Introduction to the PC

IST 523

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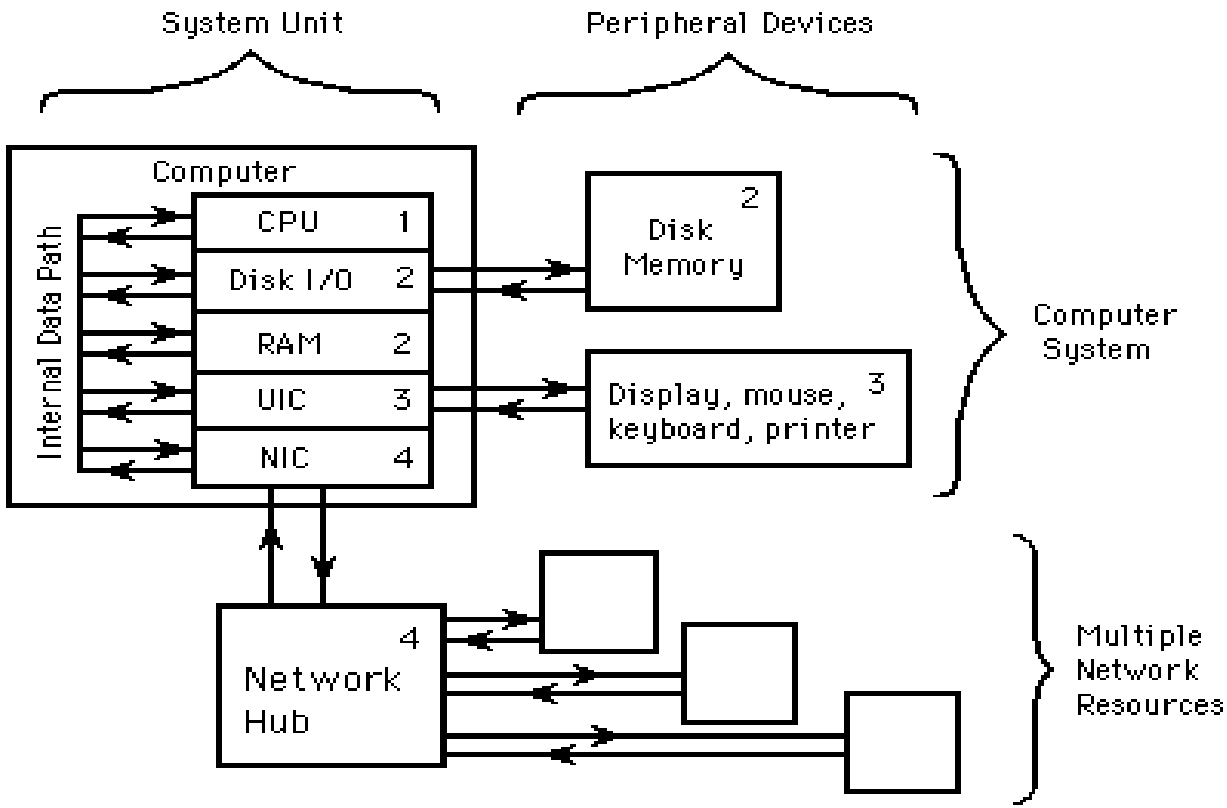
Computer system organization

- 4 major internal sections
  - CPU
  - memory
  - user interface components
  - network interface components

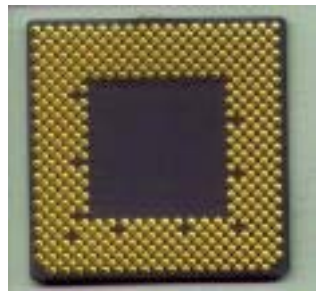
Computer system organization



Computer system organization

- Physical arrangement of hardware varies
  - laptops
  - iMacs
  - standard desktop PC
- Some components may be outside main case
- Foundation concept is the **logical** or **conceptual** organization of the modern PC

CPU



CPU

- The bus
  - Major internal data path
  - Consists of a few dozen parallel conductors that carry data or its the address or the protocols for data transfer
  - Word size of bus used to characterize PCs
    - 8-bit (original IBM PC)
    - 16- or 32-bit (current modern PCs)
    - 64- or 128-bit (large-scale systems)

