substantial amount of memory for holding fonts and bitmaps

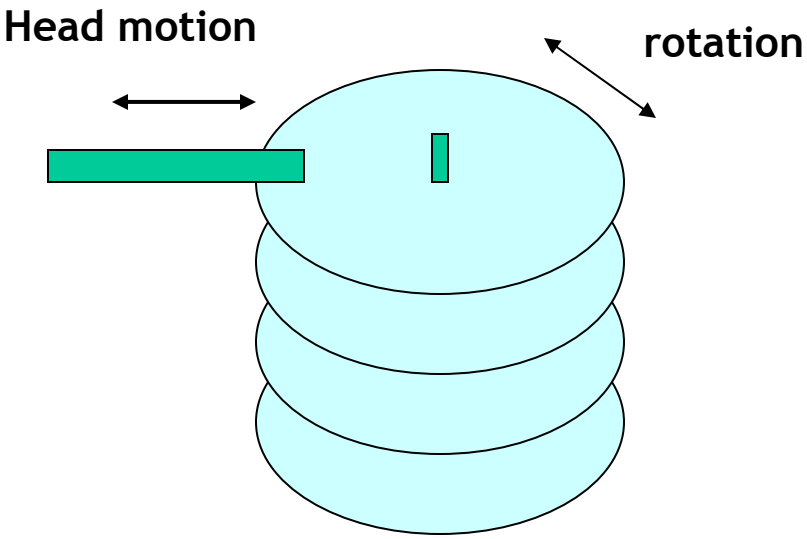
Network Interface

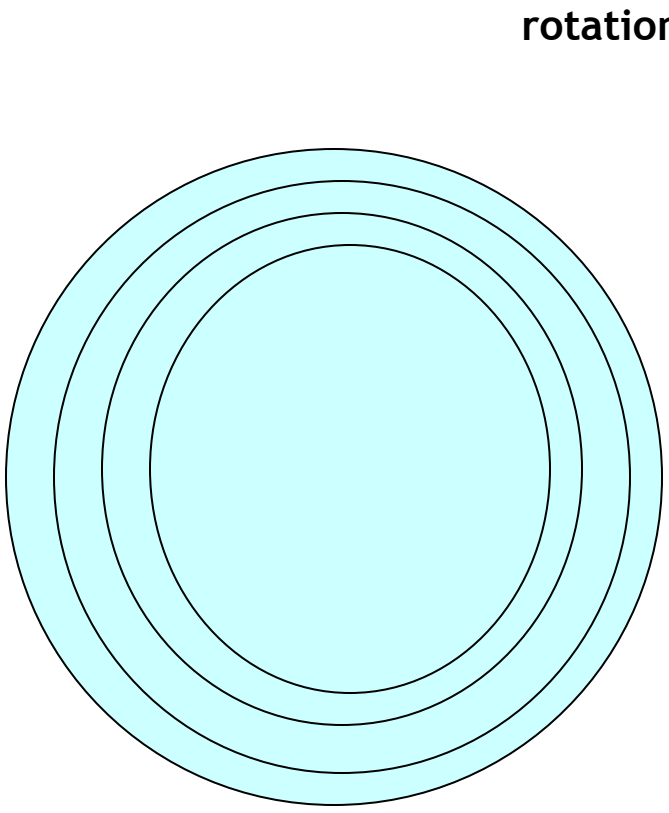
- Ethernet = local area network
- Speeds: 10 Mb/s, 100 Mb/s, and 1 Gb/s

Structure of Hard Drives

- One or more platters rotating around a spindle
  - data stored (magnetically) on surface
- Each surface has a read/write head
- Platter organized into concentric rings called tracks
- Each track subdivided into fixed-size blocks called sectors
  - ex.: 512 bytes/sector

Disk Drives





Reading/Writing a Sector

- Given: track and sector numbers
- Platters are constantly spinning at a fixed speed
- Read/write head moves to the correct cylinder; "seek time"
  - typical: 5-15 ms.
- Wait until sector rotates under the head; "rotational latency"
  - rotational speeds of 5,000-12,000 RPM
  - typical: 2-8 ms.
- Time for sector to rotate past head; "read/write time"
  - typical: 20-100 microsec.

Block-Oriented

- An entire block is written at one time
- Individual characters are written to a buffer
- When buffer is full, sector is written

CD-ROMS

- Optical technology, very low cost mass production
- A long spiral track, with pits indicating 1's and 0's
  - Change the reflection of light from a laser
- Constant linear velocity = variable angular velocity
  - Seek time can be 100ms or more
- Capacity = 600-700 MB
- 2048 bytes / sector

DVD-ROMs

- Capacity = 4.7 GB
- Up to 133 minutes of 720x480 video with high-quality audio