Group 1

**Clustered Environments**

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What is a cluster?

 A cluster is a set of computers or servers tightly integrated via high speed networks with shared or replicated storage which work in conjunction with each other to provide a highly available service or high speed calculations where needed in research projects which require massive amounts of computing power. In a society where time is money, we have developed technology in a way that enables us to either speed up processes or ensure that time is not lost due to unexpected downtime. Clustering systems is a good way to maximize uptime and monetary gains.

What is cluster used for?

 In computers, clustering is the use of multiple computers, typically Windows or UNIX workstations or servers, multiple storage devices, and redundant interconnections, to form what appears to users as a single highly available system. Cluster computing can be used for load balancing as well as for high availability. Advocates of clustering suggest that the approach can help an enterprise achieve 99.999% availability in some cases. One of the main ideas of cluster computing is that, to the outside world, the cluster appears to be a single system.

A common use of cluster computing is to load balance traffic on high-traffic websites. A web page request is sent to a "manager" server (load balancer), which then determines which of several identical or very similar web servers to forward the request to for handling. Having a web farm (as such a configuration is sometimes called) allows traffic to be handled more quickly. Clustering has been available since the 1980s when it was used in DEC's VMS systems. IBM's SYSPLEX is a cluster approach for a mainframe system. Microsoft, Sun Microsystems, and other leading hardware and software companies offer clustering packages that are said to offer scalability as well as availability. As traffic or availability assurance increases, all or some parts of the cluster can be increased in size or number.

Cluster computing can also be used as a relatively low-cost form of parallel processing for scientific and other applications that lend themselves to parallel operations. An early and well-known example was the Beowulf project in which a number of off-the-shelf PCs were used to form a cluster for scientific applications. These were originally developed by Thomas Sterling and Donald Becker at NASA in 1994. This was designed to do the work of supercomputing.

1. Load balancing: Two or more servers work together, but are transparent to the user. So the load balancer, through which the servers are connected, takes care of properly diverting the http request (in case of web servers) to the available server.
2. Failover: In case of a server failure, other servers take over the request and give the feel of an unhindered service to the user.
3. Scalability: The network size can be increased. A sense of parallel processing comes in as the different servers in the cluster are transparent to the user

Cases, Racks and Power Supplies

A computer case houses the main components of a computer. Cases are usually manufactured from steel, aluminum, or plastic. The cases usually come with room for a power supply unit, expansion slots and expansion bays, and wires for powering up a computer. Cases come with built in input/output ports that get connected to a motherboard. It is important to consider a computer case that accommodates the motherboard form factor. The motherboard form factor specifies what type of case and power supply will be supported, the placement of mounting holes, and the physical layout and organization of the board.

Some of the main form factors where computer motherboards are concerned are Advanced Technology Extended (ATX), Micro Advanced Technology Extended (Micro-ATX), Low Profile extension (LPX), New Low Profile Extended (NLX), and Balanced Technology Extended (BTX).

One of the major computer mother board form factors is ATX. Advanced Technology Extended (ATX) is a computer form factor developed by Intel in 1995. It was the first major change in computer case, motherboard, and power supply design. ATX overtook the AT form as the default form factor for new systems. The Advanced Technology (AT) form factor refers to the dimensions and placement of the motherboard for the IBM compatible personal computer which was very popular in the 1980s and early 1990s. ATX addressed many of the AT form factor's inconveniences that had frustrated system builders, and it also improved the standardization and interchangeability of parts.

 Computer cases can be broadly classified as desktop cases, tower cases, and rack mounted server cases. Desktop cases are essentially designed for personal and or business computers; they sit horizontally on a desktop and are manufactured to be sturdy enough to handle the weight of a monitor. Tower cases are classified as either mini, mid, or full-tower cases. Tower cases are vertically-oriented, and can be placed on the floor or on top of a computer desk. Rack-mounted server cases are specially designed cases for server hardware. The standard width of server cases is 19”. They range in height (measured in “U”s, which is approximately 1.5” per U) from 1U all the way up to and sometimes larger than 10U.

Mini sized tower cases are slightly bigger than desktop cases. Mini sized tower cases on average stand at a height of 12-16 inches, they usually contain 3 or less internal drive bays and 2 or less external drive bays.

The mid-sized tower tends to be the most widely used computer case. Mid-sized tower cases are bigger than mini sized cases, and they usually stand at a height of 18-24 inches. A mid-sized case has enough housing capacity for most computer systems; it usually features up to 4 internal and 4 external drive bays.

Full sized tower cases are utilized for the design of some servers, mainframes, and advanced workstations. Full-sized cases generally have a height of 24 inches or more and can have anywhere between 6 and 10 internal and external drive bays. There is a great amount of space inside these cases that can be used for installing any number of hard drives, CD ROMs and expansion slot cards (PCI cards).

 Racks are standardized frames that come in 19 inch format (482.6) wide and used for mounting multiple equipment modules (computer server equipment).

What types of racks are available? Racks available for use are: server racks, open frame racks, and 2post relay racks.

Server racks also known as cabinet racks, equipment racks and or rack enclosures typically have front and rear doors that are perforated or solid metal. The perforated doors are used for proper ventilation of the computer electronics. As of now the standard ventilation is 63 % on both the front and rear doors of the rack cabinet and if the rack cabinet has a solid door it typically contains fans in the top and the air enters the rack from the floor. Since the racks contain rear doors, there is limited space and the wires are mounted from the top to overhead trays or the bottom below a raised floor. Some enclosed racks have the option of having access on both front and back locked. This type of rack is typically the most expensive due to the amount of metal used. This particular rack starts at $899 and goes up depending on the height and is compatible with Dell, HP, and IBM computers.

Open Frame Racks also known as Four-post racks are similar to that of a rack enclosure however without the doors or side panels. There are benefits to using the open frame rack such as: they are economical, low cost, easier access to the cabling, and have an unrestricted airflow. Disadvantages to using an open frame rack are: lack of security and because they are open they tend to look not as neat. The Open Frame Racks are often used in large server rooms, where the entire room has secure access. This enables all individuals with proper authorization to work on hardware without the added hassle of locating the right key for the right rack. This particular rack is available in numerous sizes and starts at $429 and is compatible with Dell, IBM, HP and Cisco.

Last but not least, two-post relay racks also known as Telco racks. A two-post relay rack with only two uprights to support the equipment is the least expensive rack. These relay racks are commonly used in back offices and or data centers when space is premium and cooling is critical. These relay racks provide optimal ventilation due to open doors causing unrestricted airflow to and from the electronics. The Telco relay racks start at $139 and have units of 24U or 45U. Two-post relay racks are generally used to mount switches, patch panels and other “relay” type devices in a data center environment. Servers, due to their weight and size are limited to using Four-post rack assemblies or rack enclosures.

Rack enclosures and accessories include the following:

* **Airflow Management** –Improves the cooling efficiency and prevents air recirculation to reduce bypass airflow.
* **Cable Management** – Accessories designed to organize power or data cables within a rack environment.
* **Data Distribution Cable** - A pre-terminated rack to rack the network cabling in numerous lengths.
* **Mounting Hardware –** Various mounting accessories to aid in the distribution of and installation of IT equipment and to enable security of racks into position.
* **Rack Components** – Various components that can be added to any existing racks due to any requirement changes.

There are two main types of power supply units (PSU) used in servers and workstations, AT and ATX. The AT power supply was typically used in older systems before 1997, made by IBM for personal computers. It also became the standard for other compatible PCs. This power-supply was designed for the AT and also AT-compatible motherboards. Unlike modern ATX power supplies, the AT power supply required a switch to turn it off and on. Modern systems using the ATX power supplies and motherboards can accomplish this through instructions from the operating system.

The AT and ATX power supplies are not interchangeable with each-others' motherboards and any attempt to modify them to fit will not work. The AT power supplies have less varieties of voltage available. The two-part connector it uses contains four +5 volt DC wires, four ground (0 volt) wires, one -5volt wire, one +12 volt wire and one -12 volt wire. It also contains a wire that sends a signal to the motherboard to let it know that it is functioning properly.

ATX power supplies are now much more sophisticated than their AT counterparts. The outputs are either 20 pin and 24 pin and factors in that a motherboard may use one or the other. The extra 4 outputs are split into a separate plug, allowing it to be easily compatible to any ATX board that it is used with. The ATX power supply has many more voltage settings: DC- three +3.3 volt, eight ground (0 volt), five +5 volt, one -5 volt, two +12 volt, one -12 volt and four signal wires. The technology used with the ATX power supply allows a computer to reduce power through the operating system by putting a PC to “sleep,” on “standby,” or reducing power to hard drives to conserve energy when the system is not in use.

The wattage on power supplies varies a great deal. A typical 350 watt PSU will handle most duties required on an average server, depending on what the system is being used for. If the PC is being used to handle multiple disk drives or using a high performance graphics card (which are very demanding of power), a higher wattage PS will likely be needed. The quality of the power supplies also varies. A good 350w unit will function better than a cheaply made 450w unit.

For the purpose of a cluster, one might consider installing redundant power supplies. A server with redundant power supplies will actually contain two power supplies connected to two separate power sources. The purpose of this is to provide continuous power should one of the power supplies fail. Reliability is increased by plugging each part of the redundant PSU into a separate un-interruptible power supply (UPS, battery back-up) or separate power phase.

As PSUs vary in wattage, outputs, and quality, they also vary in price. A decent power supply can cost between $100 and $200 depending on the workload it needs to do, while a redundant power supply typically starts around $300.

More recent advances in power supply technology apply green technologies to make the power supply more efficient and provide variable power leveling. Hewlett-Packard (HP) has developed a smart “Platinum” power supply which remains in constant communication with the server via integrated serial interfaces to monitor the amount of power the server demands. The power supply then regulates itself so supply just the right amount of power necessary to maintain the server at its current power level.

These power supplies are even further integrated into the power distribution units (PDU) in which they are plugged into as a power source. The power supply knows which server it is installed in (system name) and communicates this back to the PDU. The PDUs are able to monitor the total power consumption of a given server and is also switchable (you can kill the power to a given server if necessary).

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| Group 2 |
| The Motherboard |
| A brief history of the motherboard and its components. |
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|  What types of motherboards are available in the market today? Describe the major components of a motherboard.  |

 Central printed circuit board also known as a PCB or a Motherboard can be found in many modern computers. A motherboard holds all of the important components of a system and also provides connectors for many of your accessories needed to carry out daily functions. In the technology world you might hear someone say main board, system board or even mobo which are all names for a motherboard used today. Through history there have been different types of motherboards presented to the public by various manufactures. Some of the most common motherboards being the AT, ATX, Micro ATX, and Baby ATX. Some of the more common manufacturers for these motherboards are ASUS, Gigabyte Technology, Intel, MSI, and Foxconn.