CPU

- contains the arithmetic and logic unit that executes the instructions
- contains several registers that can store data
- instructions executed by CPU fall into two general classes:
  - data manipulation
  - instruction-sequence alteration

Memory

Memory

- There are 3 major types:
  - RAM (sometimes called core memory)
    - main working memory
    - fastest memory, but most expensive per character
  - disk
    - common mass storage
    - cheapest and slowest
  - tape
    - sequential data storage

Information storage technologies

Information storage technologies

	RAM	hard drive	DAT tape	DLT tape	8x CD	ethernet	LocalTalk	floppy
delay	50 ns	15 ms	20 min.	5 min.	300 ms	0.01 ms	2 ms	200 ms
rate	60 MB/s	3 MB/s	0.8 MB/s	2.5 MB/s	1.2 MB/s	1 MB/s	0.03 MB/s	0.5 MB/s
size	2 GB	12 GB	2 GB	20 GB	0.7 GB	na	na	1.4 MB
cost est.	$4/MB	$30/GB	$5/GB	$4/GB	$1/GB	na	na	$0.7/MB

User interface components

User interface components

- Keyboard
- Mouse or trackball
- Display screen
- Printer

Video displays

Video displays

- Characterized by picture elements (pixels)
- Video displays usually provide between 75 and 100 pixels per inch
- Original VGA display specification provides 640 pixels horizontally and 480 vertically
- Standard VGA display provides for up to 8 bits of color information, or up to 256 different colors, at any one time
- Various forms of Super VGA provide more pixels horizontally, more pixels vertically, more simultaneous colors, a larger palette, or some combination

Mac video displays

- All standard Macintosh color displays operate with a fixed palette
- At all times the display will have the same 16 colors, or the same 256 colors, etc.
- All Macintosh models set for a particular number of colors will have exactly the same colors available

Pixels

Pixels and displays

- Info needed to represent an image
  - the product of the number of pixels horizontally
  - times the number of pixels vertically
  - times the number of bytes required for each pixel
- A 2-inch by 3-inch photograph displayed with 256 colors at 75 pixels per inch in both dimensions will contain 33,750 bytes

Pixels and displays

- a 4-inch by 6-inch photograph displayed with 256 colors at 75 pixels per inch in both dimensions, because it is twice as large in each dimension will contain *four* times as many bytes, or 135,000
- Using thousands of colors (16-bit) requires twice as many bytes
- Using millions of colors (24-bit) requires three times as many bytes.

Image compression

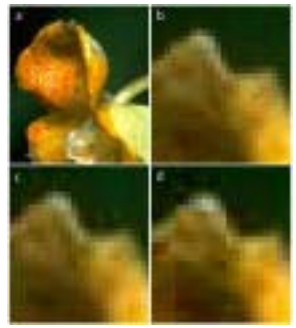


Image compression

- the GIF and JPEG algorithms are used by most Web browsers to compress images
  - **JPEG** stands for **Joint Photographic Experts Group**
  - **GIF** stands for **Graphics Interchange Format** and is a bitmap image format used for still images and for animations

Network connections

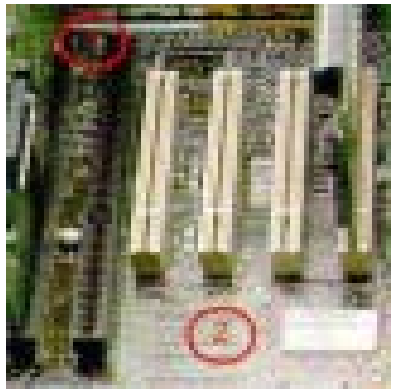
Network connections

- If close, direct wire connections or a LAN are the cheapest
- Longer distances
  - Dedicated wide area network
  - Dial-up network over telephone lines
- Network equipment required for connections (router, network interface cards, modem, switches)

Wireless

- also called WiFi or 802.11 networking
- Advantages
  - easy to set up
  - inexpensive
  - unobtrusive
- Disadvantages
  - Large homes may need repeaters to reach all areas
  - Security

