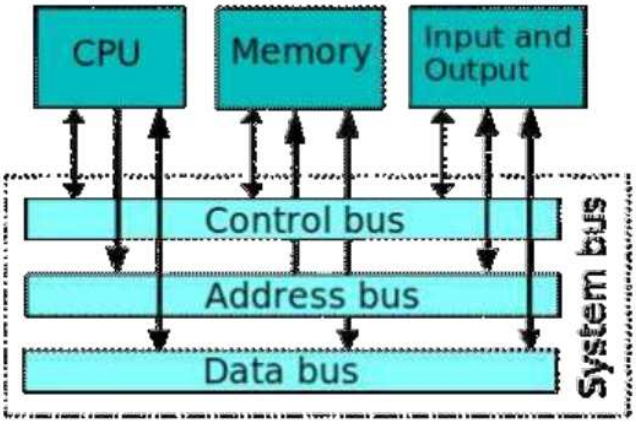
Computer Support & Maintenance

Contents

CHAPTER 1

Basic Computer Concepts

Defination: A *microcomputer* is a type of computer which is based internally on a *microprocessor*, plus a number of additional components. At its simplest, a microcomputer will consist of a microprocessor, plus random access memory (RAM), read only memory ROM, and an input/output section, connected by the three main communication buses



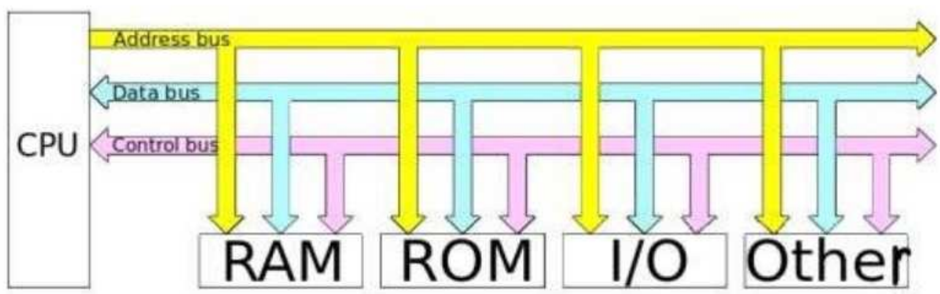
A **microprocessor** is a component that performs the instructions and tasks involved in computer processing. In a computer system, the microprocessor is the central unit that executes and manages the logical instructions passed to it.

Computer Components and Electrical communication

Inside computers, there are many internal components. In order for these components to communicate with each other they make use of wires that are known as a ***'bus'*** .

A **bus** is a **common pathway** through which information flows from one computer component to another. This pathway is used for communication purpose and it is established between two or more computer components. We are going to check different **computer bus architectures** that are found in computers.

Different Types of Computer Buses



The Computer Buses | Source

Functions of Buses in Computers

Summary of functions of buses in computers

1. **Data sharing** - All types of buses found in a computer transfer data between the computer peripherals connected to it.

The buses transfer or send data in either serial or parallel method of data transfer. This allows for the exchange of 1, 2, 4 or even 8 bytes of data at a time. (A byte is a group of 8 bits). Buses are classified depending on how many bits they can move at the same time, which means that we have 8-bit, 16-bit, 32-bit or even 64-bit buses.

2. **Addressing** - A bus has address lines, which match those of the processor. This allows data to be sent to or from specific memory locations.
3. **Power** - A bus supplies power to various peripherals connected to it.
4. **Timing** - The bus provides a **system clock** signal to synchronize the peripherals attached to it with the rest of the system.

The expansion bus facilitates easy connection of more or additional components and devices on a computer such as a TV card or sound card.

Computers have two major types of buses:

1. **System bus:-** This is the bus that connects the CPU to main memory on the motherboard. The system bus is also called the front-side bus, memory bus, local bus, or host bus.
2. **A number of I/O Buses,** (I/O is an acronym for input / output), connecting various peripheral devices to the CPU. These devices connect to the system bus via a 'bridge' implemented in the processors chipset. Other names for the I/O bus include "expansion bus", "external bus" or "host bus".

Basic Computer Components

The basic **components** of a **microcomputer** are: 1) CPU 2) Program memory 3) Data memory 4) Output ports 5) Input ports 6) Clock generator. These **components** are shown in figure below: Central Processing Unit: The CPU consists of ALU (Arithmetic and Logic Unit), Register unit and control unit.

PC Maintenance Tools

Computer maintenance is the practice of keeping computers in a good state of repair. Computer valeting is the in-depth cleaning of the physical components of a personal computer. **Computer maintenance** describes various steps to keep your computer functioning at an optimal performance level from a software and hardware point of view.

A toolkit should contain all the tools necessary to complete hardware repairs. As you gain experience, you learn which tools to have available for different types of jobs. Hardware tools are grouped into four categories:

- ESD tools
- Hand tools
- Cleaning tools
- Diagnostic tools

Maintenance Tools

To troubleshoot and repair laptop systems properly, you need a few basic tools. If you intend to troubleshoot and repair systems professionally, you may want to purchase many more specialized tools as well. These advanced tools enable you to more accurately diagnose problems and make jobs easier and faster. Here are the basic tools that should be in every troubleshooter's toolbox:

- Simple hand tools for basic disassembly and reassembly procedures, including a selection of flat-blade and Phillips screwdrivers (both medium and small sizes), tweezers, an IC extraction tool, and a parts grabber or hemostat. Most of these items are included in $10–$20 starter toolkits found at most computer stores. Although most of the same toolkits sold for conventional desktop systems will have these tools, for portable systems you may also need sets of smaller-sized flat-blade and Phillips screwdrivers and a set of small Torx drivers or Torx bits as well. For laptops, you may encounter Torx screws as small as T5, so consider purchasing a set including bits down to that size.
- Diagnostics software and hardware for testing components in a system.
- A multimeter that provides accurate measurements of voltage and resistance, as well as a continuity checker for testing cables and switches.
- Chemicals (such as contact cleaners), component freeze sprays, and compressed air for cleaning the system.
- Foam swabs, or lint-free cotton swabs if foam isn't available.
- Small nylon wire ties for "dressing" or organizing wires or small cables (such as internal Wi-Fi/Bluetooth antennas).

You may want to consider the following items, although they're not required for most work:

- Memory-testing machines (used to evaluate the operation of memory modules). Note these can be very expensive, on the order of $1,000 or more, but can be useful for professional shops or larger companies with a lot of systems to support.
- Serial and parallel loopback (or wrap) plugs to test serial and parallel ports.
- A network cable tester or scanner (many types with varying functionality are available, from simple loopback jacks to full-blown Time Domain Reflectometers).

CHAPTER 2

Power supply

Also called a *power supply unit* or *PSU*, the component that supplies power to a computer. Most personal computers can be plugged into standard electrical outlets.

The power supply then pulls the required amount of electricity and converts the AC current to DC current. It also regulates the voltage to eliminate spikes and surges common in most electrical systems. Not all power supplies, however, do an adequate voltage-regulation job, so a computer is always susceptible to large voltage fluctuations.

Power supplies are rated in terms of the number of watts they generate. The more powerful the computer, the more watts it can provide to components.

Functions/importance

1. It provides the driving (electric) power for all essential computer components, such as the processor, motherboard, memory modules, video card and add-in cards, as well as hard drives and optical drives.

2. The computer power supply converts an alternative current (AC, which is obtained from the wall socket) into a specified voltage direct current (DC, which can be used by computer components).

3. Regulates (for some PSU), the voltage to eliminate spikes and surges common in most electrical systems

Power Supplies Types/Form Factors and Use

Like motherboards and computer cases, there are several different power supply form factors, sizes, connector types, output specifications and other important specs. The detailed differences between these power supplies are extremely important and can make the difference between the ability to run a computer at its full potential and having a potentially unstable computer.

ATX

Although there are still AT form factor power supplies available for purchase, AT form factor power supplies are undoubtedly phased out products. Even the later ATX form factor power supply (ATX 2.03 and earlier versions) are falling out of favor. The major differences between the ATX and AT power supply form factors are:

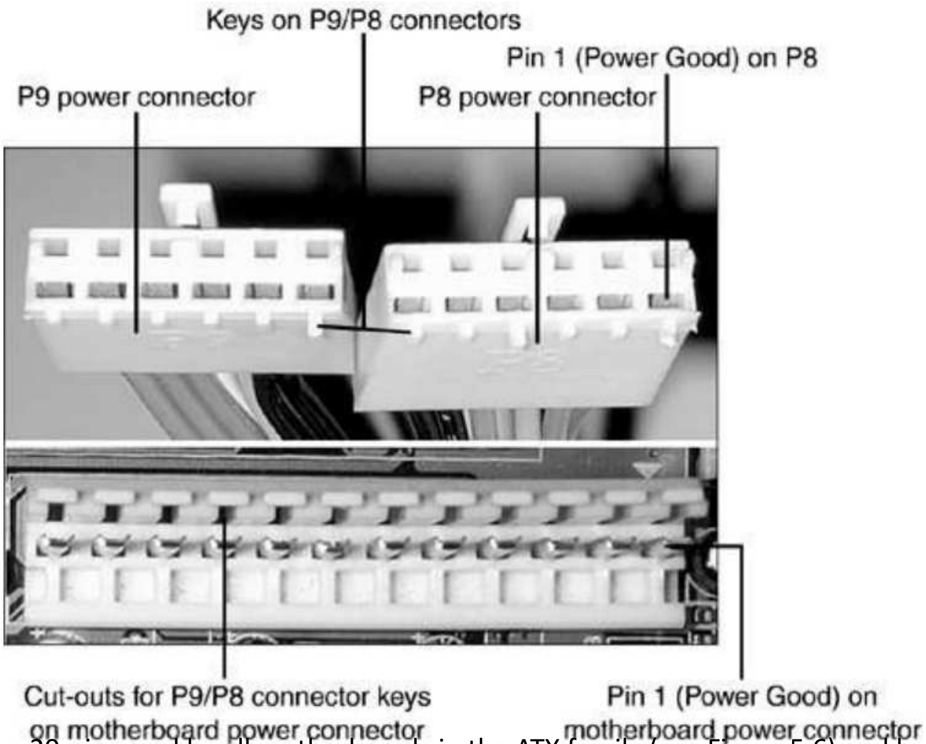
1. ATX power supplies provide an extra +3.3V voltage rail.
2. ATX power supplies use a single 20-pin connector as the main power connector.
3. ATX power supplies support the soft-off feature, allowing software to turn off the power supply.

Note

There are two major types of power connectors on motherboards:

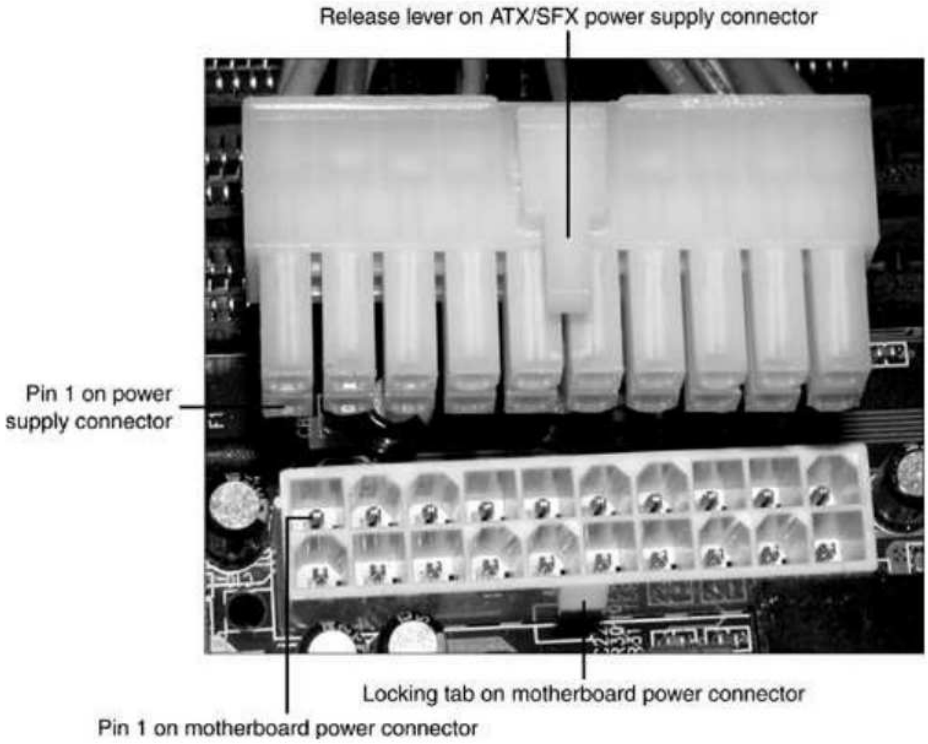
- 12-pin, modeled after the original IBM PC power connector and used on Baby-
AT and LPX motherboards (see Figure 5.5)

Figure 5.5. Twin 6-pin power connectors are used on AT/LPX and other power supply types that attach to motherboards with a 12-pin connector.



- 20-pin, used by all motherboards in the ATX family (see Figure 5.6) and by the NLX riser card (which provides power to the NLX motherboard)

Figure 5.6. The ATX power supply has a single 20-pin power connector. The extra connectors (compared to the LPX design in Figure 5.5) provide support for 3.3V and for software- or keyboard-controlled power down. Many of these power supplies don't have an external power switch for that reason.



ATX12V

The ATX12V form factor is the mainstream choice now. There are several different versions of the ATX12V form factor, and they can be very different from one another. The ATX12V v1.0 specification added over the original ATX form factor a 4-pin +12V connector to deliver power exclusively to the processor; and a 6-pin auxiliary power connector providing the +3.3V and +5V voltages. The ensuing ATX12V v1.3 specification added on top of that the 15-pin SATA power connector.

A substantial change occurred in the ATX12V v2.0 specification, which changed the main power connector from a 20-pin to a 24-pin format, removing the 6-pin auxiliary power connector. In addition, the ATX12V v2.0 specification also isolated the current limit on the 4-pin processor power connector for the 12V2 rail (+12V current is split into the 12V1 and 12V2 rails). Later, the ATX12V v2.1 and v2.2 specifications also increased efficiency requirements and mandated various other improvements.

All ATX12V form factor power supply units maintain the same physical shape and size as the ATX form factor.

EPS12V, SFX12V and Others

The EPS12V power supply form factor utilizes an 8-pin processor power connector in addition to the 4-pin connector of the ATX12V form factor. (Note: this isn't the only difference between these two form factors, but for most desktop computer users, knowing this should be sufficient). The EPS12V form factor was originally designed for entry-level servers, but more and more high-end desktop motherboards are featuring the 8-pin EPS12V processor power connector now, which enables users to opt for an EPS12V power supply.

The Small Form Factor (SFF) designation is used to describe a number of smaller power supplies, such as the SFX12V (SFX stands for Small Form Factor), CFX12V (CFX stands for Compact Form Factor), LFX12V (LFX stands for Low Profile Form Factor) and TFX12V (TFX stands for Thin Form Factor). They are all smaller than the standard ATX12V form factor power supply in terms of physical size. SFF power supplies need to be installed in corresponding SFF computer cases. **Table 3.2 Power Supply Connector Types and Form Factors**

Modern PS Form Factors	**Originated From**	**Connector Type**	**Associated MB Form Factors**
LPX style* **[Low Profile eXtension]**	IBM PS/2 Model 30 (1987)	AT	Baby-AT, Mini-AT, LPX
ATX style **[Advanced Technology Extended]**	Intel ATX, ATX12V (1985/2000)	ATX	ATX, NLX, Micro-ATX
SFX style **[Small *Form Factor]***	Intel SFX (1997)	ATX	Flex-ATX, Micro-ATX

**Note: LPX is also sometimes called Slimline or PS/2.*

Power supply problems Diagnosis:

1. The light or fan on the power supply does not work.
2. Nothing in the computer works.(plug something into the USB power to see if there is power going to it)
3. No lights / fans or beeps come from the computer.

   If any of the above happen to you try changing the power supply unit. This can be down by removing the computer case and removing the PSU. The PSU is only held by a few screws.

The following types of power-protection devices are explained in the sections that follow:

- Surge suppressors
- Phone-line surge protectors
- Line conditioners
- Standby power supplies (SPS/UPS)
- Uninterruptible power supplies (UPS)

Surge Suppressors (Protectors)

The simplest form of power protection is any one of the commercially available **surge protectors**—that is, devices inserted between the system and the power line. These devices, can absorb the high-voltage transients produced by nearby lightning strikes and power equipment. They clamp and shunt away all voltages above a certain level.

Line Conditioners

In addition to high-voltage and current conditions, other problems can occur with incoming power. The voltage might dip below the level needed to run the system, resulting in a brownout. Forms of electrical noise other than simple voltage surges or spikes might travel through the power line, such as radio-frequency interference or electrical noise caused by motors or other inductive loads.

Remember two things when you wire together digital devices (such as computers and their peripherals):

- Any wire can act as an antenna and have voltage induced in it by nearby electromagnetic fields, which can come from other wires, telephones, CRTs, motors, fluorescent fixtures, static discharge, and, of course, radio transmitters.
- Digital circuitry responds with surprising efficiency to noise of even a volt or two, making those induced voltages particularly troublesome. The electrical wiring in your building can act as an antenna, picking up all kinds of noise and disturbances.

A **line conditioner** can handle many of these types of problems. It filters the power, bridges brownouts, suppresses high-voltage and current conditions, and generally acts as a buffer between the power line and the system. A line conditioner does the job of a surge suppressor, and much more. It is more of an active device, functioning continuously, rather than a passive device that activates only when a surge is present. A line conditioner provides true power conditioning and can handle myriad problems. It contains transformers, capacitors, and other circuitry that can temporarily bridge a brownout or low-voltage situation.

UPS

Lighting, telephones, mobiles, laptops, chargers, PCs, tablets, peripherals and servers all depend absolutely upon a reliable electricity supply, as do industrial processes. The answer is to use a UPS – a mature technology that is still being improved to cope with ever more difficult power demands. UPS avoid un-planned power outages, save valuable data and provide time (autonomy) to allow safe shutdown of affected equipment.

UPS represent big and growing business because of the increasing reliance on ever greater numbers of digital devices, as well as the demand for cleaner power that they require, and from the changing nature of mains power supplies themselves. For example, as older coal-fired power stations are phased-out, and as more renewable sources are installed, grids will change in ways that are not fully understood – but there will almost certainly be shortfalls. Coming smart grids will also have an effect.

Common Power Problems and solutions

Here are some of the most common power supply problems and their likely effect on sensitive equipment:

Power Surges: A power surge takes place when the voltage is 110% or more above normal. The most common cause is heavy electrical equipment being turned off. Under these conditions, computer systems and other high tech equipment can experience flickering lights, equipment shutoff, errors or memory loss.

Possibile Solutions*: Surge Suppressors, Voltage Regulators, Uninterruptable Power Supplies, Power Conditioners*

High-Voltage Spikes: High-voltage spikes occur when there is a sudden voltage peak of up to 6,000 volts. These spikes are usually the result of nearby lightning strikes, but there can be other causes as well. The effects on vulnerable electronic systems can include loss of data and burned circuit boards.

Possibile Solutions*: Surge Suppressors,Voltage Regulators, Uninterruptable Power Supplies, Power Conditioners*

Transients: Transients are potentially the most damaging type of power quality disturbance that you may encounter. Transients fall into 2 categories.

- Impulsive
- Oscillatory

Possibile Solutions*: Surge Suppressors, Voltage Regulators, Uninterruptable Power Supplies, Power Conditioners*

Frequency Variation: A frequency variation involves a change in frequency from the normally stable utility frequency of 50 or 60 Hz, depending on your geographic location. This may be caused by erratic operation of emergency generators or unstable frequency power sources. For sensitive equipment, the results can be data loss, program failure, equipment lock-up or complete shut down. ***Possibile Solutions****: Voltage Regulators, Power Conditioners*

Power Sag: A sag is the reduction of AC Voltage at a given frequency for the duration of 0.5 cycles to 1 minute's time. Sages are usually caused by system faults, and often the result of switching on loads with high demand startup currents.

Possibile Solutions*: Voltage Regulators, Uninterruptable Power Supplies, Power Conditioners*

Electrical Line Noise: Electrical line noise is defined as Radio Frequency Interference (RFI) and Electromagnetic Interference (EMI) and causes unwanted effects in the circuits of computer systems. Sources of the problems include motors, relays, motor control devices, broadcast transmissions, microwave radiation, and distant electrical storms. RFI, EMI and other frequency problems can cause equipment to lock-up, and data error or loss.

Possibile Solutions*: Voltage Regulators, Uninterruptable Power Supplies, Power Conditioners*

Brownouts: A brownout is a steady lower voltage state. An example of a brownout is what happens during peak electrical demand in the summer, when utilities can't always meet the requirements and must lower the voltage to limit maximum power. When this happens, systems can experience glitches, data loss and equipment failure.

Possibile Solutions: *Voltage Regulators, Uninterruptable Power Supplies, Power Conditioners*

Blackouts: A power failure or blackout is a zero-voltage condition that lasts for more than two cycles. It may be caused by tripping a circuit breaker, power distribution failure or utility power failure. A blackout can cause data loss or corruption and equipment damage.

Possibile Solutions: *Generators*

CHAPTER 3

Motherboards

Computer Cases

There are two basic styles of cases the computer may come assembled in. They are basically tower and desktop style cases. Desktop style is in the shape of a rectangular box, that sets flat on a desk. Usually the computer monitor is placed on top of it. A tower case, looks similar to a tower as the name says. These computers will be placed off to the side of the keyboard and monitor. The tower case is the most popular style of desktop computer today. It is also recommended by some microprocessor manufacturers since it can be designed for better heat dissipation. Tower cases come in several sizes which are:

- Mini-tower - The smallest.
- Mid-tower - The standard size, recommended for most applications including standard desktop systems and some servers.
- Full-tower - The largest. Usually this is a very tall case and you may have a difficult time fitting it where overhead is limited. This case is usually used for high powered servers.

