Motherboards

Overview

- **In this chapter, you will learn to**
  - Explain how motherboards work
  - Identify the types of motherboards
  - Explain chipset varieties
  - Upgrade and install motherboards
  - Troubleshoot motherboard problems

How Motherboards Work

Motherboard Layouts

- **The particular way in which the components are positioned on a motherboard is called the form factor**

Configured manually using *jumpers, switches* or both.
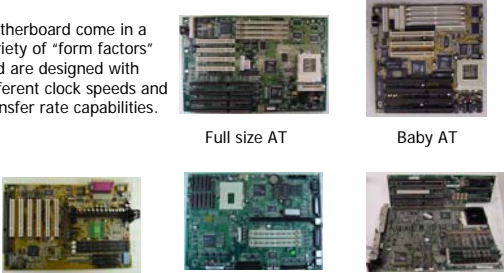
Designed around the Intel 8088 processor.

XT Mother-boards "extended technology."

Has an eight-bit ISA bus

Limited to 1MB of memory

AT-Style Form Factor

Motherboard come in a variety of "form factors" and are designed with different clock speeds and transfer rate capabilities.

Full size AT

Baby AT

ATX

LPX

NLX

The AT Form Factor

- **IBM invented the AT form factor in the early 80s**
  - Massive in size as they carry a large number of individual chips
  - Lacked support for any connections other than the keyboard
  - Expansion slots were used to add additional connectors to the motherboard
  - As the technology grew demand for smaller PCs led to creating a smaller motherboard called the Baby AT

CMOS added so configurations can be set through the keyboard

Designed for flexibility and expandability

AT Mother-boards "Advanced Technology."

Designed for the 80286 and above processor

Still maintain "backward compatibility" with 8 bit channel

ISA expanded to 16 bits

Use 16 bit internal and external bus

"Baby AT" on an Older AT Board

The Need for a New Form Factor

- **Added components such as a mouse and modem created a demand for a new form factor with more dedicated connectors**
- **The new form factors integrated dedicated connectors for the mouse and printer, as well as added connectors for video, sound, and phone**

Slimline Form Factors

- **The first slimline form factor was known as LPX and was replaced by the NLX form factor**
- **The LPX, and now the NLX, provide a slot for the insertion of a special riser card**
- **Inflexibility was the main problem with form factors like the LPX**

ATX

- **The ATX form factor was created in 1995**
  - Uses the soft power feature to turn a PC on and off through software
- **Micro ATX and Flex ATX two smaller versions of ATX**
  - Many techs and web sites use the term mini-ATX to describe these boards

ATX Motherboard Parts

Labels: AGP slot, CPU in socket, CPU fan power, External ports, PCI slots, RAM, Flash BIOS chip, System clock battery, Southbridge, Front panel connections, Power connector, DIP switches, EIDE ports, Floppy port, Northbridge

ATX Motherboard External Connection Ports

Labels: PS/2 (mouse), PS/2 (keyboard), USB ports, Serial ports, Parallel port, Mini-audio ports (speaker, line-in, microphone), Game port

