

Installing and Configuring PC Components

CompTIA®

Installing and Configuring PC Components

- Use Appropriate Safety Procedures
- PC Components
- Common Connection Interfaces
- Install Peripheral Devices
- Troubleshooting Methodology

Local Government Regulations

- Types of regulations:
 - Health and safety laws.
 - Building codes.
 - Environmental regulations.
- OSHA is a prime example of safety regulations for US-based operations.
 - Workplace free from recognized hazards.
 - Personal protective equipment.
 - Communication (labels, MSDSs, and hazmat training).
- Employers and employees both have responsibilities.
 - Employers provide a safe workplace.
 - Employee actions promote safety of themselves and others.

Health and Safety Procedures

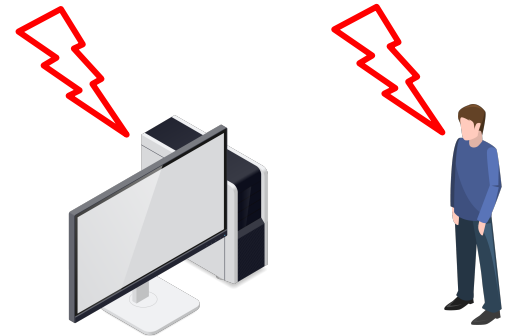
- Identify what to do in an emergency.
- Identify responsible persons (first responders, etc.).
- Identify hazardous areas and what precautions to take.
- Describe best practices for use and care of workplace and equipment.
- Establish incident reporting procedures.

General Emergency Procedures

- Raise the alarm and contact emergency services.
 - Description of emergency.
 - Location of emergency.
- If possible, secure the scene.
 - Escape routes for fire situations.
 - Disconnect power for electrical shock situations.
- If you have training, try to start handling the incident.
 - Give first aid.
 - Use firefighting equipment.
- Keep calm, and don't act rashly!

Electrical Hazards

- Most prevalent physical hazard for IT equipment and personnel.
- For humans, electrical shock can cause:
 - Muscle spasms
 - Burns
 - Paralysis
 - Cardiac arrest
 - Collateral injuries
 - Death by electrocution
- Keep equipment away from conductors.
 - Metal
 - Liquid



Fuses



Fuse: A circuit breaker designed to protect the device and users of the device from faulty wiring or supply of power (overcurrent protection).

- Electrical problems blow fuses to prevent further damage.
 - Separates a device from the power source.
- Ratings: 3A, 5A, 13A.
 - Most computer equipment is 3A or 5A.
 - Use fuses rated for the equipment.
- Power strips connect multiple devices to a power source.
 - Don't daisy chain them!
 - Total power draw should not exceed maximum load (12A).

Equipment Grounding (Slide 1 of 2)



Ground: A safe path for electrical current to flow away in the event that a device or cable is faulty.

- Creates a path of least resistance for electrical current to flow away and cause no damage.
- Ground achieved for most PCs by connecting the power cord to an electrical outlet.
- You might need to establish ground for equipment racks or other systems.

Equipment Grounding (Slide 2 of 2)



High Voltage Device Safety

- Most PC circuits are low voltage/low current.
- There are notable exceptions.
 - Power supplies.
 - CRT monitors.
 - LCD display inverter card.
 - Laser printers.
- Do not open units that are marked with High Voltage warnings unless you're specifically trained for servicing them.



Electrical Fire Safety

- When excessive current flows through a cable, the cable gets hot.
- Adjacent flammable materials could ignite.
- Use fire extinguishers designed for electrical fires.
 - CO₂ extinguishers with a black label are optimal.
 - Dry powder extinguishers can damage electronic equipment.
- Be sure to cut the power supply.
- Know where the master switches are for the buildings you work in.



Guidelines for Working Safely with Electrical Systems

- Be aware of risks and safety practices.
- Avoid repair work when you are not 100%.
- Don't assume—check things for yourself.
- Cut power to circuits before handling them.
- Press and hold the PC power button to dissipate residual power.
- Use a multimeter to check live parts for voltage.
- Use insulated tools and never grip tools by their metal parts.
- Never touch a circuit with both hands. (Hand in pocket rule.)
- Keep your hands and the surrounding area dry.
- Clean up spills and make sure you aren't walking on a wet floor.
- Avoid wearing jewelry or other items that hang from the neck or wrists.