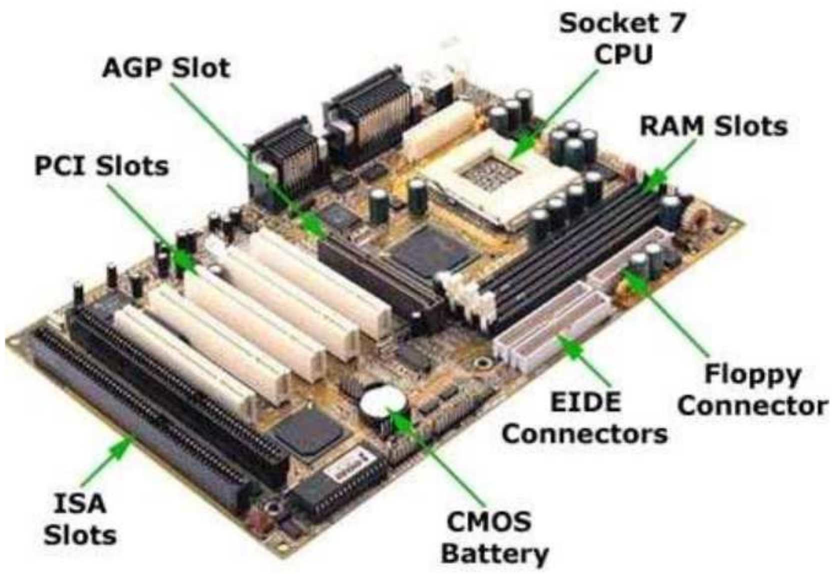
Note: The exact locations of many of the component items vary somewhat from computer to computer, but the overall layout is generally the same. Types of cases come to fit **AT** and **ATX** sizes. If you want a modern computer, you will want, or should have an ATX case. The AT or ATX version refers to the type of motherboard the case is designed to fit. The AT case is for the old type of motherboards such as for the 80486 microprocessor based computers.

Motherboard components

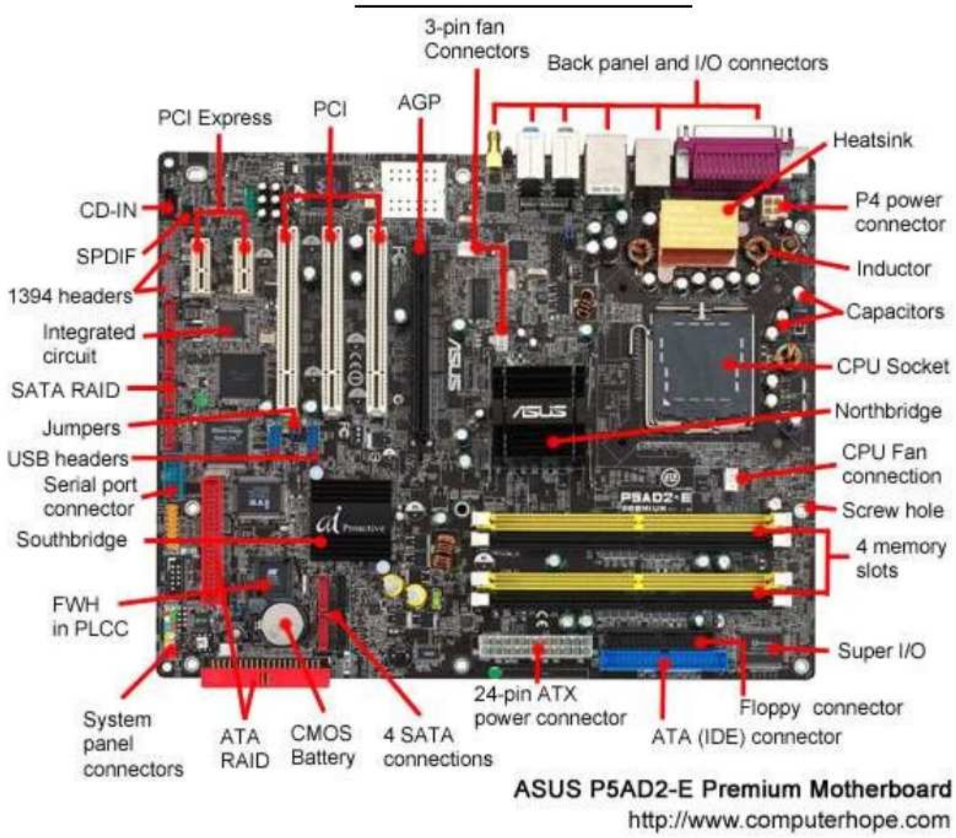
This is the main circuit board of the PC. It contains all the basic, core components of the computer. It usually contains:

- *the CPU*, which plugs into a socket designed for a particular CPU's pin arrangement. Because a motherboard has sockets that can only accept certain types of CPU, it is important to make sure when upgrading your CPU that your motherboard can accept it.
- *memory chips* - these hold data and programs that the CPU is currently using.
- *Input/output ports* ("I/O") such as connectors that hard disk drives, floppy disk drives and CD-ROM drives plug in to, serial port sockets, parallel port sockets and USB port sockets.
- *BIOS chips* (Basic Input Output System) - the BIOS chips are PROM (Programmable Read Only Memory) chips that contain the most basic information that a computer needs to start up and operate. The BIOS contains bootup information, details of what sort of CPU is installed, what hard disks are available, how the motherboard should behave etc. More details below.
- *Real time Clock (RTC)* so the computer knows the time and date. The RTC needs a battery to keep the clock running when the computer's power is turned off.
- *Chips* to control basic devices such as hard disks, floppy disks, serial/parallel ports etc. These basic chips are sometimes called the "chip set".
- Some motherboards, especially laptop motherboards, have built-in graphics chips, sound chips and modem chips so expansion cards are not needed. Unfortunately, this also means laptops can be very hard to upgrade because these chips are usually impossible to remove and replace. An example of "integrated peripherals" is **AC '97 Audio**. It combines a low-cost audio codec (**co**mpressor/**dec**ompressor) integrated circuit (IC) with a small portion of the core chipset's processing power to form a complete PC audio subsystem. Soft audio processing consumes minimal CPU overhead and does away with the need for a separate PCI audio controller (e.g. Soundblaster card). The result is reduced motherboard space and overall system cost. Building in AC '97 costs a manufacturer about $2, compared to almost $100 for a PCI sound card.

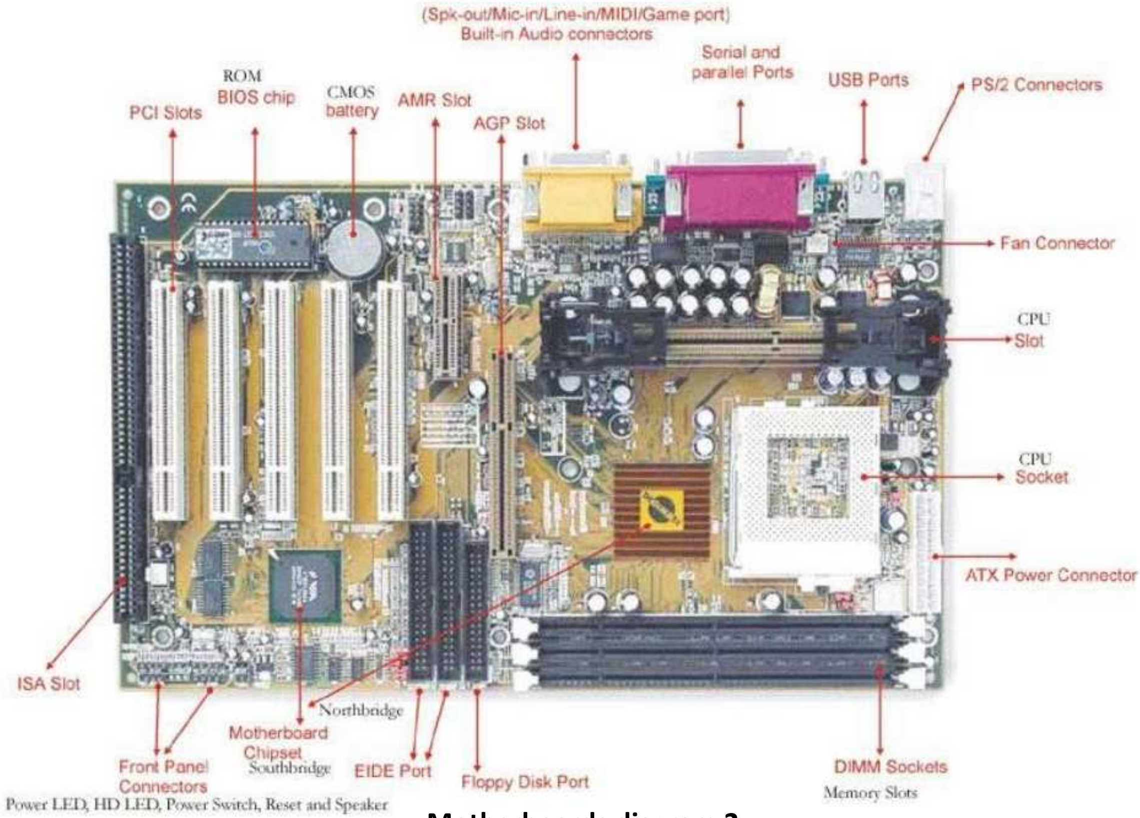
While motherboards have been getting smaller and smaller, computer cases seem to be getting bigger because the new computers generate more and more heat and need lots of empty space to ventilate themselves.



Motherboards diagram fi(a)



Motherboards diagram fi(b)



Motherboards diagram 2

Types of motherboards (Form Factors)

(Old school)

AT (Full vs. Baby)
XT (rip)
LPX (rip)

(Newer)

ATX vs. BTX motherboard

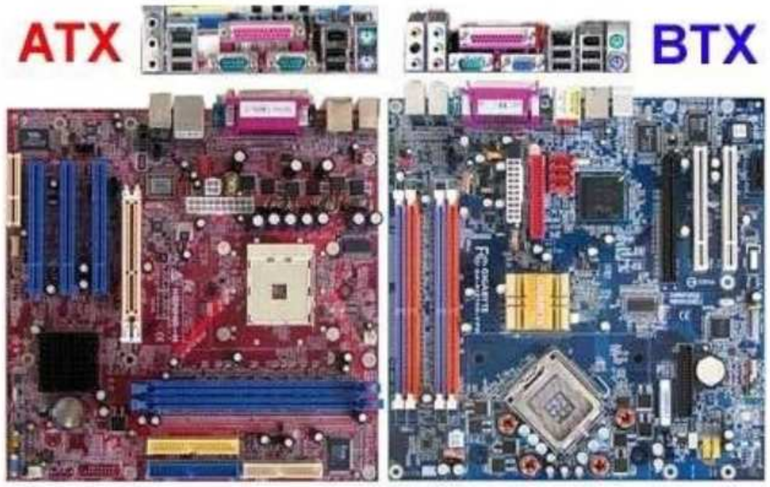
Definitions

AT - Advanced Technology, A *motherboard* that follows the same design and 12x13" form factor that was in the original IBM PC/AT. It was superseded by the Baby AT. the Baby AT reduced width from 12" to 8.5"

ATX motherboard (Advanced Technology EXtended **motherboard**) The PC **motherboard** that superseded the Baby AT design. The ATX layout rotated the CPU and memory 90 degrees, allowing full-length expansions to be plugged into all sockets. **LPX** (Low Profile eXtension), originally developed by Western Digital, was a loosely **defined motherboard** format (form factor) widely used in the 1990s.

BTX (for Balanced Technology eXtended) is a form factor for **motherboards**, originally intended to be the replacement for the aging ATX **motherboard** form factor in late 2004 and early 2005.

Note : Although all motherboards have some features in common, their layout and size vary a great deal. The most common motherboard designs in current use include ATX, Micro ATX, BTX, and NLX. Some of these designs feature riser cards and daughterboards.



ATX and Micro ATX

The ATX family of motherboards has dominated desktop computer designs since the late 1990s. ATX stands for "Advanced Technology Extended," and it replaced the AT and Baby-AT form factors developed in the mid 1980s for the IBM PC AT and its rivals. ATX motherboards have the following characteristics:

- A rear port cluster for I/O ports
- Expansion slots that run parallel to the short side of the motherboard
- Left side case opening (as viewed from the front of a tower PC)

There are four members of the ATX family, listed in Table 3-2. In practice, though, the Mini-ATX design is not widely used.

Table 3-2. ATX Motherboard Family Comparison

Motherboard Type	Maximum Width	Maximum Depth	Maximum Number of Expansion Slots	Typical Uses
ATX	12 in	9.6 in	Seven	Full tower
Mini-ATX	11.2 in	8.2 in	Seven	Full tower
microATX	9.6 in	9.6 in	Four	Mini tower

FlexATX	9.0 in	7.5 in	Four	Mini tower, small form factor

Micro ATX - A smaller version of Full ATX

Flex ATX - Another version of the ATX motherboard

BTX

One problem with the ATX design has been the issue of system cooling. Because ATX was designed more than a decade ago, well before the development of today's faster components, it's been difficult to properly cool the hottest-running components in a typical system: the processor, memory modules, and the processor's voltage regulator circuits.

To enable better cooling for these devices, and to promote better system stability, the BTX family of motherboard designs was introduced in 2004. Compared to ATX motherboards, BTX motherboards have the following:

- Heat-producing components such as the process, memory, chipset, and voltage regulator are relocated to provide straight-through airflow from front to back for better cooling.
- The processor socket is mounted at a 45-degree angle to the front of the motherboard to improve cooling.
- A thermal module with a horizontal fan fits over the processor for cooling.
- The port cluster is moved to the rear left corner of the motherboard.
- BTX cases include multiple rear and side air vents for better cooling.
- Because of the standardization of processor and memory locations, it's easy to use the same basic design for various sizes of BTX motherboards; the designer can just add slots.
- BTX tower cases use a right-opening design as viewed from the front.

Although BTX designs are easier to cool than ATX designs, the development of coolerrunning processors has enabled system designers to continue to favor ATX. There are relatively few BTX-based motherboards and systems currently on the market.

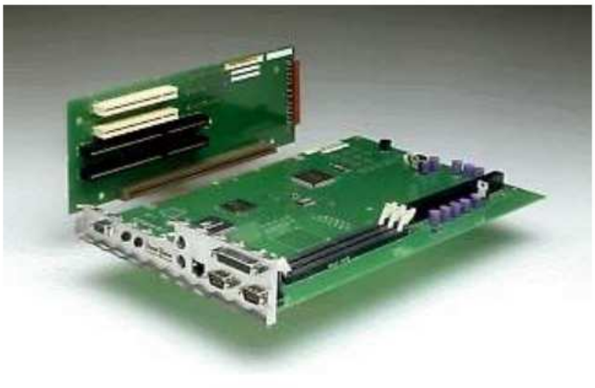
Riser Cards and Daughterboards

Riser cards and daughterboards provide two different methods for providing access to motherboard–based resources. In current slimline or rackmounted systems based on ATX or BTX technologies, riser cards are used to make expansion slots usable that would otherwise not be available because of clearances inside the case. Riser card designs can include one or more expansion slots, and are available in PCI, PCI-X (used primarily in workstation and server designs), and PCI-Express designs

The term *daughterboard* is sometimes used to refer to riser cards, but daughterboard can also refer to a circuit board that plugs into another board to provide extra functionality. For example, some small form factor motherboards support daughterboards that add additional serial or Ethernet ports, and some standard-size motherboards use daughterboards for their voltage regulators.

NLX Motherboard

NLX motherboards are designed for quick replacement in corporate environments. They use a riser card that provides power and expansion slots that connect to the right edge of the motherboard (as viewed from the front). NLX motherboards have a tworow cluster of ports along the rear edge of the motherboard. Most systems that use NLX motherboards are considered obsolete.



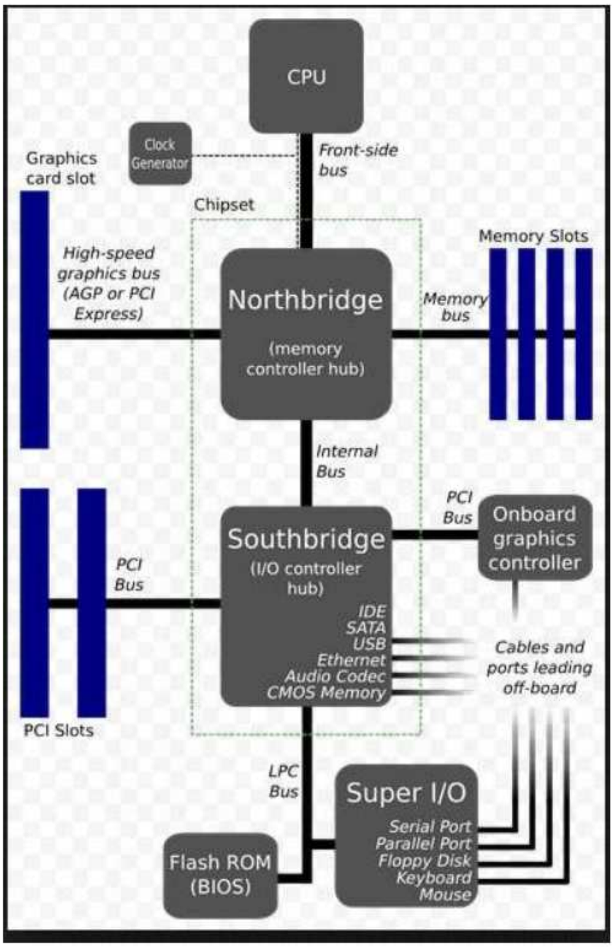
NLX (Supports motherboards with overall dimensions of 9.0" x 13.6" [maximum] to 8.0" x 10.0" [minimum]) Implemented in 1998 by Intel this form factor is gaining popularity the last couple of years because there found on most clone computers
Support for the Pentium II
Support for AGP
Support for USB.
Support for DIMM.
Easier Access to internal components
Support for motherboards that can be removed without using tools

Power supply

The power supply provides the electricity needed by the motherboard and different components in the computer. It usually provides a series of power leads carrying 12 volts or 5 volts. A special lead feeds the motherboard and other leads power the disk drives. The power supply is a sealed cube about 12cm on each side and has a fan in it to cool itself and the computer case down.

Computer bus

A **bus**, in computing, is a set of physical connections (cables, printed circuits, etc.) which can be shared by multiple hard ware components in order to communicate with one another.



The purpose of buses is to reduce the number of "pathways" needed for communication between the components, by carrying out all communications over a single data channel. This is why the metaphor of a "data highway" is sometimes used.

Characteristics

A bus is characterised by the amount of information that can be transmitted at once. This amount, expressed in bits, corresponds to the number of physical lines over which data is sent simultaneously. A 32-wire ribbon cable can transmit 32 bits in parallel. The term "**width**" is used to refer to the number of bits that a bus can transmit at once.

Additionally, the bus speed is also defined by its **frequency** (expressed in Hertz), the number of data packets sent or received per second. Each time that data is sent or received is called a **cycle**.

This way, it is possible to find the maximum **transfer speed** of the bus, the amount of data which it can transport per unit of time, by multiplying its width by its frequency. A bus with a width of 16 bits and a frequency of 133 MHz, therefore, has a transfer speed equal to:

$16 * 133.10^6 = 2128*10^6$
$bit/s, \quad or \ 2128*10^6/8 =$
$266*10^6 \ bytes/s \quad or$
$266*10^6 \ /1000 = 266*10^3 \ KB/s$
$or \ 259.7*10^3 \ /1000 = 266 \ MB/s$

Architecture

~~In reality,~~ each bus is generally constituted of 50 to 100 distinct physical lines, divided into three subassemblies:

- The **address bus** (sometimes called the *memory bus*) transports memory addresses which the processor wants to access in order to read or write data. It is a unidirectional bus.
- The **data bus** transfers instructions coming from or going to the processor. It is a bidirectional bus.
- The **control bus** (or *command bus*) transports orders and synchonisation signals coming from the control unit and travelling to all other hardware components. It is a bidirectional bus, as it also transmits response signals from the hardware.

Chipset

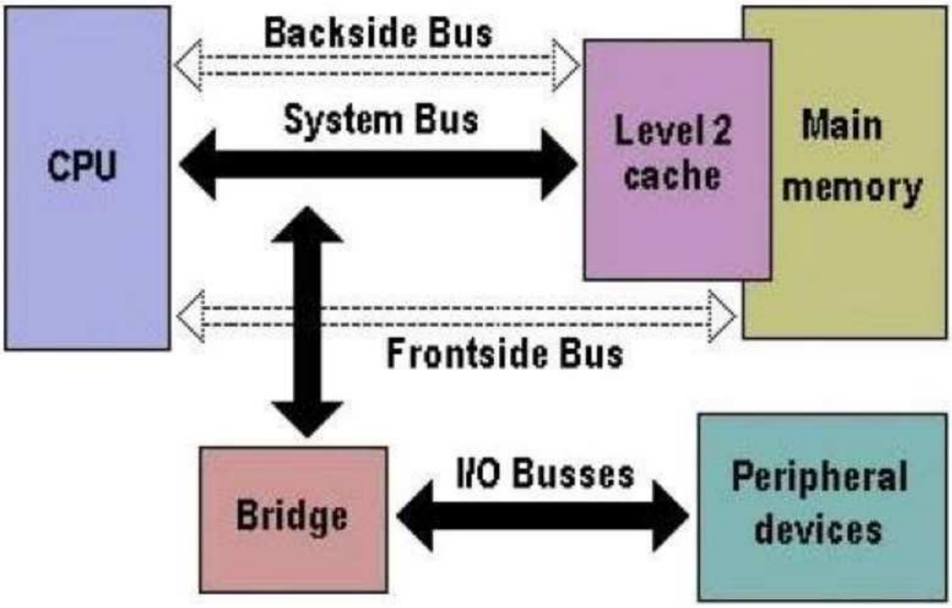
A **chipset** is the component which routes data between the computer's buses, so that all the components which make up the computer can communicate with each other. The **chipset** originally was made up of a large number of electronic chips, hence the name. It generally has two components:

- The **NorthBridge** (also called the *memory controller*) is in charge of controlling transfers between the processor and the RAM, which is way it is located physically near the processor. It is sometimes called the **GMCH**, forr *Graphic and Memory Controller Hub*.
- The **SouthBridge** (also called the *input/output controller* or *expansion controller*) handles communications between peripheral devices. It is also called the **ICH** (*I/O Controller Hub*). The tem **bridge** is generally used to designate a component which connects two buses.