ATX stands for Advanced Technology Extended and was developed by Intel in 1995. At the time it was a major change in computer design which greatly improved standardization and interchangeability of parts. Intel wanted a board to support its Pentium II processor and its new AGP slot, so the ATX board was created to fulfill this purpose.

 Baby AT was considered a huge success until recently. The baby AT motherboard is smaller than the ATX. Technicians can quickly identify this motherboard in comparisons to others by its DIN keyboard connector found in the top right corner of the board. This motherboard was created by IBM and was primary used for form factor PCs.

Micro ATX was first introduced in December of 1997, and has since become a standard in the world of motherboards. Depending on the version of micro atx the size can be vary between 6.75 inches to 9.6 inches. These motherboards were introduced to be backward compatible with ATX motherboards. The plus side off these motherboards is you can expect the same components like chipsets compared to the ATX boards, but because of the size of the micro atx motherboard you can expect to see fewer expansion slots.

 Ports are the locations where peripherals, such as printers and keyboards, communicate with the PC tower. There are four types of ports in use on most current PCs. These ports are, in order of introduction, the Serial, Parallel, PS/2 and USB ports.

 The Serial Port was the first port to be introduced on a home computer. They function by transferring data one bit at a time. These ports, due to their single bit transfer rate, are very slow and have been replaced for most applications by the USB port. Serial ports are used on most machines to connect the modem to the tower using a 9-pin male connector. These Serial ports on a PC are identified by the designation as COM1, COM2 and so on depending on the number of such serial ports.

 The next connection to be introduced was the Parallel port. This Port was introduced in the 1970’s and, unlike the Serial Port, allowed more than one bit of information to be transferred at once. This Port allowed up to 8 bits of data to be transferred at once and was used primarily for printers to be connected to the PC. Many new computers now use USB ports in place of Parallel Ports.

 Next to be introduced was the PS/2. The PS/2 was introduced by IBM for the IBM Personal System/2 series of personal computer, and was soon adopted as the industry standard for connecting both keyboards and mice to the PC tower. This connection is a 6-pin DIN found on the back of most PCs. Like the previous connections they are beginning to be superseded by USB connections.

 The current industry standard for PCs is the USB or Universal Serial Bus. Most desktops feature 4 such connections while laptops normally are equipped with 2 such ports. Introduced in 1997 many manufacturers are replacing serial, parallel and PS/2 ports with USBs to connect mice, printers, keyboards and other peripherals. USB ports are used not only for data transfer but also to provide power for devices. The IPod is one example of a device which not only uses the port to transfer data but to also recharge its battery. USBs, unlike the other Ports also have varied data rates depending on its type. The USB can come as a 1.0, 1.1, 2.0, or 3.0 connection which provides either 1.5-12 Mbps (Mega bits per sec.), for the 1.0 or 1.1, 480 Mbps for the 2.0 and up to 4.8 Gbps (Giga bites per sec.) for the 3.0. The 1.0 USB was introduced in 1996 to replace the PS/2 connection for keyboards and mice with the 1.1 being introduced in 1998. The 2.0 USB was introduced in 2001 with the 3.0 coming in 2008.

 On the motherboard you will also find expansion slots whose ports can be accessed through openings on the back of the computer. There are several types of expansion slots such as AGP, PCIe (also known as PCIexpress), PCI, and ISA. The difference in the cards is the advancement of technology. The newer ones such as the AGP and PCIe cards can transfer data at a faster rate than the older ISA and PCI cards. Expansion cards are also called add in boards, or interface cards or adapter boards. They can be inserted into the different expansion slots on the motherboard. Some examples of these are graphic cards, video cards, and networking cards. These expansion cards are used to give the pc additional capabilities such as to add internet or networking capabilities, to connect a monitor or to connect a speaker system for surround sound. Some of these capabilities can be integrated into the motherboard making the cards not needed but many manufacturers still leave slots on the motherboard to give the consumer the option of upgrading and expanding.

On the motherboard itself you can find memory slots. This is where RAM is held and where it can be added within the computers specifications. RAM is one of the most crucial elements in the computer. Applications use RAM to perform tasks quickly. RAM temporarily holds data applications need to perform their tasks. Adding memory is the easiest way to upgrade your computer. Usually the more memory you add to your computer the faster your computer will be able to run.

 The amount of slots will vary depending on the motherboard and computer specifications. There are different types of memory chips out in the market. The different types of memory chipsets are not interchangeable. The RAM module or memory chipset must be compatible with the memory controller and motherboard. There are different types of RAM modules, but some of the most common are DDR, DDR2, and DDR3. RAM modules will contain a notch which guides the module into the motherboard’s RAM slot. Each different type of memory chipset will have notches in different locations. Each one of these will also have different number of pins. DDR stands for double data rate. The number after DDR refers to the generation. As technology advances changes are made to try to improve the speed of computers and next generation modules are made. Older memory chips include SDRAM (synchronous DRAM) along with others.

The processor socket or CPU socket is design to house the processor. It is an integrated circuit socket with a high pin count. The pins are on the underside of the processor and connect to the holes in the processor socket. The CPU socket can be easily identified by its shape and the high number of pins. They are usually colored white and have a lever or latch to help secure it. The processors are created to be easily exchangeable allowing easy upgrade as well as reducing cost. You can identify the type by the markings on the head. In most desktops and server computer motherboards they are often easily found secured to the motherboard, but on some others like the laptop motherboards the CPU is directly solder.

There are many types of sockets, and each type of socket will determine the type of processor it will house. The most recent types are the LGA 775, LGA 1366, and LGA 1156 for the Intel processors, and AM2/AM2+ and AM3 for the AMD processor. Each type has unique characteristics such as the pin count and the bus speed to mention a few.

The CPU socket is normally located next to the memory slots and the Chipsets. Most motherboard designs place the CPU Socket behind the back face plate allowing it to have access to an easy flow of air.

Most CPU sockets are designed to support the installation of a heatsink. The socket must be able to protect the CPU from the weight of the heatsink (often very heavy in weight relative to the CPU) particularly during the installation and removal, but also ensuring the heatsink makes good thermal contact with the CPU. CPU sockets provide an advantage over directly attaching CPUs to the PCB by making it easier to replace the processor in the event of a failure. The CPU is often the most expensive component in the system and the cost of a CPU socket is relatively low which makes this popular among computer system manufacturers.

The Chipset is a set of chips that provides the interfaces between all of the PC’s subsystems (components). The chips that are part of the chipset are also called North Bridge and south bridge. The North Bridge interfaces with high speed devices such as main memory, graphics controllers, and the south bridge. The south bridge provides connectivity to lower-speed devices such as PCI slots, PCIe, USB, IDE, SATA, Audio, and other built in controllers.

You can identify the chipset on current motherboard by the heat sink that covers them. The most common shape is square and is directly solder to the motherboard. The manufacturer of a chipset is often independent from the manufacturer of the motherboard. The current chipsets manufactures are: Intel, AMD, Nvidia, VIA technologies, SIS, Apple, Broadcom, Sun, NeXT, SGI, and more.

The chipset is usually designed to work with a specific family of microprocessors, because it controls communications between the processor and external devices. The chipset plays a crucial role in determining system performance. In many modern chipsets, the Southbridge actually contains some on-chip integrated peripherals, such as Ethernet, USB, IDE, USB, and audio devices.

The Northbridge can be located between the processor and the AGP or PCIe slot. It is also close to the memory while the Southbridge can be located close to the PCI slots. There are some Motherboard models that the North and South Bridge are located in one chip. This is common on motherboard such as the Micro ATX and the Mini ATX.

The BIOS is one of many components of the motherboard; even though, it is very small and not a very complicated element, its function is essential. The name of this component comes from the firmware or software stored on the integrated circuit. This firmware is known as the Basic Input/output System or BIOS. The integrated circuit known as the CMOS is an acronym for Complementary Metal Oxide Semiconductor. Even though there are various manufacturers the physical description of the BIOS chips are pretty much very similar. BIOS chips are usually small about quarter size, rectangular or square, typically 32 pin, and sometimes soldered directly into the motherboard. They are usually labeled with a sticker indicating the manufacturer. Some of the more popular manufacturers include AWARD, Phoenix, and AMBIOS. There are various different types of chips that store the BIOS besides the popular 32 pin rectangular CMOS. Others like EEPROM require a special programmer and an ultraviolet light to reprogram. A CMOS based BIOS just requires an install utility and the new flash update. This BIOS location varies by motherboard type, but is usually located near the CMOS battery.

One of the functions of the BIOS is to save hardware configurations when the computer is turned off or unplugged by using CMOS memory. The battery supplies enough voltage to the CMOS/BIOS chip to hold these configurations in memory until the next boot up. In addition to holding these setting in memory the bios also runs a routing diagnostic check on all major PC components. This is known as POST or power on self test. In this test the computer checks the processor, memory, video card, and a many other crucial system components. If certain critical elements are not found the computer might alert the user with a series of beeps to indicate a hardware failure has been detected. If everything checks out in order the BIOS will locate the boot sector on the hard drive, initialize it, and allow it to take over in booting the operating system. Most users only see a glimpse of the BIOS, typically it’s the “press F2 to enter setup” message displayed for a second, followed by the operating systems splash screen or loading progress bar. If a user were to press what is typically the F2 and enter the BIOS setup the user would find many different configurable options in the BIOS. One example of this would be the boot order. Do you want the computer to boot from the main hard drive or would you like to boot up from secondary source? Some secondary sources are DVDs, cds, floppies, or even a usb?

From simple configurations to over clocking the processor, and optimizing memory usage, the BIOS allow the changes to be made and saved to memory. The storage of these settings is not stored in mass storage. If they were there would be no way for the BIOS to access them in storage because the mass storage does not get initialized until after the BIOS POST process. The RAM cannot be used for storage either since it loses all the information once the systems power is cut off. The solution lies then with the CMOS chip. CMOS chips do not require much voltage to save settings. A simple battery in circuit with the CMOS is enough to keep settings for more than 5 years. In fact most of the usage of the battery comes from long periods of a PC being turned off. In recent years there has been a trend with CMOS becoming more popular due to its energy efficiency properties. A typical CMOS battery looks like a button cell. It can be bought at Wall-Mart for fewer than five dollars, and can be replaced in a matter of minutes.

