Components of Modern Desktop Computer

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Personel Computer (PC) is a microcomputer designed for individual use, as by a person in an office or at home or school, for applications varies from word procesing to high end multimedia and mathematical simulations. A computer system consists of hardware and software components. Hardware is the physical equipment such as the case, storage drives, keyboards, monitors, cables, speakers, and printers. The term software includes the operating system and programs. The operating system instructs the computer how to operate. These operations may include identifying, accessing, and processing information. Programs or applications perform different functions. Programs vary widely, depending on the type of information that is accessed or generated.

Classification of computers according to the developmental stages (Generation)

1. **First generation computer**: Computers of this generation were very big in size and slower in processing. They used vacuum tubes as their main hardware components. They consumed huge amount of energy. Mark-I is an example of such computer. This generation computer has very small memory (Approx. 1 to 4 kb)
2. **Second-generation computer**: In 1948-49, a semiconductor device named after transistor was developed by a group of three scientists (John Burdeen, Walter H. Brattain and William B. Shockley) in the Bel Laboratories. It was a great invention of science in the field of computer because single transistor was able to replace 1000 vacuum tubes and consumes less power. This device was faster then vacuum tubes. This device made the computer faster, smaller than first generation. Second generation's computer use transistor as their main hardware device.
3. **Third generation computer**: This generation of computer uses the IC (Integrated circuit) as their main hardware. The approximate time of this generation is supposed to be started from 1966. Form this generation computers began to be connected with Visual Display Unit (VDU), high-speed printer and magnetic tape as storage. Third generation computers ware faster, smaller and more reliable than second generation.
4. **Fourth generation computer**: When Intel designed a complicated integrated circuit in 1971and started to called as VLSI (Very Large Scale Integration) or processor, the history of fourth generation started. These computers are the today's computers. They are smaller, faster, reliable and versatile. They are user friendly and easier to use. Huge storage capacity and accuracy are the main features of this generation. Our computers are the computers of this generation.

5. **Fifth generation computers:** Technology never stops. After Microprocessor, Scientists are trying to create more faster, more smaller and more reliable device known as Bio-chip by Gallium Arsenide (GaAs) after the use of which computer will have artificial intelligence (AI) to make computer able to think like human.

Classification of computer according to the model

Generally, when we talk about computer, we talk about IBM or IBM compatible. More then 80 percent computers of this world fall under these categories. So, Classification of computer according to the model refers to the classification of IBM or IBM compatible computers. These computers can be classified into three groups, they are:

1. XT computers : XT (eXtended Technology) computers are the old days computers. Originally they had a processing speed of 4.77 MHz. These computers were based on the processor called 8086. The computer with 8086, 8087 and 8088 processor are called the XT computers. These computers were capable to run the DOS and DOS based programs.
2. AT computers : AT (Advanced Technology) computers are faster and smaller then XTs. These computers are capable to run the GUI based programs . The computer with 80286, 80386, 80486 and Pentium processor are the AT computers.
3. PS/2 computers : PS/2 computers are the advanced computer made by Apple and IBM. They use the same processor made by Motorola Corporation.

Components of PC

1. **Cabinet**
2. **Power Supply (SMPS)**
3. **Mother Board**
4. **CPU/ Microprocesor**
5. **Memory(ROM,RAM,Cache)**
6. **Storage Devices**
7. **Input Devices**
8. **Output Devices**
9. **Ports and Connecters**

Computer Cabinet / Case

A computer case contains the framework to support a computer's internal components while providing an enclosure for added protection. Computer cases typically are made of plastic, steel, and aluminum and are available in a variety of styles. The size and layout of a case is called a form factor. AT,ATX,Mini ATX and Micro ATX are various stanadard form factors of desktop cabinets

Power Supply (SMPS)

The power supply converts alternating-current (AC) power coming from a wall outlet into direct-current (DC) power.DC power is required for all the components inside the computer. Most connectors today are keyed connectors. Keyed connectors are designed to be inserted in only one direction.SMPS (Switch Mode Power Supply) is the type of power supply used in PCs. Each part of the SMPS connector has a colored wire with a different voltage running through it, as described in the following table

Color	Pin	Signal
	P8.1	Power Good
	P8.2	+5 V
	P8.3	+12 V
	P8.4	−12 V
	P8.5	Ground
	P8.6	Ground
	P9.1	Ground
	P9.2	Ground
	P9.3	−5 V
	P9.4	+5 V
	P9.5	+5 V
	P9.6	+5 V