MicroATX

FlexATX

BTX
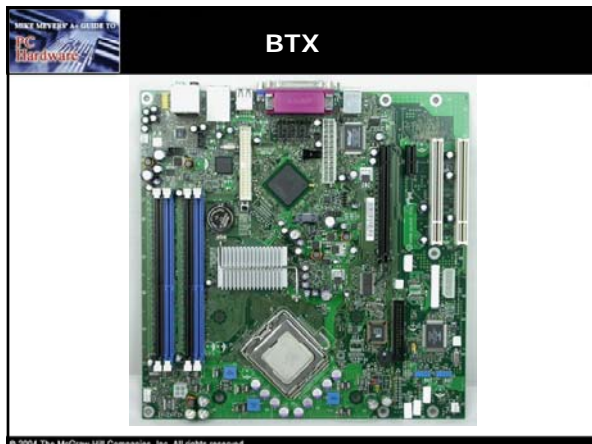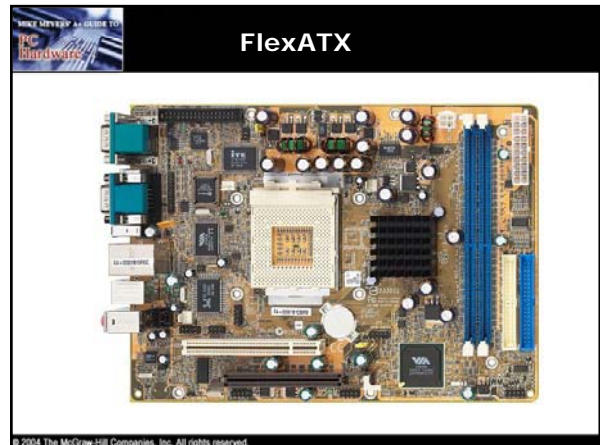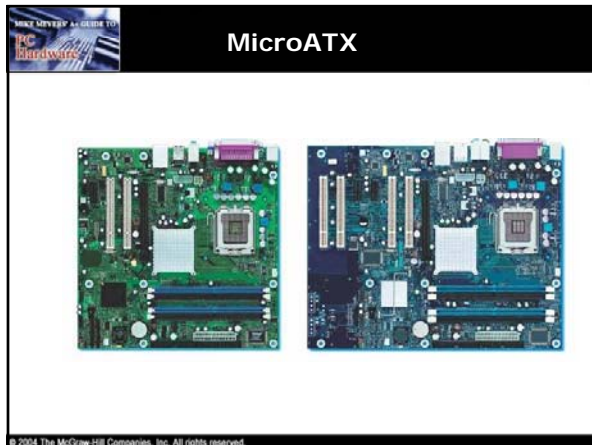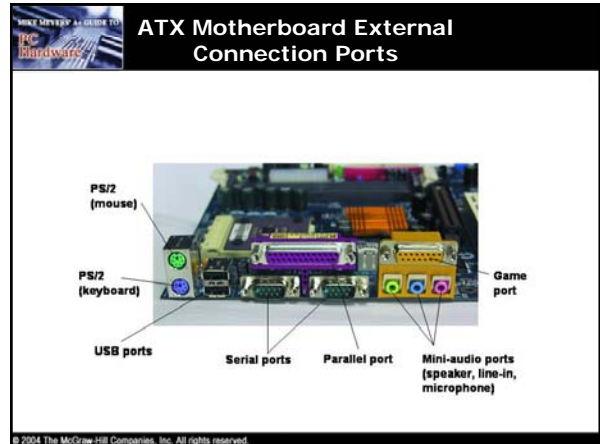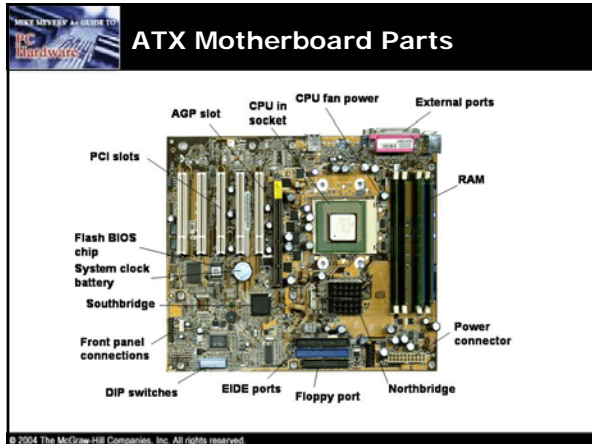
Layers of the PCB

- **Motherboards are officially printed circuit boards (PCBs)**
  - PCBs come in multiple layers with highways of wires (bus systems) in the layers carrying data back and forth between the CPU, Northbridge, RAM, and peripherals
    - These highways of wires are called traces as can be seen coming from the CPU on the back of the motherboard shown

Components of the Motherboard

Power Connector   Super I/O   CMOS/RTC/NVRAM   Memory Sockets

North Bridge

Processor Socket/Slot

Expansion Bus Slots   BIOS   South Bridge

•UART Chips   •Clock Speeds   •System Bus Types   •I/O Adapters

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Chipset Varieties

Chipsets

- **A chipset defines the processor type, type and capacity of RAM, and what internal and external devices the motherboard will support**
  - Serves as an electronic interface among the CPU, RAM, and input/output devices

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Chipset Chips

- **Northbridge**
  - Also called the Memory Controller Hub (MCH) or system controller
- **Southbridge**
- **Super I/O Chip**