System bus

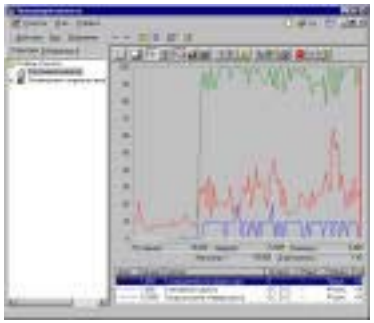


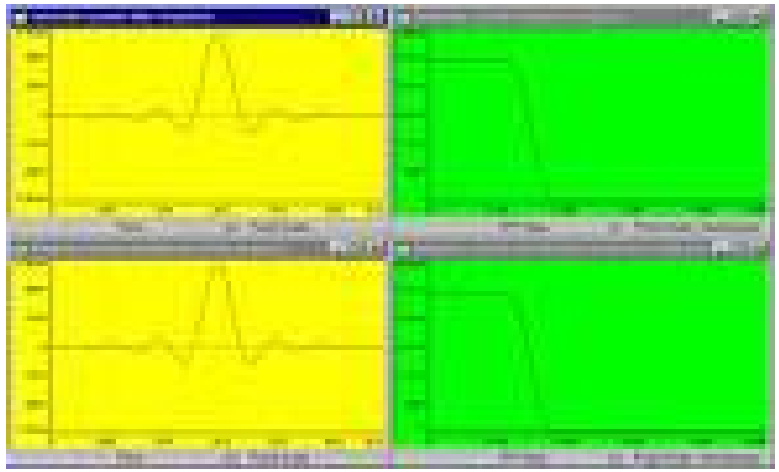
System interconnect

- Bus
  - Conventional PC interconnect
  - Shared by all devices
- Cross-bar switch
  - Multiple paths
  - Expensive

Break time

System performance

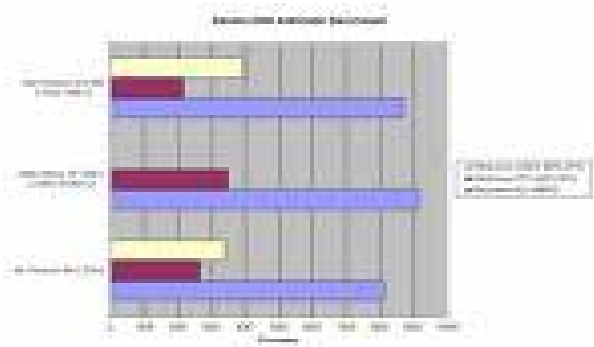




System performance

- System performance is usually limited by one primary bottleneck
- Two kinds of bottlenecks
  - Subsystem (CPU, RAM, disk, display, network)
  - A data path between two subsystems (bus)

Benchmarks



Benchmarks

- a program designed to exercise a computer system in a reproducible way to measure performance
- the only reliable benchmark for predicting system performance with your workload is testing performed with your software

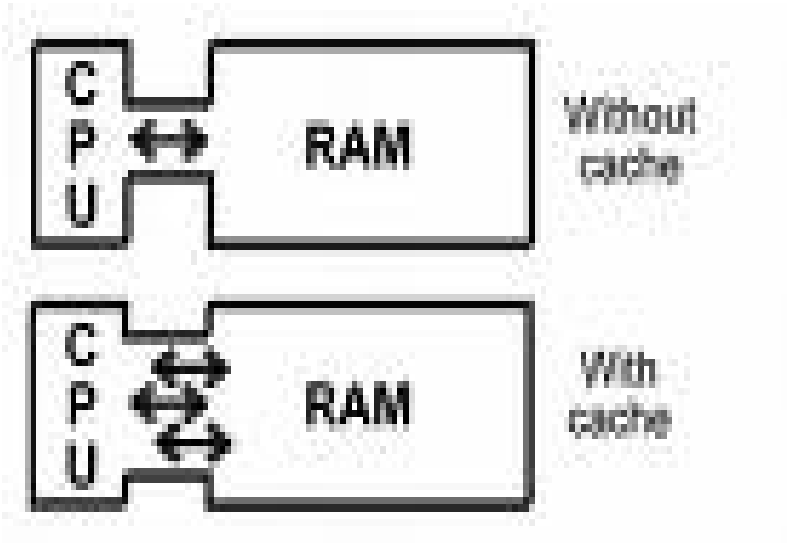
Benchmarks

- SPECmarks
  - appropriate for scientific and engineering workloads on workstations
- Transaction processing (TPS, TPM)
  - TPS, transactions per second
  - TPM, transactions per minute
- MIPS (millions of instructions per second)
- Clock speed

