



### Chapter 4 Objectives

- Describe the components in the system unit
- Describe the types of expansion slots and cards in the system unit
- Explain how the CPU uses the four steps of a machine cycle to process data
- Explain the difference between a serial, a parallel, and a USB port
- Compare and contrast various personal computer processors on the market today
- Describe how buses contribute to a computer's processing speed
- Define a bit and describe how a series of bits represents data
- Identify components in a notebook computer
- Differentiate among the various types of memory
- Identify components in a handheld computer

Next p. 42

### The System Unit What is the system unit?

- Box-like case that contains computer's electronic components
- Sometimes called the chassis

Next p. 42 Fig. 4-1

### The System Unit What are common components inside the system unit?

- Processor
- Memory module
- Expansion cards
  - Sound card
  - Modem card
  - Video card
  - Network interface card
- Ports and Connectors

Next p. 43 Fig. 4-2

### The System Unit What is the motherboard?

- Main circuit board in system unit
- Contains chips, integrated circuits, and transistors
- Also called system board

Next p. 44 Fig. 4-3

### The System Unit What chip packages are available?

- single edge contact (SEC) cartridge
- dual inline package (DIP)
- flip chip-PGA (FC-PGA) package
- pin grid array (PGA)

Next p. 44 Fig. 4-4

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What is the central processing unit (CPU) ?

- Interprets and carries out basic instructions that operate a computer
- Also called the processor

**CPU**

Next p. 45 Fig. 4.5

**Discovering Computers 2003** Central Processing Unit  
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What are the components of the CPU?

Next p. 45

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What is the control unit?

- Directs and coordinates operations in computer

**Control unit repeats four basic operations:**

- Fetch - obtain program instruction or data item from memory
- Decode - translate instruction into commands
- Execute - carry out command
- Store - write result to memory

Next p. 45

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What is a machine cycle?

- Four operations of the CPU comprise a machine cycle
- Also called instruction cycle

- Instruction time (i-time) - time taken to fetch and decode
- Execution time (e-time) - time taken to execute and store

Next p. 46

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An example of a machine cycle

Student enters math problem (100 x 52) into computer's memory

Result in memory displays on monitor's screen

Next p. 46 Fig. 4.6

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How is the CPU's speed measured?

- According to how many millions of instructions per second (MIPS) it can process

Next p. 46

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### What are two designs used for the CPU?

**CISC**

(complex instruction set computing)

- Supports large number of instructions
- CPU executes complex instructions more quickly

**RISC**

(reduced instruction set computing)

- Supports smaller number of instructions
- CPU executes simple instructions more quickly

Next p. 4.6

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### What is the arithmetic/logic unit (ALU) ?

- CPU component that performs execution part of the machine cycle

**Arithmetic**

(addition, subtraction, multiplication, and division)

**Comparison**

(greater than, equal to, or less than)

**.and. .or. .not.**

**Logical**

(AND, OR, NOT)

Next p. 4.7

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### What is pipelining?

- CPU begins executing second instruction before completing first instruction
- Results in faster processing

**Machine Cycle (without pipelining)**

**Machine Cycle (with pipelining)**

Next p. 4.7 Fig. 4.7

**Discovering Computers 2003** Central Processing Unit  
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### What is a register?

- Temporary storage area that holds data and instructions

Stores location from where instruction was fetched

Stores instruction while it is being decoded

Stores results of calculation

Next p. 4.7

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### What is the system clock?

- Synchronizes all computer operations
- Each tick is clock cycle

**MHz** - one million ticks of system clock

**GHz** - one billion ticks of system clock

Next p. 4.8

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### What is a microprocessor?

- Single processor chip found in personal computers

Next p. 4.9

### Discovering Computers 2003 Central Processing Unit

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COMPARISON OF WIDELY USED PERSONAL COMPUTER PROCESSORS

How do personal computer processors compare?