Environmental Safety

Category	Description
Trip hazards	<ul style="list-style-type: none">• Caused by objects being placed in pathways where people walk.• Cables, boxes, furniture, etc.
Lifting and carrying risks	<ul style="list-style-type: none">• Lifting heavy objects can cause back injuries.• Dropped objects can cause leg or foot injuries.• Bulky objects can also cause problems.

Toxic Waste Handling

- Contaminants can be:
 - Gaseous
 - Particulate
 - Organic
 - Poisonous
 - Corrosive
- Devices to be careful around:
 - CRT monitors
 - Batteries
 - Electronic devices (PCs, cell phones, and tablets)
 - Toner kits and cartridges



Guidelines for Working Safely Among Environmental Hazards (Slide 1 of 2)

- Secure cables with ties or other cable management products.
- Keep devices and other objects out of walkways and away from desk edges.
- Consider weight limitations as you lift or carry items.
- If necessary, use protective clothing.
- To lift heavy objects:
 - Plant your feet around the object with one foot slightly toward your destination.
 - Bend at the knees while keeping your back straight and chin up.
 - Get a firm grip and lift smoothly by straightening your legs.
 - As you carry the object, keep your back straight.

Guidelines for Working Safely Among Environmental Hazards (Slide 2 of 2)

- To lower heavy objects, reverse the lifting process. Don't trap your fingers or lower the object onto your feet.
- Ask a colleague for assistance or use a cart for bulky or excessively heavy items.
- To work with toxic materials:
 - Don't disassemble or stack CRT monitors.
 - Use gloves and goggles when working with corrosive materials.
 - Use air filter masks when working with toner.

ESD



Electrostatic discharge (ESD): A situation that occurs when electrons rush from one statically charged body to another with an unequal charge, following the path of least resistance.

- Caused by excessive static electricity.
- High voltage, but low current.
 - Less dangerous to humans than to electronics.
 - People feel ESD at 2,500V; equipment can be damaged by as little as 100V.
- ESD generators:
 - Synthetic clothing.
 - Low humidity.
 - Cooler temperatures.

Component Handling (Slide 1 of 3)



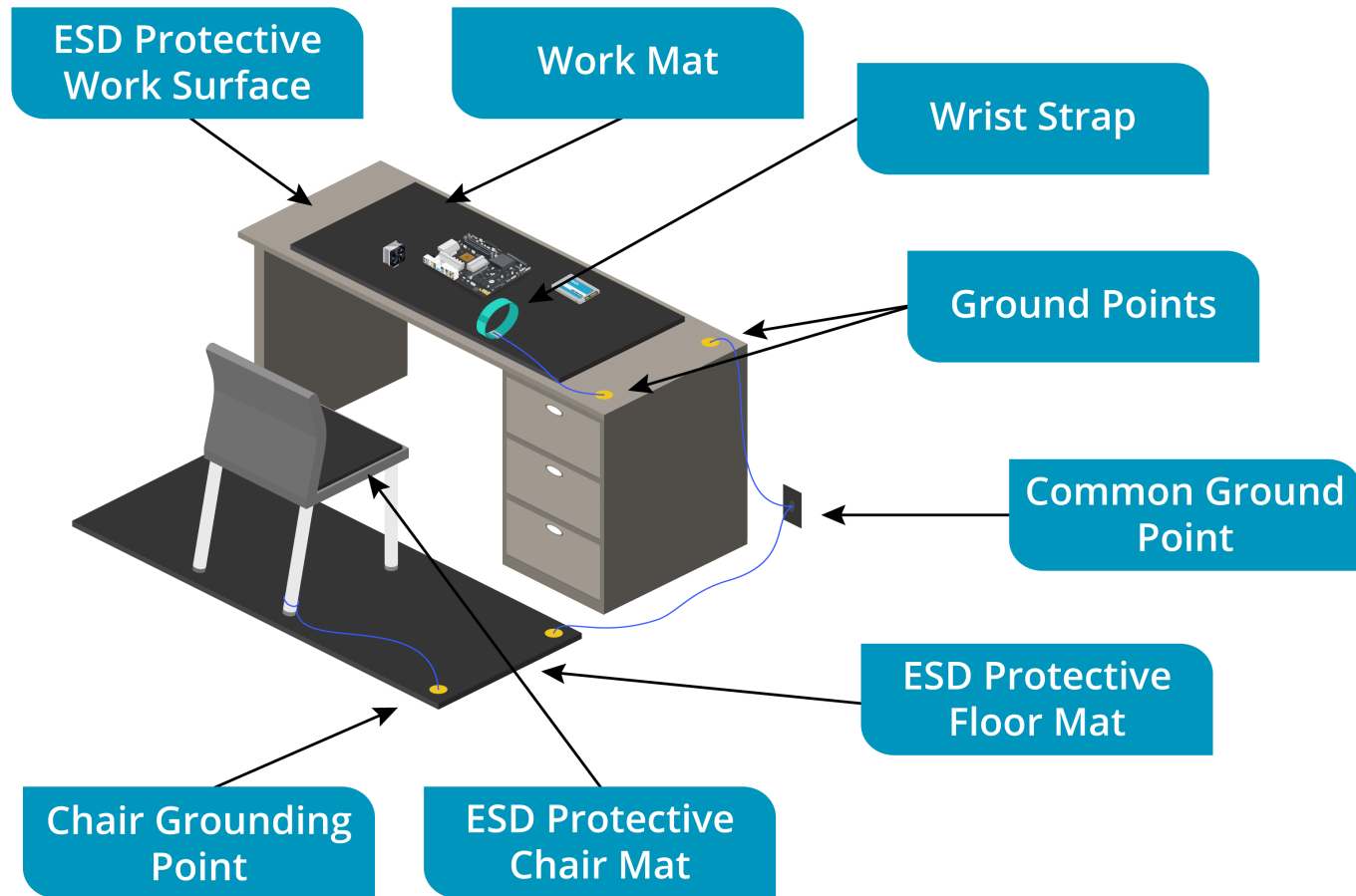
Self-grounding: The act of touching a grounded object before touching electronic equipment.

