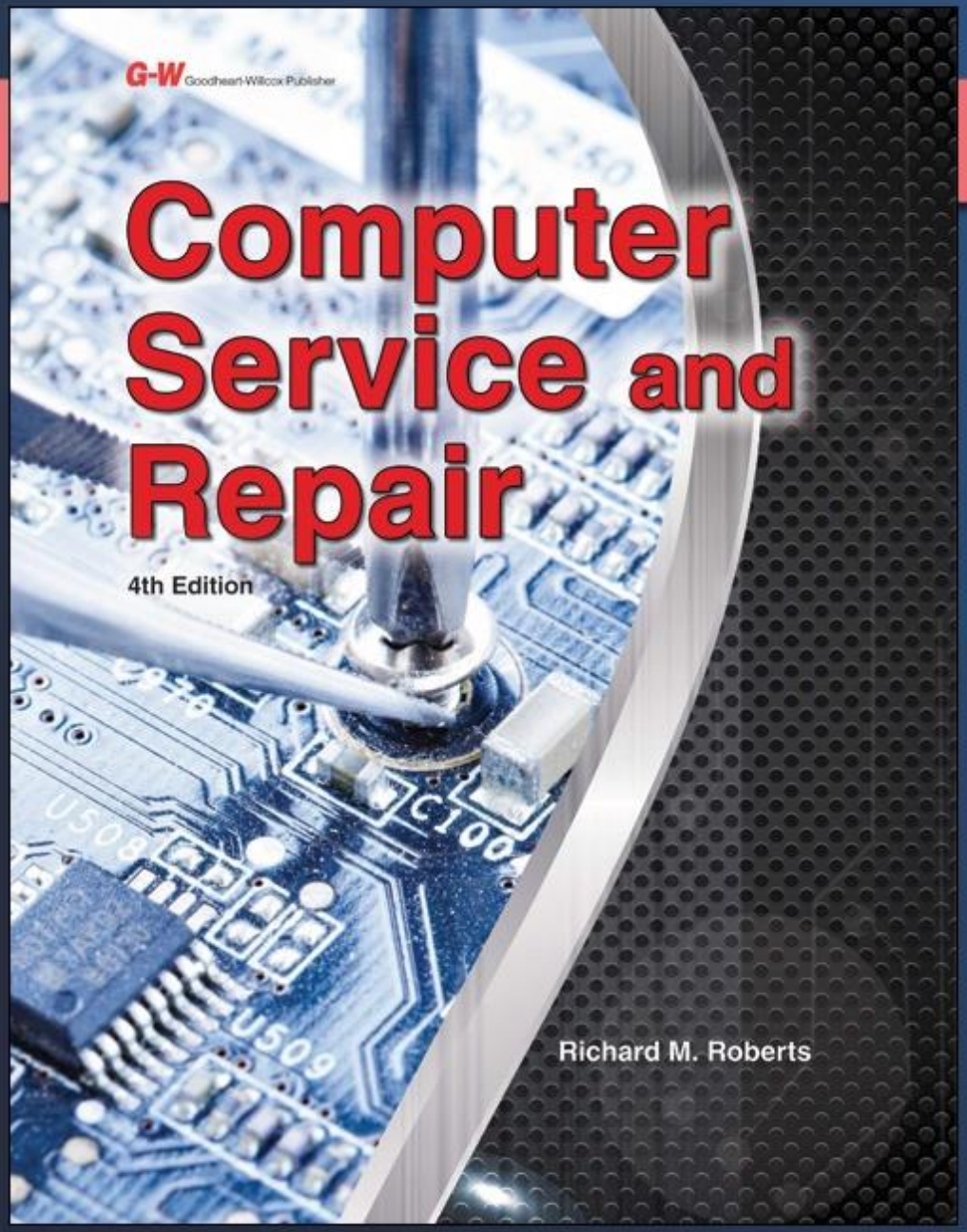


Presentations for PowerPoint

Computer Service and Repair

G-W PUBLISHER
The Goodheart-Willcox Co., Inc.
Tinley Park, Illinois

Chapter

3

Motherboards

Objectives

- Recall motherboard bus systems and their function.
- Identify common motherboard form factors.
- Explain motherboard bus architecture.
- Identify expansion card slot architectures.
- Use Device Manager and System Information to identify system resources.
- Carry out a software driver installation.
- Carry out a BIOS upgrade.

Objectives (Continued)

- Use the Setup utility to view system settings.
- Identify major parts of a motherboard.
- Check a motherboard for pinched cables, loose connections, oxidation, and high-voltage damage.