NAME	DATE INTRODUCED	MANUFACTURER	CLOCK SPEED	NUMBER OF TRANSISTORS
Xeon™	2001	Intel	1.4 GHz and up	1K
Pentium® 4	2000	Intel	1.4 GHz and higher	42 million
Pentium®	2001	Intel	800 MHz and higher	25.4-60 million
Pentium® III Xeon™	1999	Intel	500 MHz - 1 GHz	9.5-28 million
Pentium® III	1999	Intel	400 MHz - 1.2 GHz	9.5-28 million
Altium™	1999	AMD	500 MHz - 1.2 GHz	22-37 million
Duron™	1999	AMD	600 - 1.2 GHz	18 million
AMD-K6™ III	1999	AMD	400 - 450 MHz	21.3 million
Celeron™	1998	Intel	266 - 1.2 GHz	7.5-19 million
Pentium® II Xeon	1998	Intel	400 - 450 MHz	7.5-27 million
AMD-K6™ 2	1998	AMD	368 - 550 MHz	9.3 million
AMD-K6™	1998	AMD	300 MHz	8.8 million
Pentium® II	1997	Intel	234 - 450 MHz	7.5 million
Pentium® with MMX™ technology	1997	Intel	166 - 233 MHz	4.5 million
Pentium® Pro	1995	Intel	150 - 200 MHz	5.5 million
Pentium®	1993	Intel	75 - 200 MHz	3.3 million
80486DX	1989	Intel	25 - 100 MHz	1.2 million
80386DX	1985	Intel	16 - 33 MHz	275,000
80286	1982	Intel	6 - 12 MHz	134,000
PowerPC	1994	Motorola	50 - 867 MHz	Up to 50 million
68040	1989	Motorola	25 - 40 MHz	1.2 million
68030	1987	Motorola	16 - 50 MHz	270,000
68020	1984	Motorola	16 - 33 MHz	190,000

Next  
p. 4.9 Fig. 4-10

### Discovering Computers 2003 Central Processing Unit

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What is a coprocessor?

Chip that assists processor in performing specific tasks

One type is a floating-point coprocessor, also known as a math or numeric coprocessor

Next  
p. 4.13

### Discovering Computers 2003 Central Processing Unit

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What is parallel processing?

- Using multiple processors simultaneously to execute program faster
- Requires special software to divide problem and bring results together

Next  
p. 4.13 Fig. 4-13

### Discovering Computers 2003 Data Representation

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How do computers represent data?

- Most computers are digital
- Recognize only two discrete states: on or off

Next  
p. 4.13

### Discovering Computers 2003 Data Representation

Concepts for a Digital World  
Web and XP Enhanced

What is the binary system?

- Number system with two unique digits: 0 and 1

Binary Digit (bit)	Electronic Charge	Electronic State
1	ON	ON
0	OFF	OFF

Next  
p. 4.14 Fig. 4-14

### Discovering Computers 2003 Data Representation

Concepts for a Digital World  
Web and XP Enhanced

What is a byte?

- Eight bits grouped together

8-bit byte for the number 3

8-bit byte for the number 5

8-bit byte for the capital letter T

Next  
p. 4.14 Fig. 4-15

**Discovering Computers 2003** Data Representation  
 Concepts for a Digital World  
 Web and XP Enhanced

What are three popular coding systems to represent data?

- ASCII - American Standard Code for Information Interchange
- EBCDIC - Extended Binary Coded Decimal Interchange Code
- Unicode - coding scheme capable of representing all world's languages

ASCII	Symbol	EBCDIC
00110000	0	11110000
00110001	1	11110001
00110010	2	11110010
00110011	3	11110011
00110100	4	11110100
00110101	5	11110101
00110110	6	11110110
00110111	7	11110111
00111000	8	11111000
00111001	9	11111001
01000001	A	11000001
01000010	B	11000010
01000011	C	11000011
01000100	D	11000100
01000101	E	11000101

Next  
p. 4.14 Fig. 4-16

**Discovering Computers 2003** Data Representation  
 Concepts for a Digital World  
 Web and XP Enhanced

How is a character sent from keyboard to computer?