AT Power Connector

Color	Signal	Pin	Pin	Signal	Color
Orange	+3.3 V	1	13	+3.3 V	Orange
				+3.3 V sense	Brown
Orange	+3.3 V	2	14	−12 V	Blue
Black	Ground	3	15	Ground	Black
Red	+5 V	4	16	Power on	Green
Black	Ground	5	17	Ground	Black
Red	+5 V	6	18	Ground	Black
Black	Ground	7	19	Ground	Black
Grey	Power good	8	20	Reserved	N/C
Purple	+5 V standby	9	21	+5 V	Red
Yellow	+12 V	10	22	+5 V	Red
Yellow	+12 V	11	23	+5 V	Red
Orange	+3.3 V	12	24	Ground	Black

|24-pin ATX12V 2.x power supply connector

Different connectors are used to connect specific components and various locations on the motherboard:

- A Molex connector is a keyed connector used to connect to an optical drive or hard drive.
- A Berg connector is a keyed connector used to connect to a floppy drive. A Berg connector is smaller than a Molex connector.
- A 20-pin or 24-pin slotted connector is used to connect to the motherboard. The 24-pin slotted connector has two rows of 12 pins each, and the 20-pin slotted connector has two rows of 10 pins each.
- A four-pin-to-eight-pin auxiliary power connector has two rows of two to four pins and supplies power to all areas of the motherboard. The four-pin-to-eight-pin auxiliary power connector is the same shape as the main power connector, but smaller.
- Older standard power supplies used two connectors called P8 and P9 to connect to the motherboard. P8 and P9 were unkeyed connectors. They could be installed backwards, potentially damaging the motherboard or power supply. The installation required that the connectors were lined up with the black wires together in the middle.

Motherboard

The motherboard is the main printed circuit board. It contains the buses, or electrical pathways, found in a computer. These buses allow data to travel between the various components that comprise a computer. A motherboard is also known as the system board, backplane, or main board.

The motherboard accommodates the central processing unit (CPU), RAM, expansion slots, heat sink/fan assembly, BIOS chip, chip set, and the embedded wires that interconnect the motherboard components. Sockets, internal and external connectors, and various ports are also placed on the motherboard.

The form factor of motherboards pertains to the board's size and shape. It also describes the physical layout of the different components and devices on the motherboard. Motherboards have various form factors:

- Advanced Technology (AT)
- Advanced Technology Extended (ATX)
- Smaller footprint than Advanced Technology Extended (Mini-ATX)
- Smaller footprint than Advanced Technology Extended (Micro-ATX)
- Low-Profile Extended (LPX)
- New Low-Profile Extended (NLX)
- Balanced Technology Extended (BTX)

An important set of components on the motherboard is the chip set. The chip set is composed of various integrated circuits attached to the motherboard that control how system hardware interacts with the CPU and motherboard. The CPU is installed into a slot or socket on the motherboard. The socket on the motherboard determines the type of CPU that can be installed. The chip set of a motherboard allows the CPU to communicate and interact with the computer's other components and to exchange data with system memory (RAM), hard disk drives, video cards, and other output devices. The chip set establishes how much memory can be added to a motherboard. The chip set also determines the type of connectors on the motherboard. Most chip sets are divided into two distinct components, northbridge and southbridge. What each component does varies from manufacturer to manufacturer, but in general the northbridge controls access to the RAM, video card, and the speeds at which the CPU can communicate with them. The video card is sometimes integrated into the northbridge. The southbridge, in most cases, allows the CPU to communicate with the hard drives, sound card, USB ports, and other input/output (I/O) ports.

CPU/ Microprocessor

The central processing unit (CPU) is considered the computer's brain. It is sometimes called the processor. Most calculations take place in the CPU. In terms of computing power, the CPU is the most important element of a computer system. CPUs come in different form factors, each style requiring a particular slot or socket on the motherboard. Common CPU manufacturers include Intel and AMD.

The CPU socket or slot is the connector that is the interface between the motherboard and the processor. Most CPU sockets and processors in use today are built around the pin grid array (PGA) architecture, in which the pins on the underside of the processor are inserted into the socket, usually with zero insertion force (ZIF). ZIF refers to the amount of force needed to install a CPU into the motherboard socket or slot. Slot-based processors are cartridge-shaped and fit into a slot that looks similar to an expansion slot. Following tables list common CPU socket specifications.