Key Terms

- Accelerated Graphics Port (AGP)
- address bus
- backplane
- bus
- chipset
- control bus
- data bus
- direct memory access (DMA)
- expansion card slots
- Flash BIOS
- form factor
- I/O bus
- I/O port address
- IEEE-1394

Key Terms (Continued)

- internal bus
- local bus
- memory address range
- memory bus
- north bridge
- Peripheral Components Interconnect (PCI)
- Plug and Play (PnP)
- power bus
- south bridge
- Universal Serial Bus (USB)

Motherboard

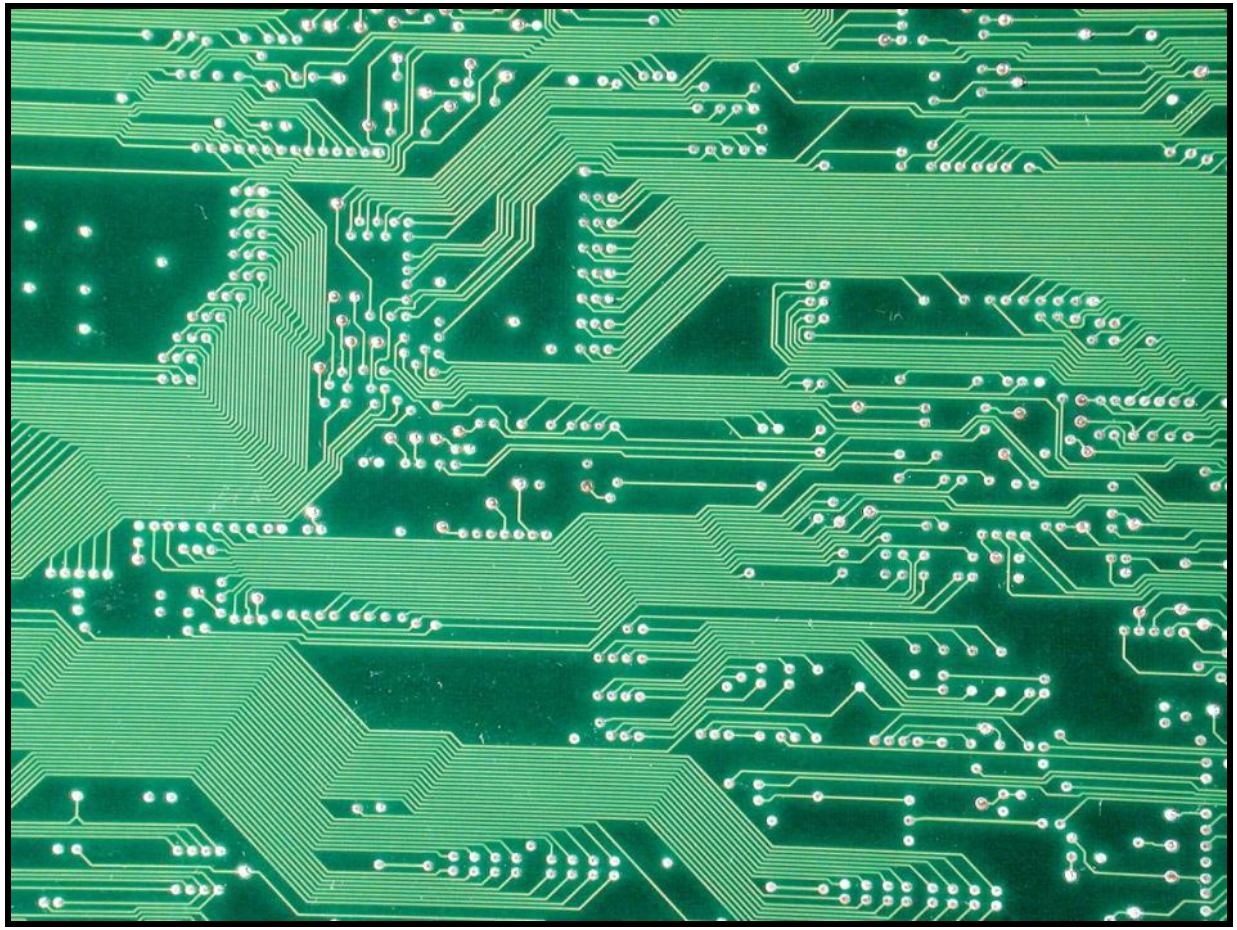
- The motherboard is the most important element of the computer design.
  - Communications center for input and output devices
  - Provides connection points for fans, speaker, on/off switch, LED indicator lights, CMOS battery
  - Provides a means for expanding and customizing the system
  - Also referred to as the *system board*, *main board*, and *planar board*

Motherboard Construction

- The motherboard is a combination of insulating material and electronic circuit paths constructed of thin conductors.
- Many of the thin conductors on the motherboard are grouped together to make up what is referred to as a *bus*.

Motherboard Construction (Continued)