Step 1: Press letter T

Step 2: Electronic signal for letter T sent to system unit

Step 3: Signal changed to its ASCII code (01010100) and stored in memory

Step 4: After processing, binary code for letter T is converted to image on output device

Next  
p. 4.15 Fig. 4-17

**Discovering Computers 2003** Memory  
 Concepts for a Digital World  
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What is memory?

- Temporary storage area for operating system, application programs, and data
- Consists of one or more chips on motherboard
- Each byte stored in unique address

Next  
p. 4.15

**Discovering Computers 2003** Memory  
 Concepts for a Digital World  
 Web and XP Enhanced

How is memory measured?

- By number of bytes available

Term	Abbreviation	Approximate Memory Size	Exact Memory Amount	Approximate Number of Pages of Text
Kilobyte	KB or K	1 thousand bytes	1,024 bytes	1/2
Megabyte	MB	1 million bytes	1,048,576 bytes	500
Gigabyte	GB	1 billion bytes	1,073,741,824 bytes	500,000
Terabyte	TB	1 trillion bytes	1,099,511,627,776 bytes	500,000,000

Next  
p. 4.16 Fig. 4-19

**Discovering Computers 2003** Memory  
 Concepts for a Digital World  
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What are two types of system unit memory?

**volatile memory**  
Loses its contents when computer's power is turned off

**nonvolatile memory**  
Does NOT lose its contents when computer's power is turned off

Next  
p. 4.16

**Discovering Computers 2003** Memory  
 Concepts for a Digital World  
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What is random access memory (RAM)?

- Memory chips that can be read from and written to by processor
- Most RAM is volatile
- The more RAM a computer has, the faster it operates

Next  
p. 4.16

**Discovering Computers 2003** Memory  
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### What are two basic types of RAM chips?

**Dynamic RAM (DRAM)**

- Most common type
- Also called main memory

**Static RAM (SRAM)**

- Used for special applications such as cache
- Faster and more reliable than DRAM chips

Next  
p. 4.18

**Discovering Computers 2003** Memory  
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### How much RAM is needed?

- Software package usually indicates RAM requirements



**Windows\***

- 333 MHz Intel Pentium® processor
- Minimum 256 MB; 1 GB\* 2003\*
- 32 MB of RAM
- Available hard disk space
- 256 color monitor capable of 800X600 resolution
- CD-ROM drive

**Macintosh\***

- Power Macintosh\*
- Processor 450 MHz
- 32 MB of free application RAM
- 40 MB of free system space
- 256 color monitor capable of 800X600 resolution
- CD-ROM drive

Next  
p. 4.18 Fig. 4-22

**Discovering Computers 2003** Memory  
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### How much RAM is needed?

- Depends on type of applications you intend to run on your computer

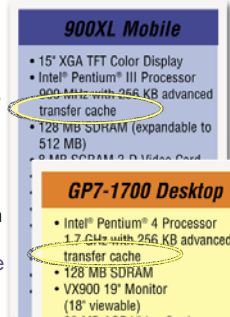
RAM (in MB)	128 to 256 MB (minimum)	256 to 512 MB (minimum)	512 MB and up
Use	Home and business users managing personal finances, using standard application software such as word processing, using educational or entertainment CD-ROMs; communicating with others on the Web	Users requiring more advanced multimedia capabilities; running number-intensive accounting, financial, or spreadsheet programs; using voice recognition; working with videos, music, and digital imaging; creating Web sites; participating in video-conferences; playing Internet games	Power users creating professional Web sites; running sophisticated CAD, 3-D design, or other graphics-intensive software
Model	C802, A130	A140, P175	P190
Processor	300 MHz Celeron® processor	1 GHz Intel® processor	1 GHz Pentium® 4 processor
Memory	128 MB SDRAM Memory	256 MB SDRAM Memory	512 MB SDRAM Memory