Socket	**Pin Count**	**Example of Compatible CPUs**
Socket 0	168	• 486 DX
Socket 1	169	• 486 DX • 486 DX2 • 486 SX • 486 SX2
Socket 2	238	• 486 DX

		• 486 DX2 • 486 SX • 486 SX2 • Pentium Overdrive
Socket 3	237	• 486 DX • 486 DX2 • 486 DX4 • 486 SX • 486 SX2 • Pentium Overdrive • 5x86
Socket 4	273	• Pentium-60 and Pentium-66
Socket 5	320	• Pentium-75 to Pentium-133
Socket 6	235	• 486 DX • 486 DX2 • 486 DX4 • 486 SX • 486 SX2 • Pentium Overdrive • 5x86
Socket 7	321	• Pentium-75 to Pentium-200 • Pentium MMX • K5 • K6 • 6x86 • 6x86MX • MII
Socket Super 7	321	• K6-2

		• K6-III
Socket 8	387	• Pentium Pro
Socket 370	370	• Celeron • Pentium III FC-PGA • Cyrix III • C3
Socket 423	423	• Pentium 4
Socket 463	463	• Nx586
Socket 478	478	• Pentium 4 • Celeron • Celeron D • Celeron M • Core Duo • Core Solo • Pentium 4 Extreme Edition • Pentium M • Mobile Pentium III • Mobile Celeron • Mobile Pentium 4
Socket 479 (Socket M)	479	• Core Duo • Core Solo • Pentium M • Mobile Pentium III • Mobile Celeron • Mobile • Pentium 4 • Celeron M
Socket 775 (LGA775) (Socket T)	775	• Pentium 4 • Pentium 4 Extreme Edition • Pentium D • Pentium Extreme Edition

		• Celeron D • Core 2 Duo • Core 2 Extreme
Socket 603	603	• Xeon • Mobile Pentium 4
Socket 604	604	• Xeon
Socket 771	771	• Xeon
Socket 418	418	• Itanium
Socket 611	611	• Itanium 2
Socket 462 (Socket A)	453	• Athlon • Duron • Athlon XP • Sempron
Socket 754	754	• Athlon 64 • Sempron • Turion 64
Socket 939	939	• Athlon 64 • Athlon 64 FX • Athlon 64 X2 • Opteron
Socket 940	940	• Athlon 64 FX • Opteron
Socket AM2	940	• Athlon 64 • Athlon 64 FX • Sempron • Athlon 64 X2
Socket AM2+	940	• Athlon 64 • Athlon 64 X2 • Opteron

		• Phenom
Socket AM3	941	• Athelon-II • Phenome-II
Socket S1	638	• Turion 64 X2
Socket F	1,207	• Opteron • Athlon 64 FX (7x models)
Slot 1	242	• Pentium II • Pentium III (Cartridge) • Celeron SEPP (Cartridge)
Slot 2	330	• Pentium II Xeon • Pentium III Xeon
Slot A	242	• Athlon (Cartridge)

The CPU executes a program, which is a sequence of stored instructions. Each model of processor has an instruction set, which it executes. The CPU executes the program by processing each piece of data as directed by the program and the instruction set. While the CPU is executing one step of the program, the remaining instructions and the data are stored nearby in a special memory called cache. Two major CPU architectures are related to instruction sets:

■ Reduced Instruction Set Computer (RISC): Architectures use a relatively small set of instructions, and RISC chips are designed to execute these instructions very rapidly.

■ Complex Instruction Set Computer (CISC): Architectures use a broad set of instructions, resulting in fewer steps per operation.

Some CPUs incorporate hyperthreading to enhance the CPU's performance. With hyperthreading, the CPU has multiple pieces of code being executed simultaneously on each pipeline. To an operating system, a single CPU with hyperthreading appears to be two CPUs. A CPU's power is measured by its speed and the amount of data it can process. A CPU's speed is rated in cycles per second. The speed of current CPUs is measured in millions of cycles per second, called megahertz (MHz), or billions of cycles per second, called giga hertz (GHz). The amount of data that a CPU can process at the one time depends on the size of the processor data bus. This is also called the CPU bus or the front-side bus (FSB).The wider the processor data bus, the more powerful the processor. Current processors have a 32-bit or 64-bit processor data bus. Overclocking is a technique used to make a processor work at a faster speed than its original specification. Overclocking is an unreliable way to improve computer performance and can damage the CPU.

MMX is a set of multimedia instructions built into Intel processors. MMX-enabled microprocessors can handle many common multimedia operations that normally are handled by a separate sound or video card. However, only software specially written to call MMX instructions can take advantage of the MMX instruction set.