Enhancing system performance

- System performance enhancements address bottlenecks
  - If the network connection is slow, a faster NIC (network interface card), wiring, router or data connection may help
  - If the PC processes instructions or loads programs slowly, additional RAM may help
  - If software is performing slowly a faster CPU may help

Cache



Cache

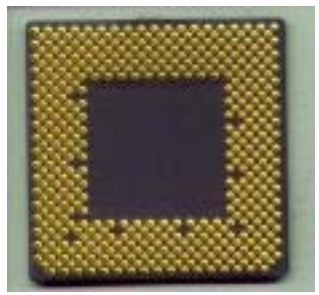
- Cache memory addresses bottlenecks in the RAM subsystem and bottlenecks in the data paths between RAM and the CPU
- Memory cache is a small, very high-speed memory that is connected to the CPU through a very high-speed bus
- Modern CPU chips usually have some cache designed into the chip itself

Disk drives

Disk drives

- Performance of disk drives can limit system performance
  - Install faster disk drives
  - Change type of connection to get faster data transfer
  - Install a disk controller that uses more efficient DMA
  - Install RAID arrays
  - Install RAM cache

CPUs



CPU types

- CISC and RISC
  - CISC
    - Complex Instruction Set Computers
    - machine languages that include single instructions that can perform multiple actions
  - RISC
    - Reduced Instruction Set Computers
    - machine languages that include only single-action instructions

CPU types

- Scalar vs vector vs superscalar
  - A scalar computer completes the execution of each instruction before it begins the execution of the next instruction
  - Vector computers perform the same instruction on multiple items in an overlapping sequence
  - Superscalar computers can perform two or more different instructions, on different data, at the same time

Multiprocessor CPUs

- Most PCs have a single general-purpose CPU
  - PCs are available with 2 or 4 CPUs
  - Intended for use as network servers
- Multiprocessor CPUs
  - Asymmetric Multiprocessors
  - Symmetric Multiprocessors ("SMP")
  - Adaptive Symmetric Multiprocessors ("ASMP")
  - Massively Parallel Multiprocessors

Multiprocessor CPUs

- Asymmetric Multiprocessors
  - One CPU is the primary CPU
  - Other CPUs are secondary
  - In general purpose PCs the primary CPU will be the bottleneck

Multiprocessor CPUs

- Symmetric Multiprocessors ("SMP")
  - Requires careful design to allow all CPUs to respond to all events
  - Can be more efficient than Asymmetric multiprocessing
  - Takes longer to design
  - Takes longer to debug

Multiprocessor CPUs

- Adaptive Symmetric Multiprocessors ("ASMP")
  - High-end server technology
  - Systems with ASMP feature hardware and software that permits multiple CPUs to be configured as several smaller SMP partitions
  - These CPUs cooperate with each other as a "cluster"
  - The CPUs communicate through the backplane of the system much faster than standard network connections
  - The allocation of CPUs among the partitions being modifiable "on-the-fly", i.e. "adaptive"

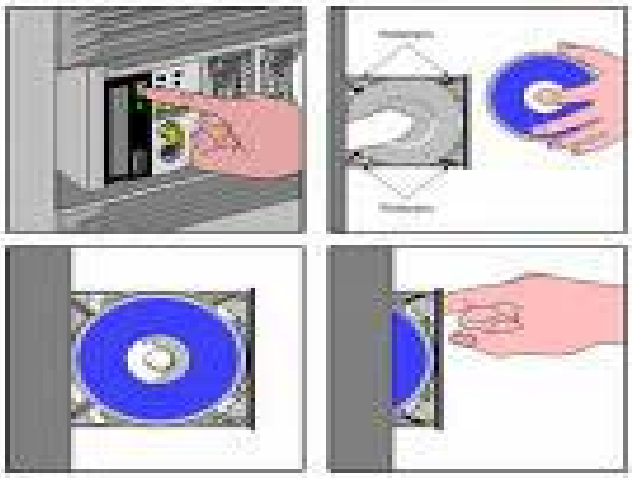
Multiprocessor CPUs

- Massively Parallel Multiprocessors
  - An extreme SMP is a massively parallel computer, which may have over 1,000 CPUs
  - Excellent tools for certain computation, such as technical or scientific needs