North Bridge

•The North Bridge is the connection between the high-speed Processor bus and the slower AGP and PCI buses

•The North Bridge is often referred to as the PAC (PCI/AGP controller)

•It is essentially the main component of the motherboard and is the only circuit that runs at full Processor Bus speed

440 LX Chipset

440 ZX Chipset

430 FX Chipset

South Bridge

•The South Bridge is the lower-speed component in the chipset

•South Bridge contains all components that make up the ISA Bus, including the Interrupt and DMA controllers

82371 EB South Bridge

•South Bridge connects to the 33MHz PCI bus and contains the interface to the 8 MHZ ISA bus

82371 FB South Bridge

•Normally contains dual IDE hard disk controller interfaces, one or two USB, the CMOS RAM and RTC Clock functions

Super I/O Chip

Contains at lease a Floppy Controller, two Serial Ports, and a Parallel Port

In newer Motherboards, the Super I/O has been placed into the South Bridge

AT Super I/O Controller

The Super I/O allows you to plug in devices and have them work just like any other device that is plugged into an Expansion Slot
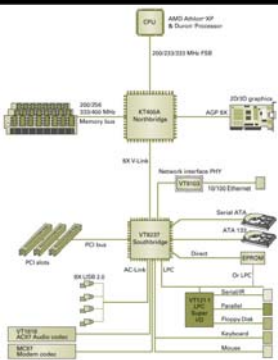
Who Makes PC Chipsets?

- **Intel**
- **VIA**
- **AMD**
- **SiS**
- **Ali**
- **NVidia**
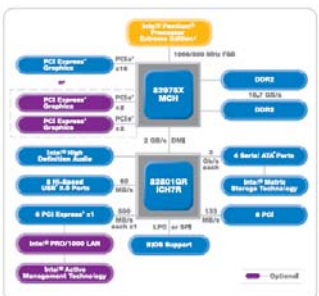
Schematic for VIA KT400A Chipset

Intel 975x

Intel 975X Express Chipset Block Diagram

Chipset Comparison Chart

- **Chipsets change constantly but here's a partial look and comparison...**

Table 6.1		Chipset Comparison Chart						
Chipset	Northbridge	Southbridge	CPU	FSB	RAM	AGP	HDD	USB	FireWire
Intel 875P	82875P MCH	82801EB ICH5 or 82801 ER ICH5R	.13 micron 478-pin Pentium 4	400, 533, 800	DDR SDRAM up to 4 GB; Dual Channel DDR266, DDR333, DDR400	v3.0 up to 8X	1 X ATA100; 2 x SATA; SATA RAID (R version)	8x USB 2.0	No
AMD 760	AMD-761	AMD-766	Athlon, Duron	200, 266	DDR SDRAM up to 4GB DDR200, DDR266	v.2.0 up to 4X	2x ATA100	USB 1.1	No
NVIDIA nForce2	SPP IGP	MCP2-T MCP2-D	Socket A	200, 266, 333, 400	DDR SDRAM Dual Channel DDR266, DDR333, DDR400	v3.0 up to 8X	2x ATA100	6x USB 2.0	Yes
VIA Apollo K8T800	VT8385	VT8237	AMD Opteron	800	DDR SDRAM 4.0 GB DDR266, DDR333	v3.0 up to 8X	2x ATA 2x SATA	8x USB 2.0	No
VIA KT400A	VT8377A	VT8237 VT8235CE	Socket A	200, 266, 333, 400	DDR SDRAM 4.0 GB DDR266, DDR333, DDR400	v3.0 up to 8X	2x ATA133	8x for VT8237 6x for VT8235CE	No
SiS648FX	SiS648FX	SiS963L	478-pin Pentium 4	400, 533, 800	DDR SDRAM 3.0 GB DDR266, DDR333, DDR400	v3.0 up to 8X	2x ATA133	6x USB 2.0	No

Legacy-free Motherboards

- **Intel along with chipset manufacturers like VIA, NVIDIA, and others have dropped support for ISA slots, serial and parallel ports, infrared, PS/2 ports, and floppy drives**
  - But many motherboards on the market today that use these new chipsets include other chips to still support some of these legacy features
  - Some of these motherboards also support better technology than provided by the chipset alone

