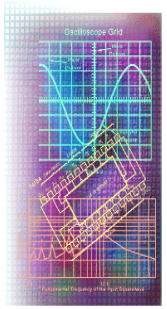
IFSM 310

Software and Hardware Concepts



"A printer consists of three main parts: the case, the jammed paper tray and the blinking red light."

- Unknown

Topics

A+ Domain 4.0
Motherboards / Processors / Memory

Chapter 5
Data Storage Technologies

A+ Domain 5.0
Printers

Tech Tales

The lab had upgraded the systems to PS/2 systems that only had 3.5 inch disks.

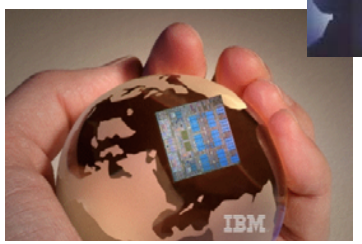
A student was having problems with her disks. She had "reformatted" her 5.25 inch disks with scissors so they would fit the 3.5 inch drives.

Up Close

The Supercomputer in the Living Room

Cover Story

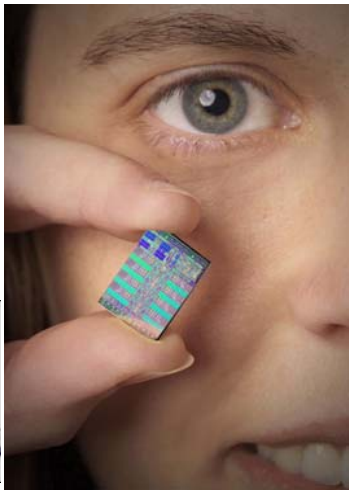
When Forbes discusses computer architecture, it has to be important.



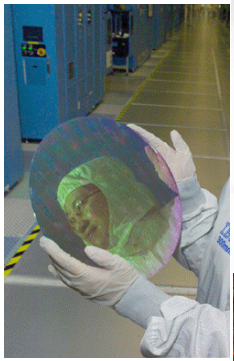
IBM's Cell

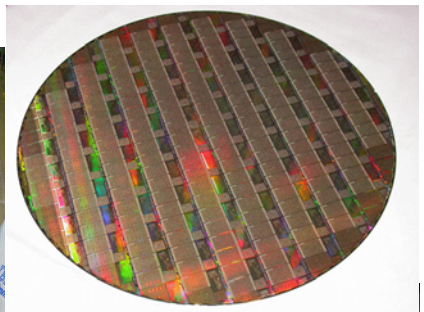
CPU in Sony's PlayStation 3

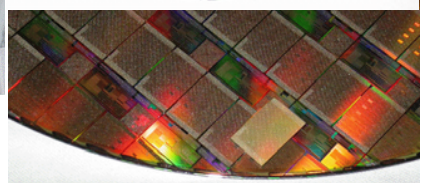
2 trillion calculations per second



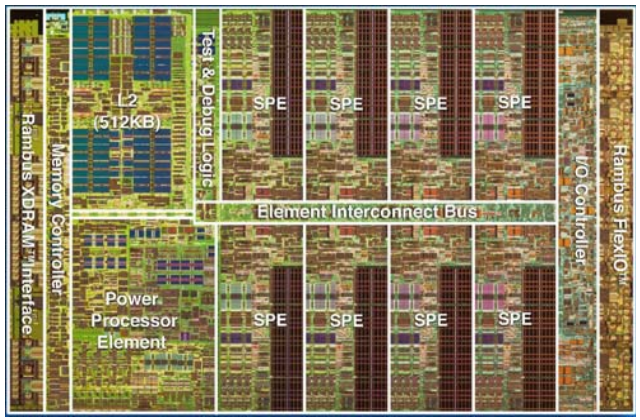
Making Chips



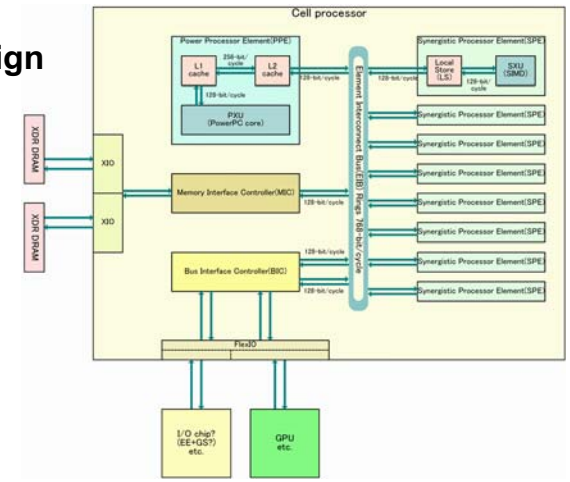




The Chip



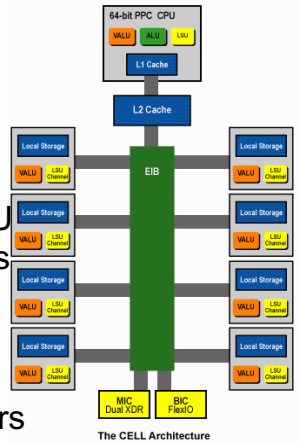
The Design



Key Attributes

64-bit CPU
8 Synergistic CPUs
SPE are RISC
Multi-OS Support
128+ concurrent CPU memory transactions

4 Ghz clock speed
256 Gflops
234 Million Transistors



The CELL Architecture

A+ Domain

Motherboards, Processors and Memory

Popular CPU Chips

Many CPU manufacturers
AMD, Cyrix, and Intel

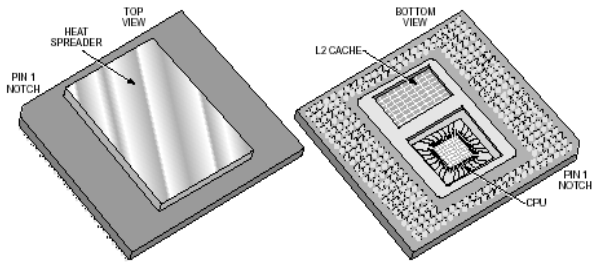
1995 started seriously compete

Fifth-generation processors

Pentium (586)