- Using ESD wrist or leg strap.
 - More effective than self-grounding.
 - Use the grounding plug or clip to attach to a ground point.
- Using ESD service mats or smocks.
- Using antistatic bags.

Component Handling (Slide 2 of 3)



Component Handling (Slide 3 of 3)



Guidelines for Protecting Components from ESD Damage

- Use proper component handling and storage procedures whenever you are performing PC maintenance work.
- To protect components and equipment from ESD damage:
 - Drain your body and clothing of static electricity before you start work.
 - If possible, work in an uncarpeted area.
 - The simplest (but least effective) means of self-grounding is to touch an unpainted metal part of the PC.
 - Try to handle vulnerable components by their edges, and avoid touching the surfaces of the chips themselves.
- Use ESD wrist or ankle straps and dissipative floor mats.

Activity



Implementing an Anti-ESD Service Kit

<https://www.youtube.com/watch?v=0GpOok2xRt0>

System Case (Chassis) Types (Slide 1 of 3)



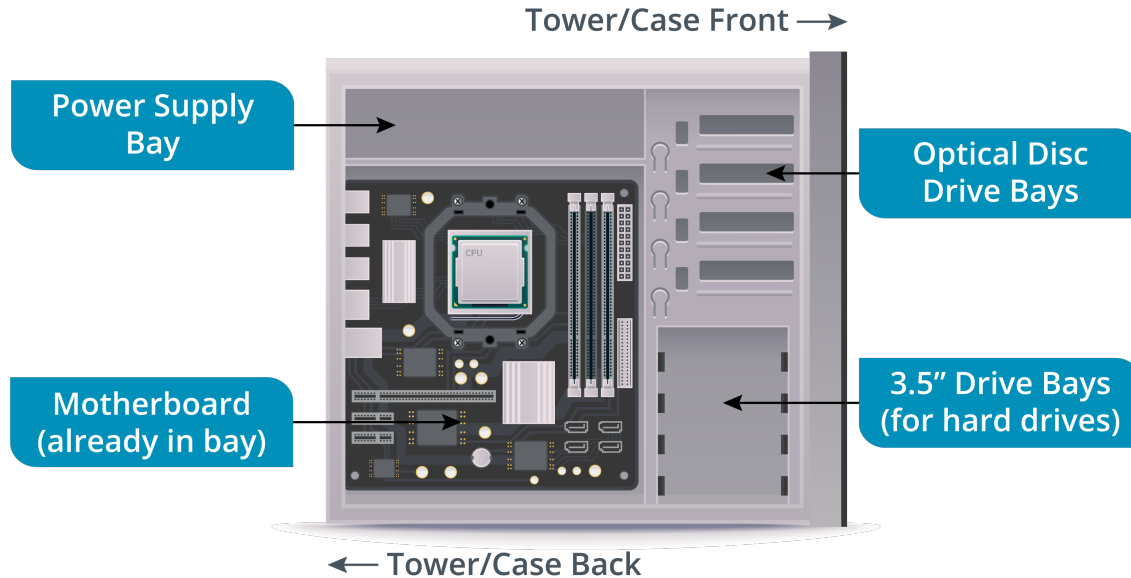
Desktop computer: A computing device designed to be placed on or near a user's desk.