Motherboard Circuit Paths



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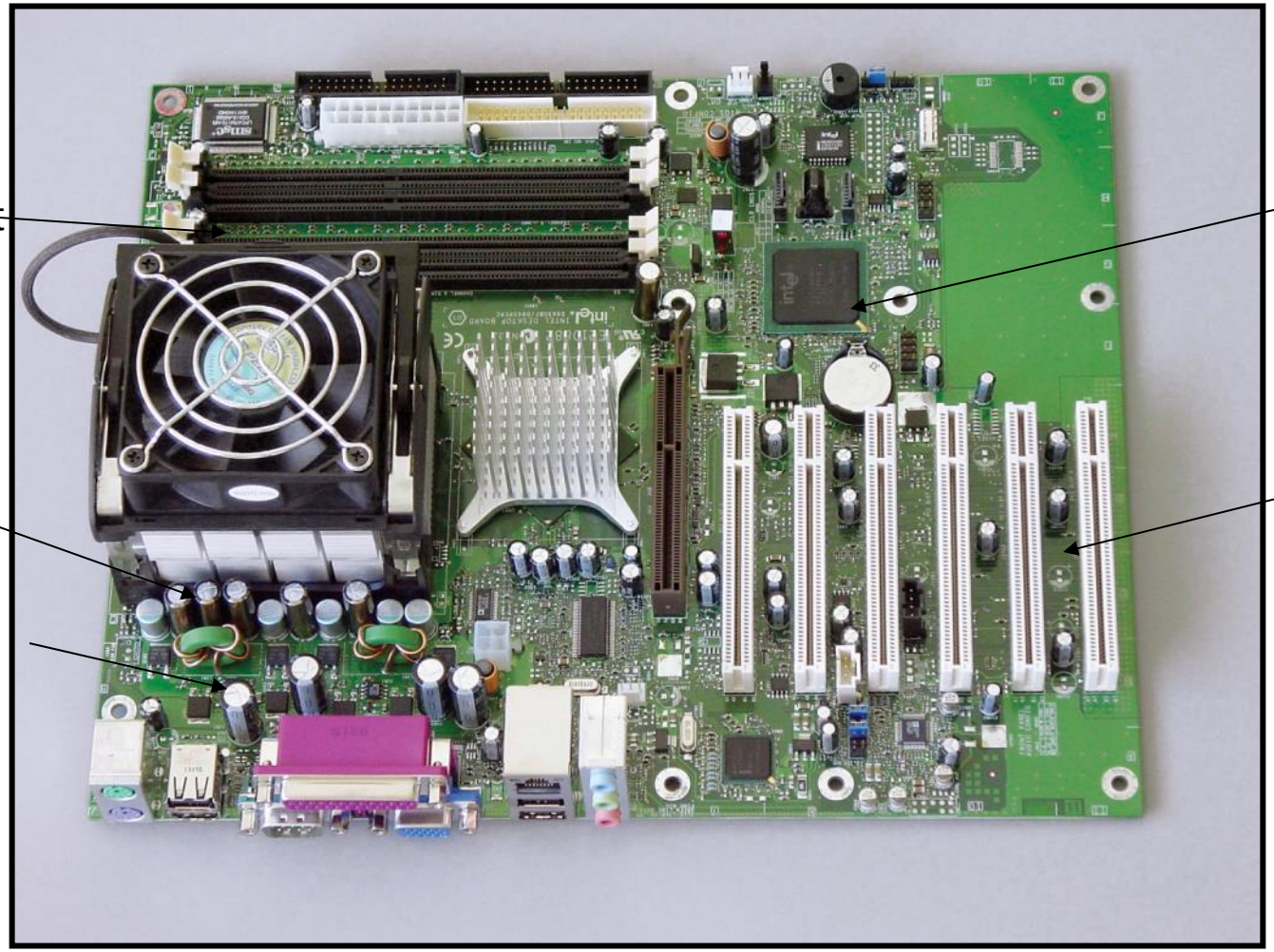
Motherboard Construction (Continued)



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Motherboard Construction (Continued)

- A **bus** is a collection of conductors that work together for a specific purpose.
- There are many types of bus systems.
  - **Data bus** is used to move data between components.
  - **Control bus** delivers command signals from the processor to activate devices such as hard drives and modems.
  - **Memory bus** connects the processor directly to the memory.

Motherboard Construction (Continued)

- Bus systems
  - **I/O bus**, also called an *expansion bus*, connects the processor to the expansion slots.
  - **Internal bus** is part of the integrated circuit inside the CPU unit.
  - **Local bus**, or *system bus*, connects directly to the CPU and provides communications to high-speed devices mounted closely to the CPU.

Motherboard Construction (Continued)

- Bus systems
  - **Address bus** connects the CPU with the main memory module. It identifies memory locations where data is to be stored or retrieved.
  - **Power bus** is used to send electrical power to low consumption devices such as speakers, lights, and switches.

Form Factors

- The **form factor** is the physical shape or outline of a motherboard and the location of the mounting holes; sometimes called the *footprint*.
  - Determines if the motherboard will fit the PC case style to be used
  - Those developed over the years are the XT, AT, ATX, mini-ITX, LPX, NLX, BTX, and backplane

Form Factors (Continued)

- XT, AT, and Baby AT
  - Original PC by IBM used an XT form factor in 1983.
  - XT was the first standardized form factor for motherboards.
    - Used an 8-bit data bus system
    - Used the DIN keyboard connector
    - Serial port used for mouse
    - P8 and P9 connectors used for power supply connection

Form Factors (Continued)

- XT, AT, and Baby AT
  - AT was slightly larger than the XT and provided a 16-bit data bus.
    - Uses the DIN keyboard connector
    - Uses a serial port for the mouse
  - Baby AT is the same size as the XT board.
    - Smaller than AT because of advancement in chip technology
    - 16-bit data bus

Form Factors (Continued)

- ATX
  - ATX is incompatible with most other motherboard form factors.
  - ATX has three common sizes (ATX, microATX, and flexATX).
  - ATX was introduced in 1996.
  - 16-bit data bus was provided in the ATX.