Intel released in March 1993
Superscalar (parallel) processor
Speed: 60 to 200MHz
Socket
4: 60, 66, 273-pin PGA
7: 75+, 296-pin
Voltage: 75+, 3.3vDC
64 bit data bus
32 bit address bus (4GB RAM)
Cache: L1 16k, L2 256-512k

Inside the Chip



Pentium Pro

Intel released in November 1995
Designed for servers
Speed: 150 to 200MHz
Socket 8: 387-pin PGA
Voltage: 3.3vDC
64 bit data bus
36 bit address bus (64GB RAM)
Cache: L1 16k, L2 256k-1M

AMD K5

Released in 1995
Designed for servers
Speed: 75 to 116MHz
Socket 7: 296-pin
Voltage: 3.52vDC
64 bit data bus
32 bit address bus (4GB RAM)
Cache: L1 8k, L2 256-512k

Cyrix MI

Cyrix, 1995, released MI (“M One”)
100–150MHz speeds
296-pin PGA
3.3vDC
64-bit data bus
32-bit address bus
16KB of L1 cache

Pentium with MMX Technology

January 1997
Multimedia Extensions (MMX)
166, 200, and 233MHz speeds
296-pin staggered PGA form
3.3vDC, Socket 7
data 64 bit, address 32 bit
32KB of L1, 256KB-521KB L2

Pentium II

May 1997
Radical form change
512KB of on-board L2 cache
single-edge contact (SEC) 242 pin
Slot 1
233, 266, 300, and 333MHz
3.3vDC
32KB of L1
64-bit data bus, 36-bit address bus
64GB of RAM

Chips

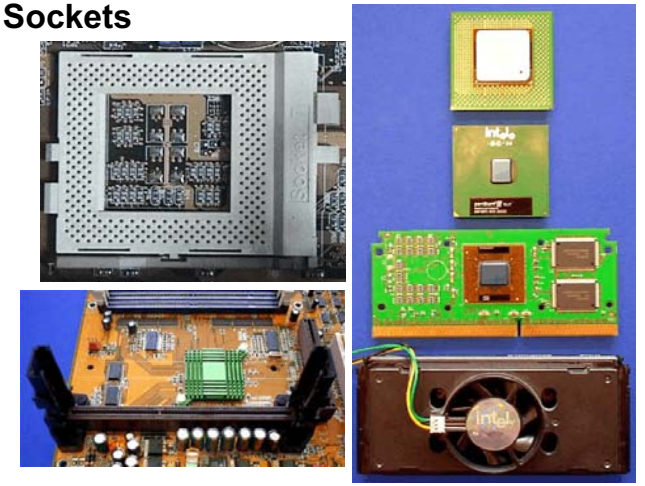
Pentium II/233

Pentium III/600

Pentium III/800

Pentium 4/1500

Sockets



AMD K6

Sixth-generation processor
166–266MHz
3.3vDC
296-pin PGA and uses Socket 7
64-bit data bus, 32-bit address bus
256KB and 1MB of L1 cache, but it does not include an on-board L2 cache.

Cyrix MII

1997, Cyrix MII processor
150, 166, or 187MHz
3.3vDC, 296-pin PGA
64-bit data bus, 32-bit address bus
64KB of L1 cache

Pentium III - March 1999

Advanced (MMX) instructions, single instruction multiple data (SIMD)
PIII 512KB L2, 100MHz bus
PIIIB uses a 133MHz bus
PIIIE 256KB adv. transfer cache
450MHz to 1.13GHz
242-pin SEC, or 370-pin PGA
32KB of L1 cache.
Data 32 bit, Address 36 bit (64GB)

AMD Duron and Athlon

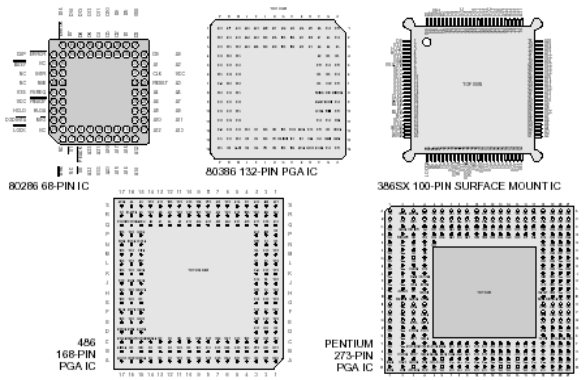
Seventh-generation processors
Released by AMD in 1999, 2000
Duron - 700 and 800MHz
Athlon - 850–1.2GHz,128KB of L1

Intel Comparison Chart

TABLE 5-1 Intel Pentium Processors

	Pentium	Pentium Pro	Pentium MMX	Pentium II	Pentium III
Form	273- or 296-pin PGA	387-pin PGA	296-pin PGA	242-pin SEC	242-pin SEC or 370-pin PGA
Socket	4, 5, or 7	8	7	Slot 1	Slot 1 or PGA370
Voltage (vDC)	3.3 or 5	3.1 or 3.3	3.3	3.3	2
Speeds	60–200MHz	150–200MHz	166–233MHz	233–333MHz	450MHz–1.13 GHz
L1 cache (KB)	16	16	32	32	32
L2 cache	256–512KB on motherboard	256–1MB on-board	256–512KB on motherboard	512KB on-board	256–512KB on-board
Notes	First to use parallel processing	Designed for servers	Enhanced multimedia	First to use SEC form	SIMD instruction set

CPU Packages



Question

Which CPU is intended to operate at a 66MHZ motherboard speed?

A. Intel 80486
B. Pentium 75
C. Pentium II 350
D. Pentium II 300

Question

Which processors use a slot 1 connection on a motherboard?