Next  
p. 4.19 Fig. 4-22

**Discovering Computers 2003** Memory  
Concepts for a Digital World  
Web and XP Enhanced

### What is cache?

- Helps speed computer processes by storing frequently used instructions and data
- Also called memory cache, cache store, or RAM cache
- L1 cache built in processor
- L2 and L3 cache not built in processor
- L2 advanced transfer cache most common



**900XL Mobile**

- 15" XGA TFT Color Display
- Intel® Pentium® III Processor
- 256 KB advanced transfer cache
- 128 MB SDRAM (expandable to 512 MB)

**GP7-1700 Desktop**

- Intel® Pentium® 4 Processor
- 256 KB advanced transfer cache
- 128 MB SDRAM
- VX900 19" Monitor (18" viewable)
- 32 MB AGP Video Card

Next  
p. 4.20 Fig. 4-24

**Discovering Computers 2003** Memory  
Concepts for a Digital World  
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### What is read-only memory (ROM)?

- Memory chips that contain data, instructions, or information that is recorded permanently

Data can only be read; cannot be modified in ROM

ROM is nonvolatile — Contents not lost when computer is turned off

**BIOS**  
(basic input/output system)  
Stored on ROM  
Sequence of instructions computer follows to load operating system and other files when you turn on the computer

Next  
p. 4.20

**Discovering Computers 2003** Memory  
Concepts for a Digital World  
Web and XP Enhanced

### Types of ROM

**Firmware**  
ROM chips manufactured with permanently written data, instructions, or information

**PROM**  
(programmable read-only memory)  
Blank ROM on which you can place items permanently

**EEPROM**  
(electrically erasable programmable read-only memory)  
Type of PROM containing microcode programmer can erase

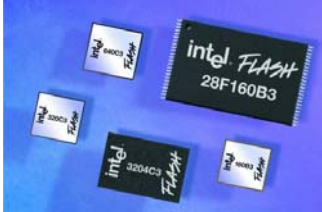
Next  
p. 4.20

**Discovering Computers 2003**  
Concepts for a Digital World  
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### Memory

#### What is flash memory?

- Nonvolatile memory that can be erased electronically and reprogrammed
- Used with handheld computers and digital cameras, cellular phones, and automobiles

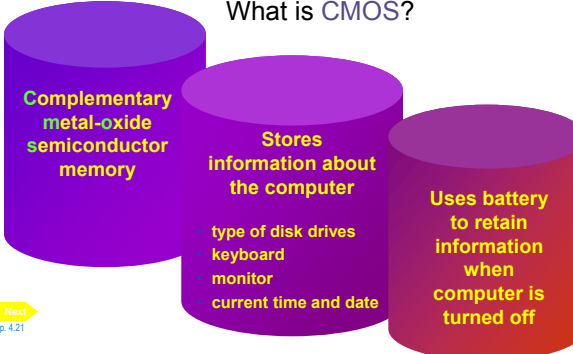


Next  
p. 421 Fig. 4-25

**Discovering Computers 2003**  
Concepts for a Digital World  
Web and XP Enhanced

### Memory

#### What is CMOS?



- Complementary metal-oxide semiconductor memory
- Stores information about the computer
  - type of disk drives
  - keyboard
  - monitor
  - current time and date
- Uses battery to retain information when computer is turned off


Next  
p. 421

**Discovering Computers 2003**  
Concepts for a Digital World  
Web and XP Enhanced

### Memory

#### What is memory access time?

- Speed at which processor can access data from memory directly
- Measured in nanoseconds (ns), which is one billionth of a second
- It takes 1/10 of a second to blink your eye; a computer can perform up to 10 million operations in same amount of time