The Integrated **Drive Electronics** (**IDE**) interface connects storage devices such as floppy, hard drive, and CD-ROM. IDE interface is a standard way for a storage device to connect to a computer. The original name, **AT Attachment** (ATA), signified that the interface was initially developed for the IBM AT computer. IDE is now known as Parallel ATA (PATA).

 PATA interface supports maximum of two devices and a cable length of 0.5 meters. The parallel nature of the interface reduces its performance since only one device at a time can communicate on the channel. Nevertheless, this interface is still widely found in hard drives, optical drives, and tape drives.

PATA is connected internally with ribbon cables. The ribbon cables have all of the wires laid flat next to each other instead of bunched or wrapped together in a bundle. PATA ribbon cables have either 40 or 80 wires. There is a connector at each end of the cable and another one about two-thirds of the distance from the motherboard connector. The three connectors are typically different colors and attach to specific items. The blue connector attaches to the motherboard, the black connector attaches to the primary (master) drive, and the grey connector attaches to the secondary (slave) drive. A single IDE interface can support two devices.

Along one side of the cable is a stripe. This stripe tells you that the wire on that side is attached to Pin 1 of each connector. The connector is missing pin 20 to ensure that the cable is attached to the drive in the correct position. Also, a cable key makes sure the cable is not reversed. The cable key is a small, plastic, square on top of the connector on the ribbon cable that fits into a notch on the connector of the device.

The next level of IDE connector is called Serial ATA (SATA). SATA provides a serial bus for data transmission, with a single device on each channel and eliminating device contention per channel. SATA has a connector pin count from forty to a mere seven. SATA cable can be up to 1 meter in length, double that of parallel ATA. The first was SATA Revision 1.0 transferred data at 1.5b gigabits per second. SATA Revision transferred at maximum input at 3.0 gigabits per second. The latest is the SATA revision 3.0 which runs at 6 gigabits per second. SATA drives were able to be built at faster speeds, higher storage capacities, and lower prices than ever before.

SATA device were usually internal devices that had to be installed within a case, but eventually they developed external SATA devices. External SATA devices made it easy to create portable devices and increase the overall capacity of most [PC](http://www.bestbrandtobuy.com/category/computer-hardware/) units.

SCSI originally stood for **Small Computer System Interface which** is a fast bus that can connect lots of devices to a computer at the same time, including [hard drives](http://www.howstuffworks.com/hard-disk.htm), [scanners](http://www.howstuffworks.com/scanner.htm), [CD-ROM/RW drives](http://www.howstuffworks.com/cd.htm), [printers](http://www.howstuffworks.com/inkjet-printer.htm) and [tape drives](http://www.howstuffworks.com/cassette.htm). SCSI is based on an older, proprietary bus interface called **Shugart Associates System Interface** (SASI). In 1986, the **American National Standards Institute** (ANSI) ratified SCSI (pronounced "scuzzy"), a modified version of SASI. SCSI uses a **controller** to send and receive data and power to SCSI-enabled devices. Some of these are hard drives and [printers](http://computer.howstuffworks.com/inkjet-printer.htm).

SCSI moves data through the bus simultaneously rather than one at a time. The newest type of SCSI, called **Serial Attached SCSI (SAS)**, uses SCSI commands but transmits data serially. SAS uses a point-to-point serial connection to move data at 3.0 gigabits per second, and each SAS port can support up to 128 devices or expanders.

A SCSI controller coordinates between all of the other devices on the SCSI bus and the computer. Also called a **host adapter**, the controller can be a card that you plug into an available slot or it can be built into the [motherboard](http://computer.howstuffworks.com/motherboard.htm). The SCSI [BIOS](http://computer.howstuffworks.com/bios.htm) is also on the controller. This is a small [ROM](http://computer.howstuffworks.com/rom.htm) or [Flash memory](http://computer.howstuffworks.com/flash-memory.htm) chip that contains the software needed to access and control the devices on the bus.

Internal devices connect to a SCSI controller with a ribbon cable. External SCSI devices attach to the controller in a **daisy chain** using a thick, round cable. In a daisy chain, each device connects to the next one in line. There are different SCSI variations using different connectors which are often incompatible with one another. These connectors usually use 50, 68 or 80 pins.

The floppy disk drive (FDD) was invented at IBM by Alan Shugart in 1967. The first floppy drives used an 8-inch [disk](http://www.howstuffworks.com/hard-disk.htm) which evolved into the 5.25-inch disk used on the first IBM Personal Computer. A floppy disk drive reads and writes data to a small, circular piece of metal-coated plastic similar to audio cassette tape. The floppy disk drive is connected by a 34-pin cable connected to the controller on a motherboard.

ATX power connectors are the specific types of connectors designed to connect a computer's power supply to an ATX motherboard. They are of the Molex type, which means that they are constructed of metal pins laid throughout a nylon matrix. A female type ATX power connector extends from the ATX power supply to plug into the motherboard. The nylon matrix on modern day ATX power connectors can contain 20 or 24 pins, depending on the power necessary for the equipped processor. Unlike previous motherboards and power supply specifications, the ATX power connector allowed a new range of options when it came to turning a computer on and off. Previously, users were required to power a computer on and off via built in hardware. However, with the ATX specification, software and Wake-on- LAN technology could be used to power the computer on and off without having to press a dedicated power button every time.

The ATX power connector also offers another benefit over its predecessor. Older power connectors did not have any direction so they could be plugged in via a variety of orientations often leading to short circuits. The ATX power connector is designed to only be plugged in one orientation.

A computer fan is any fan inside a computer case used for cooling purposes, and may refer to fans that draw cooler air into the case from the outside, expel warm air from inside, or move air across a heatsink to cool a particular component. The use of fans to cool a computer is an example of active cooling. In order for the computer fan to work it must be connected to the CPU fan connector. Almost all modern motherboards have a 4 pin CPU fan connector; while older motherboards only had a three pin CPU fan connector. The 4th pin is for a PWM (Pulse Width Modulation) which controls fan speed. A three pin fan will run on a four pin board and a four pin fan can run on a three pin board. Speed control with voltage still works on a PWM fan and if one runs a three pin fan on a four pin board there is an option in the [bios](http://www.tomshardware.com/forum/247232-28-type-connector) to control fan speed with voltage. Chassis and CPU fans may use either three-pin or four-pin power connectors. Three-pin connectors are usually used for the smaller chassis fans with lower power consumption. Four-pin connectors are usually used by CPU fans with higher power consumption.

Every motherboard has a series of front panel connector pins to power a chassis' internal speaker, power and hard drive activity lights, and power and reset buttons. There are 12 pins in total which is just three more than the number of pins used for internal USB and Firewire connectors, but a whopping 27 pins less than a standard IDE connector. Unlike internal USB, Firewire, or IDE connectors, though, front panel pins aren't arranged according to a common standard. That means that instead of being able to connect all 12 pins with a single cable and jumper block, separate wires and connectors must be used for each function. With one speaker, two lights, and two buttons, that makes five functions, and five wires to hook up.

Video Ports allow for the desktop to connect to a monitor so whatever work may be done can be displayed. The most common kind of video port is called a V.G.A (video graphics array). It is also defined as a DE-15 because it has 15 pins in its connections. Newer connections have been released over the years such as DVI (Digital Video Interface). DVI is very common and can handle many different formants in digtial and analog as well as can handle multiple video cards. HDMI ( High-Definition Multimedia Interface) is a newer connection becoming more common. They can be found on desktops and can be found more and more on laptops. This makes it possible for laptops to easily be connected to display screens with HDMI or televisions that already come with HDMI input connections. Since HDMI is digital it is usually the preferred choice for high resolution gaming or artwork and is capable of running audio.

The Graphics Processing Unit (GPU) is essentially the brain of the graphics card. It is a small computer which is used to process 3D graphics, textures, and other elements that involve producing an image. It is found in all video cards and in more modern cards it is usually located under a heat-sink and fan. GPU is measured in megahertz or gigahertz and the greater the amount the faster the processing power. There is also front side bus which is how fast the information travels from the graphic card to the computer. The GPU also contains cores which are the segments in each processing units. The highest number or cores available are quad cores which are 4 different segmentations of a processor. Each segmentation can do multiple processing at the same time so the more segments the more processing can be done.

Firewire or also known as an IEEE 1394 connection was standardized by apple. There are primarily two different types. Firewire 400 has ports that run older connections such as 100, 200, or 400 Mbit/s half duplex meaning they can only send or receive one at a time. There is also the firewire 800 which connects ports at a full duplex meaning they can send and receive at the same time. The connecters for a firewire are usually going to be a 6 circuit and a 4 circuit. The 6 circuit contains six different pins and is a large connection. The 4 circuit is a smaller connection with 4 pins and has no power. A positive about firewire is that it uses its own CPU and own technology where as USB depends on the CPU inside the computer. Another good thing about firewire is that although it runs slower it is more efficient because it does not use the computers CPU.

The sound card, or audio card, is the part of the computer managing its audio input and output. It is composed of the specialized processor, also called DSP (Digital Signal Processor), which does all the digital audio processing (such as echo, reverb, vibrato chorus, 3D effects, etc.). It also has the ADC (Digital to Analog Converter), which converts an analog input into digital data which a computer can process. Motherboards with on-board audio have three connectors on them: a microphone input (or Mic in), which is usually a pink-colored 3.5 mm jack ; a line in jack, usually blue; and one or two standard 3.5 mm line-out jacks, normally green in color . Motherboards with surround sound (4 channel, 6 channel or even 8 channel audio) need more connectors. These extra connectors are typically provided at an extra bracket that comes with the motherboard. They can also be put as extra plugs on the motherboard instead of at an I/O bracket, with the purpose of helping the user.

There is another audio option some motherboard models have: it is the SPDIF (Sony Philips Digital Interface, or S/PDIF, S-PDIF or IEC 60958 since 1998) connector for digital audio. It is an output line that sends digitized audio data to a digital amplifier using a coaxial cable with RCA connectors at the ends. SPDIF connectors, just as the standard analog connectors, can also be available at an extra I/O bracket or directly on the motherboard.

It is better for a computer to have fewer brackets, since it will have a better airflow inside the case, and a better cooling. This is the reason why it is interesting to have all audio connectors soldered to the motherboard.

Mobile and computer devices always employ mini-plugs. These 1/8th-inch diameter connectors are used to interface headphones or speakers directly to computers. Step-down versions, on the other hand, create effective wire paths between larger cable types, and computer or mobile devices.