The latest processor technology has caused CPU manufacturers to find ways to incorporate more than one CPU core into a single chip. Many CPUs can process multiple instructions concurrently:

- **Single-core CPU**: One core inside a single CPU chip that handles all the processing capability. A motherboard manufacturer may provide sockets for more than a single processor, providing the ability to build a powerful multiprocessor computer.
- **Multi-core CPU**: Two or more cores inside a single CPU chip, in which differnet cores can process information at the same time.

Cooling System

Electronic components generate heat. Heat is caused by the flow of current within the components. Computer components perform better when kept cool. If the heat is not removed, the computer may run slower. If too much heat builds up, computer components can be damaged. Increasing the air flow in the computer case allows more heat to be removed. A case / chasis fan is installed in the computer case to make the cooling process more efficient. In addition to case fans, a heat sink draws heat away from the core of the CPU. A fan on top of the heat sink moves the heat away from the CPU Other components are also susceptible to heat damage and sometimes are equipped with fans. Video adapter cards produce a great deal of heat. Fans are dedicated to cooling the graphics processing unit (GPU)

Memory Unit

ROM and RAM provide memory for a vast amount of computer equipment. They come in different memory sizes and module sizes and have different features.

ROM

Read-only memory (ROM) chips are located on the motherboard. ROM chips contain instructions that the CPU can access directly. ROM stores basic instructions for booting the computer and loading the operating system. ROM chips retain their contents even when the computer is powered down. The contents cannot be erased, changed, or rewritten by normal means. ROM types include the following:

- **Programmable read-only memory (PROM)**: Information is written to a PROM chip after it is manufactured. A PROM chip cannot be erased or rewritten.
- **Erasable programmable read-only memory (EPROM)**: Information is written to an

EPROM chip after it is manufactured. An EPROM chip can be erased with exposure to UV light. Special equipment is required.

■ **Electrically erasable programmable read-only memory (EEPROM)**: Information is written to an EEPROM chip after it is manufactured. EEPROM chips are also called flash ROMs. An EEPROM chip can be erased and rewritten without removing the chip from the computer.

RAM

Random-access memory (RAM) is the temporary storage for data and programs that are being accessed by the CPU. RAM is volatile memory, which means that the contents are erased when the computer is powered off. The more RAM in a computer, the more capacity the computer has to hold and process large programs and files, as well as enhance system performance. The different types of RAM are as follows:

■ **Static RAM (SRAM)** is a memory chip that is used as cache memory. SRAM is much faster than DRAM and does not have to be refreshed as often.

■ **Dynamic RAM (DRAM)** is a memory chip that is used as main memory. DRAM must be constantly refreshed with pulses of electricity to maintain the data stored in the chip.

■ **Fast Page Mode (FPM) DRAM** is memory that supports paging. Paging enables faster access to the data than regular DRAM. Most 486 and Pentium systems from 1995 and earlier use FPM memory.

■ **Extended Data Out (EDO) RAM** is memory that overlaps consecutive data accesses. This speeds up the access time to retrieve data from memory, because the CPU does not have to wait for one data access cycle to end before another data access cycle begins.

■ **Synchronous DRAM (SDRAM)** is DRAM that operates in synchronization with the memory bus. The memory bus is the data path between the CPU and the main memory.

■ **Double Data Rate (DDR) SDRAM** is memory that transfers data twice as fast as SDRAM. DDR SDRAM increases performance by transferring data twice per cycle.

■ **Double Data Rate 2 (DDR2) SDRAM** and **Double Data Rate 3 (DDR3) SDRAM** are faster than DDR-SDRAM memory. DDR2 and DDR3 SDRAMs improves performance over DDR SDRAM by decreasing noise and crosstalk between the signal wires.

■ **RAMBus DRAM (RDRAM)** is a memory chip that was developed to communicate at very high rates of speed. RDRAM chips are not commonly used.

Memory Modules

Early computers had RAM installed on the motherboard as individual chips. These individual memory chips, called dual inline package (DIP) chips, were difficult to install and often became

loose on the motherboard. To solve this problem, designers soldered the memory chips on a special circuit board called a memory module. The different types of memory modules are as follows:

■ **Dual Inline Package (DIP)** is an individual memory chip. A DIP had dual rows of pins used to attach it to the motherboard.