A. AMD K7
B. PENTIUM III
C. PENTIUM PRO
D. PENTIUM II XEON

Chip Sets

Composed of
- Bus controller
- Memory controller
- Data and address buffer
- Peripheral controller

Example: Intel 810

Random Access Memory

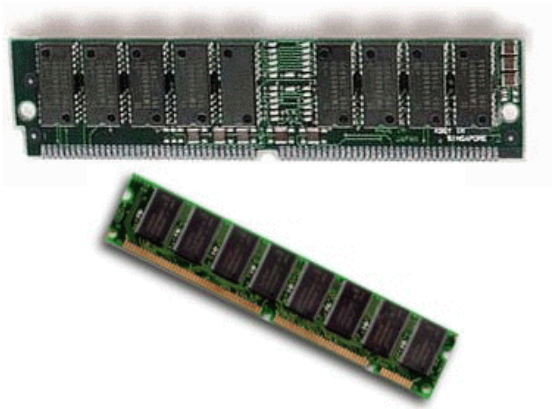
RAM
- Parity, Bits

Dynamic vs. Static

Cache

SIMMS / DIMMS

Memory



EDO RAM

Extended data out (EDO) RAM

more than one task at a time
- data is sent to the processor
- more is retrieved from the RAM

accessed at about 60ns

SDRAM

Synchronous dynamic RAM
twice as fast as EDO RAM
able to run at the speed of the system bus (up to 100–133MHz).

EDO and SDRAM are being replaced with faster memory like RDRAM and DDR RAM.

RDRAM

Rambus Dynamic RAM
developed by Rambus, Inc.

Special data channel @ 800MHz

Double data width increases to 1.6GHz data transfer

DDR RAM

Double data rate (DDR) RAM
2x standard SDRAM

Standards PC1600 and PC2100
- Bandwidth, not MHz

MHz: PC66, PC100, PC133

VRAM

Video RAM (VRAM)
specialized video memory

Video is busiest component
Adapters have own CPU, RAM

Process video data independent of CPU

WRAM

Window RAM (WRAM)

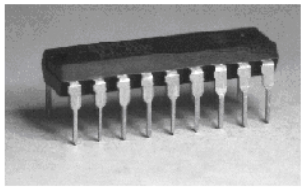
faster access than VRAM

dual-ported technology
allows read/write at same time
"window" refers to retrieving large blocks (windows) of data at one time.

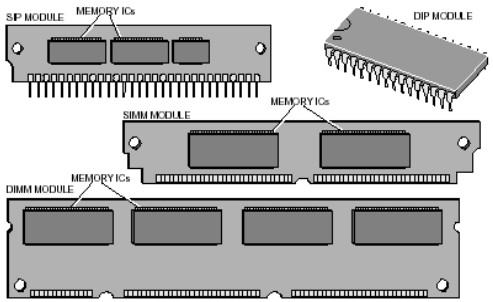
DIP

Dual Inline Package

First Memory Chips
8 - 9 chips per bank
Chip Creep

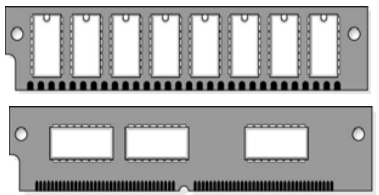


RAM Packages



SIMM

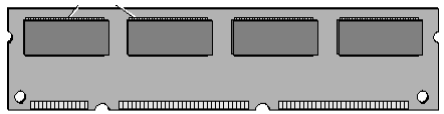
Single Inline Memory Modules
recover space on the motherboard
30-pin 8 bit
72-pin 32 bit
EDO



DIMM

Dual Inline Memory Modules

similar to SIMMs
Different slot
168 connectors
64 bit
EDO, SDRAM



RIMM

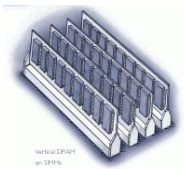
Rambus Inline Memory Module

looks like DIMMs
184 connectors
proprietary
less common
16 bit

Memory Banks

How many chips are needed
Need to match bus width
Depends on motherboard

Pentium II has a 64-bit data bus
One 64-bit DIMM
Two 32-bit SIMMs
Four 16-bit RIMMs



Parity and Nonparity Chips

Used to detect single bit errors

9 bits per byte

Use depends on motherboard

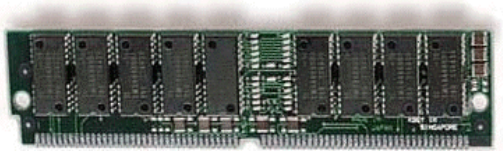
Parity

Error Detection
Extra Bit

Formats

Even	Calculated
Odd	Calculated
None	Not Included
Mark	Always 1
Space	Always 0

Parity in Action



SIMM Stick - Computer Memory
9 chips - each chip has 1 bit
9th bit is parity bit
Set on write, checked on read

Parity Bit

Memory - Extra Bit
1 byte + parity = 9 bits per byte

Calculations:
Even or Odd number of 1's in 9 bits

Byte	Odd	Even
00000000	1	0
01001011	1	0
00010000	0	1

Parity

Error Detection

Byte	P	Odd	Even
00000000	1		
01001011	0		
00010000	1		

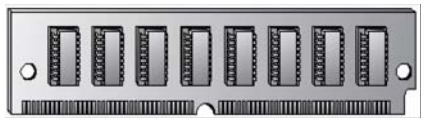
Which are correct for Odd/Even?

Names of Bit Groupings

Size	Name
1	Bit
2	*[Crumb, Tayste]*
4	Nybble
8	Byte
16	Word *[Playte]*
32	*[Dynner]*

Question

Which memory module is shown in the exhibit?



A. 30- pin SIMM
B. 72- pin SIMM
C. 168- pin DIPP
D. 168-pin DIMM

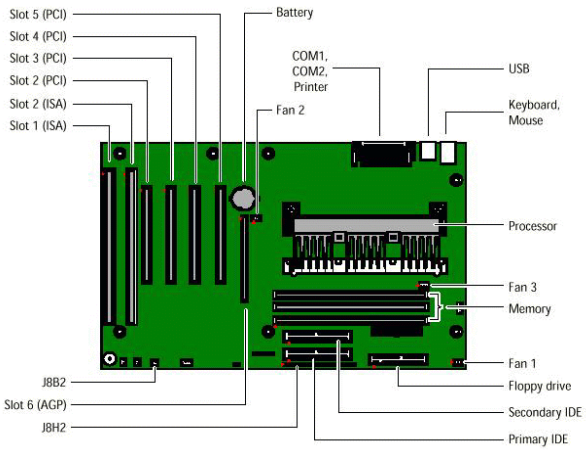
Question

How many bits wide is 72-pin non-parity SIMM memory?