A network card (or Network Adapter or Network Interface Card, NIC) is the interface between a computer and a network cable. Its purpose is to prepare, send, and control data on the network. It usually has two indicator lights (LEDs). The green LED shows that the card is receiving electricity. The orange (10 Mb/s) or red (100 Mb/s) LED indicates network activity (sending or receiving data).

In order to prepare the data to be sent the network card uses a transceiver which transforms parallel data into serial data. Each card has its own unique address, called a MAC address that is assigned by the card’s manufacturer. This makes uniquely identifiable.

In order to make sure the computer and the network are compatible the card must suit the computer’s data bus architecture as well as have the right kind of socket for the cable. Each card is designed to work with a certain type of cable. Some cards have multiple interface connectors that can be configured using jumpers, DIP switches, or software. The most common ones are RJ-45 connectors. The card must also be compatible with the computer’s internal structure (the data bus architecture) and have a connector that suits the type of cabling used.

A network card is the physical interface between the computer and cable. The data sent by the computer is converted by the card into a form which can be used by the network cable, and then it transfers that data to a different computer and controls the dataflow between the computer and cable. The card also translates the data coming from the cable into bytes so that the computer’s CPU can read it. This is the reason why a network card is an expansion card inserted into an expansion slot.

Network adapters have configuration options. Most of the time, network cards use interruption (IRQ). IRQ 5 is recommended and used as the default setting on most cards. Also, each device must have a different Input/output (I/O) base address for the corresponding port. In addition the memory address designates a RAM location in the computer. The network card uses this slot as a buffer for data entering and leaving. In general the card’s memory address is D8000. Ome network cards, however, do not use the machine’s RAM addresses, so they don’t have a configurable memory address either.

Group 3

**Information Technology Today: Input/output ports and CPUs**

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**What are the various input/output ports available on computers today? Describe their uses? What are the different CPU’s used today?**

Input and output devices are used to carry out communication between two information processing units (i.e. a person and a computer). Input devices receive the data while output data puts out the processed data. Types of input and output devices include P2 connectors, video graphic array, digital video interface, mini jacks, as well as parallel and Ethernet ports.

The evolution of computer output devices can be traced to the earliest days of the PS/2 connectors. The port was of two styles: the 5-pin DIN and 6-pin mini-DIN. The DIN standard was created by the German Standardization Organization (Deutsches Institut fuer Norm). Both connectors are electrically similar; the only practical difference between the two is the arrangement of pins. (Chapweske, 2003)

The connectors over the years became known as PS/2 and AT. Keyboards with the 6-pin mini-DIN are often referred to as "PS/2" keyboards, while those with the 5-pin DIN are called "AT" devices (Chapweske, 2003).

Adapters switch between AT and PS/2 connectors so that the newer keyboard can work with an old PC or an old keyboard can work with a newer PC. Source and image: PC magazine.

Throughout the years there was a shift away from DIN technology through the advent of laptops and the modernity of newer technology, which has almost replaced the DIN pins. Most notably the PS/2 have been replaced with USB, but still function on old computers with the assistance of adapters. If a user wants to convert their old keyboard or mouse for modern usage, the connector 1 would go into the USB Type A Female and connector 2 would go into the PS/2 Male.

USB to PS/2 Adapter Source and image: Cables to Go.

Video Graphic Array (VGA) and Digital Video Interface (DVI) are two ways in which a user can input and output information. IBM introduced VGA in 1987, forming a standard in all modern displays. VGA refers to the traditional analog connection to a monitor. The VGA port analog high-density DB has 15 pins and connects to a card that connects to the motherboard or it can be embedded on the motherboard. After booting up VGA mode, the operating system loads drivers to adjust to the set resolution. VGA can also be used when troubleshooting a computer nin safe mode. The specifications to VGA are as followed:

“In text mode, VGA systems provide a resolution of 720 by 400 pixels. In graphics mode, the resolution is either 640 by 480 (with 16 colors) or 320 by 200 (with 256 colors). The total palette of color is 262,144”. [[1]](#footnote-1)

DVIs, which provide digital signals to digital monitors, were adopted in 1999 and has since become the standard for connecting computers to digital monitors. DVI connects to a card that connects to the motherboard or it can be embedded on the motherboard. In today’s market most computers come with DVI ports. It is the most used format and has made the analog signal ports obsolete. Although DVI is a preferred socket, the industry is moving into the High-Definition Multimedia Interface also known as (HDMI). HDMI allows the user to stream all digital audio/video in high definition. The specifications to DVI are as follows:

“Single link DVI uses a 165 MHz transmitter to provide resolutions up tp 1920 X 1080 at 60 Hz. For higher resolutions, starting with 1920 X 1080 at 85 Hz and upward to 2048 x 1536 and 2560 x 1600 pixel, dual link DVI is required (two transmitters).” [[2]](#footnote-2)

Mini jacks, also referred to as TRS (tip, ring, sleeve) connectors, are audio connectors. The connectors are cylindrical and have three contacts. TRS range in measurements but typically are ¾ of an inch, 1/8 of an inch, and 3/32 of an inch. In the 20th century TRS were used for telephone operators and now range in uses from headphones for computers, iPods, and other electronic accessories.

Parallel ports are the interfaces between the computers and printers. Parallel ports are still used although USB cables are becoming more common. The interface was developed by IBM for printers designed by Centronics. The interface consisted of 25 pin connecter, which had to have a special cable since the printer had a 36 pin connecter.

The first pin carries a strobe signal, which is used to carry data. It maintains a charge between 2.8 and 5 volts but drops to .5 volts when information is being sent. Pins two though nine carry data. There is either a charge of five volts or no charge; a charge of five volts means the information is a one and if there is no charge then it is zero. The information being transmitted is binary code, which is how the computer deciphers the information. Pin 10 lets the computer know that the information being sent was received by dropping the voltage below .5. Pin 11 informs the computer know that it is busy. If there is a charge and when the printer is ready to receive more information it will drop below a charge of .5 volts. Pin 12 lets the computer know that it is out of paper by sending out a charge. If the printer is online pin 13 will receive a charge to let the computer know. Pin 14 is used for the auto feed; it also uses a 5 volt charge. There will be a voltage of less than .5 if the printers should have any problems or if there is an error. Pin 16 is used when it is ready to print. The charge of voltage will drop to initiate the printer. The computer will send and maintain a charge on the printer if you designate it to be offline. Pins 18-25 are used for grounds and for reference signals.

The standard for USB version 2.0 (High-Speed Universal Serial Bus) was released in April 2000 and serves as an upgrade for USB 1.1. To allow a smooth transition for both consumers and manufacturers, USB 2.0 has full forward and backward compatibility with original USB devices, which enables the converters to function with PS/2 technology (Brain, 2001).

Source and image: Marshall and Carmack, April 2000.

The deployment of USB 2.0 has allowed PC industry leaders to forge ahead with the development of next-generation PC peripherals to complement existing high-performance PCs (Marshall, 2000). Many peripherals are USB devices such as printers, mice, smartphones, digital cameras, storage devices and more.

Once the host powers up, the “USB process”, or enumeration, takes place. It queries all of the devices connected to the bus and assigns each one an address. Devices are also enumerated when they connect to the bus. The host also finds out from each device what type of data transfer it wishes to perform:

* Interrupt - A device like a mouse or a keyboard, which will be sending very little data, would choose the interrupt mode.
* Bulk - A device like a printer, which receives data in one big packet, uses the bulk transfer mode. A block of data is sent to the printer (in 64-byte chunks) and verified to make sure it is correct.
* Isochronous - A streaming device (such as speakers) uses the isochronous mode. Data streams between the device and the host in real-time, and there is no error correction.

 An Ethernet Port is utilized for networking. It is part of Network Interface Card. It is based on Institute of Electrical and Electronics Engineers (IEEE) 802.3 standards. This is the common standards on a Local Area Network (LAN). Most hosts have a network interface built-in just like most of the laptops; if not, an expansion slot allows for Network Interface Card (NIC) to be connected (just like the first hands-on project).

It was popularized by its access method known as Carrier Sense Multiple Access with Collision Detection (CMSA/CD) Access Method. The concept is the host device listens to the network if it is busy. This plays the part of Carrier Sense. When the network is not busy, it transmits frames to other host devices. During the transmission, the sending computer must monitor the network, in which, it detects collision. If it detects collision, a signal is sent to all other computers letting them know that collision has been detected. By this time, all computers generate random amount of time and then continue on doing the carrier sense process (Metcalfe & Boggs, 1976).

 Historically, 10 base T (10 Mbps baseband Ethernet) uses external transceivers called Multi Access Unit (MAU) (Society, 1998 ). MAU is not widely used because most NIC today comes with built-in transceiver; this is still available online (Amazon, 2010).

 Please, see below for the list of 802.3 standard improvements:

Taken from: Upgrading and Repairing PCs (19th Edition) page 871

In looking at the data, early Ethernet causes most of the bottleneck. However, due to improvements, it is still the most widely standards. Currently, Ethernet can go as fast as 10 Gb/s which is created by Intel’s latest quad-port Ethernet adapters. This adapter’s goal is to serve servers with multiple virtual machines (Wong, 2007). Soon, Ethernet can go as fast as 40 Gb/s to 100 Gb/s (Ethernet Alliance, 2010). It is currently in its testing phase.

In order to know about external Serial Advance Technology attachment (eSATA) port , it is best to start with SATA. eSATA is an external version of SATA. It is primarily used for storage devices. This port competes with other ports like USB and Firewire. Typically, eSATA is faster than USB 2.0 and Firewire, boasting a speed of up to 3Gb/s. Initially, eSATA is needs power to power up external hard drives. After some design improvements, now, it supply itself the motherboards power supply (Leung, 2008). However, it is not a well supported technology compared with USB. And compared with USB 3.0, USB 3.0 is faster than eSATA. USB 3.0 has, “data rate of up to 5Gb/s (Vaughan-Nichols, 2010).” This puts the future of eSATA into question, “Will eSATA survive?”

The Central Processing Unit (CPU) is the main processing component in a machine and is often thought of as the “brain” of a computer. The CPU must perform certain predetermined operations. The CPU is composed of three parts: the arithmetic-logic unit, or ALU, (where actual processing is carried out), the control unit (directs all of the operations), and the internal, or main, memory (registers). The control unit and the arithmetic-logic unit together form the central processing unit (CPU) of a computer (McKeown, 42-43). Modern age CPUs are on a chip, a tiny piece of silicon that packs thousands of transistors into a tiny area. The Integrated Circuit (IC) is key to the power and speed of computers today. Generally in today’s world, CPUs are attached to mother boards with wire prongs. There are many different types of pin packages however; generally all of them work the same and use a ZIF (zero insertion force) socket. The control unit manages the processing of data flow. The arithmetic-logic unit (ALU) handles the actual processing of data be performing arithmetic and logic operations on the data. It is very common for server machines to have several CPU chips which enable the server to run faster and handle a larger volume of requests. In 1965 Gordon Moore, co-founder of Intel, observed that the number of transistors that could be put on a single chip was doubling every year and correctly predicted that this pace would continue into the near future. The pace has since slowed to double about every 18 months. Due to the ever increasing technology several consequences have come true (Stallings, 4-12).