Form Factors (Continued)

- Mini-ITX
  - Mini-ITX is a smaller version of the microATX.
  - Mini-ITX provides for a compact system.
- LPX
  - LPX was designed for a low-profile desktop computer or a slim tower.
  - LPX has a single expansion slot usually mounted in the middle of the motherboard.

Form Factors (Continued)

- NLX
  - NLX uses the same principle as the bus riser card design.
  - NLX is standardized in the industry, which is a major advantage over the LPX.
- BTX
  - BTX was designed for improved system cooling and acoustics.
  - BTX is not compatible with the ATX design.

Form Factors (Continued)

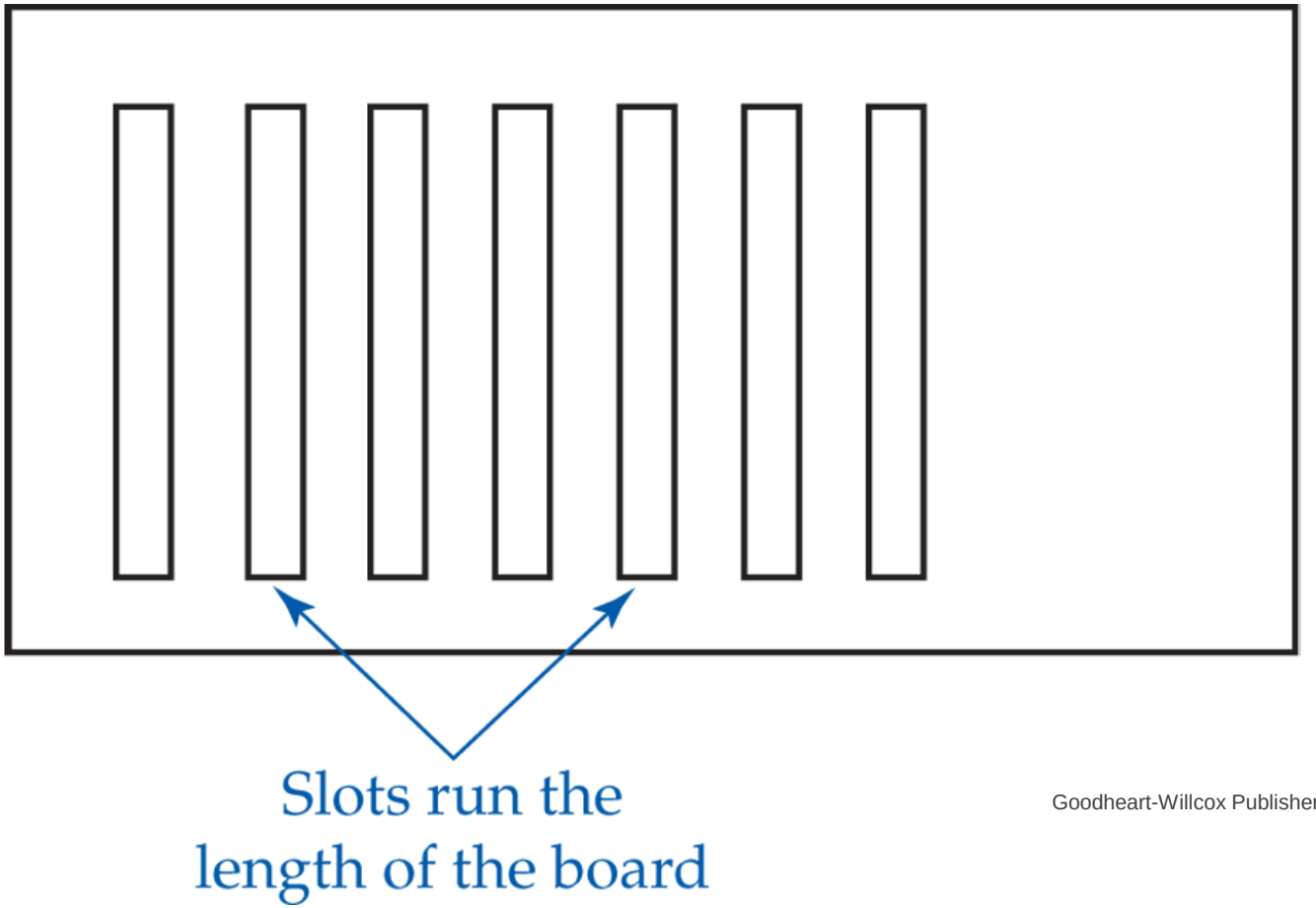
- Backplane
  - A **backplane** is a circuit board with an abundance of slots along the length of the board.
  - The CPU can insert into an expansion slot on the backplane.

Form Factors (Continued)

- Backplane
  - There are two main classifications of backplane boards.
    - *Passive*: All typical motherboard circuits and chips are located on the expansion cards and not on the backplane.
    - *Active*: Design contains the usual circuitry found on the motherboard with the exception of the main processor.

Form Factors (Continued)

Typical Backplane



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Review

Arrange the following form factors from largest to smallest.

MicroATX

Mini-ITX

FlexATX

MicroATX, flexATX, and mini-ITX.