TERM	ABBREVIATION	SPEED
Millisecond	ms	One-thousandth of a second
Microsecond	μs	One-millionth of a second
Nanosecond	ns	One-billionth of a second
Picosecond	ps	One-trillionth of a second

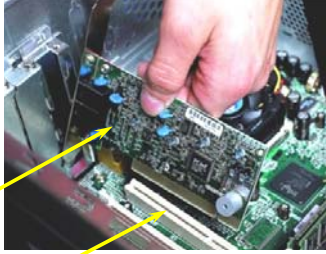
Next  
p. 422 Fig. 4-26 & 27

**Discovering Computers 2003**  
Concepts for a Digital World  
Web and XP Enhanced

### Expansion Slots and Expansion Cards

#### What is an expansion slot?

- An opening, or socket, where circuit board is inserted into motherboard
- Expansion card inserted in expansion slot



Next  
p. 423 Fig. 4-29

**Discovering Computers 2003**  
Concepts for a Digital World  
Web and XP Enhanced

### Expansion Slots and Expansion Cards

#### How are expansion cards used?


EXPANSION CARD	PURPOSE
Accelerator	To increase the speed of the processor
Controller	To connect disk drives; being phased out because newer motherboards support these connections
Game	To connect a joystick
I/O	To connect input and output devices such as a printer or mouse; being phased out because newer motherboards support these connections
Interface	To connect other peripherals such as a mouse, CD-ROM, or scanner
Memory	To add more memory to the computer
Modem	To connect to other computers through telephone lines
Network Interface	To connect to other computers and peripherals
PC-to-TV converter	To connect to a television
Sound	To connect speakers or microphone
TV Tuner	To view television channels on your monitor
Video	To connect a monitor
Video Capture	To connect a camcorder

Next  
p. 423 Fig. 4-28

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### Expansion Slots and Expansion Cards

#### What is Plug and Play?




Next  
p. 424 Fig. 4-29

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Concepts for a Digital World  
Web and XP Enhanced

### Expansion Slots and Expansion Cards

#### What is a PC card?

- Credit card-sized device used to add capabilities to notebook computers
- PCMCIA - Personal Computer Memory Card International Association
- Uses include modem, additional memory, and storage



**Next**  
p. 424 Fig. 4-30

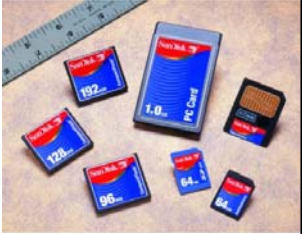
**PC card**

**Discovering Computers 2003**  
Concepts for a Digital World  
Web and XP Enhanced

### Expansion Slots and Expansion Cards

#### What is a flash memory card?

- Adds memory to handheld computers, digital music players, cellular telephones, and similar devices




**Next**  
p. 425 Fig. 4-31

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### Ports

#### What is a port?

- Connects external devices to system unit



Labels: keyboard, mouse, USB, printer (parallel port), serial port, speaker, monitor, microphone, game port, network, telephone line in, telephone line out, svideo out, FM reception, cable TV.

**Next**  
p. 425 Fig. 4-32

**Discovering Computers 2003**  
Concepts for a Digital World  
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### Ports

#### What are different types of connectors?

CONNECTOR	DB-9, 9-pin male	DB-9, 9-pin female	DB-15, 15-pin female	DB-15, 15-pin female	Miniplug
USE	serial port, external modem	EGA & CGA video	VGA & EGA video	game port	speaker & microphone
CONNECTOR	DB-25, 25-pin male	DB-25, 25-pin female	36-pin female, mini ribbon		
USE	serial port, external modem, SCSI	parallel port, printer, tape backup	printer		
CONNECTOR	36-pin Centronics female	50-pin Centronics female	5-pin 180° female DIN		
USE	printer	SCSI	keyboard, MIDI		
CONNECTOR	USB port	RJ-11, 6-pin female, modular telephone	BNC, male coaxial	6-pin male, mini DIN	
USE	connects to 127 different peripheral devices	telephone, modem, LAN	LAN	mouse, keyboard	

