

A+ Essentials

Mega Guide

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Domain 1 – Personal Computer Components

Fundamental Principles

Storage Devices

A storage device is, broadly defined, any component your computer uses to permanently store information. This is done in a variety of ways by a variety of different components, but generally speaking, storage devices are split into two categories: **fixed** and **removable**.

- A **hard disk drive** (HDD) is a fixed, non-volatile storage device that stores information on the magnetic surface of hard disk platters.
 - ▶ Hard disks are measured in terms of capacity (typically in GB) and in speed (revolutions per minute, or RPMs).
 - ▶ Today, a typical workstation's hard drive might have between 40 and 200 GB of storage space rotating at 7,200 to 10,000 RPMs.
 - ▶ Connected to the computer by one of several different connections:
 - **ATA** – Standard on most desktop computers; IDE and EIDE; cable is a flat, wide ribbon.
 - **Serial ATA** – Provides for faster communication speeds between hard drive and motherboard; it is *not* backward compatible with the ATA form factor.
 - **SCSI** – Interface allowing the connection of several devices in a chain.
 - For more information about connection types, refer to the **Motherboard Components** discussion below.
 - ▶ **RAID** (Redundant Array of Independent Disks) is a system utilizing multiple hard disks in tandem to share data across the drives. It helps provide data security and recoverability, protecting against hard drive failure.
- A floppy disk drive (FDD) is removable storage utilizing a thin, flexible magnetic storage medium, encased in a plastic shell to read and write data.
 - ▶ While over time drive capacities have changed, today's standard floppy disk drive size is 1.44 MB.
 - ▶ Floppy disk drives are quickly going out of standard use, due to the higher capacity, and much cheaper, writeable compact disks.
- The **CD** and **DVD-R** (or RW, for rewriteable) is removable storage that takes advantage of the higher capacity of optical disks to store information. Optical drives are, typically, IDE or SCSI devices.
 - ▶ CD-R (and DVD-R) drives utilize a red-light laser to "burn" data onto blank optical discs.
 - ▶ CD and DVD-R media come in several different types:
 - **CD-R** – Write-Once discs, with a standard size of 700MBs;

- **CD-RW** – Rewriteable discs, with a standard size of 700MBs;
 - **DVD-R** – Also write-once discs, DVDs have a standard capacity of 4.7 GB. This format includes the **DVD-RW**, the rewriteable form;
 - **DVD+R** – Simply another write-once format, not currently approved by the DVD Forum. It also has a rewriteable form, **DVD+RW**, and a double layer disc with a capacity of almost 8.55 GBs, referred to as **DVD+RW DL**.
- ▶ Drive speeds are as varied as media types and are issued as multiples of the original read speed of the device. CD-ROMs start at 150KB/s, and DVD-ROMs start at 1352.54KB/s. Thus, a 52x CD-ROM reads at 7800KB/s, and a 16x DVD-ROM reads at 21,640KB/s.
- Other removable storage options include:
 - ▶ **Tape Drives:** Sequential-access data media composed of a strip of magnetic or punched tape. Usually used for archival storage due to the long shelf-life of the medium.
 - ▶ **Solid State Drives:** Such as thumb, flash and SD drives. Volatile storage (like RAM) utilized for extremely quick access speeds. These are usually used in small, hand-held devices.
 - ▶ **USB** is a serial connection used to link, typically, external devices to the computer. These can be hard drives and optical drives, and are utilized for a variety of reasons but are usually used to take advantage of the ease of operability and installation. USB external devices are plug-and-play.

Motherboards

Motherboards (or mainboards) are one of the most important components in a computer. They provide the backbone of communication between all devices installed on a computer, and as such, it is important to understand how the various components on a motherboard function.

- The **form factor** of a motherboard refers to several characteristics of a motherboard, including its size and format (which in turn relates to the size and format of the computer case), as well as the particular interfaces that allow communication with other devices.
 - ▶ **ATX** (Advanced Technology Extended) is the industry standard motherboard form factor. **BTX** is a newer version of ATX, focusing on a lower profile and providing better thermal regulation. BTX is currently being used in Gateway and Dell computers.
 - ▶ **Micro ATX** and **NLX** are simply smaller versions of the ATX built for smaller, workstation oriented computers.
- **Components**
 - ▶ Most motherboards include a variety of integrated input/output components. These are usually sound, video, parallel and serial ports, and USB connections. Some motherboards also provide integrated modems, network interface cards and IEEE 1394 (or firewire) connections.
 - ▶ **Memory slots** refer to the available slots for RAM modules, and come, typically, in two styles:
 - **RIMM** – This is the industry standard for RDRAM memory. Possesses a 32-bit bus length.