Motherboard Bus System Architecture

- The original PC had a simple bus architecture connecting all major components to the RAM and CPU.
- Bus structure has evolved with the increase of CPU speed processing.
- Ports and buses of different bandwidths connecting the CPU and RAM must be joined together to make them compatible.

Motherboard Bus System Architecture (Continued)

- A **chipset** connects the motherboard buses and ports that run at different speeds. It supports the flow of data and control signals of different bus technologies.
- A chipset is divided into two parts.
  - The **south bridge** was previously used to connect slower devices, such as keyboard, mouse, printer, hard drive, and USB ports.
  - The **north bridge** was used to connect high-speed devices to the CPU, such as RAM and PCI slots. Today, motherboards have only one chipset.

Expansion Card Slots

- **Expansion card slots** provide a quick and easy method of connecting devices directly into the motherboard bus system.
  - Designed to hold inserted cards called *adapters, expansion cards, interface cards*, and *daughter boards*
  - Allows the technician to modify the existing computer system for additional hardware

Expansion Card Slots (Continued)

- Types of expansion card slots
  - PCI
  - PCI-X PCI Express
  - Mini PCI and MiniPCIe
  - USB
  - External SATA
  - IEEE-1394
  - AGP
  - AMR, ACR, and CNR

Expansion Card Slots (Continued)

- **Peripheral Components Interconnect (PCI)** was introduced in the early 1990s and was the best choice for general purpose expansion cards.
  - PCI has a 32-bit data width that transfers data at a rate of 132MBps.
  - PCI incorporates a chipset with a buffer.

Expansion Card Slots (Continued)

- PCI Extended (PCI-X) was designed as a replacement for PCI.
  - PCI-X has a 64-bit data width.
  - PCI-X is capable of operating at a higher frequency (speed) than PCI.

Expansion Card Slots (Continued)

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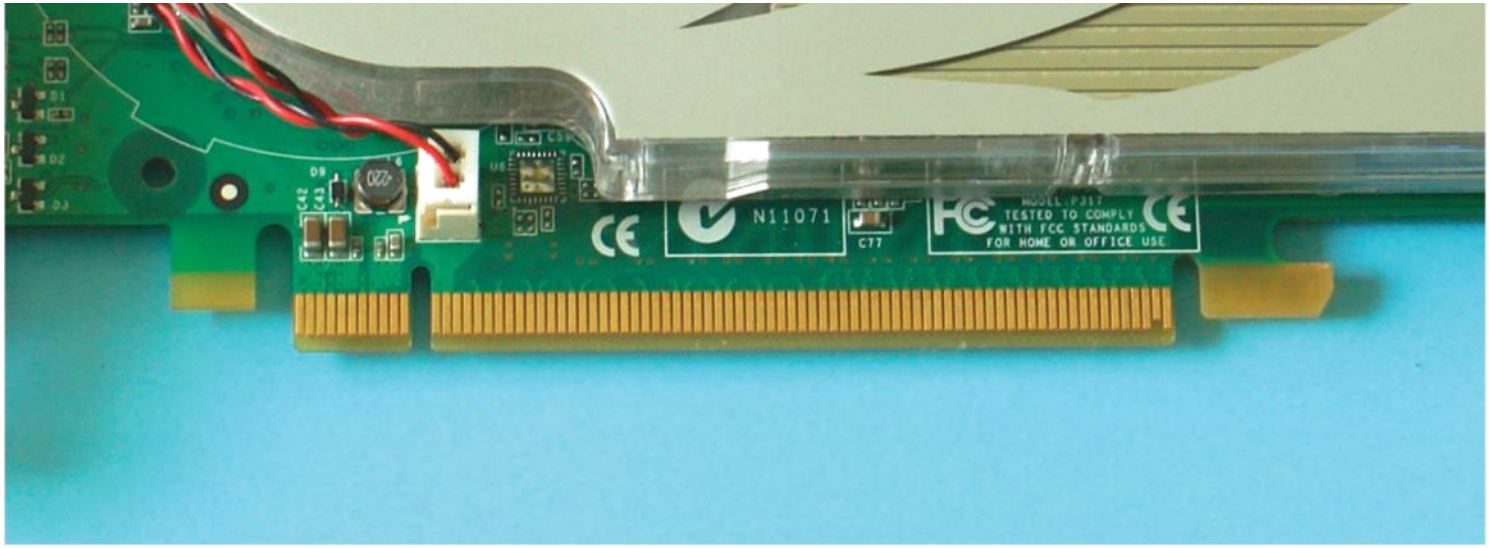
Typical PCI Expansion Card

Expansion Card Slots (Continued)

- PCI Express was designed to replace earlier versions of adapters.
  - It is abbreviated as PCIe and PCI-E.
  - PCI Express was introduced in 2004 as an expansion card technology.
  - PCI Express uses serial data.

Expansion Card Slots (Continued)



Typical PCIe Expansion Card

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Expansion Card Slots (Continued)

- PCI Express
  - Conductor length
    - When conductors have the same length, transferred data arrive at their destination at the same time.
    - When conductors run in pairs, the overall length is more closely matched and a higher data rate can be achieved.