A. 16
B. 32
C. 36
D. 64

Motherboards

CPU
Memory
Expansion
Core Logic
Keyboard / Mouse Controller
ROM BIOS
Features
Video
Ports



Differences in Motherboard Design

Proprietary
- Macintosh
- Sony
- Most Video Games

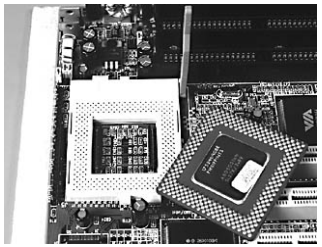
Open Architecture
- IBM PC

Attaching Chips

Soldering

Sockets

Zero Insertion Force Sockets (ZIF)



Motherboard Sizes - ATX

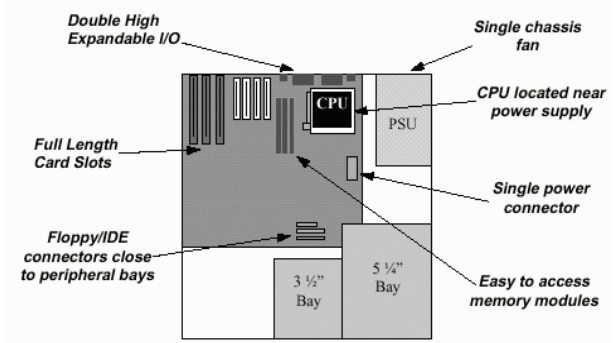


Figure 1. Summary of ATX Chassis Features

Motherboard Sizes - MicroATX

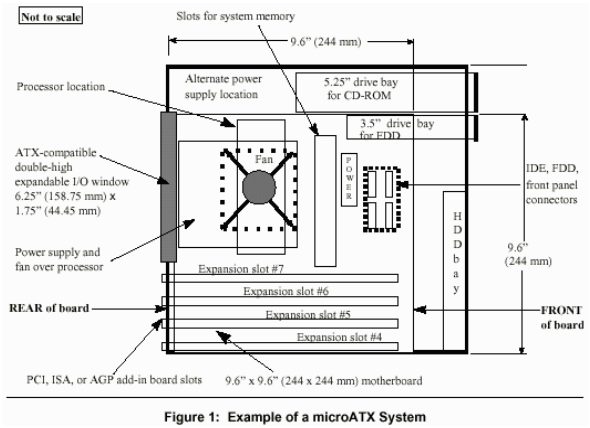


Figure 1: Example of a microATX System

Motherboard Sizes - NLX

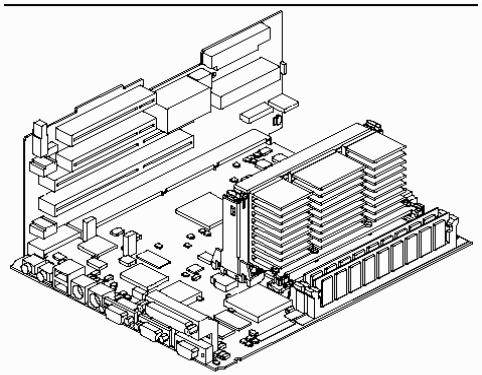


Figure 1. NLX Board and Riser Example

Motherboard Sizes - NLX

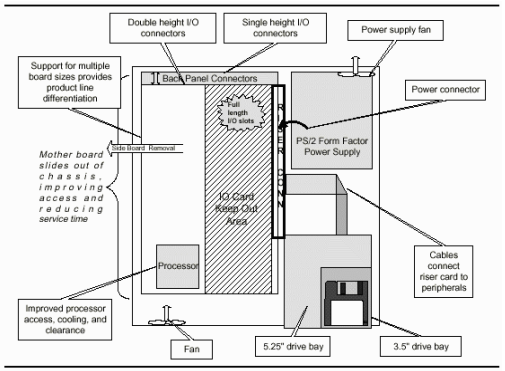
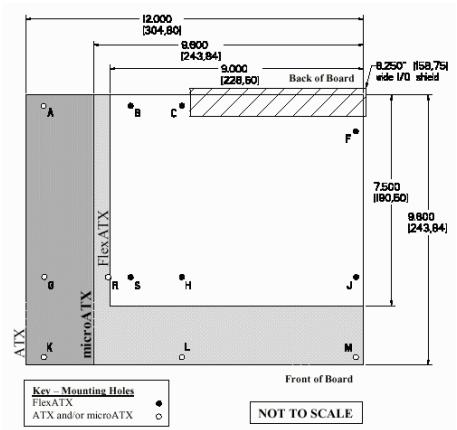


Figure 2. NLX System Layout Example

Comparing Motherboard Sizes



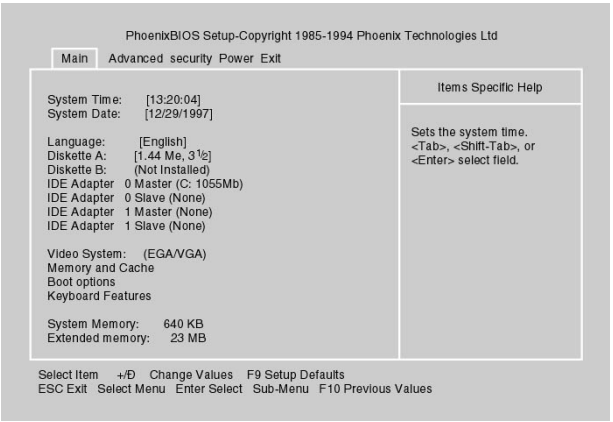
CMOS Settings

Getting in
- At Boot - Key Sequence
  <F2>, <Del>, <esc>...