Upgrading and Installing Motherboards

Choosing the Motherboard and Case

- **Modern motherboards can fit into any type of case manufactured today**
  - Use AT boxes for AT motherboards
  - Use ATX boxes for ATX motherboards
- **Make the seller guarantee the CPU and motherboard will work together**
- **Cases come in five basic sizes: slimline, desktop, mini-tower, mid-tower, tower**
  - Most Micro and Flex ATX cases are too small for a regular ATX motherboard
  - Best thing to do is to physically check to make sure the motherboard fits in the case
  - Cases come with different options

Removable Face or Bezel

Motherboard Tray

Removing the Motherboard

1. **Remove all the cards**
2. **Remove obstructing drives**
3. **Remove the power supply (only if necessary)**
4. **Document the position for wires for the speaker, turbo switch, turbo light**
5. **Unscrew the old motherboard**
   - The motherboard mounts to the case with small connectors called standouts
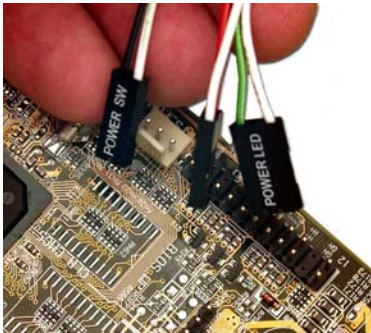

Installing the New Motherboard

1. **Install the CPU and RAM on the new motherboard before putting it in the case**
2. **Mount the new motherboard in the case**
3. **Reinstall the hard drive(s), power supply, and so forth that had to be removed to get the old motherboard out**
4. **Insert the power connections and other wires**
5. **Test!**

LED and Switch Connections

Hardware Configuration

- **Three ways to configure the motherboard:**
  - DIP switches, jumpers, CMOS RAM
- **Dual inline package (DIP) switch**
  - Has ON (binary 1) and OFF (binary 0) positions
  - Reset DIP switch when adding or removing device
  - Use pointed instrument other than graphite pencil
- **Jumpers**
  - Retain setup or installation information
  - Are opened and closed using jumper covers
  - Typical setting: enabling/disabling keyboard power-up

DIP switches are sometimes used to store setup data on motherboards
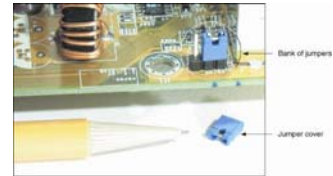
Setup information about the motherboard can be stored by setting a jumper on (closed) or off (open). A jumper is closed if the cover is in place, connecting the two pins that make up the jumper; a jumper is open if the cover is not in place.

Troubleshooting Motherboards

Troubleshooting Symptoms

- **Catastrophic failure**
  - System will not boot
  - Although uncommon most motherboards will fail (if they're going to) within the first 30 days due to manufacturing defects – called burn-in failure
  - Electrostatic discharge is the other most common cause
  - To fix, replace the motherboard

More Troubleshooting Symptoms

- **Component failure**
  - Intermittent problems
  - Examples include a hard drive that shows up in CMOS but not in Windows
  - Most common causes are electrical surges and ESD
  - Sometimes a BIOS upgrade may solve this problem if the issue is lack of BIOS support for a newer technology
  - Fixes include replacing the component with an add-on card or flashing the BIOS

More Troubleshooting Symptoms

- **Ethereal symptoms**
  - Things just don't work all the time
  - PC reboots itself for no apparent reason
  - Blue screens of death
  - Causes include faulty components, buggy device drivers or application software, slight corruption of the operating system, and power supply problems
  - Fixes include flashing the BIOS or replacing the motherboard

Troubleshooting Techniques

- **Isolate the problem by eliminating potential factors**
  - If the hard drive doesn't work, try a different hard drive or try the same hard drive with a different motherboard
    - If the new hard drive works, then it wasn't the motherboard
    - If the same hard drive with a different motherboard works, then suspect the motherboard

New Stuff

- **Relatively new in PC technology**
  - Intel's WTX standard for multi-processor servers
  - VIA's two tiny form factors called ITX and Mini-ITX
  - Shuttle's new form factor resulting in PCs the size of a toaster but still just as powerful