- **DIMM** – Dual In-line Memory Module. This doubles the bus length to 64-bits, providing higher bandwidth for access speeds.
- ▶ **Processor Sockets** refer to the socket type for the processor chip. ATX motherboards can potentially come with one of several different socket types:
 - **Socket 478** – Used for Intel’s Pentium 4 and Celeron chips. Supports high bus speeds, DDR, RD, and SD RAM.
 - **Socket A** – Used for AMD’s line of processors. While this is still in wide use, it has been ultimately replaced by the **Socket 939** for high-end AMD processors, and the **Socket 754** for budget processors.
- ▶ **External Cache Memory** refers to small amounts of volatile memory located near the CPU to provide faster access times to memory modules, by duplicating frequently used locations in the RAM modules.
- ▶ **Bus Architecture** refers to the connection medium through which peripheral cards connect to the motherboard.
- ▶ Peripheral cards connect to the computer bus through a variety of **bus slots**:
 - **PCI** – Most commonly used bus slot; most expansion cards utilize the PCI bus (with the exception of graphics cards).
 - **AGP** – PCI-derived standard with higher bus speeds utilized for 3D graphics rendering.
 - **PCI-E** – *Express* PCI slot developed more recently which utilizes a much faster serial communications protocol.
- ▶ **EIDE** (or **PATA**) and **SATA** are standards for connecting storage media to the motherboard.
 - **EIDE** utilizes a parallel connection and a shared bus consisting of a master device and a slave device.
 - **SATA** is, theoretically, faster. However, its largest benefits over EIDE are smaller power and interface cables and the ability to hotplug SATA devices. This is due, in part, to the dedicated cable and host controller for the serial device. A dedicated host controller means that the information passed along the bus can be more quickly assimilated or disassembled, resulting in faster speeds.
- ▶ **SCSI** (Small Computer System Interface) is commonly used to connect hard, optical, and tape drives; however, these can be expanded to connect a wide range of devices, including scanners and printers. There are several SCSI standards. Generally speaking, SCSI provides a higher range of data management and protection capabilities than the ATA standard. Refer to *Table 1.1, SCSI Types* for a listing of SCSI standards and their associated speeds.

SCSI Type	Bus Speed	Bus Width	Transfer Rate	Max Number of Devices
Regular SCSI-1	5 MHz	8 bit	5 MB/s	8
Wide SCSI-2	5 MHz	16 bit	10 MB/s	16
Fast SCSI-2	10 MHz	8 bit	10 MB/s	8
Fast Wide SCSI-2	10 MHz	16 bit	20 MB/s	16
Ultra SCSI-3	20 MHz	8 bit	20 MB/s	8
Ultra Wide SCSI-3	20 MHz	16 bit	40 MB/s	16
Ultra 2 SCSI-3	40 MHz	8 bit	40 MB/s	8
Ultra2 Wide SCSI-3	40 MHz	16 bit	80 MB/s	16
Ultra3 SCSI-3	40 MHz	16 bit	160 MB/s	16
Ultra4 SCSI-3	80 MHz	16 bit	320 Mb/s	16

Table 1.1 – SCSI Types

- ▶ **Chipset** refers to the specialized motherboard chips handling communications between outlying devices and the processor. These come in two classes:
 - **Northbridge** – located closest to the processor, which handles communication between RAM and AGP and PCI-E slots.
 - **Southbridge** – located furthest from the processor, handling slower devices, such as PCI, IDE, USB, etc.
- ▶ **BIOS**, or Basic Input/Output System, is hard-wired software code the computer uses to prepare the machine for control by the operating system.
 - BIOS utilizes a version of non-volatile memory to store these settings, referred to as **CMOS**, and connected to a small battery.
 - In this context, **Firmware** refers to the actual software hard-coded on the BIOS, which can be updated via a process referred to as “flashing.”

Power Supplies

A power supply's main purpose is to both **convert** AC power, typically between 120 and 240 volts (V), into useable power and to **convey** that useable power adequately throughout all of a computer's various components.

- Though power supplies come in a wide variety of form factors for different uses, most conform to the ATX standard.
- Power supplies are rated based on their maximum output power, measured in watts (W); most fall between 200 W and 500 W.
- Output leads, from the unit, supply power to the various devices.

Processors

If one can visualize the motherboard as the backbone of a computer system, then it is appropriate to imagine the processor as the brain of a computer system. The central processing unit (CPU) performs all data processing and instruction interpretation that is vital to the operation of a computer.

- Virtually all personal computers utilize one of two brands of processor chips:
 - ▶ **AMD and Intel**
 - ▶ In reality, there is very little difference between the two chips, aside from basic architecture and pin structure and the general acknowledgement that Intel processors run slightly cooler than AMD processors.
 - ▶ Processor choice should ultimately be made based on price and features.
- CPUs can potentially support a number of various chip technologies, described below:
 - ▶ **Hyper-threading** is the utilization of otherwise idle execution units to improve the over-all reaction and response time of the CPU.
 - ▶ **Dual-core** refers to a single processor which possesses two independent microprocessors.
 - ▶ **Throttling**, also known as clamping, cuts the amount of CPU time used on applications which stall the computer.
 - ▶ **Micro Code (MMX)** is a CPU instruction set, designed by Intel, which allows for the CPU to "package" larger instructions into smaller pieces, or microprograms.
 - ▶ **Overclocking** is the process of overriding a CPU's designed clock speed in favor of faster clock speeds, which in turn provides better performance.
 - ▶ A CPU's **cache** is a designated set of smaller, faster memory units, utilized by the CPU, to perform frequently utilized instructions faster.
 - ▶ The **voltage regulator module (VRM)** is the device which provides the proper amount of power to a CPU.
 - ▶ Most processors today come in a **32-bit** format, with **64-bit** processors slowly finding use in academic and corporate institutions. The essential difference between the two formats lies in their ability to handle mathematical calculations. 64-bit processors can simply handle larger numbers and can be more efficient with smaller numbers.