Setting saved in CMOS

Protected by watch battery
- Good for many years

CMOS Setup Screen



Major Features

Parallel Port
- Bidirectional, EPP, ECP
- Set depending on use

COM / Serial
- Set Port, IRQ

Floppy
- Default size, disable boot

Major Features

Hard Drive
- Configuration (Auto)
- CHS - Cylinder, Heads, Sectors

Memory
- Confirm correct amount

Boot Sequence
- Floppy, CD, Hard Drive

Major Features

Date and Time

Password
- CMOS, Boot Protection
- Lost password?
  - Pull battery
  - Reset Jumper

Plug and Play OS

Question

Which hardware device on a motherboard drive can be updated through software?

A. chip set
B. data bus
C. system BIOS
D. IDE controller

Question

A ZIF socket was put on the motherboard to help with inserting and removing?

A. CPUs
B. SIMMS
C. DIMMS
D. CPU FANS

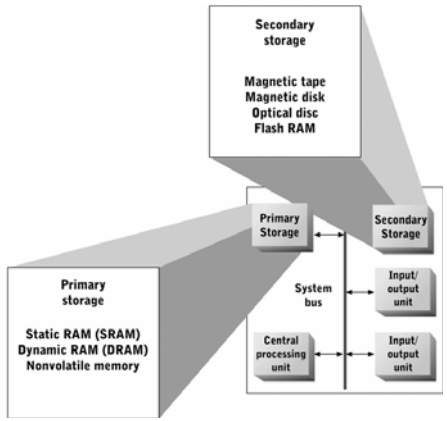
Chapter 5

Data Storage Technology

Storage Devices

- Consist of a read/write mechanism and a storage medium
  - Device controller provides interface
- Primary storage devices
  - Support immediate execution of programs
- Secondary storage devices
  - Provide long-term storage of programs and data

Figure 5-2 ►
Primary and secondary storage and their component devices



Characteristics of Storage Devices

- Speed
- Volatility
- Access method
- Portability
- Cost and capacity

Speed

- Primary storage speed
  - Typically faster than secondary storage speed by a factor of 105 or more
  - Expressed in nanoseconds (billionths of a second)
- Secondary storage speed
  - Expressed in milliseconds (thousandths of a second)
- Data transfer rate = 1 second/access time (in seconds) x unit of data transfer (in bytes)

Volatility

- Primary storage devices are generally volatile
  - Cannot reliably hold data for long periods
- Secondary storage devices are generally nonvolatile
  - Hold data without loss over long periods of time

Access Method

- Serial access (linear)
- Random access (direct access)
- Parallel access (simultaneous)

Portability

- Removable storage with standardized formats
- Typically results in slower access speeds

Cost and Capacity

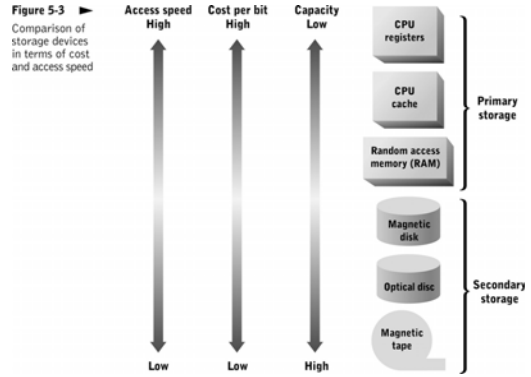
- Cost increases:
  - With improved speed, volatility, or portability
  - As access method moves from serial to random to parallel access method
- Primary storage - expensive (high speed and combination of parallel/random access methods)
- Capacity of secondary storage devices is greater than primary storage devices

Table 5-1 ►
Storage device characteristics and their relationship to cost

Characteristic	Description	Cost
Speed	Time required to read or write a bit, byte, or larger unit of data	Cost increases as speed increases
Volatility	Ability to hold data indefinitely, particularly in the absence of external power	For devices of similar type, cost decreases as volatility increases
Access method	Can be serial, random, or parallel; parallel devices are also serial or random access	Serial is the least expensive; random is more expensive than serial; parallel access is more expensive than non-parallel access
Portability	Ability to easily remove and reinstall the storage media from the device or the device from the computer	For devices of similar type, portability increases cost; if all other characteristics are held constant
Capacity	Maximum data quantity held by the device or storage medium	Cost usually increases in direct proportion to capacity

Memory-Storage Hierarchy

Figure 5-3 ►
Comparison of storage devices in terms of cost and access speed



Primary Storage Devices

- Critical performance characteristics
  - Access speed
  - Data transfer unit size
- Must closely match CPU speed and word size to avoid wait states

Random Access Memory

- Characteristics
  - Microchip implementation using semiconductors
  - Ability to read and write with equal speed
  - Random access to stored bytes, words, or larger data units
- Basic types
  - Static RAM (SRAM) – uses transistors
  - Dynamic RAM (DRAM) – uses transistors and capacitors

Random Access Memory

- To bridge performance gap between memory and microprocessors
  - Read-ahead memory access
  - Synchronous read operations
  - On-chip memory caches

Nonvolatile Memory

- Random access memory with long-term or permanent data retention
- Usually relegated to specialized roles and secondary storage; slower write speeds and limited number of rewrites
- Generations of devices (ROM, EPROM, and EEPROM)

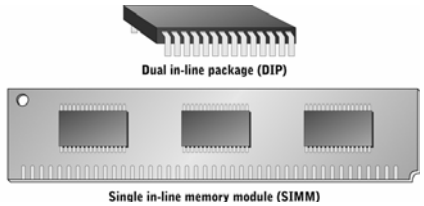
Nonvolatile Memory

- Flash RAM (most common NVM)
  - Competitive with DRAM in capacity and read performance
  - Relatively slow write speed
  - Limited number of write cycles
- NVM technologies under development
  - Ferroelectric RAM
  - Polymer memory

Memory Packaging

- Dual in-line packages (DIPs)
  - Early RAM and ROM circuits
- Single in-line memory module (SIMM)
  - Standard RAM package in late 1980s
- Double in-line memory module (DIMM)
  - Newer packaging standard
  - A SIMM with independent electrical contacts on both sides of the module

Figure 5-5 ►
Dual in-line package (DIP) chip and single in-line memory module (SIMM)