Types of Buses in Computer Architecture

Computers comprises of many internal components and in order for these components to communicate with each other, a ***'bus'*** is used for that purpose.

A **bus** is a **common pathway** through which information flows from one component to another. This pathway is used for communication purpose and can be established between two or more computer components. We are going to review different **computer bus architectures** that are used in computers.



The Computer Buses

Functions of Buses in Computers

The functions of buses can be summarized as below:

1. **Data sharing** - All types of buses found on a computer must be able to transfer data between the computer peripherals connected to it.

The data is transferred in in either serial or parallel, which allows the exchange of 1, 2, 4 or even 8 bytes of data at a time. (A byte is a group of 8 bits). Buses are classified depending on how many bits they can move at the same time, which means that we have 8-bit, 16-bit, 32-bit or even 64-bit buses.

2. **Addressing** - A bus has address lines, which match those of the processor. This allows data to be sent to or from specific memory locations.
3. **Power** - A bus supplies power to various peripherals that are connected to it.
4. **Timing** - The bus provides a **system clock** signal to synchronize the peripherals attached to it with the rest of the system.

The expansion bus facilitates the easy connection of additional components and devices on a computer for example the addition of a TV card or sound card.

Bus Terminologies

Computers can be viewed to be having just two types of buses:

1. **System bus:-** The bus that connects the CPU to main memory on the motherboard. The system bus is also called the front-side bus, memory bus, local bus, or host bus.
2. **A number of I/O Buses,** (Acronym for input/output), connecting various peripheral devices to the CPU -these are connected to the system bus via a ‘bridge’ implemented

in the processors chipset. Other names for the I/O bus include “expansion bus", "external bus” or “host bus”.

Expansion Bus Types

These are some of the common expansion bus types that have ever been used in computers:

- **ISA** - Industry Standard Architecture
- **EISA** - Extended Industry Standard Architecture
- **MCA** - Micro Channel Architecture
- **VESA** - Video Electronics Standards Association
- **PCI** - Peripheral Component Interconnect
- **PCMCIA** - Personal Computer Memory Card Industry Association (Also called PC bus)
- **AGP** - Accelerated Graphics Port
- **SCSI** - Small Computer Systems Interface. **Table of Comparisson**

8-Bit ISA card (XT-Bus)	fi6-Bit ISA (AT –Bus card)
8-bit data interface	16-bit data interface
4.77 MHZ bus	8-MHZ bus
62-pin connector	62-pin connector
	36-pin AT extension connection

Comparison of 8-bit, & 16-bit ISA Bus as used in early computers.

ISA Bus

This is the most common type of early expansion bus, which was designed for use in the original IBM PC.The IBM PC-XT used an 8-bit bus design. This means that the data transfers take place in 8 bit chunks (i.e. one byte at a time) across the bus. The ISA bus ran at a clock speed of 4.77 MHz.

For the 80286-based IBM PC-AT, an improved bus design, which could transfer 16-bits of data at a time, was announced. The 16-bit version of the ISA bus is sometimes known as the AT bus. (AT-Advanced Technology)

The improved AT bus also provided a total of 24 address lines, which allowed 16MB of memory to be addressed. The AT bus was backward compatible with its 8-bit predecessor and allowed 8-bit cards to be used in 16-bit expansion slots.

When it first appeared the 8-bit ISA bus ran at a speed of 4.77MHZ – the same speed as the processor. It was improved over the years and eventually the AT bus ran at a clock speed of 8MHz.

MCA (Micro Channel Architecture)

~~This bus was developed by IBM as~~ a replacement for ISA when they designed the PS/2 PC which was launched in 1987.

The bus offered a number of technical improvements over the ISA bus. For instance, the MCA runs at a faster speed of 10MHz and can support either 16-bit or 32-bit data. It also supports bus mastering - a technology that placed a mini-processor on each expansion card. These mini-processors controlled much of the data transfer allowing the CPU to perform other tasks.

One advantage of MCA was that the plug-in cards were software configurable i.e. they required minimal intervention by the user when configuring.

The MCA expansion bus did not support ISA cards and IBM decided to charge other manufacturers royalties for use of the technology. This made it unpopular and it is now an obsolete technology.

EISA Bus

EISA (Extended Industry Standard Architecture)

It was developed by a group of manufactures as an alternative to MCA. It was designed to use a 32-bit data path and provided 32 address lines giving access to 4GB of memory.

Like the MCA, EISA offered a disk-based setup for the cards, but it still ran at 8MHz in order for it to be compatible with ISA.

The EISA expansion slots are twice as deep as an ISA slot. If an ISA card is placed in an EISA slot it will use only the top row of connectors, whereas a full EISA card uses both rows. It offered bus mastering.

EISA cards were relatively expensive and were normally found on high-end workstations and network servers.

VESA Bus

Also known as the Local bus or the VESA-Local bus. VESA (**Video Electronics Standards Association**) was invented to help standardize PCs video specifications, thus solving the problem of proprietary technology where different manufacturers were attempting to develop their own buses.

The VL Bus provides 32-bit data path and can run at 25 or 33MHZ. It ran at the same clock frequency as the host CPU. But this became a problem as processor speeds increased because, the faster the peripherals are required to run, the more expensive they are to manufacture.

It was difficult to implement the VL-Bus on newer chips such as the 486s and the new Pentiums and so eventually the VL-Bus was superseded by PCI.

VESA slots have extra set of connectors and therefore the cards are larger. The VESA design was backward compatible with the older ISA cards.

Features of the VESA local bus card:-

- 32-bit interface
- 62/36-pin connector
- 90+20 pin VESA local bus extension

Peripheral Component Interconnect

Peripheral Component Interconnect **(PCI)** is one of the latest developments in bus architecture and is the current standard for PC expansion cards. It was developed by Intel and launched as the expansion bus for the Pentium processor in 1993. It is a local bus like VESA i.e. it connects the CPU, memory and peripherals to wider, faster data pathway.

PCI supports both 32-bit and 64-bit data width; therefore it is compatible with 486s and Pentiums. The bus data width is equal to the processor, for example, a 32 bit processor would have a 32 bit PCI bus, and operates at 33MHz.

PCI was used in developing Plug and Play (PnP) and all PCI cards support PnP i.e. the user can plug a new card into the computer, power it on and it will "self identify" and "self specify" and start working without manual configuration using jumpers.

Unlike VESA, PCI supports **bus mastering** that is, the bus has some processing capability and therefore the CPU spends less time processing data. Most PCI cards are designed for 5v, but there are also 3v and dual-voltage cards, Keying slots are used to differentiate 3v and 5v cards and slots to ensure that a 3v card is not slotted into a 5v socket and vice versa..

Accelerated Graphics Port

The need for high quality and very fast performance of video on computers led to the development of the **Accelerated Graphics Port (AGP)**. The AGP Port is connected to the CPU and operates at the speed of the processor bus. This means that video information can be sent more quickly to the card for processing.

The AGP uses the main PC memory to hold 3D images. In effect, this gives the AGP video card an unlimited amount of video memory. To speed up the data transfer, Intel designed the port as a direct path to the PC's main memory.

Data transfer rate ranges from 264 Mbps to 528mbps, 800 Mbps upto 1.5 Gbps. AGP connector is identified by its brown colour.

Personal Computer Memory Card Industry Association (PC Card)

The Personal Computer Memory Card Industry Association was founded to provide a standard bus for laptop computers. So it is basically used in the small computers.

Small Computer System Interface

Short for Small Computer System Interface, a parallel interface standard used by Apple Macintosh computers,PC's and Unix systems for attaching peripheral devices to a computer.

Universal Serial Bus (USB)

This is an external bus standard that supports data transfer rates of 12 Mbps. A single USB port can be used to connect up to **fi27 peripheral devices**, such as mice, modems, and keyboards. The USB also supports hot plugging/insertion (ability to connect a device without turning the PC of) and plug and play (You connect a device and start using it without configuration). We have two versions of USB:-

USB 1x

First released in 1996, the original USB 1.0 standard offered data rates of 1.5 Mbps. The USB 1.1 standard followed with two data rates: 12 Mbps for devices such as disk drives that need high-speed throughput and 1.5 Mbps for devices such as joysticks that need much less bandwidth.

USB 2x

In 2002 a newer specification USB 2.0, also called Hi-Speed USB 2.0, was introduced. It increased the data transfer rate for PC to USB device to 480 Mbps, which is 40 times faster than the USB 1.1 specification. With the increased bandwidth, high throughput peripherals such as digital cameras, CD burners and video equipment could now be connected with USB.

IEEE 1394

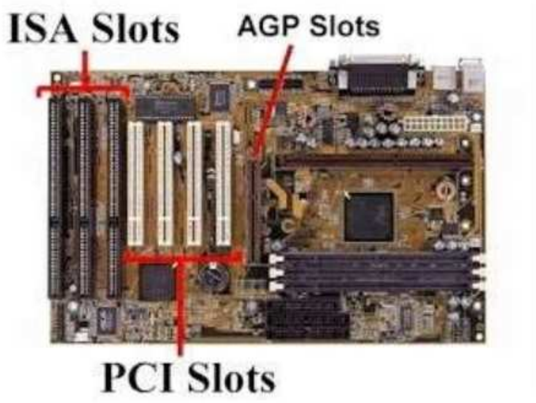
The IEEE 1394 is a very fast external serial bus interface standard that supports data transfer rates of up to 400Mbps (in 1394a) and 800Mbps (in 1394b).This makes it ideal for devices that need to transfer high levels of data in real-time, such as video devices. It was developed by apple with the name firewire.

A single 1394 port can be used to connect up 63 external devices.

- It supports Plug and play
- Supports hot plugging, and
- Provides power to peripheral devices.

Expansion slots:

These are sockets that expansion cards like network cards, sound cards, graphics cards can be plugged into. There have been various types of slots over the years to cater for increasingly complex expansion cards. The earliest cards were ISA, then came EISA, then PCI and AGP (which have special high-priority access to the CPU - AGP is used by fast graphic cards). All expansions slots connect to a bus so data can travel between subsystems and the CPU.



Cache

Cache is a storage place (buffer or bucket) that exists between two subsystems in order for data to be accessed more quickly to increase performance. Performance is increased because the cache subsystem usually has faster access technology and does not have to cross an additional bus. Cache is typically used for reads, but it is increasingly being used for writes as well. For example, getting information to the processor from the disk involves up to five cache locations:

1. L1 cache in the processor (memory cache)
2. L2 cache (memory cache)
3. Software disk cache (in main memory)
4. Hardware disk cache (common on SCSI controllers; EIDE usually uses only a FIFO buffer) 5. Disk buffer

For reads, one subsystem will usually request more data than what is immediately needed, and that excess data is stored in the cache(s). During the next read, the cache(s) are searched for the requested data, and if it is found, a read to the subsystem beyond the cache is not necessary.

How to install a computer motherboard

Installing a motherboard can be a complex process. This page provides general steps and guidelines for how to install a motherboard. Please refer to the manual and configuration guide that is included with the motherboard for specific details on installation and configuration steps.

Note: If replacing an existing motherboard in a computer with a new motherboard, you need to first remove the existing motherboard. The steps on this page can be referred to for removing the motherboard, followed in reverse order.

Before getting started

1. Write down relevant information from the top or bottom of the board, such as the Model Number, Serial Number, and specifications.
2. Ensure you are familiar with ESD and its potential dangers while working with any circuit board.
3. When installing a motherboard, turn the computer off and disconnect the power cord from the power supply.

Form factor

Before installing a computer motherboard, make sure the case supports the form factor of your motherboard. Today, the majority of available computer motherboard~~s are either~~ ATX or MicroATX.

Verify and set jumpers

Before installing the computer motherboard, make sure all the jumpers or dip switches are correct. The jumpers and dip switches can be changed when the motherboard is installed, but it is easier to verify them while the motherboard is outside of the case. Today, motherboards have the jumpers set as auto, allowing either the BIOS or the software to setup the proper settings for the CPU and memory and other settings. If the motherboard supports this feature, make sure the jumpers are set to auto. If you want to adjust the settings manually for your peripherals, make sure you are using acceptable settings. Although you may be able to overclock a system, it is recommended you use auto or the real values of the system first to make sure the system works before tampering with its settings.

Install pegs or standoffs

After checking the jumpers, if pegs or standoffs are not in the chassis, insert these attachments now. These are required to prevent the motherboard from shorting out and must be inserted before installing the motherboard.

When installing the pegs or standoffs make sure to insert them into the proper holes. Many cases support different motherboard form factors, and if not placed in the proper holes, it may cause damage to the motherboard. The holes on the case have a small indication of what the holes are for; for example, a hole may have the words ATX listed next to it to indicate the hole is for an ATX motherboard.

As the standoff is being installed, make sure they are installed firmly into the case to help prevent issues such as the pegs coming loose when unscrewing the screw from the peg.

Motherboard Installation

After the standoffs are attached and the I/O plate is in place, install the motherboard into the case and make sure you align the b~~ack of the~~ motherboard with the back of the case. As the motherboard is being installed align the holes in the motherboards with the pegs or standoffs.

Once aligned, begin placing screws into the motherboard that should go into the peg or standoff inserted earlier.

Caution: when screwing in the screw you do not want the screw to be too tight. If tightened too much it can cause the motherboard to crack. However, the screw should be in enough to hold the motherboard in place.

Install essential components

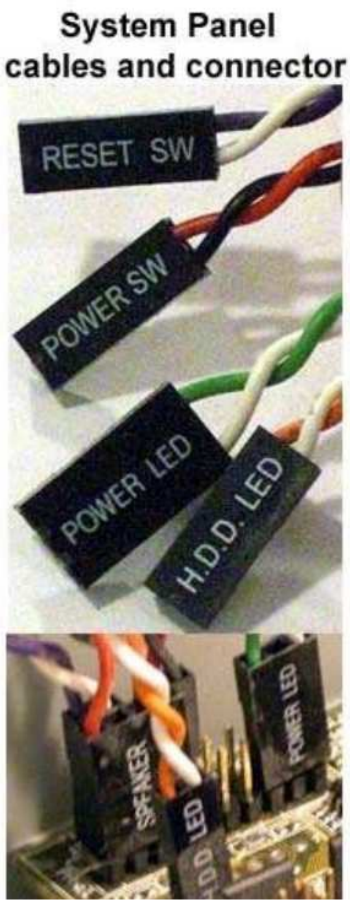
If not already installed, install the below necessary components into the computer.

Front Panel Setup

Once the motherboard has been successfully physically installed into the computer, the Fpanel (short for front panel connectors) must be connected. This panel controls such things as the power button, reset button, hard drive light, and power light.

Unfortunately, the setup of this panel can be confusing at first, even with the instructions provided from the motherboard manufacturer. Below are steps and additional information and help with successfully connecting the cables to this connector.

1. This connector consists of a series of two pin connectors.
2. The cables that connect to the connector are 2, 3 or 4pin connectors.
3. The cables consist of red, green, blue, white or another color cable with a black cable. This may vary, the important thing to remember is that the black cable or the dark color of the cable is ground or '-'.



4. Most cases have a separate cable for each setting, but some computers now have all of these cables as one large connector. If the computer has one large connector, it only connects in one direction. If you are installing a new computer motherboard into an OEM case that uses a large connector, it may not work with your motherboard since it could be proprietary.
5. Finally, the computer cannot boot if one or more of the cables is not properly connected. If you are unable to turn on the computer or receive no post, check these cables first.

Connect Cables

Once the front panel cables are connected, connect the other cables in the below order.

1. Connect the main motherboard ATX style power cable coming from the power supply to the motherboard.

   Note: Connect the cables in the right direction and never force the cable. If improperly connected, it can damage the motherboard. Today, ATX and other motherboard form factors have a keyed power supply connector that allows the cable to be connected in only one direction.
2. Next, connect the IDE/EIDE, SATA, or SCSI cables to the motherboard from the hard drive, CD Drive, floppy drive.
3. Connect the Molex power cables from the power supply to each of the drives in the computer.

CMOS setup

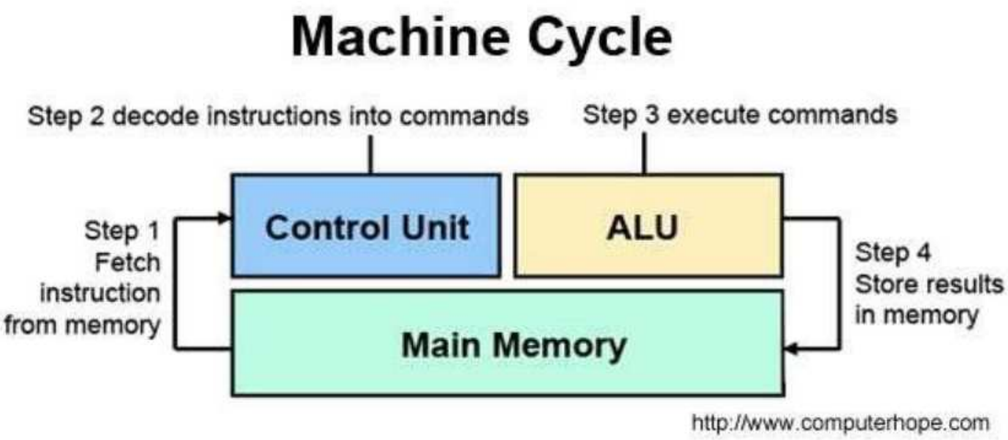
Once the motherboard has been successfully installed and connected into the computer, connect the keyboard, monitor, and power to the computer. Do not connect all of the cables yet in case you encounter problems and need to disconnect all the cables again. Once the computer boots enter CMOS setup and set all of the values not automatically detected. We recommend you check or set the below values.

1. **CPU Settings** - make sure the proper CPU speed and voltage is shown or that it is set to auto.
2. **Memory** - make sure the memory settings are right, and all memory is detected.
3. **Drives** - verify the floppy, hard drive, and CD-ROM drive are all shown.
4. If onboard video, modem, network, or sound is on your motherboard and you want to them disabled for an expansion card you are installing, disable these devices now.
5. Check other settings such as the time, date, and COM ports.

Once everything has been properly detected and setup, save the settings, then exit CMOS setup and reboot the computer.

Computer Processing Unit (CPU)
Alternatively referred to as the **brain of the computer**, **processor**, **central processor**, or **microprocessor**, the **CPU** (pronounced as C-P-U) short for **Central Processing Unit**. The computer CPU is responsible for handling all instructions it receives from hardware and software running on the computer.

Components of the CPU
In the CPU, the primary components are the ALU (Arithmetic Logic Unit) that performs mathematical, logical, and decision operations and the CU (Control Unit) that directs all of the processors operations.



Microprocessors

A **microprocessor** is a computer processor that incorporates the functions of a computer's central processing unit (CPU) on a single integrated circuit (IC),http://en.wikipedia.org/wiki/Microprocessor or at most a few integrated circuits

Introduction/Overview
A processor, or "**microprocessor**," is a small chip that resides in computers and other electronic devices. Its basic job is to receive input and provide the appropriate output. While this may seem like a simple task, modern processors can handle trillions of calculations per second.
The central processor of a computer is also known as the CPU, or "central processing unit." This processor handles all the basic system instructions, such as processing mouse and keyboard input and running applications.
Three basic characteristics differentiate microprocessors:

- **Instruction set**: The set of instructions that the microprocessor can execute.
  Bandwidth : The number of bits-processed in a single instruction. The amount of data that can be transmitted in a fixed amount of time
- **Clock speed :** Given in megahertz (MHz), the clock speed determines how many instructions per second the processor can execute.

In both cases, the higher the value, the more powerful the CPU. For example, a 32-bit microprocessor that runs at 50MHz is more powerful than a 16-bit microprocessor that runs at 25MHz.

Specifications

Important specifications to consider when selecting microprocessor chips (MPU) include:

- **Data bus** - Most microprocessor chips are available with an 8-bit, 16-bit, 24-bit, 32-bit, 64-bit, 128-bit, or 256-bit data bus.
- **Microprocessor family** - Products from many proprietary microprocessor families are commonly available.
- **Supply voltage** - Supply voltages range from - 5 V to 5 V and include intermediate voltages such as - 4.5 V, - 3.3 V, - 3 V, 1.2 V, 1.5 V, 1.8 V, 2.5 V, 3 V, 3.3 V, and 3.6 V.
- **Clock speed** - Clock speed, the frequency that determines how fast devices connected to the system bus operate, is generally expressed in megahertz (MHz).
- **Random access memory (RAM)** - RAM is usually expressed in kilobytes (kB) or megabytes (MB).
- **Power dissipation** - Power dissipation, the device's total power consumption, is generally expressed in watts (W) or milliwatts (mW).
- **Operating temperature** - Operating temperature is a full-required range.

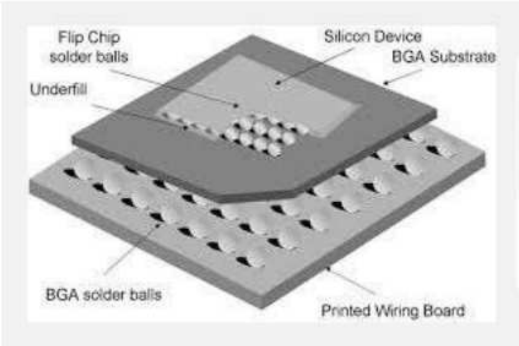
CPU Packaging (Microprocessor Types)

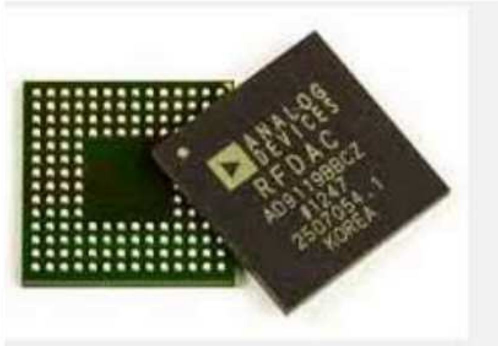
The actual microprocessor and its associated electronic circuits are packaged in a protective outer packaging. When you look at a processor, it's the packaging you see and not the microprocessor itself. Typically, the processor's packaging is ceramic or plastic.