■ **Single Inline Memory Module (SIMM)** is a small circuit board that holds several memory chips. SIMMs have 30-pin and 72-pin configurations.

■ **Dual Inline Memory Module (DIMM)** is a circuit board that holds SDRAM, DDR SDRAM, and DDR2 SDRAM chips. There are 168-pin SDRAM DIMMs, 184-pin DDR DIMMs, and 240-pin DDR2 and DDR3 DIMMs.

■ **RAM Bus Inline Memory Module (RIMM)** is a circuit board that holds RDRAM chips. A typical RIMM has a 184-pin configuration.

Cache Memory

SRAM is used as cache memory to store the most frequently used data. SRAM gives the processor faster access to the data than retrieving it from the slower DRAM, or main memory. The three types of cache memory are as follows:

■ L1 is internal cache integrated into the CPU.

■ L2 is external cache originally mounted on the motherboard near the CPU. L2 cache is now integrated into the CPU.

■ L3 is used on some highend workstations and server CPUs.

Adapters and ports

Adapter cards increase a computer's functionality by adding controllers for specific devices or by replacing malfunctioning ports. Adapter cards are used to expand and customize the computer's capability:

■ NIC connects a computer to a network using a network cable.

■ Wireless NIC connects a computer to a network using radio frequencies.

■ Sound adapter provides audio capability.

■ Video adapter provides graphic capability.

■ Modem adapter connects a computer to the Internet using a phone line.

■ SCSI adapter connects SCSI devices, such as hard drives or tape drives, to a computer.

■ RAID adapter connects multiple hard drives to a computer to provide redundancy and to improve performance.

■ USB port connects a computer to peripheral devices.

■ Parallel port connects a computer to peripheral devices.

■ Serial port connects a computer to peripheral devices.

Computers have expansion slots on the motherboard to install adapter cards. The type of adapter card connector must match the expansion slot. A riser card is used in computer systems with the LPX form factor to allow adapter cards to be installed horizontally. The riser card is mainly used in slimline desktop computers. The different types of expansion slots are as follows:

- **Industry Standard Architecture (ISA)** is an 8-bit or 16-bit expansion slot. This is older technology and is seldom used.
- **Extended Industry Standard Architecture (EISA)** is a 32-bit expansion slot. This is older technology and is seldom used.
- **Microchannel Architecture (MCA)** is an IBM-proprietary 32-bit expansion slot. This is older technology and is seldom used.
- **Peripheral Component Interconnect (PCI)** is a 32-bit or 64-bit expansion slot. PCI is the standard slot currently used in most computers.
- **Advanced Graphics Port (AGP)** is a 32-bit expansion slot. AGP is designed for video adapters.
- **PCI-Express** is a serial bus expansion slot. PCI-Express is backward-compatible with PCI slots. PCI-Express has x1, x4, x8, and x16 slots.

Storage Devices

A storage drive reads or writes information to magnetic or optical storage media. It can be used to store data permanently or to retrieve information from a media disk. Storage drives can be installed inside the computer case, such as a hard drive. For portability, some storage drives can connect to the computer using a USB port, a FireWire port, or a SCSI port. These portable storage drives are sometimes called removable drives and can be used on multiple computers.

- Floppy drive
- Hard drive
- Optical drive
- Flash drive

Floppy Drives

A floppy drive, or floppy disk drive, is a storage device that uses removable 3.5-inch floppy disks. These magnetic floppy disks can store 720 KB or 1.44 MB of data. The floppy drive can be used to boot the computer if it contains a bootable floppy disk. A 5.25-inch floppy drive is older technology and is seldom used. The floppy drive is slowly being replaced by cheaper, faster, and largercapacity storage such as writable CDs, DVDs, and flash drive media.

Hard Drives

A hard drive, or hard-disk drive, is a magnetic storage device that is installed inside the computer. The hard drive is used as permanent storage for data. The storage capacity of a hard drive is measured in billions of bytes, or gigabytes (GB). The speed of a hard drive is measured in revolutions per minute (rpm). Multiple hard drives can be added to increase storage capacity.

Optical Drives

An optical drive is a storage device that uses lasers to read data on the optical media. Two types of optical drives exist:

- Compact disc (CD)
- Digital versatile disc (DVD)

CD and DVD media can be prerecorded (read-only), recordable (write once), or rerecordable (read and write multiple times). CDs have a data storage capacity of approximately 700 MB. DVDs have a data storage capacity of approximately 8.5 GB on one side of the disc.