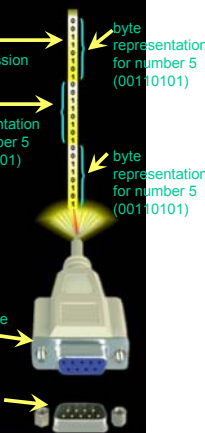
**Next**  
p. 426 Fig. 4-34

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Concepts for a Digital World  
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### Ports

#### What is a serial port?

- Transmits one bit of data at a time
- Used to connect slow-speed devices, such as mouse, keyboard, modem



Labels: serial transmission of data, byte representation for number 5 (00110101), DB-9 female connector, DB-9 male connector.


**Next**  
p. 427 Fig. 4-35

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### Ports

#### What is a parallel port?

- Connects devices that can transfer more than one bit at a time, such as a printer



Labels: byte representation for number 1 (00110001), byte representation for number 3 (00110011), byte representation for number 5 (00110101), DB-25 male connector, DB-25 female connector.

**Next**  
p. 427 Fig. 4-36

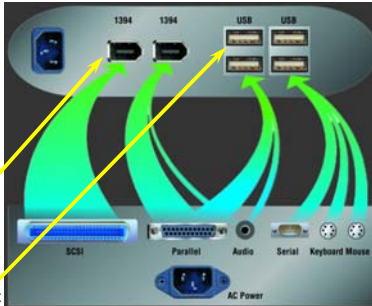


**Discovering Computers 2003**  
Concepts for a Digital World  
Web and XP Enhanced

### Ports

#### What is a universal serial bus port (USB) ?

- Connector that supports newer peripherals and plug and play
- Other popular ports include 1394, MIDI, SCSI, and IrDA



1394 port

USB port

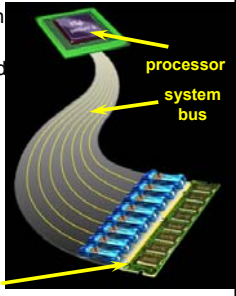
Next  
p. 4.28 Fig. 4-37

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Concepts for a Digital World  
Web and XP Enhanced

### Buses

#### What is a bus?

- Channel that allows devices inside computer to communicate with each other
- System bus connects processor and RAM
- Bus width determines number of bits transmitted at one time
- Word size determines number of bits processor can interpret and execute at a given time



processor

system bus

RAM

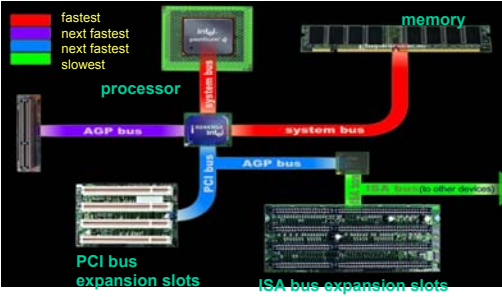
Next  
p. 4.29 Fig. 4-39

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Concepts for a Digital World  
Web and XP Enhanced