The outer covering of the processor protects its core (also called the die) that contains the microchip and the wiring that connects the chip to the processor's mounting pins. A variety of packaging types have been used on processors. Here are the basic types.

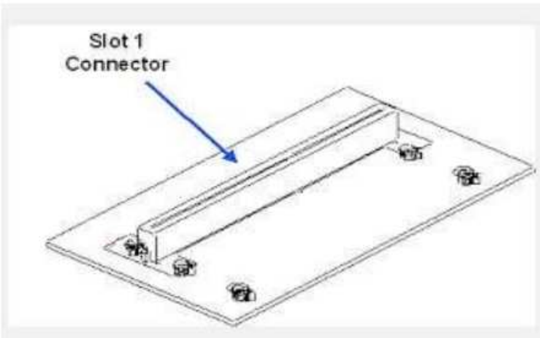
1) Pin Grid Array (PGA): Common among early processors, the mounting pins are located on the bottom of the chip in concentric squares. The earliest chips were packaged in the Ceramic PGA (CGPA). Later chips , including some current ones, use the Plastic PGA (PPGA). The early Pentium chips used a variation that staggered the pin pattern (in order to cram more pins onto the package) called the Staggered PGA (SPGA). The Pentium III features a variation of the PGA package with its Slot 370-like Flip Chip-Pin Graphics Assembly (FC-PGA)

2) Plastic Ball Grid Array (PBGA): The Primary difference between this packaging technology and the PGA is that the PBGA doesn't have mounting pins projecting from the bottom of the chip, which eliminates the threat of bent pins on the bottom of the processor. Otherwise, these package styles look similar.





3) Single Edge Connector (SEC): You may find a few variations on the packageing ~~technology, including the Sing~~le Edge Contact Cartridge (SECC) and others. They all boil down to a packaging style that is mounted perpendicular to the motherboard into a single slot, much like expansion cards and memory modules. The Pentium II was the first processor to sport this new packaging style. This style made cooling the processor easier.



Processor selection and upgrades

Upgrading your CPU can be a frustrating experience, even though the physical acts of removing an old processor and installing the new one are pretty easy. The more difficult questions to answer are these: When is the right time for me to upgrade a CPU? What processor will give me the best bang for the buck?

Complicating the matter for Intel CPU users is the plethora of socket formats that may be involved. At last count, Intel had four active socket formats for desktop PCs:

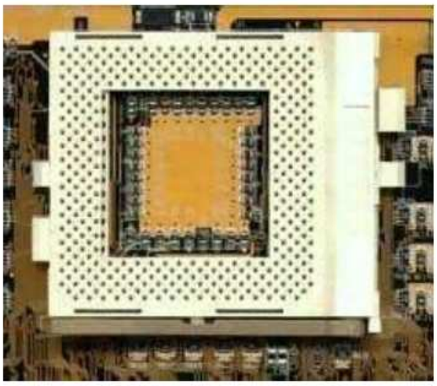
Choosing a replacement processor
Socket type, motherboard compatibility, and other factors limit the range of suitable upgrade processors. Even with those limitations, though, you'll likely have at least several and possibly dozens of processors to choose among. **Microprocessor manufacturers**
There are a bunch of microprocessor manufacturers but Intel and AMD are the major producers and distributers in the microprocessor market.

Intel - *Intel is the leading microprocessor manufacturer. Its microprocessors include the Pentium, Celeron and Core lines.* **Intel Corporation** is an American *multinational technology company* headquartered in *Santa Clara, California*. Intel is one of the *world's largest and highest valued semiconductor* chip makers, based on revenue. It is the inventor of the *x86* series of *microprocessors*, the processors found in most personal computers.

AMD - AMD is Intel's main microprocessor rival. Its microprocessors include the Athlon, Turion and Phenom lines. Advanced Micro Devices, Inc. (AMD) is an American worldwide semiconductor company based in Sunnyvale, California, United States, that develops computer processors and related technologies for business and consumer markets.

Processor Socket and Slot Types
The motherboard has one or more sockets or slots into which the processor is inserted. The type of processor that can be used is defined by the type of socket or slot present on the motherboard.

A **CPU socket** or CPU slot is a mechanical component(s) that provides mechanical and electrical connections between a microprocessor and a printed circuit board (PCB). This allows the CPU to be placed/ sat and replaced without soldering.

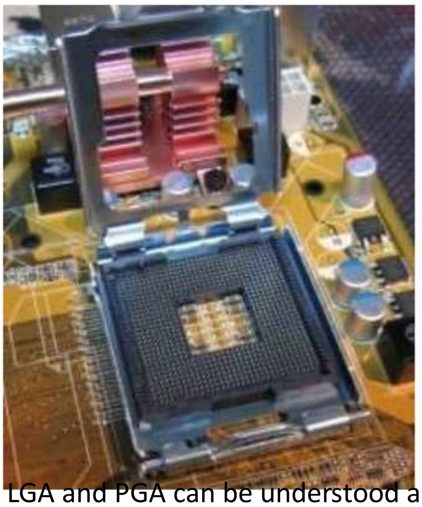


CPU socket example

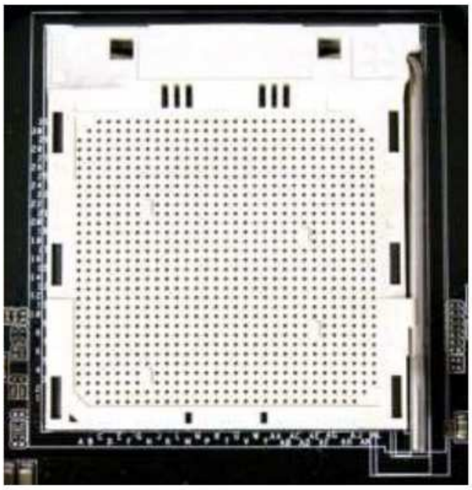
A **CPU slot** is a computer processor connection designed to make upgrading the processor much easier, where the user would only have to slide a processor into a slot.

What Types Of Sockets Exist?

Many sockets have existed throughout history but only three are relevant today. These are LGA, PGA and BGA.



LGA and PGA can be understood as opposites. LGA stands for land grid array and consists of a socket with pins on which the processor is placed. PGA, on the other hand, places the pins on the processor, which are then inserted in a socket with appropriately placed holes. Intel uses the former while AMD uses the latter.



Then there’s BGA, which stands for ball grid array. This technique is used to permanently attach a processor to its motherboard during production, making future upgrades impossible. BGA is typically less expensive and requires less physical space than a socket-able processor.

BGA technically is not technically a socket because it’s permanent. It’s worth mentioning however, because it serves the same function and may become the socket’s replacement. Intel will start to ship more processors with BGA packaging by 2014 and ARM processor manufacturers, like ffiualcomm and Nvidia, already rely heavily on BGA.

How to Install a New Computer Processor on a Motherboard Things You Need:

- Processor
- Motherboard
- Screwdriver

Building your own computer can be a fun and challenging do-it-yourself project. Installing a new **computer processor** on your **motherboard** is the most delicate and important upgrade installation you can do. The **computer processor** is the centerpiece of the entire machine. You'll want to be cautious when installing processors in a socket on your **motherboard**, but it's a quick and simple task. Follow these simple steps to install your own computer **processor** safely.

Installing a Computer Processor:

1. Check motherboard compatibility: Each motherboard has a computer processor socket, but not all processors fit all motherboards. If you've already purchased either the motherboard or the processor or both, be sure that your computer processor is compatible with the processor socket on the motherboard.
2. Prepare the motherboard: If you're simply upgrading an old computer processor on an old motherboard, you may want to disassemble the computer and remove the motherboard from the computer case. Work on your computer in a non-carpeted area to reduce static electricity which can damage your computer processor, your motherboard and other components. Touch an unpainted metal surface to discharge static from your body.
3. Inspect the computer processor: The bottom of your processor will have many tiny pins. If any of the pins are broken or severely bent, you may need to return it for a new one.
4. Insert the processor: Most motherboards have a zero insertion force (ZIF) computer processor socket. This means you won't need to press down on the processor to install it. You'll instead use a lever on the motherboard socket itself.
    - Unlock the processor socket on the motherboard by lifting the small metal or plastic lever on the side of the processor socket. If you're replacing the old computer processor, remove it now and set it aside. o Align the processor with the socket. The pins on the bottom of your computer processor are arranged in a specific pattern. When properly aligned, the pins will simply fall into place on the motherboard socket. Often, one corner of the processor will

be marked to match up with a corresponding corner on the motherboard socket.

- Drop the processor into place and lock the socket. Once the pins are aligned with the holes in the processor socket, very gently lower and drop the processor into the socket on the mother board. Don't apply any pressure or force. Instead, gently close the socket lever and lock it in place. Your computer processor is now installed.

5. Finish installing components and test: Once you've finished installing the motherboard and other components into the computer case, test your computer system.

CHAPTER 5

Memory

Memory is the electronic holding place for instructions and data that your computer's microprocessor can reach quickly. When your computer is in normal operation, its memory usually contains the main parts of the operating system and some or all of the application programs and related data that are being used.

Memory is sometimes distinguished from *storage*, or the physical medium that holds the much larger amounts of data that won't fit into RAM and may not be immediately needed there.

Characteristics of Computer Memory

1. **Electrical Characteristics -** The voltage and current requirements depend on the manufacturing technology of the device. The voltage level is not of major concern because most of the semiconductor memory devices operate at TTL voltage levels.
2. **Speed -** There is a finite time delay between the application of address and the availability of stable and accurate data on the data lines. This memory delay depends on the manufacturing technology and other factors such as size.
3. **Capacity** representing the global volume of information (in bits) that the memory can store. Memory is small in size and hence its storage is relatively low

Types of Memories

1. **Random access memory**, generally called **RAM** is the system's main memory, i.e. it is a space that allows you to temporarily store data when a program is running.

   Unlike data storage on an auxiliary memory such as a hard drive, RAM is volatile, meaning that it only stores data as long as it supplied with electricity. Thus, each time the computer is turned off, all the data in the memory are irremediably erased.

2. **Read-only memory**, called **ROM**, is a type of memory that allows you to keep the information contained on it even when the memory is no longer receiving electricity. Basically, this type of memory only has read-only access. However, it is possible to save information in some types of *ROM* memory.

3. **Flash memory** is a compromise between RAM-type memories and ROM memories. Flash memory possesses the non-volatility of ROM memories while providing both read and write access However, the access times of flash memories are longer than the access times of RAM.

TYPES OF MEMORY MODULES PACKAGING

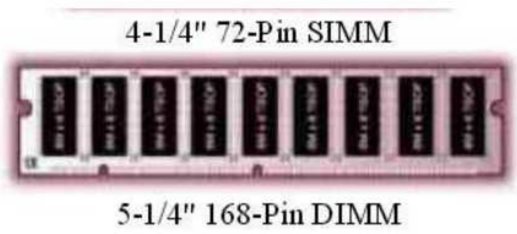
SIMMS

SIMM stands for Single In-Line Memory Module. Like other types of memory modules, a SIMM consist of memory chips soldered onto a modular printed circuit board (PCB), which inserts into a socket on the motherboard. 72 pin SIMMs transfer 32 bits of data at a time, therefore in modern microcomputers with a 64-bit data bus two SIMMs have to be paired up in order to function.

DIMMS

~~Dual In-~~line Memory Modules, or DIMMs, closely resemble SIMMs. Like SIMMs, most DIMMs install vertically into expansion sockets. The principal difference between the two is that on a SIMM, pins on opposite sides of the board are "tied together" to form one electrical contact; on a DIMM, opposing pins rem a in electrically isolated to form two separate contacts.

168-pin DIMMs transfer 64 bits of data at a time and are typically used in computer configurations that support a 64-bit or wider memory bus. Some of the physical differences between 168-pin DIMMs and 72-pin SIMMs include: the length of module, the number of notches on the module, and the way the module installs in the socket. Another difference is that many 72-pin SIMMs install at a slight angle, whereas 168-pin DIMMs install straight into the memory socket and remain completely vertical in relation to the system motherboard. The illustration below compares a 168-pin DIMM to a 72-pin SIMM.

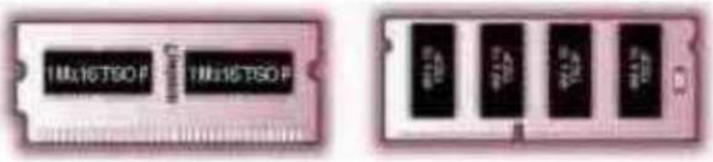


Comparison of a 72-pin SIMM and a 168-pin DIMM.

SO DIMMS

A type of memory commonly used in notebook computers is called SO DIMM or Small Outline DIMM. The principal difference between a SO

DIMM and a DIMM is that the SO DIMM, because it is intended for use in notebook computers, is significantly smaller than the standard DIMM. The 72-pin SO DIMM is 32 bits wide and the 144-pin SO DIMM is 64 bits wide.

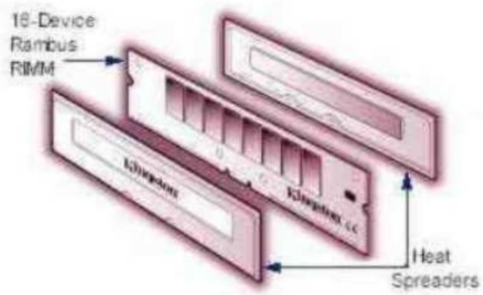


2.35" 72-pin SO DIMM 2.66" 144-Pin SO DIMM

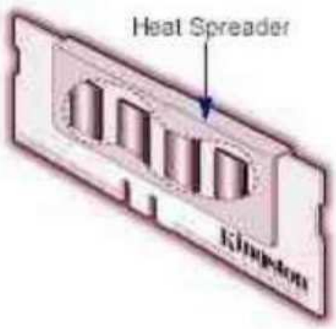
Comparison of a 72-pin SO DIMM and a 144-pin SO DIMM.

RIMMS AND SO-RIMMS

RIMM is the trademarked name for a Direct Rambus memory module. RIMMs look similar to DIMMs, but have a different pin count. RIMMs transfer data in 16-bit chunks. The faster access and transfer speed generates more heat. An aluminums heath, called a heat spreader, covers the module to protect the chips from overheating. A 184-pin Direct Rambus RIMM shown with heat spreaders pulled away.



An **SO-RIMM** looks similar to an SO DIMM, but it uses Rambus technology.



A 160-pin SO-RIMM module.

Memory-Mapping

What Is Memory-Mapping?

Memory-mapping is a mechanism that maps a portion of a file, or an entire file, on disk to a range of addresses within an application's address space. The application can then access files on disk in the same way it accesses dynamic memory. This makes file reads and writes faster in comparison with using functions such as `fread` and `fwrite`.

Benefits of Memory-Mapping

The principal benefits of memory-mapping are efficiency, faster file access, the ability to share memory between applications, and more efficient coding.

Faster File Access

Accessing files via memory map is faster than using I/O functions such as `fread` and `fwrite`. Data are read and written using the virtual memory capabilities ~~that are~~ built in ~~to the o~~perating system rather than having to allocate, copy into, and then deallocate data buffers owned by the process.

Efficiency

Mapping a file into memory allows access to data in the file as if that data had been read into an array in the application's address space. Initially, As a result, memory-mapped files provide a mechanism by which applications can access data segments in an extremely large file without having to read the entire file into memory first.

Memory Mapping types

There are a few different kinds of mappings that can be specified in the map attribute. All use the format described in the previous section.

Device Mapping: The most common kind of mapping. It is used for devices, RAM and ROM objects. The *target* field is not set.

Translator Mapping: Sometimes the address has to be modified between memory-spaces, or the destination memory-space depends on the address or some other aspect of the access such as the initiating processor. In these cases a *translator* can be used. A translator mapping is specified with the translator in the *object* field, and the default target as *target*. The translator has to implement the TRANSLATE interface. When an access reaches a translator mapping, the ***translate*** function in the TRANSLATE interface is called. The translator can then modify the address if necessary, and specify what destination memory-space to use. If it doesn't specify any new memory-space, the default one from the configuration is used. The following fields can be changed by the translator: `physical_address`, `ignore`, `block_STC`, `inverse_endian` and `user_ptr`.

Translate to RAM/ROM Mapping: Used to map RAM and ROM objects with a translator first. The *object* field is set to the translator, and *target* is set to the RAM/ROM object.

Space-to-space Mapping: Map one memory-space in another. Both *object* and *target* should be set to the destination memory-space object.

Bridge Mapping: A bridge mapping is typically used for mappings that are setup by some kind of bridge device. The purpose of a bridge mapping is to handle accesses where nothing is mapped, in a way that corresponds to the bus architecture. For a bridge mapping, the *object* field is set to the bridge device, implementing the `BRIDGE` interface. The *target* field is set to the destination memory-space.

Selection and upgrading memory

Do you suspect your computer could use more memory? Here's how to tell. Here are a few simple — but telling — signs that your computer could benefit from a memory upgrade.

You experience poor or sub-par performance in everyday tasks. For instance, a program doesn't respond or seems to take forever to open.

You get system notifications that say "low memory" or "out of memory".

You are having display problems. Like when you pull up a page and it either partially loads or if refuses to load at all. Or you see a blank space where data should be. In some cases, the PC refuses to operate at all. When you try to open anything, the system will not respond.

If you are experiencing any of these symptoms, a memory upgrade may be in order.

It's easy to tell how much memory is installed on your system and how much is being used.

Hardware Tips: Choose the Right Kind of Memory for Your System

Adding RAM to your PC usually delivers the most bang for your upgrade buck, but only if you buy the right kind of memory module for your PC. There are more types of PC RAM than there are lattes at Starbucks: Do you want SDRAM, PC100, non-parity, or un-buffered DIMM? Why not enjoy a refreshing DDR SDRAM, PC2700, CL2.5, or registered DIMM? Here are the ins and outs of PC memory.

Begin by checking your system's user manual to identify the types of RAM your PC's motherboard supports. If you don't have the manual, visit the manufacturer's Web site and search for downloadable manuals or other tools that might help you find the information you need.

Before you buy, ascertain the following:

Maximum module size**:** Find out the maximum size of memory module that your PC supports. Don't buy a module larger than what your motherboard's memory slots can each accommodate.

RAM and connector types**:** Determine which of the four types of RAM your system uses: DRAM (EDO or FPM), SDRAM, DDR SDRAM, or RDRAM. All four types are mounted on one of three module types: SIMM, DIMM, or RIMM.

Most machines support only one type of RAM and have one type of module or connector, so mixing types isn't an option. The few motherboards that do accept two types of RAM allow only a single type to be used at any one time.

Memory speed**:** SDRAM, DDR SDRAM, and RDRAM are rated to match or exceed the PC's front side bus speed, which is the speed at which data moves between the CPU and RAM. If your system comes with PC66 SDRAM, you can use PC100 SDRAM to replace it and get the faster speed, as long as your PC's front side bus supports the higher rate. But if you mix RAM of different speeds, all RAM will operate at the speed of the slowest chip.

Memory banks**:** On some PCs, the memory slot closest to the CPU--usually called bank 0--~~must be filled~~ before the motherboard's other memory slots. On other systems, bank 0 must have the largest RAM module (if you are using modules of different sizes). There's no fixed rule, so check your PC's documentation.

Non-parity or ECC**:** If your system supports error-correcting code (ECC) and has more ~~than 512MB of R~~AM, buying ECC memory may be worth the added cost. Large amounts of RAM are more likely to experience occasional, random errors (which may be caused by cosmic rays, among other sources). However, unless your current RAM is ECC, forget it; you can use non-parity and ECC modules together, but error correction will be disabled.

To determine your type of memory, count the number of chips on the memory module. If the number is divisible by three, you have ECC or parity memory.

Column address strobe**:** The lower the CAS rating--or the CL rating--is, the better. ~~SDRAM comes in CL~~2 or CL3 types, and DDR SDRAM comes in CL2 or CL2.5. Unless your motherboard requires a specific CAS or CL rating, get the lower (faster) rated module. Cost differences should be negligible. Again, if you mix modules of different speeds, they'll all operate at the slowest module's speed.

CHAPTER 6

Disks and Drives

Computer data storage, often called **storage** or **memory**, is a technology consisting of computer components and recording media used to retain digital data. It is a core function and fundamental component of computers. There are two different types of storage devices:

Primary Storage Devices: Generally smaller in size, are designed to hold data temporarily and are internal to the computer. They have the fastest data access speed, and include RAM and cache memory. Secondary Storage Devices: These usually have large storage capacity, and they store data permanently. They can be both internal and external to the computer, and they include the hard disk, compact disk drive and USB storage device.
Note: A disk is a device on which data is stored while a drive is a device used to record/read from a disk. Some devices incorporate the disk and drive together (i.e. Hard drive/hard disk drive) but others are in separate (i.e. CD/Floppy disks and drives)

Types of computer storage and Disks

The following are some examples of types of storage devices used with computers.

Magnetic storage/disks devices - Today, magnetic storage is one of the most common types of storage used with computers and is the technology that many computer hard drives use. It uses magnetism as its method of reading and writing data.

- Floppy diskette
- Hard drive
- Super Disk
- Tape cassette
- Zip diskette

Optical storage/disks devices - Another common storage is optical storage, which uses lasers and lights as its method of reading and writing data.

- Blu-Ray disc
- CD-ROM disc
- CD-R and CD-RW disc
- DVD-R, DVD+R, DVD-RW, and DVD+RW disc

Storage/Disk organization
If data needs to be kept whilst a computer is turned off then it must be stored on **backing store**. Any programs or data that are not currently being used by a computer will be kept on backing store. When programs or data are used they are copied (loaded) into main memory
(RAM) for faster access.

The purpose of storage in a computer is to hold **data** and get that data to the CPU as quickly as possible when it is needed. Computers use disks for storage: most commonly, hard disks that are located inside the computer (non-removable), and floppy or compact disks that are used externally (removable). Three types of Backing Storage media we will overview in this topic are; **Magnetic, Optical** and **Electronic** media.

Storage Media vs Storage Drives

Information stored on backing store is placed on a storage **medium**.