Several types of optical media exist:

- CD-ROM is CD read-only memory media that is prerecorded.
- CD-R is CD recordable media that can be recorded once.
- CD-RW is CD rewritable media that can be recorded, erased, and rerecorded.
- DVD-ROM is DVD read-only memory media that is prerecorded.
- DVD-RAM is DVD random-access memory media that can be recorded, erased, and rerecorded.
- DVD+/-R is DVD recordable media that can be recorded once.
- DVD+/-RW is DVD rewritable media that can be recorded, erased, and rerecorded.

Flash Drives

A flash drive, also known as a thumb drive or pen drive, is a removable storage device that connects to a USB port. A flash drive uses a special type of memory that requires no power to maintain the data. These drives can be accessed by the operating system in the same way other types of drives are accessed. The storage capacity of a flash drive varies from a couple of megabytes to 3 2 gigabytes.

Types of Drive Interfaces

Hard drives and optical drives are manufactured with different interfaces that are used to connect the drive to the computer. When you install a storage drive in a computer, the connection interface on the drive must be the same as the controller on the motherboard. Some common drive interfaces are as follows:

- I**ntegrated Drive Electronics (IDE)**, also called **Advanced Technology Attachment**

(ATA), is an early drive controller interface that connects computers and harddisk drives. An IDE interface uses a 40-pin connector.

■ **Enhanced Integrated Drive Electronics (EIDE)**, also called ATA-2, is an updated version of the IDE drive controller interface. EIDE supports hard drives larger than 512 MB, enables Direct Memory Access (DMA) for speed, and uses the AT Attachment Packet Interface (ATAPI) to accommodate optical drives and tape drives on the EIDE bus. An EIDE interface uses 80-pin connector.

■ **Parallel ATA (PATA)** refers to the parallel version of the ATA drive controller interface.

■ **Serial ATA (SATA)** refers to the serial version of the ATA drive controller interface. A SATA interface uses a seven-pin connector.

■ **Small Computer System Interface (SCSI)** is a drive controller interface that can connect up to 15 drives. SCSI can connect both internal and external drives. A SCSI interface uses a 50-pin, 68-pin, or 80-pin connector.

Internal Cables

Drives require both a power cable and a data cable. A power supply has a SATA power connector for SATA drives, a Molex power connector for PATA drives, and a Berg four-pin connector for floppy drives. The buttons and the LED lights on the front of the case connect to the motherboard with the front panel cables. Data cables connect drives to the drive controller, which is located on an adapter card or themotherboard. Some common types of data cables are as follows:

■ Floppy disk drive (FDD) data cable has up to two 34-pin drive connectors and one 34-pin connector for the drive controller.

■mPATA (IDE) data cable has 40 conductors, up to two 40-pin connectors for drives, and one 40-pin connector for the drive controller.

■ PATA (EIDE) data cable has 80 conductors, up to two 40-pin connectors for drives,and one 40-pin connector for the drive controller.

■ SATA data cable has seven conductors, one keyed connector for the drive, and one keyed connector the drive controller.

■ SCSI data cable: Three types of SCSI data cables exist:

■ A narrow SCSI data cable has 50 conductors, up to seven 50-pin connectors for drives, and one 50-pin connector for the drive controller, also called the host adapter.

■ A wide SCSI data cable has 68 conductors, up to 15 68-pin connectors for drives, and one 68-pin connector for the host adapter.

■ An Alt-4 SCSI data cable has 80 conductors, up to 15 80-pin connectors for drives, and one 80-pin connector for the host adapter.

Ports and cables

I/O ports on a computer connect peripheral devices, such as printers, scanners, and portable drives. The following ports and cables are commonly used:

- Serial
- USB
- FireWire
- Parallel
- SCSI
- Network
- PS/2
- Audio
- Video

Serial Ports and Cables

A serial port can be either a DB-9, or a DB-25 male connector. Serial ports transmit 1 bit of data at a time. To connect a serial device, such as a modem or printer, a serial cable must be used. A serial cable has a maximum length of 50 feet (15.2 m).

USB Ports and Cables

The Universal Serial Bus (USB) is a standard interface that connects peripheral devices to a computer. It was originally designed to replace serial and parallel connections. USB devices are hot-swappable, which means that users can connect and disconnect the devices while the computer is powered on. USB connections can be found on computers, cameras, printers, scanners, storage devices, and many other electronic devices. A USB hub is used to connect multiple USB devices. A single USB port in a computer can support up to 127 separate devices with the use of multiple USB hubs. Some devices can also be powered through the USB port, eliminating the need for an external power source.