1. The cost of a chip has remained virtually unchanged during this period of rapid growth in density. This means the cost of computer logic and memory circuitry has fallen at a dramatic rate.
2.  Because logic and memory elements are places closer together on more densely packed chips, the electrical path length is shortened, which in turn has increased operating speed.
3. The computer becomes smaller, making it more convenient to place in a variety of environments.
4. There is a reduction in power and cooling requirements
5. The interconnections on the integrated circuit are much more reliable than solder connections. With more circuitry on each chip, there are fewer interchip connections.

Central processor units are sometimes referred as processors. The processor is an integrated circuit built in a slice of silicon which contains millions of transistors interconnected together by pieces of aluminum to store and manipulate data. Processors are used in Motorola devices, satellites, and computers. The CPU is the brain of the computer that performs arithmetic and logic operations. Arithmetic operation refers to mathematical operations such a adding and multiplying while logic operations determine if the date is true or false. For example, when a user inputs two numbers for multiplication, these numbers are sent to the CPU for analysis. The CPU then identifies it as multiplication and sends the answer. The idea of all processors is the same input > apply logic > and output. ([www.pantherproducts.co.uk](http://www.pantherproducts.co.uk), 2010).

The processor is the primary device that carries out computer functions. Such functions include reading data from memory, calculating the data, storing those calculations in mass storage device, and writing data for display to the user. The electrical components in the motherboard use a clock. This clock in reference to the CPU and the motherboards is the number of pulses per second generated by an oscillator on the motherboard. The clock speed is determined by a crystal very similar to those that are used by radio system and is what the oscillator uses to create that pulse in voltage. When this piece of quartz is subjected to electrical current it begins to vibrate. As it vibrates it changes temporarily to conducting state. For the computer the conducting state equals 1 (on) and non-conducting state equals 0 (off) (InetDamon, 2010). The number of times the oscillator changes from on and off per second is measured in hertz. This clock timing today could reach up to MHZ or GHZ. These are millions of pulses per second or billions of pulses per second. Older models such as the 4633 and 4666 were very tied to clock speed. Intel’s 4633 processor would run at 33 MHZ and Intel’s 4666 processor would run at 66 MHZ. Today, newer CPUs are not as tied to the clock speed of the motherboard clock as were the older models. On newer system we deal with the CPU clock and the front side bus. The Front side bus connects the processor to ram memory and other components such as chipset, ram memory, graphics cards in the motherboard. It is measure in hertz. A fast processor with a very slow Front side bus can create a bottleneck. Newer processors use a multiplier. With multipliers processors can be configured to run at a multiple of the CPU clock speed provided by the motherboard. For example by using a multiplier, 133 MHZ processors would double its speed of the motherboard to 266 MHZ. New processors also come with several features that increase the processors performance. MMX extensions (SSE/SSE2/SSE3) for example; allow the CPU to perform multimedia functions that are much faster than a CPU that does not have this feature. Another feature is multiprocessing**,** which takes place when two or more CPUS take complex jobs and split those jobs on the two processors. A thread is an instruction to be process. Hyper threading feature isamodification made to the Intel processor that enables multithreading applications to execute the threads in parallel. Hyper threading is like having a single processor that has two CPUs cores built-in. This is similar effect of having two CPUs in the system but with the advantage of costing less, consume less space, and consumes less power because it is only one CPU.

There are several various instructions sets that can be utilized within a processor (processor only implements one instruction set). The most common  are CISC or Complex Instruction Set Computing allows the processor to make more which means each instruction can execute several low-level operations such as, load from memory, an arithmetic operation, and store data in memory all in a single instruction. Another popular instruction set is known as RISC or Reduced Instruction Set Computing the RISC strategy is based on the insight that simplified (as opposed to complex) instructions can provide higher performance. The basic idea is that this simplicity enables much faster execution of each instruction. CISC type processors are generally referred to as ‘x86’ and are the most common. RISC type processors used to have more usage when the powerPC chips where being used by apple in their MAC products. (Apple has since switched to x86 Intel chips). Even with the increase in CPU speed we must utilize new techniques to get more through put even as our processors get faster. Such techniques as parallel processing (pipeline instructions), distributed processing (having multiple cores or processors working together to produce result).

Intel Corporation, meaning Integrated Electronics, is a technology company and one of the world leader’s manufacturers of processors in the world. The Company designs and manufactures computing and communications components, such as microprocessors, chipsets, motherboards, and wireless and wired connectivity products, as well as platforms that incorporate these components ([New](http://topics.nytimes.com) York Times, 2010). Its first CPU was created in 1971 and it was a 4-- bit model 4004. This processor could execute 92000 per second ([Kanellos](http://news.cnet.com), 2010). Processors now can execution millions of instructions per second. Some processors are suited for transaction processing, databases, scientific modeling, tree D rendering and gaming such as the 64-bit processors. Processors can come as a 32-bit or 64-bit processor. By 32 or 64 it is referring to the data bus width. The 64-bit can carry more data than the 32-bit processors. There is a variety of Intel models. Some Intel models are the 4 bit Intel 4004, the 8 bit processors such 8008, the 16-bit process 8086, the 32-bit processor such as 80386. Today we have a variety of processors such as Intel Core I7-940 processor, Intel Pentium Processor E2200, Intel Celeron Processor E1200, and Intel Xeon Processor X5482. On some of these models a higher number indicates more features such as cache, clock speed, etc. In some the letters such as E means Energy efficient, or X in Xeon processor number means performance.

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Assignment 1

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**Intro**

In this paper we will discuss some of the key features of any computer system. The topics will include memory which will address different types,performance, and application.  Hard drives, which will cover different form factors and applications. As well as RAID which will cover different types, performance, benefits and implementation.

**Memory**

The memory in a computer is an essential component because depending on the type, it is the temporary or permanent storage of data which is used by programs and the overall system.   There are two major types of computer memory: volatile and non-volatile. Volatile memory necessitates power in order to maintain its stored information, while non-volatile memory will retain its stored information regardless of whether power is present or not. Read only memory (ROM) is an example of non-volatile memory which is usually used to store firmware, such as in the BIOS of motherboards. The different kinds of memory mentioned here are SRAM, DRAM, SDRAM, Cache, External Hard drives/External Memory, and Virtual Memory.

**Static RAM:**

There are several volatile types of memory such as static random access memory (SRAM): It is a semiconductor type of memory. It uses bistable latch circuitry to store each bit.  SRAM can be in three different states reading, writing and standby.  SRAM can be both asynchronous and non-volatile SRAM.  Asynchronous has a fast access time of SRAM, these are ready to be used in processors (main memory). They are widely used in industrial electronics, measurement systems and hard discs.  They are also used in networking equipment such as switches, routers, etc.  Non-volatile SRAM on the other hand has standard SRAM functionality but it saves data when power is not present.  They have been widely used in aerospace, networking, etc., where data storage is important and batteries are not used. These provide 20ns or less access time.  In conclusion, SRAM is costly, fast, and consumes less power.

**Dynamic RAM:**

Another type of memory is dynamic random access memory (DRAM), where each bit of data is stored in different capacitors that are refreshed periodically in an integrated circuit. There are different types of DRAM as well: asynchronous and synchronous.  Asynchronous DRAM (ADRAM) is called basic RAM from which all others derive.  ADRAM chip contains power connections, address inputs and a few bidirectional data lines. On the other hand, Synchronous DRAM (SDRAM) is transmitted per clock cycle so it is not able to respond as rapidly to changes as DRAM since it has to wait per clock signal from the computer’s system bus.  There are different types of SDRAM too and they are: double data rate 1 (DDR1), DDR2, DDR3, and DDR4.  In DDR1 each internal read of DRAM is a row of thousands of bits, which allows for a very high potential bandwidth.  In order to make more bandwidth available to the users a double data rate interface was developed, it accepts the same number of commands per cycle but it reads or writes two words of data per clock cycle (one on rising edge the other on falling edge).  Clock rates of typical DDR1 are 133,166 and 200 MHz (periods of 7.5,6, and 5 ns/cycle). DDR2 compared to DDR1, allows four words of data to be read or written per clock cycle. To allow higher performance operation the bus protocol was simplified allowing the increase of bus rate (doubled) without increase of the clock rate of internal RAM operations.  Clock rates of typical DDR2 are 200,266,333 or 400 MHz (periods of 5,3.75,3 and 2.5 ns). DDR3 compared to DDR2, allows eight words of data to be read or written per clock cycle.  The bus rate and bandwidth are doubled compared to DDR2 without change in internal RAM operations.  DDR3 is the present SDRAM being used significantly.  The common clock rates are 667 and 800 MHz which are referred to as DDR3-1333 and DDR3-1600, respectively.  DDR4 SDRAM is currently in the design state and it is expected to be released in 2012. This SDRAM is proposed to be working at 1.2 V or less and with 2 billion data transfers per second.

**Cache:**

The computer cache is a component that stores frequently used data thus improving the performance of the system. When the requested data  is present in the cache,it  takes less amount of time to process as the processing time for the cache is very less , if not the data is fetched from main memory which takes more processing time.

Present computers have three types of cache they are instruction cache which is used to increase the speed of the executable instructions, data cache which is used to increase data fetch and store and a translation look aside buffer which is used to increase the speed of virtual to physical address translation.

Based on the access time and size cache is divided into three levels L1, L2, and L3  (L3 may exist or may not). The L1 cache is present in the processor’s chip, whose access time is around 8.5 nanoseconds and this is smaller in size. The L2 cache is present on the motherboard, whose access time is around 30 nanoseconds and it is larger than L1 cache. Some CPUs may contain 2 caches present in the processor’s chip or off the chip then the second one is called the L3 cache,whose  access time is greater than the L2.

In a real time scenario when a request is made to , the CPU checks for the information in the L1 cache first and if present it determines as a “hit” and if not  if not present a “miss”. If a miss occurs the CPU then checks for the information into the L2 cache; if there is also a miss , the CPU looks into the L3 cache. Then, if the information is not present in any of the cache the CPU looks into the computers main memory. The more number of CPU cache contained in a computer, the more the increase in the computer’s performance.