The data is read from or written to the storage medium by a piece of hardware known as a **drive** or a **storage device**. That is, a **storage device** records and retrieves items to and from a storage medium.

It takes much longer to access data which is on backing store than data which is in main memory, typically 100 to 1000 times as long.
This is because most backing storage devices operate **mechanically**. Computer systems have much more backing store than main memory for two reasons:

1. Main Memory only needs to store programs and data that are currently being used whereas the backing store needs to hold all of the programs and data that can be
   used on the computer.
2. Backing store is much cheaper per Mb than Main Memory.

Capacity is the number of bytes a storage medium can hold.

Reading is the process of transferring data, instructions, and information from a storage medium into memory.

Writing is the process of transferring these items from memory to a storage medium.

Characteristics of Backing store

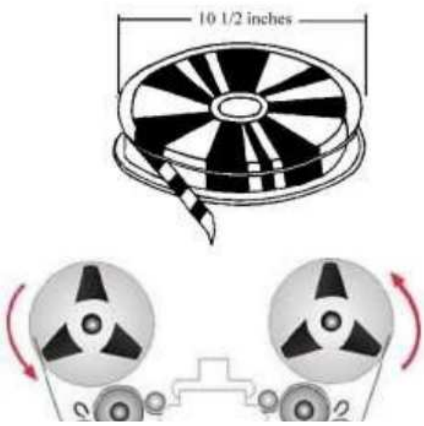
Data is usually accessed using read/write heads. These transfer the data while the medium rotates in the drive

Access to backing store is slower that to main memory

They are **non-volatile**. The data is stored on the medium until it is deleted.

Magnetic Media

Magnetic tape



Magnetic tape is a narrow plastic ribbon coated with an easily magnetisable material on which data can be recorded. It is used in sound recording, audiovisual systems (videotape), and backups.

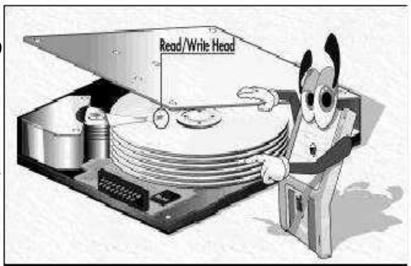
Tape is still used to make backup copies of important data. Information is recorded on the tape in binary form, with two different strengths of signal representing 1 and 0.
The device that reads the tape is the **Tape Drive** or **Tape Unit**.

Magnetic tape comes mainly in two different forms:

Reel to Reel	Large reels of tape which must be loaded into a reel-to-reel tape drive. This type of tape is usually used by mainframe computers.
Cartridges	The tape is supplied in a small cartridge rather like a music tape. This type of tape is used on PCs (microcomputers) and the device used to read/write the tapes is called a **tape streamer**. Capacities of cartridges vary from 10Gb to 200Gb.

Magnetic Discs - Hard Disks

The hard disk is a magnetic disk, usually fixed in the drive (internal) although nowadays there also exist external hard disks. Access to data is far faster than access to floppy disks. Hard disks store far more data than floppy disks. They are more reliable then floppy disks - there is better protection against dirt. Hard disks are used to store the operating system, application software and users' files.



A hard disk is made of a rigid disk which is coated with a magnetisable material. Hard disks spin much more quickly than floppy disks and the disk **read/write head** is positioned very close to the disk (thousandths of a millimeter away). Because the disk head is positioned so close to the disk hard drives can easily be damaged by dust or vibration. Therefore the disk, the drive head and all the electronics needed to operate the drive are built together into a sealed unit. This picture shows a hard disk drive with the case removed.

Usually (as in the picture above) several physical disks are contained in one hard disk unit. Each disk is known as a **platter**. Typical hard disk capacities for a home PC now start at up to 180 Gb.

Floppy Disks

Consists of a plastic case that measures 3 1/2 by 5 inches. Inside that case is a very thin piece of plastic (see picture at right) that is coated with microscopic iron particles (magnetic). This disk is much like the tape inside a video or audio cassette. Never touch the inner disk - you could damage the data that is stored on it.
Floppy disks are the smallest type of storage, holding only 1.44MB.

inside view

Access to data is much slower than for hard disk. The data on the disk can be protected by sliding a small write-protect tab which prevents the contents of the disk from being changed.

Some hardware companies now produce storage devices (Zip disks) which are very similar to floppy disks but can store 100Mb or even 250Mb of data. These devices are also much faster than standard floppy disk drives.

back view

How Hard disks and Floppy Disks Work - Magnetic

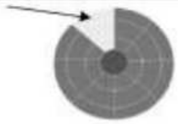
The process of reading and writing to a hard or floppy disk is done with electricity and magnetism. The surfaces of both types of disks can be easily magnetized. The electromagnetic head of the disk drive records information to the disk by creating a pattern of magnetized and non-magnetized areas on the disk's surface. Do you remember how the binary code uses *on* and *off* commands to represent information? On the disk, magnetized areas are *on* and non-magnetized areas are *off*, so that all information is stored in binary code. This is how the electronic head can both write to or read from the disk surface.

It is very important to always keep magnets away from floppy disks and away from your computer! The magnets can erase information from the disks!

Format of Magnetic Disks

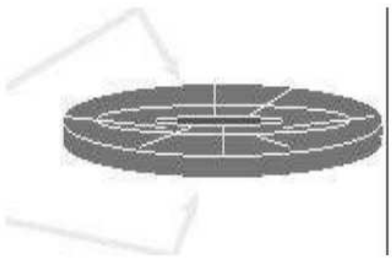
All magnetic disks are similarly **formatted**, or divided into areas, called Tracks and Sectors. The formatting process sets up a method of assigning addresses to the different areas. It also sets up an area for keeping the list of addresses. Without formatting there would be no way to know what data went with what.

Tracks - A track is a circular ring on one side of the disk. Each track has a number. The diagram shows 3 tracks.



Sectors - A disk sector is a wedgeshape piece of the disk. Each sector is numbered.

Double sided

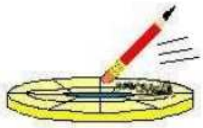


A typical magnetic disk has two surfaces or sides. Each surface holds data in circular tracks and each track is divided into equal sections called sectors. The track number and sector number are used as an adderss to find where data is on the disk. Data can be both both written to or read from the disk. Magnetic

	disk are direct access i.e. any data item can be accessed without reading other data first.

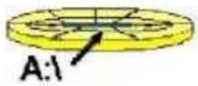
What happens when a disk is formatted?

~~1. **All data is** *erased*. ***Don't forget this!!***~~



2. ***Surfaces*** are ***checked*** for physical and magnetic defects.

3. A **Filing system** (with root directory) is created to list where things are on the disk.

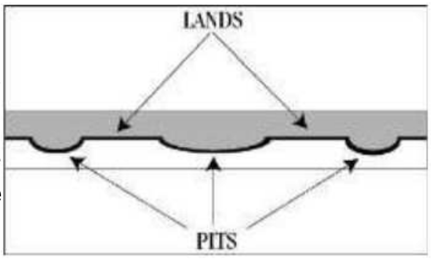


Optical Media

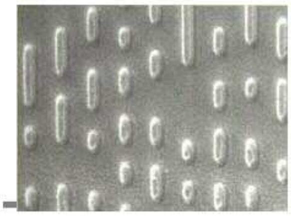
An optical disk is a storage medium in which laser technology is used to record and read large volumes of digital data.

Compact Disks

CDs use _________ (microscopic indentations) and _____________ (flat surfaces) to store information much the same way floppies and hard disks use magnetic and non-magnetic storage. Inside the CDRom is a laser that reflects light off of the surface of the disk to an electric eye.



Compact disks are exchangeable and easy to transport. Access to data is faster than access to floppy disks but slower than hard disks. CDs typically hold 650 or 700



megabytes of data, and are used in distributing large amounts of text and graphics, such as encyclopedias, catalogues, and technical manuals.

As with a hard disk the drive head in an optical drive can move directly to any file on the disk so optical disks are direct access.

CD-ROM (Compact Disk - Read Only Memory) - The data is written onto the CD-ROM disk before it is sold and can not be changed by the user. CD-ROMs are used for applications such as distributing software, digital videos or multimedia products.

CD-R (Compact Disk - Recordable) - A CD-R disk is blank when it is supplied. The user can write data to it just once. After data has been written to the disk it can not be changed. CD-Rs are often used for making permanent backups of data and distributing software when only a small number of copies are required.

CD-RW (Compact Disk - Rewriteable) - CD-RW disks can be read from and written to.

DVDs

DVD-ROM (Digital Versatile Disk - Read Only Memory) - DVD disks are able to store much more data than CD disks. The DVD standard includes disk capacities up to 30Gb. DVD-ROM disks can be read from but can not be written to.

DVD-RAM (Digital Versatile Disk - Random Access Memory) - DVD-RAM disks have all of the benefits of DVD-ROM disks and can be written to as well. These very high capacity disks are ideal for producing backups.

Because of their high capacity, DVD disks are used to store high quality video such as complete movies.

Disk management

Disk Management is an extension of the Microsoft *Management* Console that allows full *management* of the *disk*-based hardware recognized by Windows.

You can use Disk Management in this version of Windows to perform disk-related tasks such as creating and formatting partitions and volumes, and assigning drive letters.

What is a system utility?

System utilities are programs that are designed to help you fix and enhance your current computer system. Many operating systems include a range of utility programs to perform common tasks such as checking disks, backing up information, restoring information and reorganising information. Many other system utilities are available as third party software – this means that you purchase and install these utilities separately from the operating system software. Third party system utilities are designed to perform specific functions that the current operating system either does not perform or performs at a lesser standard.

The types of system utilities we'll look at in this reading will allow you to perform these basic tasks:

- disk scan
- disk defragment
- file back up
- file recovery
- get system information.

What is a disk scan?

~~A disk scan is a use~~ful utility to help identify and repair problems on a hard disk or floppy disk; it is provided with some operating systems. It can perform a thorough check of the disk's surface to ensure that it is able to read and write information on all areas of the disk. If the disk scan utility finds a problem it will usually display a message and offer to fix the problem.

There is a disk scan utility on recent versions of Microsoft Windows and Apple Macintosh operating systems, where if you turn off your computer without exiting the system, the **Scan Disk** utility will run automatically the next time you start your computer.

There are also third party utilities that you are able to use that will perform similar and sometimes more thorough scans of the disk.

What is defragment?

~~To a computer, defra~~gment means that all the files on the computer's hard disk will be placed in a neat and tidy order.

Gradually, as a computer hard disk has many files added, updated and deleted, the files can start to become fragmented. **Fragmentation** means that portions of the files are scattered all over the disk. A defragment will ensure that all files are reordered so that their parts are placed adjacent to one another. This will mean the computer can now read these files much more quickly.

Depending on how many files need to be reorganised, a defragment can take hours. If you use your computer regularly you should try and do a **defragment at least once a month**. A good time to do a defragment may be overnight – when nobody will be using the computer.

Often an operating system will include several system tools, including the defragment utility. If it is not included with the operating system, a defragment program can be purchased as an external software program (a third party utility).

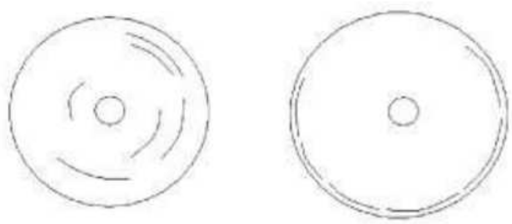


Figure 1: A diagram of a disk before and after a defragment. The picture on the left displays a disk with lines (representing data) that have been randomly placed on the disk. The picture on the right displays a disk after defragmentation — the lines (data) now appear in a consecutive order.

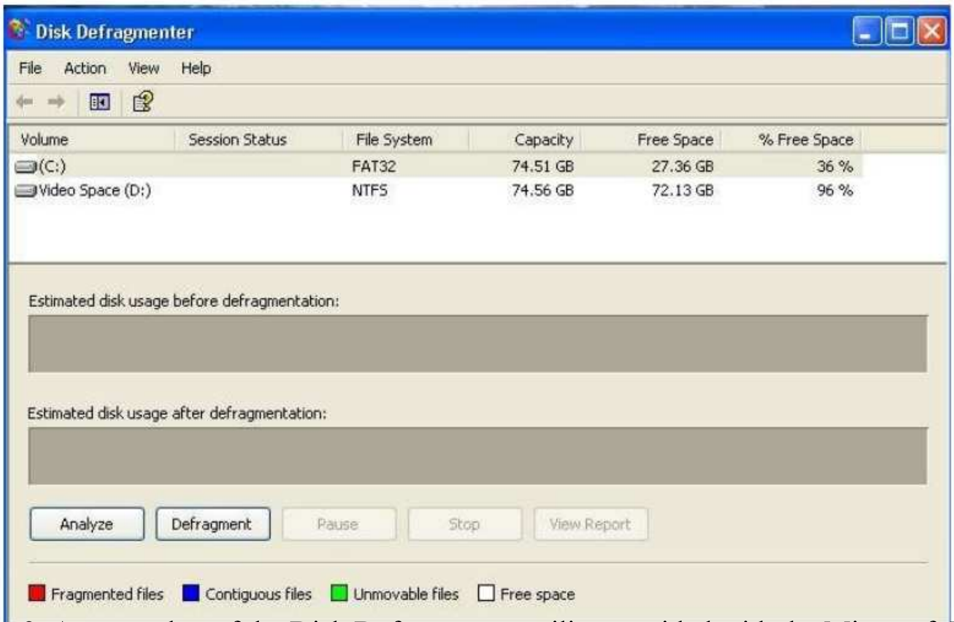


Figure 2: A screenshot of the Disk Defragmenter utility provided with the Microsoft Windows XP operating system

Backing up

Backing up means making a copy of your files, in case your computer hard disk fails and your original files become 'corrupted'. Although for the majority of time the computer's hard disk will not have any problems, occasionally a disk may fail unexpectedly. Some reasons why a hard disk may fail include: a sudden power failure

- computer virus damaging the hard disk
- damaged caused by knocking or moving the hard disk.

Backups need to be done on a **regular basis**, so if there is a problem you will still have a recent copy of your files. It is also a good idea to keep backups in another location away from your computer. Make sure where you store your backup information is away from sunlight, dust and magnetic fields.

Choosing a backup media

It is important to choose the most appropriate kind of media to backup data to. When choosing media, be realistic; it is better to store backups using media that has a large capacity. Some suggestions include:

- **Second hard disk**: Some computers may have a second hard disk available that will allow a fast and easy method of backing up data.

- **CD or DVD:** Many computers have CD and DVD burners that will allow you to 'burn' data onto a writeable CD or DVD.
- **Zip disk**: Zip disks are removable disks that hold between 100MB and 250MB of information.
- **Tape drive**: A medium that may be used by a business to backup business information.

What should you backup?

Backup anything that you have created yourself — including documents, digital photographs and video. All of these items will have no other way of being replaced if there are problems later on. If there is a problem, you can always reinstall the operating system and the application software using the original software CDs.

How often should you backup?

How often you backup will really depend on how often you use the computer and what is being stored on the computer. If, for example, your computer contains important business information that you are using everyday, it is a good idea to try to back up **everyday**. If, however, you only use your computer occasionally to play games or write the odd letter, a backup will probably only need to be done **once a month**.

How to perform a backup

Some operating systems include special backup utilities that make it easy for you to back up important files. If you don't have a backup utility already installed you could install a third party program that is designed to do backups or manually copy and paste your files from the hard disk to your backup device.

Backup programs allow you to easily select files that you want to back up, then they copy the files to the chosen backup device. A backup program may also compress the files before they are copied so you can fit more files onto the backup device.

Recovery

A recovery utility is used to **undelete** a file that has been accidentally deleted. Many operating systems now include special recovery utilities to help you restore files that have accidentally been removed. Microsoft Windows includes a **Recycle Bin** and Macintosh operating systems include **Trash**. Both of these utilities allow you a second chance to undelete any files on the hard disk.

There is also a recovery utility in recent version of Microsoft Windows called **System Restore**. The System Restore utility keeps a regular log of all current settings so if, for example, a new installation of a program is causing problems System Restore will be able to reset all settings back to how they were before the installation.

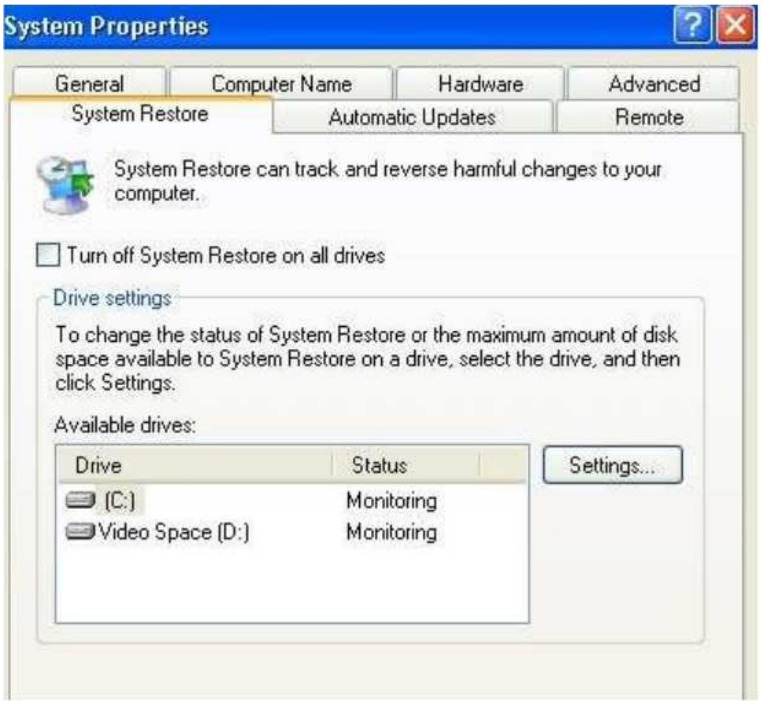


Figure 3: A screenshot of the System Restore utility in Microsoft Windows XP operating system

Hard Disk Interface(s)

Hard drives and other devices are connected to a computer motherboard through some type of cable. These cables use multiple smaller wires in parallel to transmit the proper signals for reading and writing to and from the drive. There are multiple types of cables, which transmit at different speeds and use different types of connectors. Here we will look at some of the most common device cables and the differences between them.

SCSI - SCSI stands for Small Computer System Interface and used a parallel cable to attach both internal and external devices. One of the benefits of SCSI interfaces is that multiple devices could be chained together to a single port. Another benefit is that the interface includes features like error checking and hand shake signals between devices.

IDE - IDE stands for Integrated Drive Electronics and refers more to the standard than the cable type itself. The technology is also often referred to as ATA or PATA. ATA cables can only be up to 18 inches in length and are fairly large and flat, which makes them a poor choice for external devices, so the interface is mainly used for internal devices. The cable uses a combination of 40 or 80 wires in parallel.

SATA - SATA stands for Serial ATA and is an evolution of the original ATA (or IDE) interface. The SATA interface is faster in speed, at up to 3GB/s. Another major benefit of the interface is that the cables and connectors are much smaller, taking up less space inside a computer case and not restricting air flow. There is an external version of SATA known as eSATA for connecting external hard drives and other devices.

Interface cables have improved quite a bit over the years, but the basic concept of input and output has remained mainly the same. New interfaces such as Thunderbolt have added even faster transfer speeds and taken some of the benefits from multiple technologies to make an improved connection.

Formatting and Partitioning a Hard Drive

Definitions

There are a few words we need to define before going any further. Don't worry, there *won't* be a test. :-)

- **Partition, partitioning:** Free space on a hard disk must be partitioned before it can be used by an operating system. Creating a partition reserves a physical portion of the hard drive space for use as a logical drive, or volume, that the operating system can address.
- **Volume:** A volume is how the operating system 'sees' your free disk space. Volumes (also called logical drives) are represented in Windows by drive letters such as C:, E:, etc. Volumes are formed by partitioning the free space of a hard drive. Volumes must be formatted with a file system before data can be stored on them.
- **Formatting:** Formatting is the act of creating a file system on a volume, so that the operating system can store and retrieve data on that volume.
- **File system:** A file system provides a means of organizing and retrieving information written to a hard disk or any other storage medium. A file system is created on a volume when it is formatted. Common Windows file systems include FAT32 (File Allocation Table 32) and NTFS (New Technology File System).

Partition can be thought of as a division or "part" of a real hard disk drive. When you partition a hard drive, you make it available to an operating system. Multiple partitions on a singe hard drive appear as separate drives to the operating system.
A partition also is used to mean the *division* of certain kinds of secondary storage (such as hard disk drives (HDDs)), via the creation of multiple sub-divitions. Partitions are logical containers which are usually used to house file systems, where operating systems, applications, and data are installed on. A single partition may span the entirety of a physical storage device.
Disk formatting is the process of preparing a data storage device such as a hard disk drive, solid-state drive, floppy disk or USB flash drive for initial use.
The first part of the formatting process that performs basic medium preparation is often referred to as "low-level formatting".

The second part, Partitioning is the common term for the part in the process in disc preparation, making the data storage device visible to an operating system.
The third part of the process, usually termed "high-level formatting" most often refers to the process of generating a new file system. In some operating systems all or parts of these three processes can be combined or repeated at different levels and the term "format" is understood to mean an operation in which a new disk medium is fully prepared to store files.

CHAPTER 7

Computer display

A **computer monitor** or a **computer display** is an electronic visual display for computers A **display device** is an output device for presentation of information in visual or tactile form (the latter used for example in tactile electronic displays for blind people). When the input information is supplied has an electrical signal, the display is called an *electronic display*.

display adapter

A plug-in card in a desktop computer that performs graphics processing. Also commonly called a "graphics card" or "video card," modern display adapters use the PCI Express interface, while earlier cards used PCI and AGP. The display adapter determines the maximum resolution, refresh rate and number of colors that can be displayed, which the monitor must also be able to support. On many PC motherboards, the graphics circuits are built into the chipset, and a separate plug-in card is not required.

Types of computer monitors

Most people use computer monitors daily at work and at home. And while these come in a variety of shapes, designs, and colors, they can also be broadly categorized into three types. If you are not sure what these are and would like an introduction to the different types of computer monitors then here we explain the three main types, as well as the pros and cons of each.