Multiprocessor CPUs pros & cons

- Getting efficient use out of multiple CPUs, even in an SMP configuration, is an experimental art
- Generally, the "overhead" of coordinating among the multiple CPUs will require at least 5% of the total CPU capacity of a two-processor system
- Most operating systems have not been designed to support SMP and display even worse overhead
- As each additional CPU is added, a smaller and smaller percentage of that added capacity is available for real work.
- The size of the overhead, and the way it increases with CPU count, are unforgiving measures of the quality of an SMP operating system

CD-ROMs



CD-ROM drives

- Multimedia demands are well-met by CD-ROM technology
- Software installation of programs and operating systems

Backup devices

Back-up devices

- Information stored on magnetic media (hard or floppy disk drives or tape) can be altered or destroyed
- Backups need to be stored at a location different from the original
- People typically don’t do backups unless it’s very convenient
  - Use removable media
  - If possible, have files stored on network server and all files of all users are backed up centrally
  - If not possible, have a high-speed high-capacity backup drives

Backup devices

- Tape
  - DAT (digital audio tape) holds 2 to 24 gigabytes
  - DLT (digital linear tape) holds 20 to over 40 gigabytes

Backup devices

- Removable cartridge disks
  - Iomega is the primary manufacturer
    - ZIP drives
      - are substantially slower than a conventional hard disk, but much faster than a floppy.
      - are slightly larger than conventional floppy disks and about twice as thick
      - can hold 100 or 250 MB of data.
    - JAZ drives
      - are comparable to the speed of a conventional hard disk
      - hold up to 2 GB of data
      - fast data rates and large storage capacity make them a viable alternative for backup storage as well as everyday use

Backup devices

- CD-R and CD-RW
  - CD-R
    - compact disk recordable
    - a type of CD you can record on once and read it many times
  - CD-RW
    - compact disc rewritable
    - a type of CD you can write to in multiple sessions multiple times, just like a floppy or hard disk

Backup devices

- DVD-RAM, DVD-RW/DVD+RW
  - ***DVD--d****igital* ***v****ersatile* ***d****isc* or ***d****igital* ***v****ideo* ***d****isc,* a type of optical disk technology similar to CD-ROM
  - A DVD holds a minimum of 4.7GB of data, enough for a full-length movie
    - DVD-RAM is a DVD format where these discs can be recorded and erased repeatedly but are only compatible with devices manufactured by the companies that support the DVD-RAM format
    - DVD-RW/DVD+RW are re-recordable DVD formats where the data can be erased and recorded over numerous times without damaging the medium

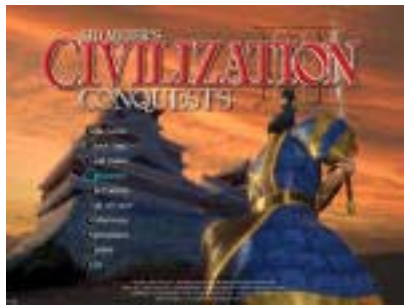
Operating systems

Mac OS

Operating Systems

- Single-user, single task (DOS)
- Single-user, task switching (Macintosh, Windows 3.1, Windows 95)
- Single-user, multitasking (Windows NT, 2000, XP, Vista, MacOS X)
- Multi-user (VMS, unix, VM)

Application software



Application software

- Analyze business activities and tasks
- Select tasks to be computer-assisted
- Identify software types to be used
- Select specific packages (MS Office 2007, XP Standard, Pro, Student; open office)

Training

Training considerations

- For top management
- For middle managers
- For staff
- Time and costs

Vendors


PC Connection


DELL


CDW
The Right Technology.
Right Away.


mySimon


BEST
BUY

Vendor choices

- Direct from manufacturer (Dell)
- Mail-order, phone order or online order from multi-vendor warehouse (CDW)
- VAR (value-added reseller)
- Superstore (Best Buy)
- Local store (Joe’s PC)

Any questions?