**External Memory:**

External memory, which is mostly known as portable storage is a great way to save information and have the ease to take it everywhere.  There are different types of external memory, such as: external hard drives, memory cards, flash drives, etc.  The way that they work is usually through a USB port that is detected by the operating system when connected to the computer.  Finally, it is ready to use and start saving any data.  The most common type of external memory used by most people would have to be a portable flash drive, which is also classified as flash memory. Memory cards are another type of external memory that also has flash memory.  Memory cards are often used in cell phones, digital cameras, and GPS systems.  There is an assortment of memory cards but the most recognizable memory card will be Micro SD.  The way that memory cards work is the same way the flash drive does, and when disconnecting it from the system the information still remains in the card like in the flash drive. However, in order to transfer the data to the computer from the memory card and vice versa, an adapter should be used.  Due to the fact that some memory cards can come in a relatively small size, and adapter is needed to plug it into the system.  When the data is saved into any of the devices already mentioned, it can be carried around anywhere. This type of memory is a non-volatile, and re-writable. Flash memory can be faster than others, and if all the data stored in it was properly saved then there is no risk of losing it in case the computer crashes plus it can be less costly and convenient.

**Virtual Memory:**

Virtual memory makes it so that when a program attempts to communicate with the system’s primary and secondary levels of storage, it only “sees” what it believes is one hardware memory device that behaves like a RAM module. This allows the system to efficiently use its hardware memory, to extend its primary memory as well as simplify the programming required in making programs work with memory. Essentially, virtual memory was developed for multitasking kernels as a memory management technique. It also creates a situation where each program believes it has sole access to this virtual RAM module in what is referred to as an address space. Virtual memory does require hardware support from a memory management unit (MMU) which usually is contained in the CPU. This MMU administrates access to memory from the CPU by translating virtual addresses (from programs) to physical addresses (actual primary or secondary hardware), along with bus arbitration, memory protection and cache control. Pages of usually at least 4 KiB (4x1024 bytes) in size that are composed of a block of virtual memory addresses that each have a mapping to its physical address, are used by the MMU to disperse instructions that that appropriate hardware needs to process.

**Hard Drives**

Hard drives are non-volatile storage devices which store digitally encoded data on rapidly rotating platters with magnetic surface. However, hard drives have evolved to more solid states which do not require rotating platters to store data and are more energy efficient.  Different types of hard drives are available in today’s market and are much faster than earlier models. A closer look at hard drives will provide a bit more information of how they work, types of performance they offer, and the uses that they have.

The main concept is that needs to be understood is that there is not just one type of hard drive. There are two main types of hard drives which are conventional hard drives and Solid State Drives. Conventional hard drives are categorized as Parallel Advanced Technology Attachment (PATA), Serial Advanced Technology Attachment (SATA), Small Computer System Interface (SCSI) or “skuzzy.” The structure of conventional hard drives are the same they still rely on rotating platters to encode data; yet, they are categorized depending on the type of interface used to connect the actual hard drive to the motherboard.

People understand that hard drives are where the store their information and also retrieve it for later view the saved data. However, there are many things that make a hard drive read and write data stored within them that people do not know how they operate. Speed, durability, flexibility, and amount of storage available are key features that distinguish each of the mentioned categories of conventional hard drives.

**Internal Hard Drives:**

Most if not all of the types of hard drives from PATA to Solid State Drives can be used as internal hard drives. An internal hard drive is a storage medium that can be placed inside the computer case. The cables used to connect the hard drives to the mother board are usually 40-wire/40-pin HDD ribbon cable, or an 80-wire/40-pin HDD ribbon cable, where external hard drives are connected via USB port. Internal Drives that dominate the hard drive market are SATA and SCSI. These two types of conventional hard drives have been able to evolve and better it performance and durability.

SATA hard drives offer consumer a range from 7200-10000rpm; thus, reducing the latency is another major advantage that is offered using this interface. On the other hand, faster speeds, also lead to faster breakdowns and less life expectancy of the drive. Unlike PATA, Serial ATA drives can be used as internal and external devices and offer speed that were only offered by SCSI. SATA has become one on the most prosperous type of conventional hard drives since it is nearly close to perfection.

SCSI also relies on fast revolving platter to write/read data. While this may be true, the fact is that SCSI spin at a much greater speed which in turn provides even faster access to data stored in the hard drive. SCSI provide speed of 10000-15000rpm giving better performance these are usually found in gaming PCs that require better graphics. SCSI is faster than both IDE and SATA, yet those speeds become a vulnerability which can lead to a decrease in the hard drive life expectancy.

SSD Drives:With the advancement of technology and increase demand by consumers for speedier application time, a new form of hard drive has emerged in today’s market known as solid state.  The conventional hard drives such as SATA, PATA and SCSI hard drives all contain moving parts, magnetic coating and platters that spin.  These types of hard drives have their own set of setbacks as mentioned above.  Solid state drives, on the other hand do not, which has taken data storage and access to a whole new level.    Solid State drives use microchips, which translates to less susceptibility to shock, less noise, less heat, no sensitivity to magnets, improved durability, increased lifespan and data access speed.  In 2010, most solid state drives began to included nand flash memory, which introduced the retainment of memory even with the loss of power and almost instant access to data.  Another advantage that SSDs have over conventional hard drives is the faster start up because no spin up is required. Furthermore, solid state drives have the same interfaces as conventional hard drives.  They are appearing right now in ultra mobile pc’s and few light weight systems.  However, the biggest drawback is the price which is expected to be less of a factor as popularity increases and prices drop.

Internal Drives, just like there external counter parts differ in cost depending on the performance and also the amount of space that they offer to consumers. The most affordable hard drives start $30 to the most expensive being close to $1200 if not more.

**External Hard Drives:**

External hard drives are very similar to internal hard drives except that they are located outside computers and have a type of cable, usually an USB cable, which connects it to the computer.
External hard drives are nothing new to the computer market. Some of the first computer hard drives were actually external because they were too big to fit inside computers. Over time, they were made small enough to fit inside desktops and laptops. One would think that external hard drives would virtually become nonexistent after this technology advancement; however, external hard drives still remain relevant, popular and widely available because of their usefulness and the several benefits they offer over internal hard drives. Some of these advantages include data storage, data protection, and costs.

DATA storage – external hard drives are one neat data storage option. In today’s world, people constantly have to save more data onto their internal hard drives such as music, photos and other types of file and on the move. If the internal hard drive runs out of space, external hard drives are one solution to this problem. External hard drives come in several sizes or rather have different data storage capabilities. Deciding which one to get usually depends on the user needs.

USB flash Drives have become very popular today and can save anywhere from 1 gigabyte to 32 gigabytes of information. USB flash drives come in handy because they are small enough to carry in a pocket and have no mechanical parts in them. Most computers today have USB ports to connect them to. The only real issue with them is that they are small and can easily be lost.

The portable external hard drives are about the size of a laptop hard drive. They are still relatively small and light and are protected by a plastic covering. They normally store up to 500 gigabytes of data. They are also usually USB powered supplied, which means they do not require their own power supply.

Larger external hard drives, also known as desktop external desktop hard drives, are usually about the size of a book and can store up to 1 terabyte (1,000 GB). Although they have great data storage capability, they do require their own power supply and come with a fan to keep them cool.

**Data Protection:**

Backing up files or data is vital, especially with all the threats that pose to a computer and the internal hard drives in them. External hard drives are just another way to back up that important data securely. One great benefit having an external hard drive is the exact reason they go outside of the computer. If the computer crashes or, all data saved in the internal hard drive could be lost. Retrieving the data could be a costly investment or time consuming problem. On the other hand, this would not be the case with an external hard drive because all information saved on it does not depend on the functionality of the computer. External hard drives could easily be store in safe and secure place.

**Costs:**

The costs of external hard drives continue to drop. Today some external hard drives with capabilities of storing up to 1 terabytes of data can costs less than $100.

**RAID**

Building upon the information presented on hard drives, take into account capacity, reliability, and performance when it comes to storing data on servers and on today's powerful personal computers. In this digital day and age our main driving force is information (data), since hard drives are the main form on data storage and are susceptible to failure a viable solution to this problem is needed.

This is where RAID comes in, so what exactly is RAID? At Its most basic definition RAID is a redundant array of independent disks although when introduced by researchers at University of California, Berkeley it stood for redundant array of *inexpensive* disks, this may seem overly technical at first, but it's really just a group (2 or more) of hard drives that connected in parallel that appear as one large drive to an operating system. Using this configuration can provide larger storage capacity at a reduces cost, increase read/write (RAID 0), provide fault tolerance which is the ability to recover data from a failed drive, and in some cases both read/write and fault tolerance are provided.

At its very core RAID uses "striping", with striping a data file is broken down and is written throughout the disks available in a circular motion, meaning if the first chunk of data is written on disk 1 the second chunk will be written on disk 2 and so on. Striping in done in two ways byte level and block level, in byte level it is as it implies data is broken down into bytes but can also be done as a sectors which is (512 bytes) with Block Level striping data can be broken down into larger chunks which can be a few megabytes in size.