CRT (cathode ray tube) monitors

These monitors employ CRT technology, which was used most commonly in the manufacturing of television screens. With these monitors, a stream of intense high energy electrons is used to form images on a fluorescent screen. A cathode ray tube is basically a vacuum tube containing an electron gun at one end and a fluorescent screen at another end.

While CRT monitors can still be found in some organizations, many offices have stopped using them largely because they are heavy, bulky, and costly to replace should they break. While they are still in use, it would be a good idea to phase these monitors out for cheaper, lighter, and more reliable monitors.

LCD (liquid crystal display) monitors

The LCD monitor incorporates one of the most advanced technologies available today. Typically, it consists of a layer of color or monochrome pixels arranged schematically between a couple of transparent electrodes and two polarizing filters. Optical effect is made possible by polarizing the light in varied amounts and making it pass through the liquid crystal layer. The two types of LCD technology available are the active matrix of TFT and a passive matrix technology. TFT generates better picture quality and is more secure and reliable. Passive matrix, on the other hand, has a slow response time and is slowly becoming outdated.

The advantages of LCD monitors include their compact size which makes them lightweight. They also don't consume much electricity as CRT monitors, and can be run off of batteries which makes them ideal for laptops.

Images transmitted by these monitors don't get geometrically distorted and have little flicker. However, this type of monitor does have disadvantages, such as its relatively high price, an image quality which is not constant when viewed from different angles, and a monitor resolution that is not always constant, meaning any alterations can result in reduced performance.

LED (light-emitting diodes) monitors

LED monitors are the latest types of monitors on the market today. These are flat panel, or slightly curved displays which make use of light-emitting diodes for back-lighting, instead of cold cathode fluorescent (CCFL) back-lighting used in LCDs. LED monitors are said to use much lesser power than CRT and LCD and are considered far more environmentally friendly.

The advantages of LED monitors are that they produce images with higher contrast, have less negative environmental impact when disposed, are more durable than CRT or LCD monitors, and features a very thin design. They also don't produce much heat while running. The only downside is that they can be more expensive, especially for the high-end monitors like the new curved displays that are being released.

Being aware of the different types of computer monitors available should help you choose one that's most suited to your needs. Looking to learn more about hardware in today's world? Contact us and see how we can help.

Factors That Affect The Quality Of A Display Device
(Monitor performance measurement)

The quality of a CRT monitor depends largely on its resolution, dot pitch, and refresh rate. The quality of an LCD monitor or display depends primarily on its resolution.

A CRT monitor's screen is coated with tiny dots of phosphor material, called pixels, that glow when electrically charged to produce an image.

Resolution, which describes the sharpness and clearness of that image, is related directly to the number of pixels a monitor can display. The greater the number of pixels the display uses, the better the quality of the image.

Dot pitch, a measure of image clarity, is the distance between each pixel on a display. The smaller the distance between pixels (dot pitch), the sharper the image.

Refresh rate is the speed that a monitor redraws images on the screen. Refresh rate should be fast enough to maintain a constant, flicker-free image.

The resolution of an LCD monitor or display generally is proportional to the size of the monitor or display. That is, the resolution increases for larger monitors and devices.

Computer Monitor Troubleshooting
How to Test a Computer Monitor that Isn't Working

1. Check to make sure your monitor is on! Some monitors have more than one power button or switch - check to make sure they're all switched on.
2. ~~Check fo~~r disconnected monitor power cable connections. Your monitor might be ~~working fine and your only problem may be a loose or u~~nplugged monitor power cable.

   Note: A disconnected monitor power cable could be the cause of your problem if your monitor's power light is completely off.
3. Check for disconnected monitor data cable connections. Again, your monitor might be turning on without a problem but no information can get to it because the cable that connects your monitor to your computer is disconnected or loose.

   Note: A disconnected monitor data cable could be the cause of your problem if your monitor's power light is on but is amber or yellow instead of green.
4. Turn the monitor's brightness and contrast settings completely up. Your monitor might be showing information but you just can't see it because these display settings are too dark.

   Note: Most monitors today have a single onscreen interface for all settings, including brightness and contrast. If it turns out that your monitor isn't working at all then you'll likely not have access to this interface. An older monitor might have manual knobs for adjusting these settings.

1. Test that your computer is working correctly by connecting a different monitor that you are *certain is working properly* to your PC. Your monitor may be working fine but your computer might not be sending information to it.

   - If the new monitor you connected does not show anything either, proceed to Step 6.
   - If the new monitor you connected does show information from your computer, proceed to Step 7.

   Important: When testing with the new monitor, make sure you use the data cable that came with it and not the one from your original monitor.

1. Determine why your computer isn't sending information to your monitor. Since neither monitor works, you now know that the computer is not sending information to the monitor. In other words, you've proven that your computer is the reason that nothing shows up on your monitor.
   Chances are your original monitor is working fine.
2. Test your original monitor with a monitor data cable that you *know is working*. It's possible that the monitor itself is working properly but it can't receive information from the computer because the cable that connects the monitor to the PC is no longer working.

   Note: If possible, test using the data cable from the monitor that you successfully tested with in Step 5. If not, purchase a replacement monitor data cable to test with.

   Note: The data cable on some older monitors are permanently connected to the monitor and are not replaceable. In these cases, you'll have to skip this step and proceed to Step 8.
3. Replace the monitor.

   WARNING: A computer monitor is not a user serviceable device. In other words - do not open the monitor and attempt to repair it yourself. If you would rather have your dead monitor serviced instead of replaced then please let a professional do it.

How To Fix a Computer That Turns On But Displays Nothing

Fixing a computer with this problem could take anywhere from minutes to hours depending on why exactly the computer isn't displaying anything on the monitor, which we'll figure out as we troubleshoot the issue.

1. Test your monitor. Before you begin more complicated and time-consuming troubleshooting with the rest of your computer, make sure your monitor is working properly.

   It's possible that your computer is working fine and your monitor is your only problem.
2. Verify that your PC has fully power cycled. In other words, make sure your computer has completely reset - make sure that it's coming on from a completely powered-off state.

   Often times a computer will appear to "not be on" when actually it's just having problems resuming from either the Standby/Sleep or Hibernate power saving mode in Windows.

   Note: You can power off your computer completely while in a power saving mode by holding the power button down for 3 to 5 seconds. After the power is completely off, turn on your PC and test to see if it will boot normally.

1. Troubleshoot the cause of the beep code if you're lucky enough to get one. A beep code will give you a very good idea of exactly where to look for the cause of your computer turning off.

If you don't resolve the problem by troubleshooting to the specific beep code, you can always return here and continue with the steps below.

1. Clear the CMOS. Clearing the BIOS memory on your motherboard will return the BIOS settings to their factory default levels. A BIOS misconfiguration could be why your PC won't startup all the way.

   Important: If clearing the CMOS does fix your problem, make sure any changes you make in BIOS are completed one at a time so if the problem returns, you'll know which change caused your issue.
2. Verify that the power supply voltage switch is set correctly. If the input voltage for the ~~power supply is not correct (based on your country) then~~ your computer may not turn on ~~completely.~~

   There's a good possibility that your PC wouldn't power on at all if this switch is wrong but an incorrect power supply voltage might also prevent your computer from starting properly in this way too.
3. Reseat everything possible inside your PC. Reseating will reestablish the various connections inside your computer and is very often a "magic" fix to problems like this one.

   Try reseating the following and then see if your computer begins to display something on screen:
   - Reseat all internal data and power cables
   - Reseat the memory modules
   - Reseat any expansion cards

   Note: Unplug and reattach your keyboard and mouse as well. There isn't a great possibility that the keyboard or mouse is causing your computer to not turn on fully but we might as well reconnect them while we're reseating everything else.

1. Reseat the CPU only if you suspect that it might have come loose or might not have been installed properly.

   Note: I call this out separately only because the chance of a CPU coming loose is very slim and because installing one is a sensitive task. This isn't a big concern if you're careful, so don't worry!
2. Check for causes of electrical shorts inside your computer. This is often the cause of the problem when the computer powers off by itself but certain shorts can also prevent your computer from booting fully or showing anything on the monitor.
3. Test your power supply. Just because your computer's fans and lights are working does not mean that the power supply is functioning properly. The PSU tends to cause more problems than any other hardware and is often the cause of a computer not coming on all the way.

   Replace your power supply immediately if it fails any test you perform.

Important: I want to make this point very clear - *do not skip a test of your power supply* thinking that your problem can't be the PSU because "things are getting power." Power supplies can work in varying degrees - one that isn't fully functional needs to be replaced.

Tip: After replacing the power supply, assuming you do, keep your PC plugged in for 5 to 10 minutes prior to turning it on. This gives time for some recharging of the CMOS battery, which may have been drained.

1. Start your computer with essential hardware only. The purpose here is to remove as much hardware as possible while still maintaining your PC's ability to power on.

   ○ If your computer starts normally with only essential hardware installed, proceed to Step 11. ○ If your computer still isn't displaying anything on your monitor, proceed to Step 12.

   Important: This step is easy enough for a novice to complete, takes no special tools, and could provide you with a lot of valuable information. This isn't a step to skip if, after all the steps above, your computer is still not turning on completely.

2. Reinstall each piece of hardware that you removed in Step 10, one piece at a time, testing after each installation.

   Since your computer powered on with only the essential hardware installed, those components must work properly. This means that one of the hardware components you removed is causing your PC to not turn on properly. By installing each device back into your PC and testing each time, you'll eventually find the hardware that caused your problem.

   Replace the nonworking hardware once you've identified it. These Hardware Installation Videos should come in handy as you're reinstalling your hardware.

3. Test your computer's hardware using a Power On Self Test card. If your PC still isn't displaying information on your monitor with anything but essential computer hardware installed, a POST card will help identify which piece of remaining hardware is causing your computer to not come on completely.

   If you don't have and are unwilling to purchase a POST card, skip to Step 13.

4. Replace each piece of essential hardware in your computer with an identical or equivalent spare piece of hardware (that you know is working), one component at a time, to determine which piece of hardware is causing your computer to not come on all the way. Test after each hardware replacement to determine which component is faulty.

   Note: The average computer user doesn't have a collection of working spare computer

CHAPTER 5

Memory

Memory is the electronic holding place for instructions and data that your computer's microprocessor can reach quickly. When your computer is in normal operation, its memory usually contains the main parts of the operating system and some or all of the application programs and related data that are being used.

Memory is sometimes distinguished from *storage*, or the physical medium that holds the much larger amounts of data that won't fit into RAM and may not be immediately needed there.

Characteristics of Computer Memory

1. **Electrical Characteristics -** The voltage and current requirements depend on the manufacturing technology of the device. The voltage level is not of major concern because most of the semiconductor memory devices operate at TTL voltage levels.
2. **Speed -** There is a finite time delay between the application of address and the availability of stable and accurate data on the data lines. This memory delay depends on the manufacturing technology and other factors such as size.
3. **Capacity** representing the global volume of information (in bits) that the memory can store. Memory is small in size and hence its storage is relatively low

Types of Memories

1. **Random access memory**, generally called **RAM** is the system's main memory, i.e. it is a space that allows you to temporarily store data when a program is running.

   Unlike data storage on an auxiliary memory such as a hard drive, RAM is volatile, meaning that it only stores data as long as it supplied with electricity. Thus, each time the computer is turned off, all the data in the memory are irremediably erased.

2. **Read-only memory**, called **ROM**, is a type of memory that allows you to keep the information contained on it even when the memory is no longer receiving electricity. Basically, this type of memory only has read-only access. However, it is possible to save information in some types of *ROM* memory.

3. **Flash memory** is a compromise between RAM-type memories and ROM memories. Flash memory possesses the non-volatility of ROM memories while providing both read and write access However, the access times of flash memories are longer than the access times of RAM.

TYPES OF MEMORY MODULES PACKAGING

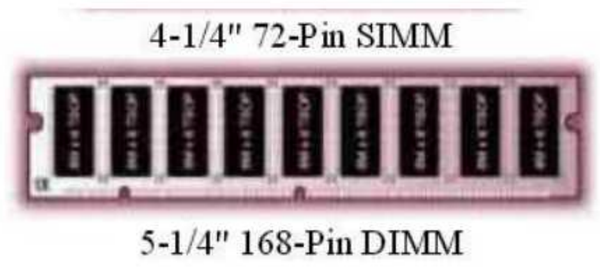
SIMMS

SIMM stands for Single In-Line Memory Module. Like other types of memory modules, a SIMM consist of memory chips soldered onto a modular printed circuit board (PCB), which inserts into a socket on the motherboard. 72 pin SIMMs transfer 32 bits of data at a time, therefore in modern microcomputers with a 64-bit data bus two SIMMs have to be paired up in order to function.

DIMMS

~~Dual In-~~line Memory Modules, or DIMMs, closely resemble SIMMs. Like SIMMs, most DIMMs install vertically into expansion sockets. The principal difference between the two is that on a SIMM, pins on opposite sides of the board are "tied together" to form one electrical contact; on a DIMM, opposing pins rem a in electrically isolated to form two separate contacts.

168-pin DIMMs transfer 64 bits of data at a time and are typically used in computer configurations that support a 64-bit or wider memory bus. Some of the physical differences between 168-pin DIMMs and 72-pin SIMMs include: the length of module, the number of notches on the modu[illegible]y the module installs in the socket. Another difference is that many 72-p[illegible] install at a slight angle, whereas 168-pin DIMMs install straight into the memory socket and remain completely vertical in relation to the system motherboard. The illustration below compares a 168-pin DIMM to a 72-pin SIMM.

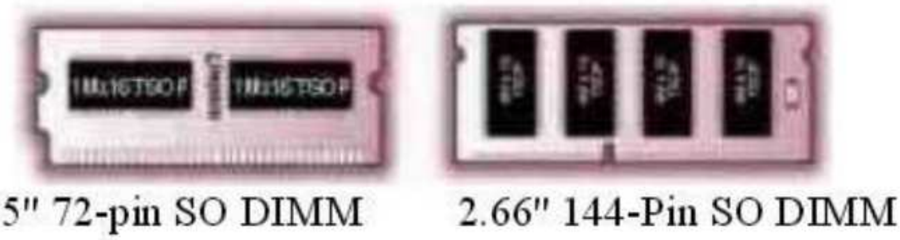


Comparison of a 72-pin SIMM and a 168-pin DIMM.

SO DIMMS
A type of memory commonly used in notebook computers is called SO DIMM or Small Outline DIMM. The principal difference between a SO

0 | 0

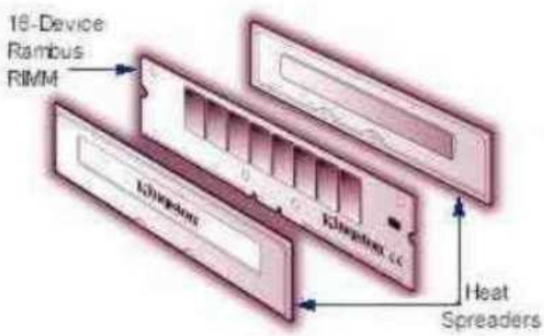
DIMM and a DIMM is that the SO DIMM, because it is intended for use in notebook computers, is significantly smaller than the standard DIMM. The 72-pin SO DIMM is 32 bits wide and the 144-pin SO DIMM is 64 bits wide.



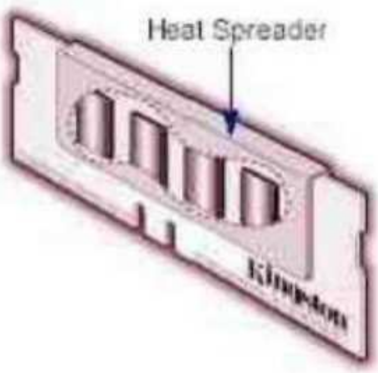
Comparison of a 72-pin SO DIMM and a 144-pin SO DIMM.

RIMMS AND SO-RIMMS

RIMM is the trademarked name for a Direct Rambus memory module. RIMMs look similar to DIMMs, but have a different pin count. RIMMs transfer data in 16-bit chunks. The faster access and transfer speed generates more heat. An aluminums heath, called a heat spreader, covers the module to protect the chips from overheating. A 184-pin Direct Rambus RIMM shown with heat spreaders pulled away.



An **SO-RIMM** looks similar to an SO DIMM, but it uses Rambus technology.



A 160-p… M module.

Memory-Mapping

What Is Memory-Mapping?

Memory-mapping is a mechanism that maps a portion of a file, or an entire file, on disk to a range of addresses within an application's address space. The application can then access files on disk in the same way it accesses dynamic memory. This makes file reads and writes faster in comparison with using functions such as `fread` and `fwrite`.

Benefits of Memory-Mapping

The principal benefits of memory-mapping are efficiency, faster file access, the ability to share memory between applications, and more efficient coding.

Faster File Access

Accessing files via memory map is faster than using I/O functions such as `fread` and `fwrite`. Data are read and written using the virtual memory capabilities ~~that are~~ built in ~~to the~~ operating system rather than having to allocate, copy into, and then deallocate data buffers owned by the process.

Efficiency

Mapping a file into memory allows access to data in the file as if that data had been read into an array in the application's address space. Initially, As a result, memory-mapped files provide a mechanism by which applications can access data segments in an extremely large file without having to read the entire file into memory first.

Memory Mapping types

There are a few different kinds of mappings that can be specified in the map attribute. All use the format described in the previous section.

Device Mapping: The most common kind of mapping. It is used for devices, RAM and ROM objects. The *target* field is not set.
Translator Mapping: Sometimes the address has to be modified between memory-spaces, or the destination memory-space depends on the address or some other aspect of the access such as the initiating processor. In these cases a *translator* can be used. A translator mapping is specified with the translator in the *object* field, and the default target as *target*. The translator has to implement the `TRANSLATE` interface. When an access reaches a translator mapping, the ***translate*** function in the `TRANSLATE` interface is called. The translator can then modify the address if necessary, and specify what destination memory-space to use. If it doesn't specify any new memory-space, the default one from the configuration is used. The following fields can be changed by the translator: `physical_address`, `ignore`, `block_STC`, `inverse_endian` and `user_ptr`.
Translate to RAM/ROM Mapping: Used to map RAM and ROM objects with a translator first. The *object* field is set to the translator, and *target* is set to the RAM/ROM object.
Space-to-space Mapping: Map one memory-space in another. Both *object* and *target* should be set to the destination memory-space object.

Bridge Mapping: A bridge mapping is typically used for mappings that are setup by some kind of bridge device. The purpose of a bridge mapping is to handle accesses where nothing is mapped, in a way that corresponds to the bus architecture. For a bridge mapping, the *object* field is set to the bridge device, implementing the BRIDGE interface. The *target* field is set to the destination memory-space.

Selection and upgrading memory

Do you suspect your computer could use more memory? Here's how to tell. Here are a few simple — but telling — signs that your computer could benefit from a memory upgrade.

You experience poor or sub-par performance in everyday tasks. For instance, a program doesn't respond or seems to take forever to open.

You get system notifications that say "low memory" or "out of memory".

You are having display problems. Like when you pull up a page and it either partially loads or if refuses to load at all. Or you see a blank space where data should be. In some cases, the PC refuses to operate at all. When you try to open anything, the system will not respond.

If you are experiencing any of these symptoms, a memory upgrade may be in order.

It's easy to tell how much memory is installed on your system and how much is being used

It's easy to tell how much memory is installed on your system and how much is being used.

Hardware Tips: Choose the Right Kind of Memory for Your System

Adding RAM to your PC usually delivers the most bang for your upgrade buck, but only if you buy the right kind of memory module for your PC. There are more types of PC RAM than there are lattes at Starbucks: Do you want SDRAM, PC100, non-parity, or un-buffered DIMM? Why not enjoy a refreshing DDR SDRAM, PC2700, CL2.5, or registered DIMM? Here are the ins and outs of PC memory.

Begin by checking your system's user manual to identify the types of RAM your PC's motherboard supports. If you don't have the manual, visit the manufacturer's Web site and search for downloadable manuals or other tools that might help you find the information you need.

Before you buy, ascertain the following:
Maximum module size**:** Find out the maximum size of memory module that your PC supports. Don't buy a module larger than what your motherboard's memory slots can each accommodate.

RAM and connector types**:** Determine which of the four types of RAM your system uses: DRAM (EDO or FPM), SDRAM, DDR SDRAM, or RDRAM. All four types are mounted on one of three module types: SIMM, DIMM, or RIMM.

Most machines support only one type of RAM and have one type of module or connector, so mixing types isn't an option. The few motherboards that do accept two types of RAM allow only a single type to be used at any one time.

Memory speed**:** SDRAM, DDR SDRAM, and RDRAM are rated to match or exceed the PC's front side bus speed, which is the speed at which data moves between the CPU and RAM. If your system comes with PC66 SDRAM, you can use PC100 SDRAM to replace it and get the faster speed, as long as your PC's front side bus supports the higher rate. But if you mix RAM of different speeds, all RAM will operate at the speed of the slowest chip.

Memory banks**:** On some PCs, the memory slot closest to the CPU--usually called bank 0-- ~~must be filled~~ before the motherboard's other memory slots. On other systems, bank 0 must have the largest RAM module (if you are using modules of different sizes). There's no fixed rule, so check your PC's documentation.

Non-parity or ECC**:** If your system supports error-correcting code (ECC) and has more ~~than 512MB of RA~~M, buying ECC memory may be worth the added cost. Large amounts of RAM are more likely to experience occasional, random errors (which may be caused by cosmic rays, among other sources). However, unless your current RAM is ECC, forget it; you can use non-parity and ECC modules together, but error correction will be disabled.

To determine your type of memory, count the number of chips on the memory module. If the number is divisible by three, you have ECC or parity memory.

Column address strobe**:** The lower the CAS rating--or the CL rating--is, the better. ~~SDRAM comes in CL~~2 or CL3 types, and DDR SDRAM comes in CL2 or CL2.5. Unless your motherboard requires a specific CAS or CL rating, get the lower (faster) rated module. Cost differences should be negligible. Again, if you mix modules of different speeds, they'll all operate at the slowest module's speed.