Expansion Card Slots (Continued)

- PCI Express
  - Conductor proximity
    - Inductive reactance describes a resistance to the flow of electrons through a conductor.
    - When the conductors are bundled together, inductive reactance is reduced to a minimum or nearly canceled, thus allowing for higher data rates than a flat ribbon data cable.

Expansion Card Slots (Continued)

PCIe Specifications

Bus Type	PCIe 1.1	PCIe 2.0	PCIe 3.0
Raw Data Rate GT/s	2.5 GT/s	5 GT/s	8 GT/s
Interconnect Bandwidth	2 Gbps	4 Gbps	8 Gbps
Bandwidth per Lane per Direction	250 Mb/s	500 MB/s	1 Gb/s
Total Bandwidth for ×16 Link	8 Gb/s	16 Gb/s	32 Gb/s

Note: PCIe 4.0 is scheduled for 2014–2015 release and is proposed at this time by the PCI Special Interest Group (PCI-SIG). PCIe 4.0 is expected to double the PCIe 3.0 rates.

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Expansion Card Slots (Continued)

- MiniPCI and miniPCIe are smaller versions of the PCI and PCIe expansion cards.
  - Both are designed for laptops, notebooks, and similar portable devices.
  - These are typically used for wireless network cards.

Expansion Card Slots (Continued)

- **Universal Serial Bus (USB)** system was designed to replace the existing variety of ports and expansion slots with the exception of high data-rate video expansion slots.
  - Designed as a port rather than a traditional slot
  - Designed for Plug and Play support
  - Must be used with operating system and recently developed chipset

Expansion Card Slots (Continued)

USB Standards and Associated Data Rates

Name	USB Standard	Data Rate
Low-Speed	1.0	1.5 Mbps
Full-Speed	1.1	12 Mbps
Hi-Speed	2.0	480 Mbps
SuperSpeed	3.0	5 Gbps

Expansion Card Slots (Continued)

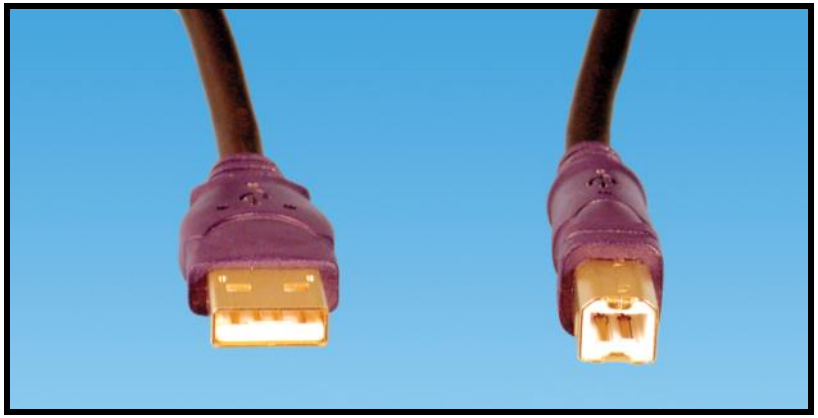
- USB 3.0 made improvements over the previous version.
  - Higher data transfer rates
  - Less power consumption
    - Not constantly “poled” like previous versions
    - Requires two times the power when transferring data, but transfers ten times the data
    - Less transfer overhead

Expansion Card Slots (Continued)

- USB cables and connectors
  - USB 2.0 and earlier versions consist of four wires
    - Two data lines
    - One voltage bus wire
    - One ground wire
  - USB carries commands and data on two data lines.
  - USB 3.0 increased the number of conductors (wires) and connection pins to achieve high bandwidth.

Expansion Card Slots (Continued)

USB Cable Connectors



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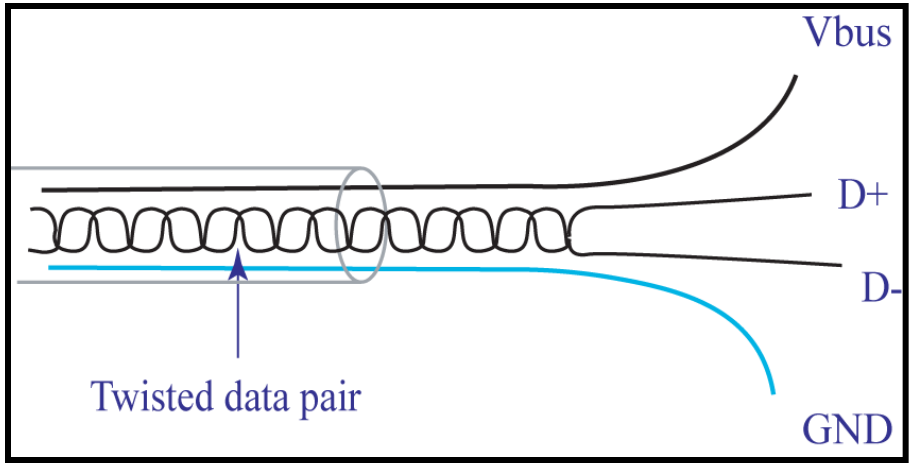
USB Cable Design



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Expansion Card Slots (Continued)

- Upgrading to USB 3.0
  - Upgrade a computer from USB 2.0 to 3.0 by installing a new expansion card.
  - USB 3.0 data speeds cannot be achieved without the proper drivers.
  - Alternatively, upgrade a computer to USB 3.0 by installing exterior ports using an adapter.