**Types of RAID**

* RAID-0: Block-level striping without parity or mirroring**.** This technique has striping but no redundancy of data. It offers the best performance but no fault-tolerance meaning if a disk goes down the array goes down and catastrophic data loss is the end result. This RAID configuration requires 2 disks and offers no fault tolerance.
* RAID-1: Also known as disk mirroring without parity or striping uses at least 2 drives, just as the name implies there is duplicate data on all the drives(mirrored sets) instead of using striping. RAID-1 offers fault tolerance since the array will continue to work as long as one drive in the set is working. This type of RAID is best suited for multi-user systems. This RAID configuration requires 2 disks and offers a fault tolerance of n-1 disks.
* RAID-2: Bit-level striping with dedicated Hamming-code parity. All disk spindle rotation is synchronized, and data is striped such that each sequential bit is on a different disk. Hamming-code parity is calculated across corresponding bits on disks and stored on one or more parity disks. Extremely high data transfer rates are possible. This RAID configuration requires 3 disks and offers a fault tolerance of 1 disk when the fact that the disk is corrupt isn't found by anything but the hamming-recover-record-code.
* RAID-3: Byte-level striping with dedicated parity, this type uses striping and dedicates one drive to storing parity information. The embedded error checking (ECC) information is used to detect errors. Data recovery is accomplished by calculating the exclusive OR (XOR) of the information recorded on the other drives. Since an I/O operation addresses all drives at the same time, RAID-3 cannot overlap I/O. For this reason, RAID-3 is best for single-user systems with long record applications**.** This RAID configuration requires 3 disks and offers a fault tolerance of 1 disks.
* RAID-4: Block-level striping with dedicated parity. RAID Level 4 stripes data at a block level across several drives, with parity stored on one drive. The parity information allows recovery from the failure of any single drive. The performance is very good for read operations however write operations require that parity data be updated each time which can lead to a bottle neck this slows small random writes, though large writes or sequential writes are fairly fast. This RAID configuration requires 3 disks and offers a fault tolerance of 1 disks.
* RAID-5: Block-level striping with distributed parity. This type includes a rotating parity array, thus addressing the write limitation in RAID-4. Thus, all read and write operations can be overlapped. RAID-5 stores parity information but not redundant data (but parity information can be used to reconstruct data). It's best for multi-user systems in which performance is not critical or which do few write operations. This RAID configuration requires 3 disks and offers a fault tolerance of 1 disks.
* RAID-6: This type is similar to RAID-5 but includes a second parity scheme that is distributed across different drives and thus offers extremely high fault- and drive-failure tolerance. This RAID configuration requires 4 disks and offers a fault tolerance of 2 disks.
* RAID-10: Combining RAID-0 and RAID-1 is often referred to as RAID-10, which offers higher performance than RAID-1 but at much higher cost. There are two subtypes: In RAID-0+1, data is organized as stripes across multiple disks, and then the striped disk sets are mirrored. In RAID-1+0, the data is mirrored and the mirrors are striped.
* RAID-50 (or RAID-5+0): This type consists of a series of RAID-5 groups and striped in RAID-0 fashion to improve RAID-5 performance without reducing data protection.

**Benefits of RAID**

* **Data Reliability:**  Reliability is improved through redundancy.  Instead of having a single copy of data information, redundant information is stored amongst an array of disks.  This information is organized so that in case of a disk failure, it can be used to reconstruct the information of the failed disk.  When creating your array you have to decide where to store the information.  You can store the redundant information on a small number of check disks or distribute it uniformly over all disks.  Then you have to decide how to compute the redundant information.  Most disk arrays store parity information.   In a parity scheme an extra disk will have information that would be used to recover from a failure of any one disk of an array.
* **Improved Availability:**  Having the ability for users to continue to have access to their data is what availability means.  Access to data on RAID systems have improved availability by being able to recover from hardware problems without disruption.  Availability of an array depends on several things.  The higher the reliability of the hardware in the array then less chances of hardware problems and best way to keep availability high.  RAID arrays that can allow hot swapping of drives eliminate the need to shut down a system in case of a disk failure.  With a system that is always running having the ability to automatically rebuild the drive while the array continues to run is also important.
* **More Capacity:** You are able to connect several smaller hard disks on one array have your computer recognize it as one large hard disk.  Back then the cost of larger sized hard disks was a bit costly.  Smaller drives were more affordable.  If you had a database that needed to be a size that was larger than the capacity of a single disk, then you had the ability to connect the drives on an array, giving you more disk space.  You could split up the database amongst smaller drives but then you would have to remember where things were.  The combination of disks would be recognized as one large disk allowing room for the large database and making the disk management a bit easier.   Now a days the cost of larger drives have become cheaper and even better than drives of the past.
* **Better Performance:**   Performance is increased through data striping.  Data striping distributes data over several disks to give the impression of having a single large, very fast disk.  A RAID system can improve performance by allowing maximum throughput to be pushed by all drives at once; increasing maximum data flow.  In RAID, the drives are able to be accessed in parallel which is important to increase performance.  This ability to access multiple disks at the same time allows for data to be written or read from the RAID array faster than would be possible on a single disk.

**Implementation**

**Hardware RAID**

Hardware RAID has many advantages over the use of Software RAID even though it will be a
bit more expensive to implement which is one of its drawbacks. In recent years the prices for
RAID 0/1 controllers have decreased significantly that even some manufacturers are already
including them in the motherboard. RAID 5 hardware is one that requires more monetary
investment due to the required circuitry that is needed to add more computing ability. The main
advantage of hardware RAID is that it is independent from the CPU which means it will not
interfere with CPU's processing power and cache memory.

There are two common ways to implement Hardware RAID. The first one is a special processor
or subsystem in the array called IOP; The other option called IOC is to rely on the processor in
the controller to handle multiple RAID tasks .

• IOP RAID is the most expensive method of hardware implementation and it is the most
flexible since it has the capability of handling different tasks such as recovery and disk
array rebuilding and level mitigation than other methods. All of these components make
the IOP one of the best methods although it is available at a very high cost.

• IOC RAID is a more inexpensive option of hardware RAID, this process of
implementation uses the processors on the disk controllers in order to give RAID
functionality. This option comes with its drawback since it is not as flexible and lacks
the performance of the IOP RAID. Since IOC is limited by memory bandwidth of the
controller and the power of the processor it is not as fast as the other option. Although it
is not the best option for most of the high performance applications is a good option to
enjoy the benefits provided by hardware RAID.

**Software RAID**

Software RAID is considered more of a dependent implementation since it uses processing
power from other applications in the CPU therefore slowing the CPU's performance . Depending
on the RAID level, the highest the level, the more processing power it requires from the CPU.
The advantage of Software RAID is the low cost since it does not require any extra investment,
which makes it more affordable.

Although software RAID is the less expensive option when implementing RAID in to a CPU,
many people opt to acquire Hardware RAID since over the years it has become relatively more
inexpensive than in the past, and it provides more advantages to the user.

Just like Hardware RAID with Software RAID there are two options to chose from. These are
the implementation of Software RAID in the disk controller driver or the operating system.

• The Disk Controller Driver-based RAID as the name implies, is implemented in the
drivers of the hard disk controllers. Its advantage is that it does not directly rely on the
operating system, rather for RAID functionality it relies on the specific make of the
controller.

• The Operating System based RAID is a RAID engine in the operating system. This is not
dependent on the controller like the Disk Controller Driver-based RAID, but rather in the
Operating System.

Both of these options are dependent on the system processor and memory resources to be able to function. This significantly affect the CPU's performance in an overloaded environment.

**Group 5**

What is an operating system? What does it do? How does it work with the computer? These are some of the questions that people ask themselves when it comes to computers. People know about Windows and some of the different releases of windows and that it runs on a computer, but do people ultimately know what an operating system is? Unless you are in the technology field you may have never heard of Linux, UNIX or any other operating system other than Windows and Mac OS which are the popularized operating systems. Even if you know the main operating system does really anyone understand what they do and how they work? Looking back in time we find ourselves with a computer which only reads 1 and 0, on or off. With that comes a challenge to make that type of technology work for people and have it work fast for them. Technology has advanced so much over the years and has grown in so many directions one of the main advancements is the operating system and what its functions are in the computer.

# History

The first operating systems were not really operating systems but they were computers that would process information one program at a time. Started in the 1950s people would come to the computer with punch cards and insert them and wait for the computer to finish the program or crash and they would interface/debug with their program using a series of toggles and buttons in front of the computer. The name of the computer that was being used in this time was the Manchester Mark 1 for example. Later on machines started to come with libraries of software which would be linked to the users program to assist the program in operational. In the 1950s many new features such as batch processing link libraries, input/output interrupt, buffering, and so many other features were started to be introduced to mainframe computers which made it easier for a programmer to interface with a program. In 1959 SHARE Operating System was released to try to make an integrated unity among the IBM 704, 709, 7090 mainframes. Mainframe computers pioneered some of the basics for operating systems and eventually the mainframe computer was reduced with microcomputers that started to come out such as the Apple II which was apples first computer. In the microcomputer world the first computer had MS-DOS on them which became one of the most popular operating systems for the IBM PC. With MS-DOS installed on these computers it gave the user a minimalistic approach to doing work the operating system would load a program into the ROM and then the user was able to use it. In the 1980s Apple Inc. abandoned the Apple II computer and started the Apple Macintosh computer with a GUI (graphical user Interface). When a 32-bit processor was introduced it started to give the regular user the ability to start to multitask and so operating systems started to make that feature happen. Microsoft saw the potential for this type of technology so Microsoft hired Dave Cutler who was developing VMS operating systems and later on he would lead the development of Windows NT which continues to be the basis for which Microsoft operating systems run on. With the advancement of the processer so came the advancements of the Operating System and Apple Inc. started to use an operating system that was developed by co-founder Steve Jobs and FreeBSD to create the Mac OSX Core.

# Microsoft Windows Operating Systems

Windows has been around since 1985 and was started with the MS-DOS Core and had a GUI over it and was called Windows 1.0 and was released in November 1985 Windows 2.0 was released in 1987 and soon after that Windows 2.1 was released in to flavors Windows/386 and Windows/286 the main difference was the use of High memory or kernel protected mode. In 1990 windows 3.0 was released and in 1992 windows 3.1 which improved design mainly due to virtual memory problems that arose in windows 3.0. In August 1995 Windows 95 was introduced and featured new user interface and support for long file names and introduced Plug and Play features which allowed the user to plug in many devices and then right off the bat start to use them and have access to them using USB 1.1 or USB 2.0. In June 1998 Windows 98 came out and shortly after Windows 98 Second Edition came out in May 1999. In September 2000 Windows Millennium Edition came out which updated the windows 98 core and adopted the same aspects of windows 2000 and removed the boot in DOS mode. The Windows NT Family was started in the 1993 with the release of Windows NT 3.1 and in years to computer lead to 4.0 in 1996 with versions released in between finally in 2000 Windows release Windows 2000. Windows moved to combine the consumer version and business version of the operating system and came out with Windows XP which lasted a very long time and remains to be the most common operating system. In 2006 Windows Vista was introduced and basically updated the core files and updated the graphical user interface. In 2009 windows 7 was introduced as Release to Manufacturing version and later on in the year was officially released to the public which brings us to the present. Windows 7 features the GUI of windows vista and the ability to be backwards compatible with other operating systems such as Windows 98 SE using the core files that the operating system used. Windows also had a server class of operating systems which offered more tools that could be implemented for networking and tracking using a Domain and DNS and DHCP. The first system was Windows Server 2000 which was the same core files as Windows 2000 but had some minor differences and was updated in 2003 with the Windows Server 2003. Server 2003 offered the same tools that 2000 had but supported more network applications and had more management features over the desktops. In 2008 Windows Server 2008 was released and supported 2003 Domains and did the same as Windows Server 2003 but had many features that were useful to any environment and had more security to the operating system and the network. This Operating system built up on the Group Policy and implements a Group Policy on the domain level and allows for more control of the computers through the group policy. Server 2008 was released in x86 and x64 and there are still many other versions to it and in 2009 had another release called R2 edition which built more features and Snap-Ins to Microsoft Management Console.