CHAPTER 6

Disks and Drives

Computer data storage, often called **storage** or **memory**, is a technology consisting of computer components and recording media used to retain digital data. It is a core function and fundamental component of computers. There are two different types of storage devices:

Primary Storage Devices: Generally smaller in size, are designed to hold data temporarily and are internal to the computer. They have the fastest data access speed, and include RAM and cache memory. Secondary Storage Devices: These usually have large storage capacity, and they store data permanently. They can be both internal and external to the computer, and they include the hard disk, compact disk drive and USB storage device.
Note: A disk is a device on which data is stored while a drive is a device used to record/read from a disk. Some devices incorporate the disk and drive together (i.e. Hard drive/hard disk drive) but others are in separate (i.e. CD/Floppy disks and drives)

Types of computer storage and Disks

The following are some examples of types of storage devices used with computers.

Magnetic storage/disks devices - Today, magnetic storage is one of the most common types of storage used with computers and is the technology that many computer hard drives use. It uses magnetism as its method of reading and writing data.

- Floppy diskette
- Hard drive
- Super Disk
- Tape cassette
- Zip diskette

Optical storage/disks devices - Another common storage is optical storage, which uses lasers and lights as its method of reading and writing data.

- Blu-Ray disc
- CD-ROM disc
- CD-R and CD-RW disc
- DVD-R, DVD+R, DVD-RW, and DVD+RW disc

Storage/Disk organization

If data needs to be kept whilst a computer is turned off then it must be stored on **backing store**. Any programs or data that are not currently being used by a computer will be kept on backing store. When programs or data are used they are copied (loaded) into main memory
(RAM) for faster access.

The purpose of storage in a computer is to hold **data** and get that data to the CPU as quickly as possible when it is needed. Computers use disks for storage: most commonly, hard disks that are located inside the computer (non-removable), and floppy or compact disks that are used externally (removable). Three types of Backing Storage media we will overview in this topic are; **Magnetic, Optical** and **Electronic** media.

Storage Media vs Storage Drives

Information stored on backing store is placed on a storage **medium**.

The data is read from or written to the storage medium by a piece of hardware known as a **drive** or a **storage device**. That is, a **storage device** records and retrieves items to and from a storage medium.

It takes much longer to access data which is on backing store than data which is in main memory, typically 100 to 1000 times as long.
This is because most backing s[illegible]es operate **mechanically**. Computer systems have much more backing store than main memory for two reasons:

1. Main Memory only needs to store programs and data that are currently being used whereas the backing store needs to hold all of the programs and data that can be
used on the computer.
2. Backing store is much cheaper per Mb than Main Memory.

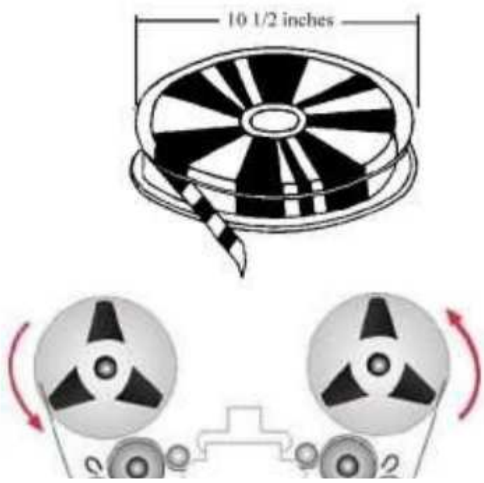
Capacity is the number of bytes a storage medium can hold.

Reading is the process of transferring data, instructions, and information from a storage medium into memory.

Writing is the process of transferring these items from memory to a storage medium.

Characteristics of Backing store

Data is usually accessed using read/write heads. These transfer the data while the medium rotates in the drive
Access to backing store is slower that to main memory
They are **non-volatile**. The data is stored on the medium until it is deleted.



Magnetic Media

Magnetic tape

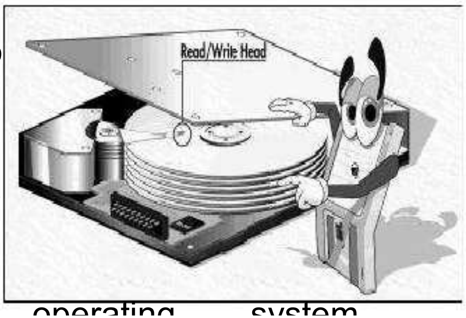
Magnetic tape is a narrow plastic ribbon coated with an easily magnetisable material on which data can be recorded. It is used in sound recording, audiovisual systems (videotape), and backups.

Tape is still used to make backup copies of important data. Information is recorded on the tape in binary form, with two different strengths of signal representing 1 and 0.
The device that reads the tape is the **Tape Drive** or **Tape Unit**.

Magnetic tape comes mainly in two different forms:

Reel to Reel	Large reels of tape which must be loaded into a reel-to-reel tape drive. This type of tape is usually used by mainframe computers.
Cartridges	The tape is supplied in a small cartridge rather like a music tape. This type of tape is used on PCs (microcomputers) and the device used to read/write the tapes is called a **tape streamer**. Capacities of cartridges vary from 10Gb to 200Gb.

Magnetic Discs - Hard Disks



The hard disk is a magnetic disk, usually fixed in the drive (internal) although nowadays there also exist external hard disks. Access to data is far faster than access to floppy disks. Hard disks store far more data than floppy disks. They are more reliable then flopp[illegible]ere is better protection against dirt. [illegible] are used to store the operating system

the operating system, application software and users' files.

A hard disk is made of a rigid disk which is coated with a magnetisable material. Hard disks spin much more quickly than floppy disks and the disk **read/write head** is positioned very close to the disk (thousandths of a millimeter away). Because the disk head is positioned so close to the disk hard drives can easily be damaged by dust or vibration. Therefore the disk, the drive head and all the electronics needed to operate the drive are built together into a sealed unit. This picture shows a hard disk drive with the case removed.

Usually (as in the picture above) several physical disks are contained in one hard disk unit. Each disk is known as a **platter**. Typical hard disk capacities for a home PC now start at up to 180 Gb.

Floppy Disks

Consists of a plastic case that 1/2 by 5 inches. Inside that case is a very thin piece of picture at right) that is coated with microscopic iron particles (magnetic). This disk is much like the tape inside a video or audio cassette. Never touch the inner

like the tape inside a video or audio cassette. Never touch the inner disk - you could damage the data that is stored on it.
Floppy disks are the smallest type of storage, holding only 1.44MB.


inside view

Access to data is much slower than for hard disk. The data on the disk can be protected by sliding a small write-protect tab which prevents the contents of the disk from being changed.


back view

Some hardware companies now produce storage devices (Zip disks) which are very similar to floppy disks but can store 100Mb or even 250Mb of data. These devices are also much faster than standard floppy disk drives.

How Hard disks and Floppy Disks Work - Magnetic

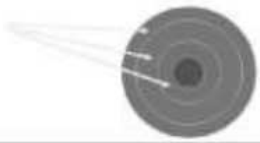
The process of reading and writing to a hard or floppy disk is done with electricity and magnetism. The surfaces of both types of disks can be easily magnetized. The electromagnetic head of the disk drive records information to the disk by creating a pattern of magnetized and non-magnetized areas on the disk's surface. Do you remember how the binary code uses *on* and *off* commands to represent information? On the disk, magnetized areas are *on* and non-magnetized areas are *off*, so that all information is stored in binary code. This is how the electronic head can both write to or read from the disk surface.

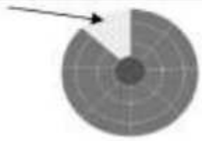
It is very important to always keep magnets away from floppy disks and away from your computer! The magnets can erase information from the disks!

Format of Magnetic Disks

All magnetic disks are similarly **formatted**, or divided into areas, called Tracks and Sectors. The formatting process sets up a method of assigning addresses to the different areas. It also sets up an area for keeping the list of addresses. Without formatting there would be no way to know what data went with what.

Tracks - A track is a circular ring on one side of the disk. Each track has a number. The diagram shows 3 tracks.

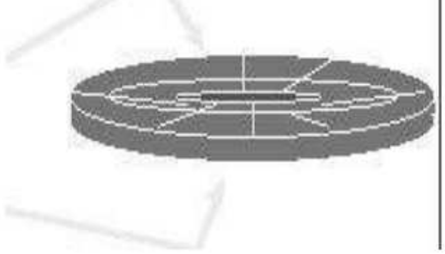




Sectors - A disk sector is a wedgeshap e piece of the disk. Each sector is numbered.

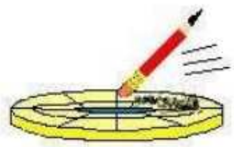
Double sided

A typical magnetic disk

		has two surfaces or sides. Each surface holds data in circular tracks and each track is divided into equal sections called sectors. The track number and sector number are used as an adderss to find where data is on the disk. Data can be both both written to or read from the disk. Magnetic

	disk are direct access i.e. any data item can be accessed without reading other data first.

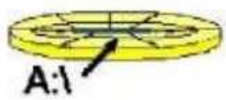
What happens when a disk is formatted?



~~1. **All data is** *erased*. ***Don't forget this!!***~~

2. ***Surfaces*** are ***checked*** for physical and magnetic defects.

3. A **Filing system** (with root directory) is created to list where things are on the disk.



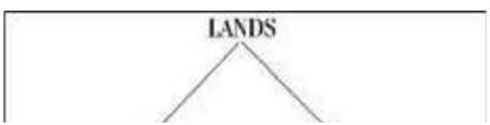
Optical Media

An optical disk is a storage medium in which laser technology is used to record and read large volumes of digital data.

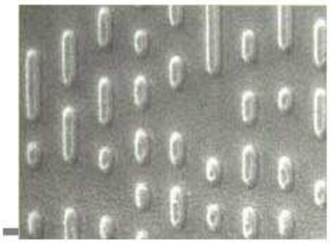
Compact Disks

CDs use _________ (microscopic indentations) and _____________ (flat surfaces) to store information much the same way floppies and hard disks use magnetic and non-magnetic storage. Inside the CDRom is a laser that reflects light off of the surface of the disk to an electric eye.

Compact disks are exchang easy to transport. Access to data is faster than access to floppy disks but slower than hard disks. CDs typically

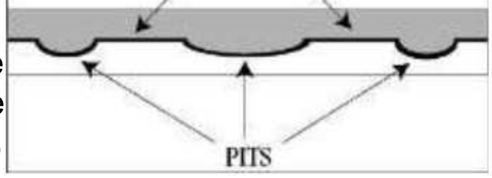


hold 650 or 700



51

megabytes of data, and are used in distributing large amounts of text and graphics, such as encyclopedias, catalogues, and technical manuals.



As with a hard disk the drive head in an optical drive can move directly to any file on the disk so optical disks are direct access.

CD-ROM (Compact Disk - Read Only Memory) - The data is written onto the CD-ROM disk before it is sold and can not be changed by the user. CD-ROMs are used for applications such as distributing software, digital videos or multimedia products.

CD-R (Compact Disk - Recordable) - A CD-R disk is blank when it is supplied. The user can write data to it just once. After data has been written to the disk it can not be changed. CD-Rs are often used for making permanent backups of data and distributing software when only a small number of copies are required.

CD-RW (Compact Disk - Rewriteable) - CD-RW disks can be read from and written to.

DVDs

DVD-ROM (Digital Versatile Disk - Read Only Memory) - DVD disks are able to store much more data than CD disks. The DVD standard includes disk capacities up to 30Gb. DVD-ROM disks can be read from but can not be written to.

DVD-RAM (Digital Versatile Disk - Random Access Memory) - DVD-RAM disks have all of the benefits of DVD-ROM disks and can be written to as well. These very high capacity disks are ideal for producing backups.

Because of their high capacity, DVD disks are used to store high quality video such as complete movies.

Disk management

Disk Management is an extension of the Microsoft *Management* Console that allows full *management* of the *disk*-based hardware recognized by Windows.
You can use Disk Management in this version of Windows to perform disk-related tasks such as creating and formatting partitions and volumes, and assigning drive letters.

What is a system utility?
System utilities are programs that are designed to help you fix and enhance your current computer system. Many operating systems include a range of utility programs to perform common tasks such as checking disks, backing up information, restoring information and reorganising information. Many other system utilities are available as third party software – this means that you purchase and install these utilities separately from the operating system software. Third party system utilities are designed to perform specific functions that the current operating system either does not perform or performs at a lesser standard.

The types of system utilities we'll look at in this reading will allow you to perform these basic tasks:

- disk scan
- disk defragment
- file back up
- file recovery
- get system information.

What is a disk scan?

~~A disk scan is a use~~ful utility to hel[illegible] repair problems on a hard disk or floppy disk; it is provided with some operating systems. It can perform a thorough check of the disk's surface to ensure that it is able to read and write information on all areas of the disk. If the disk scan utility finds a problem it will usually display a message and offer to fix the problem.

There is a disk scan utility on recent versions of Microsoft Windows and Apple Macintosh operating systems, where if you turn off your computer without exiting the system, the **Scan Disk** utility will run automatically the next time you start your computer.

There are also third party utilities that you are able to use that will perform similar and sometimes more thorough scans of the disk.

What is defragment?

To a computer, defragment means that all the files on the computer's hard disk will be placed in a neat and tidy order.

Gradually, as a computer hard disk has many files added, updated and deleted, the files can start to become fragmented. **Fragmentation** means that portions of the files are scattered all over the disk. A defragment will ensure that all files are reordered so that their parts are placed adjacent to one another. This will mean the computer can now read these files much more quickly.

Depending on how many files need to be reorganised, a defragment can take hours. If you use your computer regularly you should try and do a **defragment at least once a month**. A good time to do a defragment may be overnight – when nobody will be using the computer.

Often an operating system will include several system tools, including the defragment utility. If it is not included with the operating system, a defragment program can be purchased as an external software program (a third party utility).

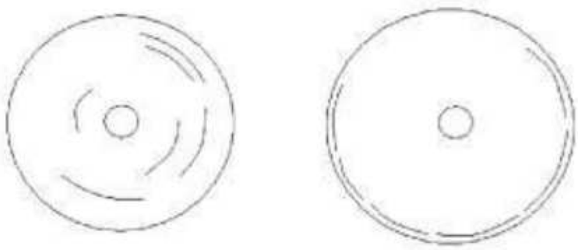


Figure 1: A diagram of a disk before and after a defragment. The picture on the left displays a disk with lines (representing data) that have been randomly placed on the disk. The picture on the right displays a disk after defragmentation — the lines (data) now appear in a consecutive order.

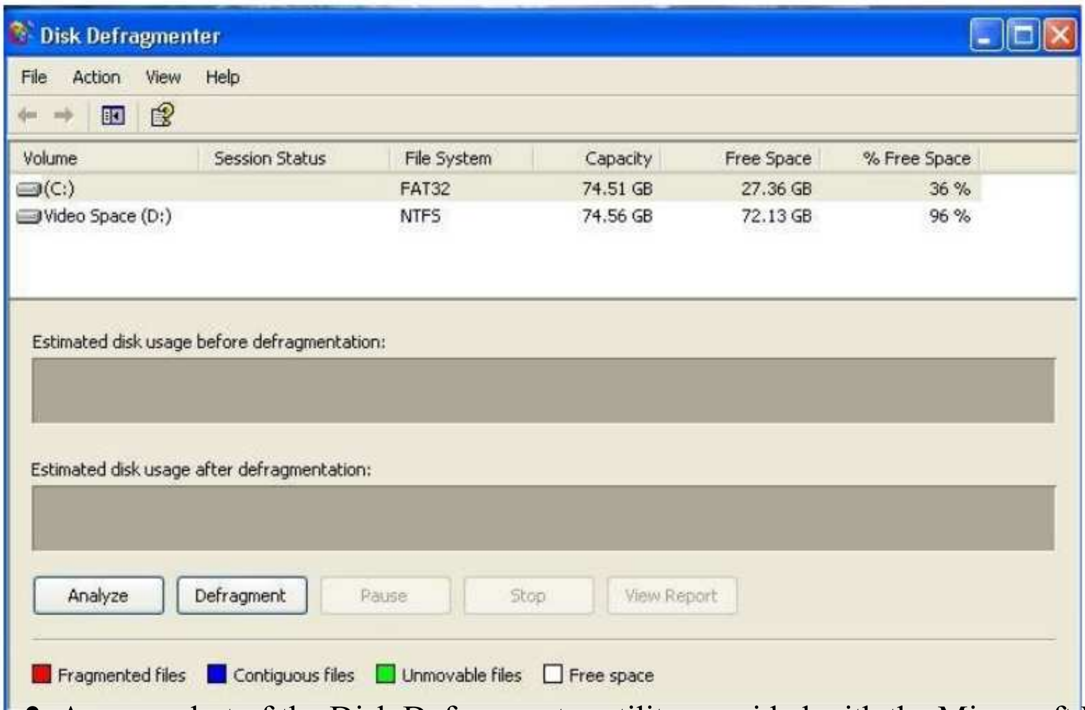


Figure 2: A screenshot of the Disk Defragmenter utility provided with the Microsoft Windows XP operating system

Backing up

Backing up means making a copy of your files, in case your computer hard disk fails and your original files become 'corrupted'. Although for the majority of time the computer's hard disk will not have any problems, occasionally a disk may fail unexpectedly. Some reasons why a hard disk may fail include: 🎬 a sudden p

- computer virus damaging the hard disk

- damaged caused by knocking or moving the hard disk.

Backups need to be done on a **regular basis**, so if there is a problem you will still have a recent copy of your files. It is also a good idea to keep backups in another location away from your computer. Make sure where you store your backup information is away from sunlight, dust and magnetic fields.

Choosing a backup media

It is important to choose the most appropriate kind of media to backup data to. When choosing media, be realistic; it is better to store backups using media that has a large capacity. Some suggestions include:

- **Second hard disk**: Some computers may have a second hard disk available that will allow a fast and easy method of backing up data.

- **CD or DVD:** Many computers have CD and DVD burners that will allow you to ‘burn’ data onto a writeable CD or DVD.
- **Zip disk**: Zip disks are removable disks that hold between 100MB and 250MB of information.
- **Tape drive**: A medium that may be used by a business to backup business information.

What should you backup?

Backup anything that you have created yourself — including documents, digital photographs and video. All of these items will have no other way of being replaced if there are problems later on. If there is a problem, you can always reinstall the operating system and the application software using the original software CDs.

How often should you backup?

How often you backup will really depend on how often you use the computer and what is being stored on the computer. If, for example, your computer contains important business information that you are using everyday, it is a good idea to try to back up **everyday**. If, however, you only use your computer occasionally to play games or write the odd letter, a backup will probably only need to be done **once a month**.

How to perform a backup

Some operating systems include special backup utilities that make it easy for you to back up important files. If you don’t have a backup utility already installed you could install a third party program that is designed to do backups or manually copy and paste your files from the hard disk to your backup device.

Backup programs allow you to easily select files that you want to back up, then they copy the files to the chosen backup device. A backup program may also compress the files before they are copied so you can fit more files onto the backup device.

Recovery

A recovery utility is used to **undelete** a file that has been accidentally deleted. Many operating systems now include special recovery utilities to help you restore files that have accidentally been removed. Microsoft Windows includes a **Recycle Bin** and Macintosh operating systems include **Trash**. Both of these utilities allow you a second chance to undelete any files on the hard disk.

There is also a recovery utility in recent version of Microsoft Windows called **System Restore**. The System Restore utility keeps a regular log of all current settings so if, for example, a new installation of a program is causing problems System Restore will be able to reset all settings back to how they were before the installation.


System Properties
General
Computer Name
Hardware
Advanced
System Restore
Automatic Updates
Remote
System Restore can track and reverse harmful changes to your computer.
Turn off System Restore on all drives
Drive settings

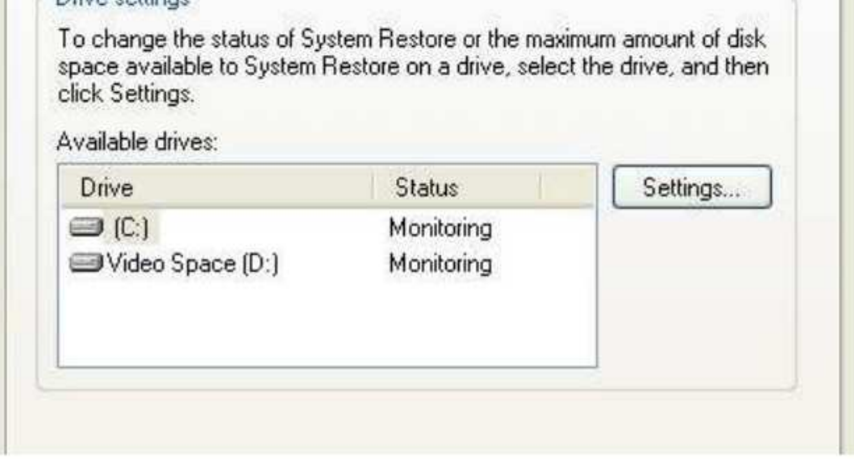


Figure 3: A screenshot of the System Restore utility in Microsoft Windows XP operating system

Hard Disk Interface(s)

Hard drives and other devices are connected to a computer motherboard through some type of cable. These cables use multiple smaller wires in parallel to transmit the proper signals for reading and writing to and from the drive. There are multiple types of cables, which transmit at different speeds and use different types of connectors. Here we will look at some of the most common device cables and the differences between them.

SCSI - SCSI stands for Small Computer System Interface and used a parallel cable to attach both internal and external devices. One of the benefits of SCSI interfaces is that multiple devices could be chained together to a single port. Another benefit is that the interface includes features like error checking and hand shake signals between devices.

IDE - IDE stands for Integrated Drive Electronics and refers more to the standard than the cable type itself. The technology is also often referred to as ATA or PATA. ATA cables can only be up to 18 inches in length and are fairly large and flat, which makes them a poor choice for external devices, so the interface is mainly used for internal devices. The cable uses a combination of 40 or 80 wires in parallel.

SATA - SATA stands for Serial ATA and is an evolution of the original ATA (or IDE) interface. The SATA interface is faster in speed, at up to 3GB/s. Another major benefit of the interface is that the cables and connectors are much smaller, taking up less space inside a computer case and not restricting air flow. There is an external version of SATA known as eSATA for connecting external hard drives and other devices.