CPU Memory Access

- Critical design issues for primary storage devices and processors
  - Physical organization of memory
  - Organization of programs and data within memory
  - Method(s) of referencing specific memory locations

Physical Memory Organization

- Physical memory
  - Actual number of memory bytes that physically are installed in the machine
- Most and least significant bytes
- Big endian and little endian
- Addressable memory
  - Highest numbered storage byte that can be represented

Memory Allocation and Addressing

- Memory allocation
  - Assignment of specific memory addresses to system software, application programs, and data
- Absolute addressing
- Indirect addressing (relative addressing)
  - Offset register

Figure 5-7 ►
A simple memory allocation scheme

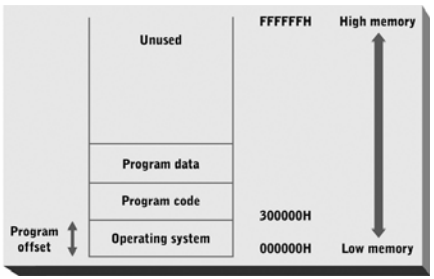
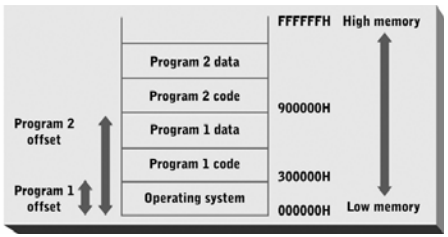


Figure 5-8 ►
Memory allocation for multiple programs



Magnetic Storage

- Exploits duality of magnetism and electricity
  - Converts electrical signals into magnetic charges
  - Captures magnetic charge on a storage medium
  - Later regenerates electrical current from stored magnetic charge
- Polarity of magnetic charge represents bit values zero and one

Figure 5-9 ►
Principles of magnetic data storage

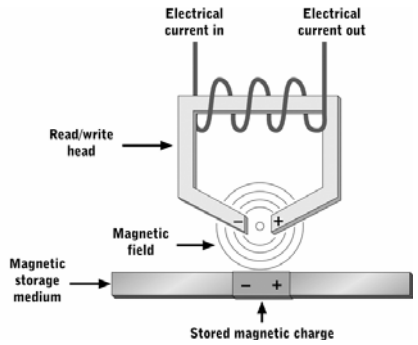
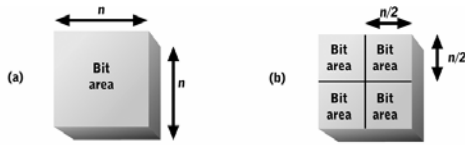


Table 5-2 ►
Factors that lead to data loss in magnetic storage devices

Factor	Description
Magnetic decay	Natural charge decay over time—data must be written at higher power than the read threshold to avoid data loss
Magnetic leakage	Cancellation of adjacent charges of opposite polarity and migration of charge to nearby areas—data must be written at higher power than the read threshold to avoid data loss
Coercivity	Ability of storage medium to hold charge—medium must be of sufficient mass and coercivity to hold charges strong enough to counteract decay and leakage
Areal density	Coercible material per bit decreases as areal density increases—higher areal density makes stored data more susceptible to loss due to decay and leakage
Media integrity	Stability of coercible material and its attachment to substrate—physical stress and temperature/humidity extremes must be avoided to prevent loss of coercible material

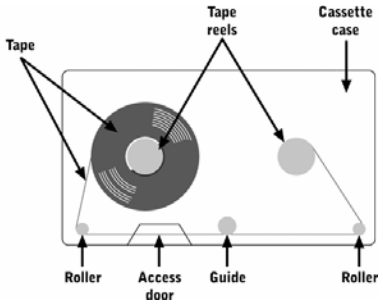
Figure 5-10 ►
Areal density is a function of the length and width of an individual bit area (a). Density may be quadrupled by halving the length and width of bit areas (b)



Magnetic Tape

- Ribbon of plastic with a coercible (usually metallic oxide) surface coating
- Mounts in a tape drive for reading and writing
- Relatively slow serial access
- Compounds magnetic leakage; wraps upon itself
- Susceptible to stretching, friction, temperature variations

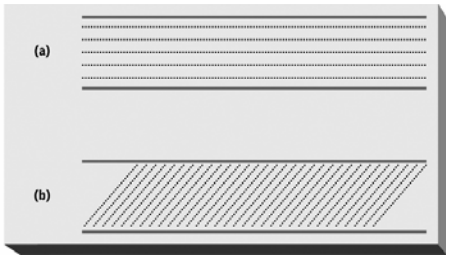
Figure 5-11 ►
Components of a typical cassette or cartridge tape



Magnetic Tape

- Two approaches to recording data
  - Linear recording
  - Helical scanning
- Several formats and standards (e.g., DDS [DAT], AIT, Mammoth, DLT, LTO)

Figure 5-12 ►
Data recorded in linear parallel tracks (a) and with helical scanning (b)



Magnetic Disk

- Flat, circular platter with metallic coating that is rotated beneath read/write heads
- Random access device; read/write head can be moved to any location on the platter
- Hard disks and floppy disks
- Cost performance leader for general-purpose on-line secondary storage

Figure 5-13 ►
Primary components of a typical disk drive

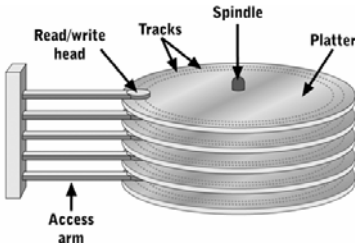
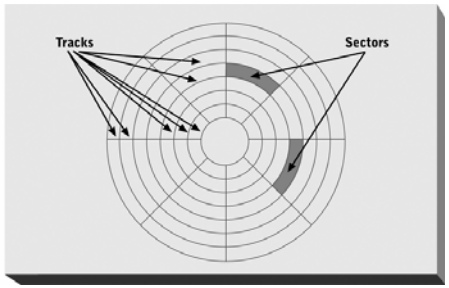


Figure 5-14 ►
Organization of tracks and sectors on one surface of a disk platter