USB 1.1 allowed transmission rates of up to 12 Mbps in full-speed mode and 1.5 Mbps in low-speed mode.

USB 2.0 allows transmission speeds up to 480 Mbps. USB devices can only transfer data up to the maximum speed allowed by the specific port.

USB3.0 specification uses the same concepts of USB2.0 but added a new transfer type call Super Speed or SS – 5Gbps

FireWire Ports and Cables

FireWire is a high-speed, hot-swappable interface that connects peripheral devices to a computer. A single FireWire port in a computer can support up to 63 devices. Some devices can also be powered through the FireWire port, eliminating the need for an external power source. FireWire

uses the IEEE 1394 standard and is also known as i.Link. The IEEE 1394a standard supports data rates up to 400 Mbps and cable lengths up to 15 feet (4.5 m). This standard uses a six-pin connector or a four-pin connector. The IEEE 1394b standard supports data rates in excess of 800 Mbps and uses a nine-pin connector.

Parallel Ports and Cables

A parallel port on a computer is a standard Type A DB-25 female connector. The parallel connector on a printer is a standard Type B 36-pin Centronics connector. Some newer printers may use a Type C high-density 36-pin connector. Parallel ports can transmit 8 bits of data at a time and use the IEEE 1284 standard. To connect a parallel device, such as a printer, a parallel cable must be used. A parallel cable has a maximum length of 15 feet (4.5 m).

SCSI Ports and Cables

A SCSI port can transmit data at rates in excess of 320 Mbps and can support up to 15 devices. If a single SCSI device is connected to a SCSI port, the cable can be up to 80 feet (24.4 m) in length. If multiple SCSI devices are connected to a SCSI port, the cable can be up to 40 (12.2 m) feet in length. A SCSI port on a computer can be one of three different types,

- DB-25 female connector
- High-density 50-pin female connector
- High-density 68-pin female connector

Network Ports and Cables

A network port, also called an RJ-45 port, connects a computer to a network. The connection speed depends on the type of network port. Standard Ethernet can transmit up to 10 Mbps, Fast Ethernet can transmit up to 100 Mbps, and Gigabit Ethernet can transmit up to1000 Mbps. The maximum length of network cable is 328 feet (100 m).

PS/2 Ports

A PS/2 port connects a keyboard or mouse to a computer. The PS/2 port is a six-pin mini-DIN female connector. The connectors for the keyboard and mouse are often colored differently.

Audio Ports

An audio port connects audio devices to the computer. The following audio ports are commonly used:

- Line In connects to an external source, such as a stereo system.
- Microphone In connects to a microphone.
- Line Out connects to speakers or headphones.
- Auxiliary In is an additional line in.
- Gameport/MIDI connects to a joystick or MIDI-interfaced device.

Video Ports and Connectors

A video port connects a monitor cable to a computer. Several video port and connector types exist:

■ Video Graphics Array (VGA) has a three-row 15-pin female connector and provides analog output to a monitor.

■ Digital Visual Interface (DVI) has a 24-pin female connector or a 29-pin female connector and provides compressed digital output to a monitor. DVI-I provides both analog and digital signals. DVI-D provides digital signals only.

■ High-Definition Multimedia Interface (HDMI) has a 19-pin connector and provides digital video and digital audio signals.

■ S-Video has a four-pin connector and provides analog video signals.

■ Component/RGB has three shielded cables (red, green, and blue) with RCA jacks and provides analog video signals.

Input Devices

An input device is used to enter data or instructions into a computer. Here are some examples of input devices:

■ Mouse and keyboard

■ Digital camera and digital video camera

■ Biometric authentication device

■ Touch screen

■ Scanner

The mouse and keyboard are the two most commonly used input devices. The mouse is used to navigate the graphical user interface (GUI). The keyboard is used to enter text commands that control the computer.

Digital cameras and digital video cameras create images that can be stored on magnetic media. The image is stored as a file that can be displayed, printed, or altered.

Biometric identification uses features that are unique to an individual user, such as fingerprints, voice recognition, or a retinal scan. When combined with ordinary usernames, bio-metrics guarantees that the authorized person is accessing the data.

A touch screen has a pressure-sensitive transparent panel. The computer receives instructions specific to the place on the screen that the user touches.

A scanner digitizes an image or document. The digitization of the image is stored as a file that can be displayed, printed, or altered. A bar code reader is a type of scanner that reads Universal Product Code (UPC) bar codes. It is widely used for pricing and inventory information.