Interface cables have improved quite a bit over the years, but the basic concept of input and output has remained mainly the same. New interfaces such as Thunderbolt have added even faster transfer speeds and taken some of the benefits from multiple technologies to make an improved connection.

Formatting and Partitioning a Hard Drive

Definitions

There are a few words we need to define before going any further. Don't worry, there *won't* be a test. :-)

- **Partition, partitioning:** Free space on a hard disk must be partitioned before it can be used by an operating system. Creating a partition reserves a physical portion of the hard drive space for use as a logical drive, or volume, that the operating system can address.
- **Volume:** A volume is how the operating system 'sees' your free disk space. Volumes (also called logical drives) are represented in Windows by drive letters such as C:, E:, etc. Volumes are formed by partitioning the free space of a hard drive. Volumes must be formatted with a file system before data can be stored on them.

- **Formatting:** Formatting is the act of creating a file system on a volume, so that the operating system can store and retrieve data on volume, so that the operating system can store and retrieve data on that volume.

- **File system:** A file system provides a means of organizing and retrieving information written to a hard disk or any other storage medium. A file system is created on a volume when it is formatted. Common Windows file systems include FAT32 (File Allocation Table 32) and NTFS (New Technology File System).

Partition can be thought of as a division or "part" of a real hard disk drive. When you partition a hard drive, you make it available to an operating system. Multiple partitions on a singe hard drive appear as separate drives to the operating system.
A partition also is used to mean the *division* of certain kinds of secondary storage (such as hard disk drives (HDDs)), via the creation of multiple sub-divitions. Partitions are logical containers which are usually used to house file systems, where operating systems, applications, and data are installed on. A single partition may span the entirety of a physical storage device.
Disk formatting is the process of preparing a data storage device such as a hard disk drive, solid-state drive, floppy disk or USB flash drive for initial use.
The first part of the formatting process that performs basic medium preparation is often referred to as "low-level formatting".

The second part, Partitioning is the common term for the part in the process in disc preparation, making the data storage device visible to an operating system.
The third part of the process, usually termed "high-level formatting" most often refers to the process of generating a new file system. In some operating systems all or parts of these three processes can be combined or repeated at different levels and the term "format" is understood to mean an operation in which a new disk medium is fully prepared to store files.

CHAPTER 7

Computer display

A **computer monitor** or a **computer display** is an electronic visual display for computers A **display device** is an output device for presentation of information in visual or tactile form (the latter used for example in tactile electronic displays for blind people). When the input information is supplied has an electrical signal, the display is called an *electronic display*.

display adapter

A plug-in card in a desktop computer that performs graphics processing. Also commonly called a "graphics card" or "video card," modern display adapters use the PCI Express interface, while earlier cards used PCI and AGP. The display adapter determines the maximum resolution, refresh rate and number of colors that can be displayed, which the monitor must also be able to support. On many PC motherboards, the graphics circuits are built into the chipset, and a separate plug-in card is not required.

Types of computer monitors

Most people use computer monitors daily at work and at home. And while these come in a variety of shapes, designs, and colors, they can also be broadly categorized into three types. If you are not sure what these are and would like an introduction to the different types of computer monitors then here we explain the three main types, as well as the pros and cons of each.

CRT (cathode ray tube) monitors

These monitors employ CRT technology, which was used most commonly in the manufacturing of television screens. With these monitors, a stream of intense high energy electrons is used to form images on a fluorescent screen. A cathode ray tube is basically a vacuum tube containing an electron gun at one end and a fluorescent screen at another end.

While CRT monitors can still be found in some organizations, many offices have stopped using them largely because they are heavy, bulky, and costly to replace should they break. While they are still in use, it would be a good idea to phase these monitors out for cheaper, lighter, and more reliable monitors.

LCD (liquid crystal display) monitors

The LCD monitor incorporates one of the most advanced technologies available today. Typically, it consists of a layer of color or monochrome pixels arranged schematically between a couple of transparent electrodes and two polarizing filters. Optical effect is made possible by

polarizing the light in varied amoun… g it pass through the liquid crystal layer. The two types of LCD technology available are the active matrix of TFT and a passive matrix technology. TFT generates better picture quality and is more secure and reliable. Passive matrix, on the other hand, has a slow response time and is slowly becoming outdated.

The advantages of LCD monitors include their compact size which makes them lightweight. They also don't consume much electricity as CRT monitors, and can be run off of batteries which makes them ideal for laptops.

Images transmitted by these monitors don't get geometrically distorted and have little flicker. However, this type of monitor does have disadvantages, such as its relatively high price, an image quality which is not constant when viewed from different angles, and a monitor resolution that is not always constant, meaning any alterations can result in reduced performance.

LED (light-emitting diodes) monitors

LED monitors are the latest types of monitors on the market today. These are flat panel, or slightly curved displays which make use of light-emitting diodes for back-lighting, instead of cold cathode fluorescent (CCFL) back-lighting used in LCDs. LED monitors are said to use much lesser power than CRT and LCD and are considered far more environmentally friendly.

The advantages of LED monitors are that they produce images with higher contrast, have less negative environmental impact when disposed, are more durable than CRT or LCD monitors, and features a very thin design. They also don't produce much heat while running. The only downside is that they can be more expensive, especially for the high-end monitors like the new curved displays that are being released.

Being aware of the different types of computer monitors available should help you choose one that's most suited to your needs. Looking to learn more about hardware in today's world? Contact us and see how we can help.

Factors That Affect The Quality Of A Display Device
(Monitor performance measurement)

The quality of a CRT monitor depends largely on its resolution, dot pitch, and refresh rate. The quality of an LCD monitor or display depends primarily on its resolution.

A CRT monitor's screen is coated with tiny dots of phosphor material, called pixels, that glow when electrically charged to produce an image.

Resolution, which describes the sharpness and clearness of that image, is related directly to the number of pixels a monitor can display. The greater the number of pixels the display uses, the better the quality of the image.

Dot pitch, a measure of image clarity, is the distance between each pixel on a display. The smaller the distance between pixels (dot pitch), the sharper the image.

Refresh rate is the speed that a monitor redraws images on the screen. Refresh rate should be fast enough to maintain a constant, flicker-free image.

The resolution of an LCD monitor or display generally is proportional to the size of the monitor or display. That is, the resolution increases for larger monitors and devices.

Computer Monitor Troubleshooting

How to Test a Computer Monitor that Isn't Working

1. Check to make sure your monitor is on! Some monitors have more than one power button or switch - check to make sure they're all switched on.
2. ~~Check fo~~r disconnected monitor power cable connections. Your monitor might be ~~working fine and your only problem may be a loose or~~ unplugged monitor power cable.

Note: A disconnected monitor power cable could be the cause of your problem if your monitor's power light is completely off.

3. Check for disconnected monitor data cable connections. Again, your monitor might be turning on without a problem but no information can get to it because the cable that connects your monitor to your computer is disconnected or loose.

   Note: A disconnected monitor data cable could be the cause of your problem if your monitor's power light is on but is amber or yellow instead of green.
4. Turn the monitor's brightness and contrast settings completely up. Your monitor might be showing information but you just can't see it because these display settings are too dark.

   Note: Most monitors today have a single onscreen interface for all settings, including brightness and contrast. If it turns out that your monitor isn't working at all then you'll likely not have access to this interface. An older monitor might have manual knobs for adjusting these settings.

1. Test that your computer is working correctly by connecting a different monitor that you are *certain is working properly* to your PC. Your monitor may be working fine but your computer might not be sending information to it.

   - If the new monitor you connected does not show anything either, proceed to Step 6.
   - If the new monitor you connected does show information from your computer, proceed to Step 7.

   Important: When testing with the new monitor, make sure you use the data cable that came with it and not the one from your original monitor.

1. Determine why your computer isn't sending information to your monitor. Since neither monitor works, you now know that the computer is not sending information to the monitor. In other words, you've proven that your computer is the reason that nothing shows up on your monitor.
   Chances are your original monitor is working fine.
2. Test your original monitor with a monitor data cable that you *know is working*. It's possible that the monitor itself is working properly but it can't receive information from the computer because the cable that connects the monitor to the PC is no longer working.

   Note: If possible, test using the data cable from the monitor that you successfully tested with in Step 5. If not, purchase a replacement monitor data cable to test with.

   Note: The data cable on some older monitors are permanently connected to the monitor and are not replaceable. In these cases, you'll have to skip this step and proceed to Step 8.
3. Replace the monitor.

   WARNING: A computer monitor is not a user serviceable device. In other words - do not open the monitor and attempt to repair it yourself. If you would rather have your dead monitor serviced instead of replaced then please let a professional do it.

How To Fix a Computer That Turns On But Displays Nothing

Fixing a computer with this problem could take anywhere from minutes to hours depending on why exactly the computer isn't displaying anything on the monitor, which we'll figure out as we troubleshoot the issue.

1. Test your monitor. Before you begin more complicated and time-consuming troubleshooting with the rest of your computer, make sure your monitor is working properly.

   It's possible that your computer is working fine and your monitor is your only problem.
2. Verify that your PC has fully power cycled. In other words, make sure your computer has completely reset - make sure g on from a completely powered-off state.

   Often times a computer will appear to "not be on" when actually it's just having problems resuming from either the Standby/Sleep or Hibernate power saving mode in Windows.

Note: You can power off your computer completely while in a power saving mode by holding the power button down for 3 to 5 seconds. After the power is completely off, turn on your PC and test to see if it will boot normally.

1. Troubleshoot the cause of the beep code if you're lucky enough to get one. A beep code will give you a very good idea of exactly where to look for the cause of your computer turning off.

If you don't resolve the problem by troubleshooting to the specific beep code, you can always return here and continue with the steps below.

1. Clear the CMOS. Clearing the BIOS memory on your motherboard will return the BIOS settings to their factory default levels. A BIOS misconfiguration could be why your PC won't startup all the way.

   Important: If clearing the CMOS does fix your problem, make sure any changes you make in BIOS are completed one at a time so if the problem returns, you'll know which change caused your issue.
2. Verify that the power supply voltage switch is set correctly. If the input voltage for the power supply is not correct (based on your country) then your computer may not turn on completely.

   There's a good possibility that your PC wouldn't power on at all if this switch is wrong but an incorrect power supply voltage might also prevent your computer from starting properly in this way too.
3. Reseat everything possible inside your PC. Reseating will reestablish the various connections inside your computer and is very often a "magic" fix to problems like this one.

   Try reseating the following and then see if your computer begins to display something on screen:
   - Reseat all internal data and power cables
   - Reseat the memory modules
   - Reseat any expansion cards

   Note: Unplug and reattach your keyboard and mouse as well. There isn't a great possibility that the keyboard or mouse is causing your computer to not turn on fully but we might as well reconnect them while we're reseating everything else.

1. Reseat the CPU only if you suspect that it might have come loose or might not have been installed properly.

   Note: I call this out separately only because the chance of a CPU coming loose is very slim and because installing one is a sensitive task. This isn't a big concern if you're careful, so don't worry!
2. Check for causes of electrical shorts inside your computer. This is often the cause of the problem when the computer powers off by itself but certain shorts can also prevent your computer from booting fully or showing anything on the monitor.
3. Test your power supply. Just because your computer's fans and lights are working does not mean that the power supply is functioning properly. The PSU tends to cause more problems than any other hardware and is often the cause of a computer not coming on all the way.

   Replace your power supply immediately if it fails any test you perform.

vulnerability using tools such as firewalls or Intrusion Detection Systems should be put into place.

- Make regular backups of critical data.
  It is important to ensure that regular copies of important files are kept either on removable media such as portable drives or tape to ensure you have a trusted source for data in the event that the network is infected with a computer virus. Not only will this ensure that important data is available in the event of a computer virus infecting the company's network, backups will also enable the company to restore systems to software that is known to be free from computer virus infection. For added security you should store these backups securely offsite. That way should a major disaster happen to the business, e.g. the building goes on fire, the data will remain safe in the secure offsite location and can be restored quickly in a new facility

- Develop an Information Security Policy.
  The creation and publication of an Information Security Policy is key to ensuring that information security receives the profile it requires in the organisation and is the first critical step in securing the company's systems and data. It is important that senior management support the Information Security Policy and that all users are made aware of their roles and responsibilities under this policy.

- Monitor logs and systems.
  Regular monitoring of network and system logs can assist in the early identification of a computer virus infecting the network or other attacks by criminals. Unusual traffic patterns or log entries could indicate that the network has been infected or that its security has been compromised. As well as monitoring for suspicious traffic and events, it is important that logs for other devices are checked regularly to ensure that the network remains protected. Log files for the backups should be checked regularly to ensure that the backups succeeded, likewise the log files for anti-virus software deployed should be regularly checked to ensure that all PCs are running the latest version of the anti-virus software.

- Develop an Incident Response Plan.
  Knowing what to do when a computer virus enters the network or when you suffer a security breach is critical to minimise the damage they may cause, both to the business and also to customers and suppliers. The incident response plan should outline the roles and responsibilities that people have in the event of a computer virus infecting the network or indeed any other type of security breach. This plan should be drawn up and agreed between all relevant parties before an incident occurs. Remember, the worst time to develop a security incident response plan is in the middle of such an incident.

- Restrict end user access to systems
  Where possible, end users should not be given administrative privileges to their workstations. Most computer viruses can only run in the context of the user that is logged into the system, i.e. they only have the same permissions as the user running the program. If that user has their access restricted, then the virus will be similarly restricted. Unfortunately

many applications designed for the Windows platform require the end user to have such privileges; however these users should be the exception rather than the rule.

Cyber criminals poses a very real and constant threat to every business. It is important that businesses recognise this threat and take the appropriate steps, such as those outlined above, to reduce the likelihood and minimise

CHAPTER 14
Emerging issues and trends

1. Best Practices **2.** Help Desk **3.** IT **4.** Operations

5. Productivity

Introduction

Today's enterprise IT support organizations and help desks are experiencing a dramatic shift in the way technologies are developed, deployed and consumed. Applications are evolving faster than ever, with new cloud-based solutions emerging almost weekly to replace the stodgy onpremise solutions of generations past. User expectations arent far behind; a new generation of tech-savvy users increasingly expects the latest and greatest, including mobile compatibility. The result is a constantly evolving portfolio of applications and technologies that IT organizations must support, while being more responsive and empathetic than ever beforeall without increasing costs.

As always, progress is a double-edged sword for IT support. Because IT is responsible for enabling company-wide productivity, it sits squarely under the collective corporate microscope. User satisfaction is now at the forefront as new technologies enable more efficient communication, which is both boon and bane to IT support. Seeking comments and anticipating issues are the keys to effective support, and new technologies are also simplifying the feedback process.

This paper presents five interrelated trends impacting the way IT support organizations operate:

Productivity pressures Cloud computing Consumerization of IT Corporate social media Raising the bar on service

The intended audience for this paper includes executives, IT management, software development/QA leadership, and anyone else interested in delivering unsurpassed support.

1. Productivity Pressures

Perhaps no single organization is as vital to company-wide productivity as IT. While most organizations are responsible for their own efficiency, IT ultimately owns that of the entire enterprise. Driving efficiency across an entire organization comes down to two key areas: tools and procedures. IT must effectively select and employ both to keep everyone happy and productive.

Choosing the right software

Ideal applications combine usability and consistency with brisk implementation and low maintenance. The former, usability and consistency, are vital to managing the IT help desk's workload. Ensuring that users are quickly able to understand the interface and that it works consistently will minimize the number of end-user issues. By keeping implementation times short and maintenance low, IT technicians have more time to focus on resolving existing issues and implementing new productivity-enhancing systems.

Stringent vs. fluid procedures

Many IT support organizations looking to increase efficiency are turning to best practice frameworks, such as ITIL, that provide guidance on how IT should deploy and support software. However, there's a significant risk of getting bogged down in endless processes, paperwork, and heavyweight technology deployments aimed at optimizing the support experience. **The IT help desk must balance the desire to comply with rigid standards and best practices with the reality of needing to provide excellent service to their customers (end users) right now.** Ultimately, successful organizations will use ITIL and related methodologies as a blueprint and let procedures evolve as feedback dictates.

The right support platform

The last piece of the IT help desk puzzle is using a support platform that makes life easier for agents and end users alike. For end users, this means a simple interface for submitting issues and knowledge bases where users can quickly locate answers or discuss issues with the community. For agents, this means a system that increases end-user visibility into ticket status, is able to automate repetitive tasks and helps process feedback. Finding the right blend is vital, since all customer interactions are routed through the customer support platform. (More on this in trend five: Raising the Bar on Customer Service.)

2. Cloud Computing

The C-suite mantra for IT has always been faster, better, cheaper — doing more with less. Software as a service (SaaS or cloud-based software) is now delivering on this promise. Improvements in underlying infrastructure have solved the uptime and scaling issues that plagued SaaS solutions in the early 2000s, turning them into the go-to delivery method for customer relationship management (CRM), marketing automation and customer support. Cloudbased solutions have several benefits over on-premise solutions:

- Simple and inexpensive deployment
- Access to data from anywhere, including mobile devices
- No hardware or maintenance costs
- Fewer data security issues
- Seamless product updates
- Affordable, pay-as-you go pricing

Many large providers are now planning to migrate legacy on-premise solutions to the cloud knowing that IT departments are increasingly willing to outsource data security, upgrades and maintenance to software providers. As cloud becomes the industry standard, help desk staff must be ready to support a diverse set of applications that need less technical day-to-day involvement, but change more often and require them to support these changes.

When things go wrong, the IT help desk is the first line of support, whether these resources and applications reside in the cloud, behind the firewall, or a mixture of both. In fact, there's a good chance most users won't know (or care) who owns the resource: all they know is that they need help — right now, and they're unsympathetic to gaps between data that lives in the cloud and data that resides on-premise.

3. Consumerization of IT

Today's users are reaping the rewards of two rapidly evolving fields, mobile device manufacturing and consumer website development, which are increasing IT expectations in today's user base.

As mobile devices continue to expand their power, sophistication and reach, users are acclimating to streamlined native application experiences, intuitive interfaces and constant data availability. Further, phones are becoming the center of many peoples' online lives thanks to robust social apps like Path® and Foursquare®, leaving them unwilling to adopt separate work devices. These high expectations are creating a bring-your-own-device (BYOD) culture where support for multiple platforms is expected.

A recent CIO.com article showed that 60% of respondents are seeing increased support demand for Apple®'s Mac® OS X®10. This is partly due to the rising popularity of iOS through the iPhone and iPad, but also a sign that Macs are gaining market share at home where employees are skewing the traditional work/life balance. At home, consumer websites, such as Facebook® and Twitter®, are gaining mobile-like elegance and interactivity thanks to advancements in front-end languages, and many of these popular consumer sites also have accompanying mobile apps that allow on-the-go access, which many now desire from their work applications. Even the most progressive IT departments are struggling to adapt responsibly.

These expectations are helping fuel cloud popularity thanks to browser-delivered flexibility. Many cloud apps support multiple operating systems and mobile devices, whereas on-premise solutions have limited compatibility. Cloud applications also benefit from the same front-end programming developments as consumer applications, meaning they have better interfaces that are more easily updated than their on-premise counterparts. Further, some cloud solutions have companion mobile apps that provide secure access to the native experience users crave. From a support perspective, **native apps help IT cope with today's BYOD climate by offloading compatibility and data security to providers.**

4. Corporate Social Media

For many employees, social-networking platforms (e.g. Facebook and Twitter) are at the heart of their personal online experiences. Given their reliance on these tools, companies are turning to analogous corporate social media tools, such as Yammer®, to help fuel collaboration across divisions.

Unsurprisingly, employees are using these channels to seek assistance and/or vent about ITrelated issues, making it an important channel for harnessing feedback and even deflecting issues. The help desk should monitor these channels for relevant conversations and interject when necessary by pointing users to relevant knowledge base articles or asking them to submit tickets for further help. By participating in the conversation, support looks proactive and can raise awareness about self-service resources — the latter of which may help deflect issues that would otherwise result in issues.

Further, corporate social media enables faster feedback and collaboration through polls and groups. What once took weeks of coordination can now be accomplished in a matter of hours by polling users or setting up a small task force to discuss an issue. In short, corporate social media can fuel productivity for IT departments the same way it does across the rest of the organization.

5. Raising the Bar on Service

IT is and always will be a service organization that's goal is to create a safe, productive environment for employees. For too long, IT organizations have focused on technology rather than users, but the tide is turning. Today's IT organizations are being encouraged to adopt a customer service view of IT support where customer satisfaction is the new measuring stick.

This is partly driven by IT's desire for continual process improvement, and partly driven by more demanding users. In an effort to align operations with the business and provide better service to this customer base, many IT teams are actively implementing industry standard best practices, including IT service management (ITSM) process-improvement methodologies.

Regardless of the exact name, these IT best practices recommend visualizing the interaction experience from the perspective of the customer (i.e. the user). This treats the delivery of all IT benefits as services, which is very different than traditional technology-centric viewpoints of IT and its offerings.

User requirements for the speed and quality of IT support are now much higher than ever before. IT organizations must adjust their focus towards their primary mission: delivering speedy, highquality services that will be consumed by people, rather than spending excessive time tending to the underlying support technology that helps deliver these services. To ensure that they're on the right track and delivering the best possible service, it's essential for the IT team to continually seek feedback from their customers using surveys and other quantitative methods.

Self-service

Support organizations are learning that it's no longer possible to dictate how users will receive service. Self-service has become an increasingly common part of daily life, and users expect resources that help them answer their own questions. Providing online communities, FAQs and knowledge bases are simple ways to provide the 24-hour support users crave, and many customer support solutions include this functionality.

Conclusion

Coping with today's rapidly changing IT environment requires an agile team that's willing to adopt new technologies and take measured risks to better serve their internal customers. Cloudbased software is one of the best ways to cope with increased productivity pressures and device compatibility issues, making it a must on every CIO's list for future upgrades. As the cloud lessens maintenance concerns, support organizations must be ready to stay vigilant and improve documentation in order to better serve users at scale, while simultaneously harnessing feedback to adapt and improve processes and foresee issues. Lastly, progressive IT organizations will need to balance adherence to strict procedures with the need to keep internal customers happy.