Expansion Card Slots (Continued)

- External SATA (eSATA) allows devices to be connected outside the PC case.
  - SATA technology was originally limited to internal PC connections used for hard drives and DVD drives.
  - SATA and eSATA are often confused with USB cable and ports.

Expansion Card Slots (Continued)

- **IEEE-1394** is a bus system providing a high rate of data transfer, which is needed for devices such as video cameras.
  - There are two IEEE-1394 standards: IEEE-1394a with 400 Mbps data transfer rate and IEEE-1394b with a 800 Mbps data transfer rate.
  - The use of IEEE-1394 and UBS has resulted in less slots on motherboards.
  - IEEE-1394 are becoming less common in PCs.

Expansion Card Slots (Continued)

- **Accelerated Graphics Port (AGP)** was designed exclusively for the video card, especially for 3-D graphic support.
  - The most power feature of AGP is Direct Memory Execute (DIME) which is direct access to main memory used only to support video.
  - AGP is almost obsolete now, as most video cards are PCIe.

Expansion Card Slots (Continued)

- AMR, ACR, and CNR are three special motherboard slot specifications that allow the combining of the functions of separate technologies into a single unit.
  - Audio/Modem Riser (AMR), Advanced Communications Riser (ACR), and the Communications and Networking Riser (CNR) are incorporated into one riser board inserted into a slot on the motherboard.
  - This type of combination results in a more economical device.

Review

What does the acronym PCIe represent?

PCI Express

How many conductors are in a single PCIe lane?

Four

System Resources

- System resources must be assigned and made available for devices such as printers, modems, hard drives, DVD drives, and sound cards.
- Major system resources to consider include the I/O port address, memory addresses, IRQ, and DMA settings.
- System resources are automatically assigned by the operating system and device drivers.

System Resources (Continued)

- Device manager
  - System resource assignments can be used in Windows Device Manager.
  - Device Manager presents a list of hardware devices installed in the computer system.
- System information
  - System resources can be viewed from the System Information program.
  - It is accessed by running msinfo32.exe.
  - The information is organized by category.

System Resources (Continued)

- I/O port and memory address range
  - A **memory address range** is an assigned section of memory used as a temporary storage area for data before it is transferred.
  - An **I/O port address** is assigned to a device for identification.
  - Both use hexadecimal numbers for their assignments and are often confused as a result.

System Resources (Continued)

- IRQ settings
  - *IRQ* stands for interrupt request.
  - An IRQ interrupts processes taking place in the CPU to give attention to another device.
  - There are typical IRQs assignments numbered 0 to 15 in today's PCs.
  - IRQs are also assigned priorities to resolve conflicts.
  - Two IRQ assignments can be shared if the devices are not going to be used at the same time.

System Resources (Continued)

- DMA channels
  - **Direct memory access (DMA**) is a combination of hardware and software that allows the hard drive to transfer all the data directly to memory without involving the CPU.
  - The DMA controller is a chip that connects certain devices directly to memory, bypassing the CPU.
  - DMA technology was primarily used for PATA hard drives, legacy printers, and floppy drives.

System Resources (Continued)

- Bus mastering
  - Another method of control that allows data to be transferred directly between two devices without the intervention of the CPU.
  - Bus mastering differs from DMA in that it takes control of the bus system to which it is attached, while DMA is used to access the memory system.
  - Bus mastering was designed to speed up the common operations involving data flow.

System Resources (Continued)

- Plug and Play
  - **Plug and Play (PnP)** is the automatic assignment of system resources such as DMA channels, interrupts, memory, and port assignments.
  - BIOS, hardware, and the operating system must all support PnP technology.

Review

What are the four major system resources used by computer devices?

The four major system resources used by computer devices are port address, memory addresses, IRQ setting, and DMA setting.

Installing Software Drivers

- Many hardware device manufacturers recommend installing the software drivers before installing the device.
- By installing the drivers first, the operating system can find the correct drivers.
- Device Manager has a **Roll Back Driver** option, which can be used to replace the current driver with an earlier version.

Installing Software Drivers (Continued)

- Motherboard chipsets also require software drivers.
- When installing the motherboard drivers using the setup CD/DVD, read all of the information provided and perform a custom install.

Upgrading the BIOS

- Upgrading the BIOS is fairly common when upgrading hardware systems on older computers.
- On early motherboards, the BIOS chip had to be replaced or an ultraviolet light had to be used to erase the program on the BIOS chip in order to reprogram the chip.
- BIOS chip is erasable programmable read-only memory (EPROM).

Upgrading the BIOS (Continued)

- Modern computers use flash BIOS to upgrade BIOS.
  - **Flash BIOS** is an electrically erasable programmable read-only memory (EEPROM) module, which can be reprogrammed after being electrically erased.
  - Flash BIOS is easily programmable using software available and an updated BIOS program file.

Setup Utility

- The Setup utility is used to store a computer's date and time and information about hardware.
- The Setup utility is activated by a special set of keystrokes during the boot up period.
- Not all look the same, but Setup utility screens are similar in appearance and function.
- The usual default setting for the boot sequence begins with the hard drive, then the CD/DVD drive.
- This utility can be password protected.