Output Devices

An output device is used to present information to the user from a computer. Here are some examples of output devices:

- Monitors and projectors
- Printers, scanners, and fax machines
- Speakers and headphones

Monitors and Projectors

Monitors and projectors are primary output devices for a computer. The most important difference between these monitor types is the technology used to create an image:

- **CRT**: Cathode ray tube monitors are the most common monitor type. Red, green, and blue electron beams move back and forth across the phosphorous-coated screen. The phosphor glows when struck by the electron beam. Areas not struck by the electron beam do not glow. The combination of glowing and nonglowing areas is what creates the image on the screen. Most televisions also use this technology.
- **LCD**: Liquid crystal display is commonly used in laptops and some projectors. It consists of two polarizing filters with a liquid crystal solution between them. An electronic current aligns the crystals so that light can either pass through or not pass through. The effect of light passing through in certain areas and not in others is what creates the image. LCD comes in two forms—active matrix and passive matrix. Active matrix is sometimes called thin film transistor (TFT). TFT allows each pixel to be controlled, which creates very sharp color images. Passive matrix is less expensive than active matrix but does not provide the same level of image control. LCD Monitors are becoming the most common type of computer monitor.
- **DLP**: Digital light processing is another technology that is used in projectors. DLP projectors use a spinning color wheel with a microprocessor-controlled array of mirrors called a digital micromirror device (DMD). Each mirror corresponds to a specific pixel. Each mirror reflects light toward or away from the projector optics. This creates a monochromatic image of up to 1024 shades of gray between white and black. The color wheel then adds the color data to complete the projected color image.

Monitor resolution refers to the level of image detail that can be reproduced.

Display Standard	Linear Pixels (HXV)	Aspect Ratio
CGA	320×200	16:10
EGA	640×350	11:6
VGA	640×480	4:3
WVGA	854×480	16:9
SVGA	800×600	4:3
XGA	1024×768	4:3
WXGA	1280×800	16:10
SXGA	1280×1024	5:4
WSXGA	1600×1024	25:16
UXGA	1600×1200	4:3
HDTV	1920×1080	16:9
WUXGA	1920×1200	16:10
QXGA	2048×1536	4:3
QSXGA	2560×2048	5:4
WQUXGA	3840×2400	16:10

Higher-resolution settings produce better image quality. Several factors are involved in monitor resolution:

■ **Pixels:** The term pixel is an abbreviation of picture element. Pixels are the tiny dots that comprise a screen. Each pixel consists of red, green, and blue.

■ **Dot pitch**: Dot pitch is the distance between pixels on the screen. A lower dot pitch number produces a better image.

■ **Refresh rate:** The refresh rate is how often per second the image is rebuilt. A higher refresh rate produces a better image and reduces the level of flicker.

■ **Interlaced/noninterlaced:** Interlaced monitors create the image by scanning the screen two times. The first scan covers the odd lines, top to bottom, and the second scan covers the even lines. Noninterlaced monitors create the image by scanning the screen one line at a time from top to bottom. Most CRT monitors today are noninterlaced.

■ **Horizontal Vertical Colors (HVC)**: The number of pixels in a line is the horizontal resolution. The number of lines in a screen is the vertical resolution. The number of colors that can be reproduced is the color resolution.

■ **Aspect ratio**: Aspect ratio is the horizontal-to-vertical measurement of the monitor's

viewing area. For example, a 4:3 aspect ratio applies to a viewing area that is 16 incheswide by 12 inches high. A 4:3 aspect ratio also applies to a viewing area that is 24 inches wide by 18 inches high. A viewing area that is 22 inches wide by 12 inches high has an aspect ratio of 11:6.

Monitors have controls for adjusting the image quality. Here are some common monitor settings:

- Brightness is the image's intensity.
- Contrast is the ratio of light to dark.
- Position is the vertical and horizontal location of the image on the screen.
- Reset returns the monitor settings to the factory defaults.

Printers, Scanners, and Fax Machines

Printers are output devices that create hard copies of computer files. Some printers specialize in particular applications, such as printing color photographs. Other all-in-one-type printers are designed to provide multiple services such as printing, fax, and copier functions.

Speakers and Headphones

Speakers and headphones are output devices for audio signals. Most computers have audio support either integrated into the motherboard or on an adapter card.Audio support includes ports that allow input and output of audio signals. The audio card has an amplifier to power headphones and external speakers.