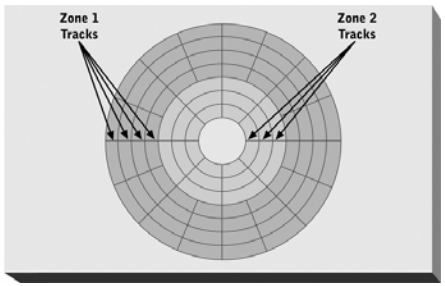
Magnetic Disk Access Time

- Head-to-head switching time
- Track-to-track seek time
- Rotational delay
- Most important performance numbers
  - Average access time
  - Sequential access time
  - Sustained data transfer rate

Table 5-5 ►
Hard disk drive performance statistics

Manufacturer	Model	Platters	Capacity (GB)	Rotation Speed (RPM)	Average Access Time (Milliseconds)
Seagate	ST336752	8	36.7	15,000	3.6
	ST373405	8	73.4	10,000	5.1
	ST1181677	24	181.6	7,200	7.4
Maxtor	8C073L0	8	73.4	15,000	3.2
	KU018L2	2	18.4	10,000	4.5
	6L060L3	2	60	7,200	8.5

Figure 5-15 ►
A platter divided into two zones with more sectors per track in the outer zone

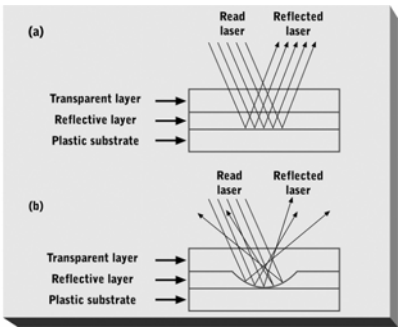


To increase capacity per platter, disk manufacturers divide tracks into zones and vary the sectors per track in each zone.

Optical Mass Storage Devices

- Store bit values as variations in light reflection
- Higher areal density and longer data life than magnetic storage
- Standardized and relatively inexpensive
- Uses: read-only storage with low performance requirements, applications with high capacity requirements, and where portability in a standardized format is needed

Figure 5-17 ►
Optical disc read operations for a one bit (a) and a zero bit (b)



Optical storage devices read data by shining laser beam on the disc.

Table 5-6 ►
Technologies and storage formats for optical and magneto-optical storage

Technology/Format	Writable?	Description
CD-ROM	No	Adaptation of musical compact disc technology, 650 MB capacity
CD-R	One time only	CD-ROM format with a dye reflective layer that can be written with a low-power laser
CD-RW	Yes	CD-ROM format with a phase change reflective layer, can be written up to 1000 times
Magneto-optical	Yes	Combination of optical and magnetic technology, expensive and outdated, rapidly giving way to CD-RW and writeable DVD
DVD-ROM	No	Adaptation of DVD video technology, similar to CD-ROM but more advanced, 4.7 GB capacity
DVD-R	One time only	DVD-ROM format, same basic technology as CD-R with performance and capacity improvements
DVD-RAM	Yes	Format similar but not completely compatible with DVD-ROM, updated CD-RW phase change technology with performance and capacity improvements
DVD-RW	Yes	A competitor to DVD-RAM
DVD+RW	Yes	A competitor to DVD-RAM

Question

How many pins does a standard IDE connector have?

A. 34
B. 40
C. 50
D. 68

Question

What is the smallest storage access unit on an IDE hard drive?

A. Track
B. Sector
C. Partition
D. Cylinder

A+ Domain

Printers

5.01 Basic Printer Concepts

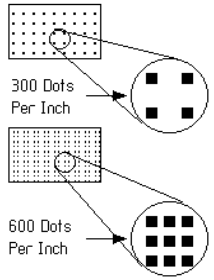
Most common peripheral

Causes most problems

WYSIWYG
Not until Bitmapped Video

Color vs. Black and White

Printer resolution



Resolution is usually measured in dots per inch (dpi). This is the number of vertical and horizontal dots that can be printed; the higher the resolution, the better the print quality.

Printer Speed

This is usually given in pages printed per minute, where the page consists of plain text with five percent of the printable page covered in ink or toner.

Graphics and PCL Support

If the device is used to print graphics, it should support one or more of the popular printer languages, such as Adobe PostScript and Hewlett Packard's LaserJet PCL (Printer Control Language).

Paper capacity

The number and types of paper trays available, the number of pages that can be placed in them, and the sizes of pages that can be printed all vary widely among printers. Some smaller units hold as few as 10 sheets, while high-volume network printers hold several reams in different sizes.

Duty Cycle

This is the number of sheets of paper the printer is rated to print per month. It is based on a plain-text page with five percent coverage and does not include graphics.

Printer memory

Laser printers that will be used to print complex graphics and full-color images require larger amounts of memory than those which print simple text only. In many cases, this memory can be added as an option.

Cost of paper

Will a printer require special paper? Some printers must use special paper to produce high-quality (photo-quality) images or even good text. Some paper stocks are too porous for ink-jet printers and will cause the ink to smear or distort, causing a blurred image.

Cost of consumables

When comparing the cost of various printers, be sure to calculate and compare the total cost per page for printing, rather than just the cost of a replacement ink or toner cartridge.

Types of Printers

Two main classifications

Impact

print head mechanism strikes an inked ribbon located between the print head and the paper.

The main types of impact printers are Dot-Matrix and Daisy-Wheel.

Types of Printers

Two main classifications

Non-Impact

print head does not make contact with the paper, and no inked ribbon is necessary.

The main types of non-impact printers are LaserJet, ink-jet and thermal.