Review

How is a computer's Setup utility accessed?

A computer's Setup utility can be accessed by pressing a designated key or keys during the boot up process.

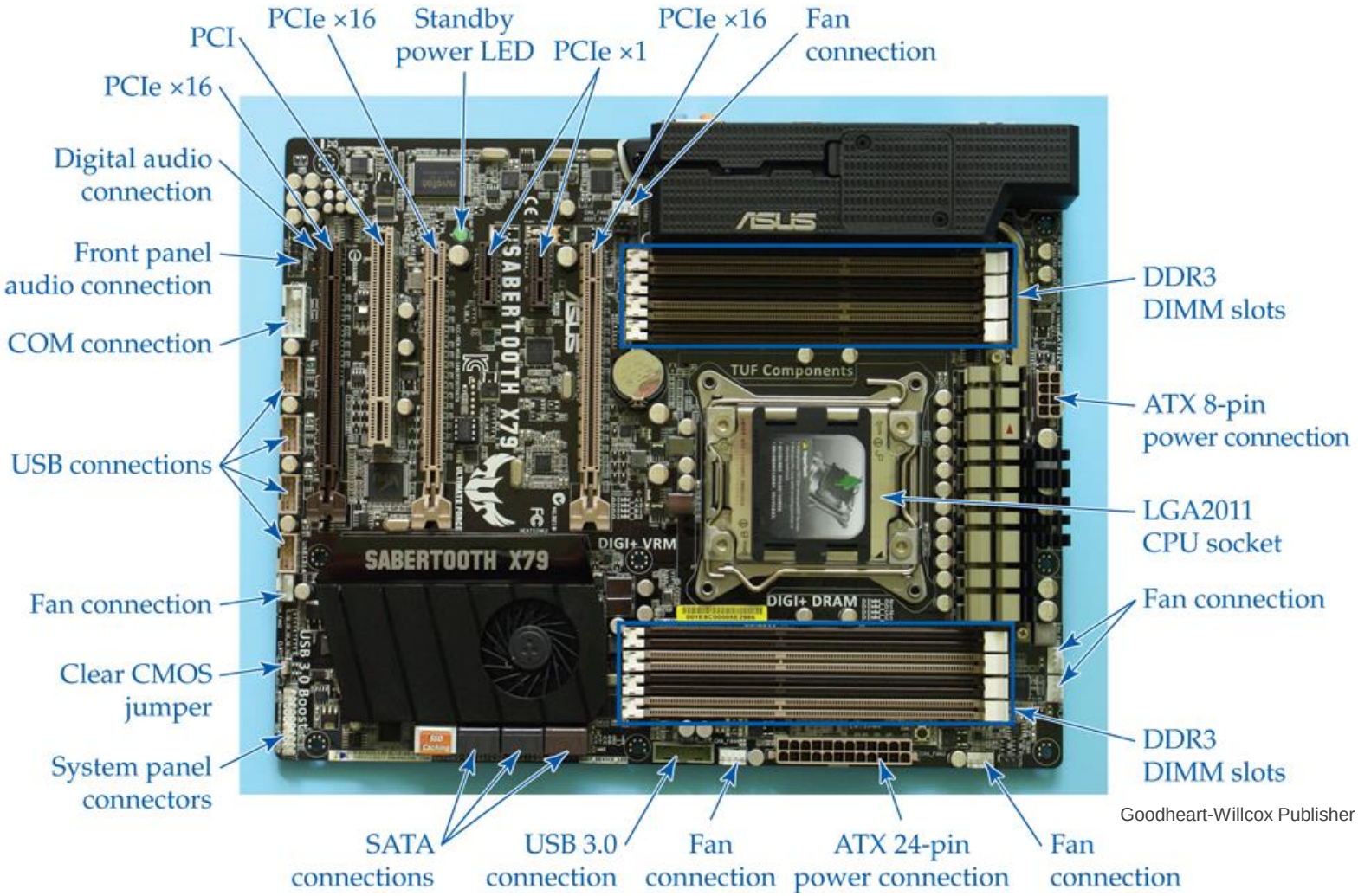
What can be done to protect the Setup utility from accidental changes?

Password protection can be set to protect the Setup utility from accidental changes.

Identifying Motherboard Components

- Identifying motherboard components can be confusing.
- Motherboard manufacturers include a drawing of the motherboard with locations of all common connection points.
- Motherboard components can be easily identified by their relative position and outline on each motherboard.
- Some motherboards provide a front panel connector kit.

Identifying Motherboard Components (Continued)



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Troubleshooting Motherboards

- There are several things to check when troubleshooting a motherboard.
  - Check for obvious signs of lightning or high-voltage surge damage.
  - Check for loose connections.
  - Check for damage caused by a loose connection to the motherboard power connector.
  - Check the motherboard manufacturer's website for information and procedures.

Review

What can a PC technician use to aid in component identification on a motherboard?

A PC technician can use the motherboard's user guide to aid in component identification on a motherboard.

When troubleshooting a motherboard, what are some things a PC technician should check?

When troubleshooting a motherboard, a PC technician should check for pinched cables, loose connections, oxidation, and high-voltage damage.