# Macintosh

Macintosh or Mac first released an operating system called “System” in 1984 and that was dubbed 1 and it featured the basic operating system features. The first release of system had some limitations such as it could only run one program at a time and was limiting the use of the production that the user could do. System had many updates and only releases 1, 4, 5, and 6 were really where the Operating system changed in a dramatic way. System 5 allowed the user to run multiple programs at once which was called MultiFinder. System 7 was released in May 13, 1991 this was a major update because it added a significant update to the user interface and new applications stability improvements and many new features. The most significant update in this release was the use of Virtual memory which previously was available as a 3rd party add-on. On July 26, 1997 OS 8 was released and shortly after Steve Jobs returned to Apple Inc. and this release was mainly to keep Apple Moving forward in the operating system field. OS 9 came out on October 23, 1999 it was generally a steady version of Mac 8 it added improvement to AirPort wireless networking and improved Sherlock search engine. 9 also added some transitional technology to help application developers adopt some of Mac OS X features before it came out. In 2000 Mac introduced their latest version of System which was OS X or ten and each release was named after big cats Mac OS X Cheetah, X.1 Puma, X.2 Jaguar, X.3 Panther, X.4 Tiger, X.5 Leopard, X.6 Snow Leopard and that is the latest version that Mac is on. Each Mac OSX Version release was improving on the previous system in some way and had some notable difference in the GUI and the way that the system was working with the applications and the hardware.

# Unix/Linux Systems

UNIX was created and implemented in 1969 at ATT Bell Labs in the United States by Ken Thompson, Dennis Ritchie, Douglas Mcllroy and Joe Ossanna. When UNIX was written in 1971 it was written in assembly language and was not as portable as the developers wanted it to be it was also very slow and called MULTICS. Later on in 1973 it was re-written in the programming C by Dennis Ritchie which made UNIX a little more portable between computers and systems. UNIX quickly grew and became adopted by academic institutions and companies because of the legal glitch that ATT had with the OS source code. The GNU Project which was a project to create a complete UNIX compatible software system was started in 1983 composed of freeware. MINIX which is an inexpensive minimal Unix-like operating system designed for educational use and mainly tailored to computer science MINIX was written by Andrew S. Tanenbaum. In 1991 Linus Torvald was curious about the operating system UNIX and frustrated by the licensing of MINIX which was only for educational use at the time so he decided to write his own operating system and he ended up writing the Linux kernel. Torvald developed the Linux kernel on MINIX and then Linux took over and was able to be developed on its own later on all MINIX applications were converted to the GNU project because the source code was freely available soon after all the conversions were done the legal issues were solved by converting the Linux source code so that the developers of the GNU GPL could integrate and make Linux a fully functional free operating system.

Today Linux is used in many types of environments and different types of systems from embedded systems to super computers Linux has earned its place among the operating system world offering a users experience that is closely related to Windows and provides added features. The main difference that is seen in Linux compared to other operating systems is the Linux has become open source code software that offers its use to all types of usage environments. Linux has become a popular operating system for the reason that most versions of Linux are free and there are hundreds of applications that can be used on them to make them run faster better and user friendlier. Linux has many versions of itself now in the world thanks to Linus Turvald and the open source GNU copyright that is implemented on Linux. Once Linux was open source many other flavors spanned from the initial release that was created by Turvald some of the versions were adopted and free others were adopted and added some copyright to them. Some examples of Linux distributions would be Ubuntu, Debian, FreeBSD, Knoppix, Back Track, DSL, and so many other versions listed in Figure 1. These are the Unix-Like versions of Unix which is called Linux.

Figure

# Redundancy: Power Supply and Data

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| When building your machine it is important to understand the importance of redundancy. Redundancy is the duplication of critical components of a system with the intention of increasing reliability of the system. Reliability can be increased by adding a redundant power supply. Usually used in higher-end machines, such as servers, redundant power supplies are also available to the general public. Even though they are a bit on the expensive side, the extra cost is worth the extra security. Basically the power supply contains two separate units within it, each with the capability to power the system by itself. If by chance one of the units fails or seizes to work properly, the second one can seamlessly continue powering the system without any damage to the PC. If one should fail you can swap it out for a new one, all the while without powering down the PC or Server, known simply as hot swapping. An additional complement to a redundant power supply would be the use of a UPS or Uninterruptible Power Supplies. A UPS is basically a block which provides power to your PC. It receives power from two inputs, Utility power and the battery. So if there was a power surge, such as those during a thunder storm, your PC would not be affected or crash. With the aid of a UPS and redundant power supply you create a fail-safe which would allow you to continue or safely turn off your machine to prevent any damage or loss of data. Could redundancy be applied to data? Iomnis, an IT service company in the greater Houston area, wrote, “Anyone who has lost days of work due to a system crash knows the value of data redundancy and regular data backup.” Data Redundancy means that some data is stored twice, or that some data can be derived from other data. This provides users with a “safety net” so that if there was a system crash, the user could retrieve the same data since it had been duplicated.A disk array is a good example of data redundancy. A disk array is a disk storage system which contains multiple disk drives which are generally used to replace larger, single disk drives systems. RAID or redundant array of inexpensive disks/ redundant array of independent disks, is a technology which provides storage reliability with the use of multiple low-cost, less reliable disk drives components into a logical unit where all drives are interdependent. According to SearchStorage.com, there are actually nine types of RAID plus a non-redundant array known simply as (RAID-0):* RAID-0: This technique has striping but no redundancy of data. It offers the best performance but no fault-tolerance.
* RAID-1: This type is also known as *disk mirroring* and consists of at least two drives that duplicate the storage of data. There is no striping. Read performance is improved since either disk can be read at the same time. Write performance is the same as for single disk storage. RAID-1 provides the best performance and the best fault-tolerance in a multi-user system.
* RAID-2: This type uses striping across disks with some disks storing error checking and correcting (ECC) information. It has no advantage over RAID-3.
* RAID-3: This type uses striping and dedicates one drive to storing parity information. The embedded error checking (ECC) information is used to detect errors. Data recovery is accomplished by calculating the exclusive OR (XOR) of the information recorded on the other drives. Since an I/O operation addresses all drives at the same time, RAID-3 cannot overlap I/O. For this reason, RAID-3 is best for single-user systems with long record applications.
* RAID-4: This type uses large stripes, which means you can read records from any single drive. This allows you to take advantage of overlapped I/O for read operations. Since all write operations have to update the parity drive, no I/O overlapping is possible. RAID-4 offers no advantage over RAID-5.
* RAID-5: This type includes a rotating parity array, thus addressing the write limitation in RAID-4. Thus, all read and write operations can be overlapped. RAID-5 stores parity information but not redundant data (but parity information can be used to reconstruct data). RAID-5 requires at least three and usually five disks for the array. It's best for multi-user systems in which performance is not critical or which do few write operations.
* RAID-6: This type is similar to RAID-5 but includes a second parity scheme that is distributed across different drives and thus offers extremely high fault- and drive-failure tolerance.
* RAID-7: This type includes a real-time embedded operating system as a controller, caching via a high-speed bus, and other characteristics of a stand-alone computer.
* RAID-10: Combining RAID-0 and RAID-1 is often referred to as RAID-10, which offers higher performance than RAID-1 but at much higher cost. There are two subtypes: In RAID-0+1, data is organized as stripes across multiple disks, and then the striped disk sets are mirrored. In RAID-1+0, the data is mirrored and the mirrors are striped.
* RAID-50 (or RAID-5+0): This type consists of a series of RAID-5 groups and striped in RAID-0 fashion to improve RAID-5 performance without reducing data protection.
* RAID-53 (or RAID-5+3): This type uses striping (in RAID-0 style) for RAID-3's virtual disk blocks. This offers higher performance than RAID-3 but at much higher cost.
* RAID-S (also known as Parity RAID): This is an alternate, proprietary method for striped parity RAID from EMC Symmetrix that is no longer in use on current equipment. It appears to be similar to RAID-5 with some performance enhancements as well as the enhancements that come from having a high-speed disk cache on the disk array.

By using a RAID system you increase your data reliability, drive-failure tolerance or input/output performance. If creating and managing databases, an individual would find that data redundancy would be more of a problem rather than a solution. By storing the same data values within the same table or other tables you create the possibility for errors to occur such as update, insertion, and deletion. The best remedy to fix these issues would be to practice data normalization, which should help with data redundancy. |

# Backups

Another method to protect a users data from damage or loss would be a computer backup. A computer backup is the storage of copies of your files on a medium other than your hard drive. The purpose of a computer backup is to have the computer’s files available in the event that the initial copies of the files are erased or damaged beyond usability, therefore, providing a copy of the files for use.

A backup is done by copying all of your files onto an exterior media source, such as a floppy disk (almost obsolete), CD-ROMs, CD-RWs, key drives, or an online server. In the event of erasure or corruption, the disaster recovery of files is easy and the files are available. Since a backup contains all information deemed “worth saving,” some backups may be large in size.

The information for backups is selected, extracted and manipulated. The files can be compressed, encrypted, and de-duplicated. As information changes and evolves, backups need to be updated to contain the new information.

Solutions for Backups:

Flash memory is not susceptible to damage caused by magnets and can last up to 10 years. They can range in storage capabilities from 64 MB to 8 GB. They can plug into any computer with a USB drive and can be repeatedly rewritten. Flash memory is also known as memory sticks, flash drives and thumb drives.

DVD storage is more suitable for personal or small business backups. Storage capabilities range from 4.7 GB (single-layer DVDs) to 8.5 GB (dual-layer DVDs). DVD storage can be DVD-RW, DVD+RW, DVD-R, DVD+R and DVD-RAM.

Hard drives are gaining popularity due to the ease of copying and retrieving data from various hard drives. Also, the price of hard drives has continued to drop in recent years. One downside to hard drives is the fear that malware, which infects the primary drive, could also affect copies and storage drives.

Tape backups provide the highest storage capacities at the lowest cost. However, the tape devices are becoming decreasingly accessible and less popular, almost obsolete for home computer users. They speed at which they write is comparatively slow to modern storage devices.

Online backups are the most accessible storage techniques available, since all you need is a computer with internet access. Online backups allow people to upload information to a reliable server in a secure environment.

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