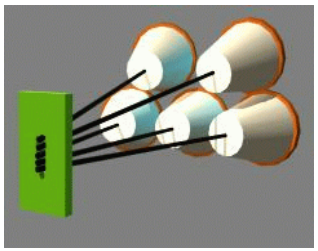
Dot Matrix

Character built from dots

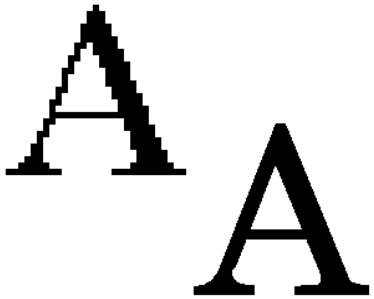
Printed One Column at a time

Pin Density

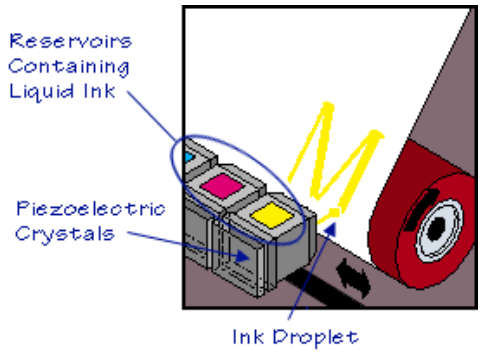
24 pin



Near Letter Quality

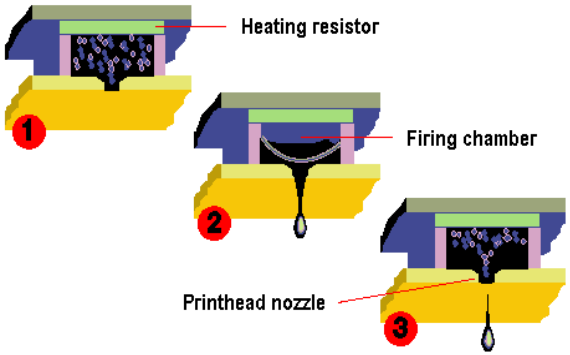


Ink Jet Printers

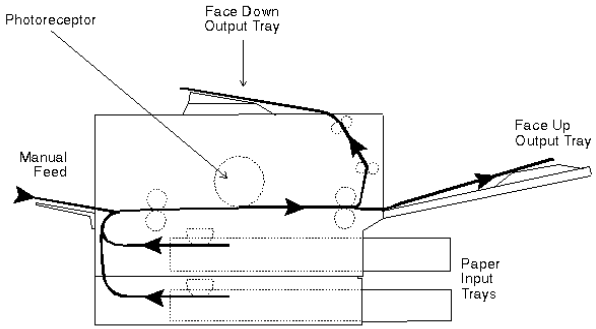


Inkjets

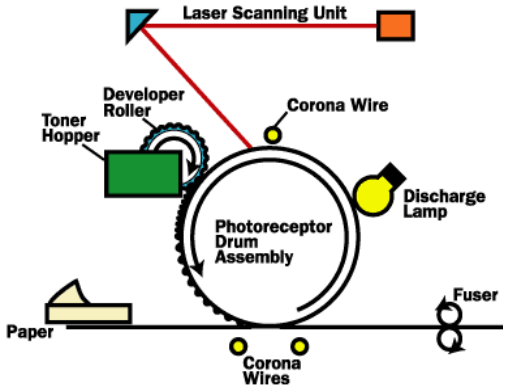
How it shoots ink...



Inside a Laser Printer



Inside a Laser Printer



How a Laser Printer Works

1. Cleaning
   - Drum is cleaned / Scraped
   - Electrostatically cleaned by erase lamps

2. Conditioning (Charging)
   - A uniform negative charge on the surface of the drum
   - Applied by primary corona wire

How a Laser Printer Works

3. Writing
   - Laser beam is used to discharge
   - Creates an electrostatic image

4. Developing
   - Toner transferred from developer cylinder to the drum
   - Toner particles have a negative charge

How a Laser Printer Works

5. Transfer
   - Toner transferred to the paper
   - Corona wire is positioned behind the paper so that the paper
   - Attracts the toner from drum

6. Fusing
   - Toner is melted to paper
   - Fusing Roller

Printer Interfaces

Parallel Port
- Mode: Bidirectional, ECP

USB

Network
- Printer has NIC card, IP address

Shared
- to other system on the LAN

Care, Service, and Troubleshooting

Printers are the most common source of problems

Feed and Output

Paper Jam
- Fan paper before putting in tray
- Don't overload printer
- Don't have too few pages in tray
- Try different weight paper
- Clean printer
- Don't pull paper too hard

Print Quality

Blank Pages
- Ribbon / Ink / Toner Empty
- Ink: Clean Nozzles

Speckles on page
- Clean printer
- Regular: Clean rollers / drum

Ghost Images
- Laser: replace drum

Print Quality

Wrong Colors
- Inkjet: Cartridges in wrong

Smudged
- Wait for ink to dry

Printer Troubleshooting

Your Printer Does Not Print

Check to make sure that the printer is turned on and is not offline, and that it has paper.

Make sure that the cables are attached properly.

Your Printer Does Not Print

Try turning the printer off, waiting a few seconds, and then turning it on again. This could clear any memory problems that it might be having.

Check the printer on your computer queue for additional information as to why the job might not be printing.

Your Printer Does Not Print

If you are printing to a network printer, try opening the printer from the Printers section of the Control Panel. If the printer is turned off, is offline, or is having problems, you might not be able to connect to the printer, which may indicate that a network problem exists.

You Receive a Message about an Error for Insufficient Memory or Disk Space

Make sure that you have sufficient free disk space on the drive on which Windows is installed. By default Windows uses print spooling, which temporarily stores the print job on your hard drive.

Only part of the page is printed

Not enough memory in the printer

Add more RAM
Lower the resolution
Reduce the size of the graphics
Reduce number of fonts

Errors

Paper Out
- Check Paper
- Tray Closed?

I/O Error
- Driver / Configuration problem

Incorrect Port Mode
- BIOS: LPT Mode: Bi, EPP, ECP

Errors

No Default Printer selected
- Many application need one

Toner Low
- Remove and rock toner gently
- Temporary solution

Safety Precautions

Don't operate printer when open

Laser printers get VERY hot
- 200+ degrees

Clean printers on a regular basis

Question

Which printer type would MOST likely produce the most noise?

A. Dot Matrix
B. Ink Dispersion
C. Laser
D. Thermal

Question

Which device should not be plugged into a standard UPS?

A. Any monitor
B. Laser printer
C. An inkjet printer
D. External Modem

Parting Thought

"How do I set a laser printer to stun?"

- Anonymous

End of Lesson