### Buses

#### What is an expansion bus?

- Allows processor to communicate with peripherals



fastest

next fastest

next fastest

slowest

processor

memory

system bus

AXP bus

AXP bus

PCI bus expansion slots

ISA bus expansion slots

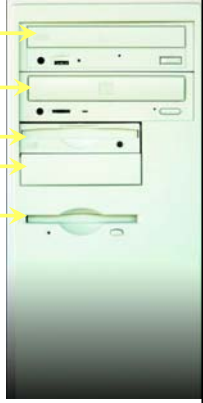
Next  
p. 4.31 Fig. 4-41

**Discovering Computers 2003**  
Concepts for a Digital World  
Web and XP Enhanced

### Bays

#### What is a bay?

- Open area inside system unit used to install additional equipment



DVD-ROM drive

CD-RW drive

Zip drive

empty drive bay

floppy disk drive

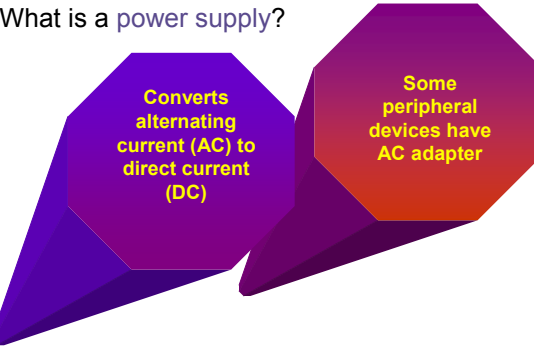
Next  
p. 4.32 Fig. 4-42

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Concepts for a Digital World  
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### Power Supply

#### What is a power supply?

- Converts alternating current (AC) to direct current (DC)
- Some peripheral devices have AC adapter



Converts alternating current (AC) to direct current (DC)

Some peripheral devices have AC adapter

Next  
p. 4.32

**Discovering Computers 2003**  
Concepts for a Digital World  
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### Mobile Computers

#### What is a mobile computer?

- Notebook, which weighs between 2.5 and 8 pounds, or Handheld

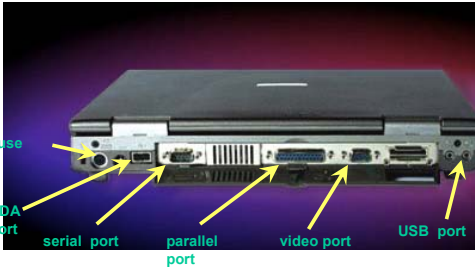


system unit on handheld computer

Next  
p. 4.33 Fig. 4-43

**Discovering Computers 2003** Mobile Computers  
Concepts for a Digital World  
Web and XP Enhanced

What ports are on a notebook computer?



keyboard/mouse port  
IrDA port  
serial port  
parallel port  
video port  
USB port

Next  
p. 4.34 Fig. 4-45

**Discovering Computers 2003** Mobile Computers  
Concepts for a Digital World  
Web and XP Enhanced

How is data transferred from a handheld computer?

- ⇒ An IrDA port allows the handheld computer to communicate wirelessly with other computers or devices
- ⇒ Handheld computers also can rest in a cradle, so you can transfer data to your desktop computer

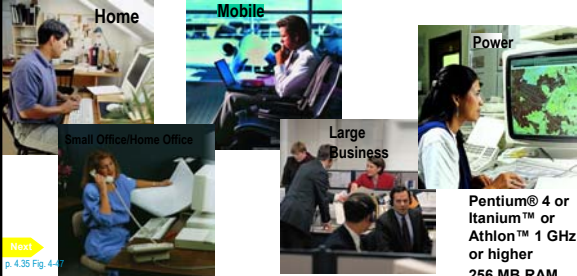


IrDA port  
cradle

Next  
p. 4.34 Fig. 4-46

**Discovering Computers 2003** Putting It All Together  
Concepts for a Digital World  
Web and XP Enhanced

What are suggested processor, clock speed, and RAM requirements based on the needs of various types of users?



Home  
Mobile  
Power  
Small Office/Home Office  
Large Business

Pentium® 4 or Itanium™ or Athlon™ 1 GHz or higher  
256 MB RAM

Next  
p. 4.35 Fig. 4-47

**Discovering Computers 2003**  
Concepts for a Digital World  
Web and XP Enhanced

**Summary of the Components of the System Unit**

- The system unit
- Central processing unit
- Data representation
- Memory
- Expansion slots and expansion cards
- Ports, buses, bays
- Power supply
- Mobile computers

Chapter 4 Complete

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