System case/chassis: A plastic and metal box that houses components such as the motherboard, CPU, memory, adapter cards, disk drives, and power supply unit.

Tower case: A desktop computer designed to sit vertically on a surface, so that it is taller than it is wide.

- Tower case options:
 - Full tower: Gaming computers, 3rd party graphics cards, multi-thread CPU
 - Mid tower: Average users, room and slots for optional components
 - Mini tower: Limited space for internal devices and adapter cards
 - Slimline: Need low profile adapter cards (horizontal or vertical)

System Case Types (Slide 2 of 3)



System Case Types (Slide 3 of 3)



SFF case: (small form factor) A case for motherboards and connectors that is designed to take up less space.

All-in-one unit: A desktop computer in which all the computer components, except the keyboard and mouse, are contained within the monitor case.



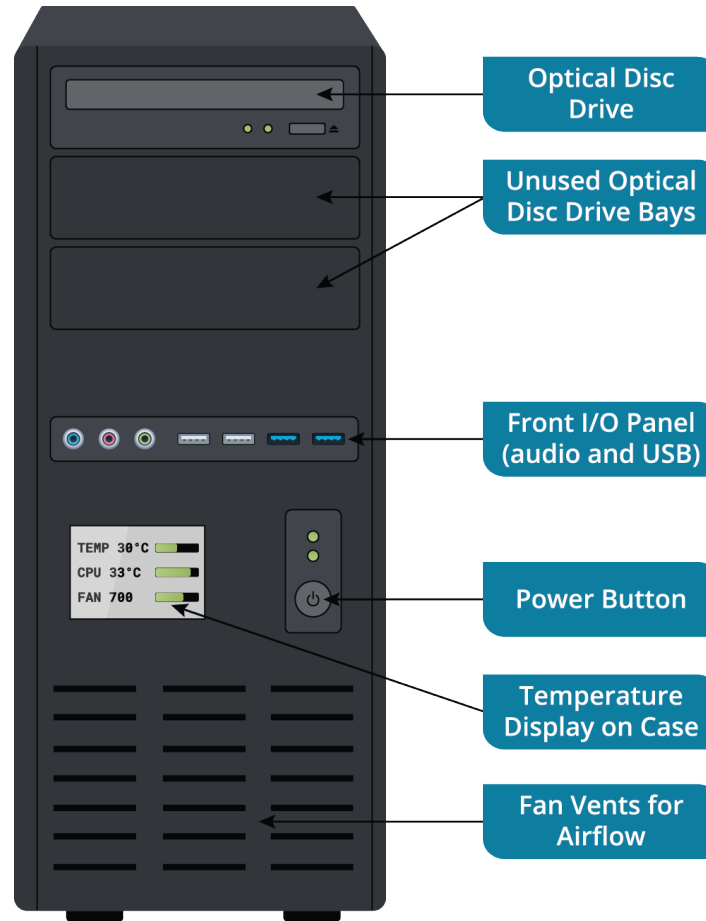
Parts of the System Case (Slide 1 of 4)



Cover: The removable portion of the system case that allows access to the motherboard and internal components. (usually one of the sides)

Front panel: The portion of the system case that provides access to removable media drives, power switch, and LEDs to indicate driver operation.

Parts of the System Case (Slide 2 of 4)



Parts of the System Case (Slide 3 of 4)

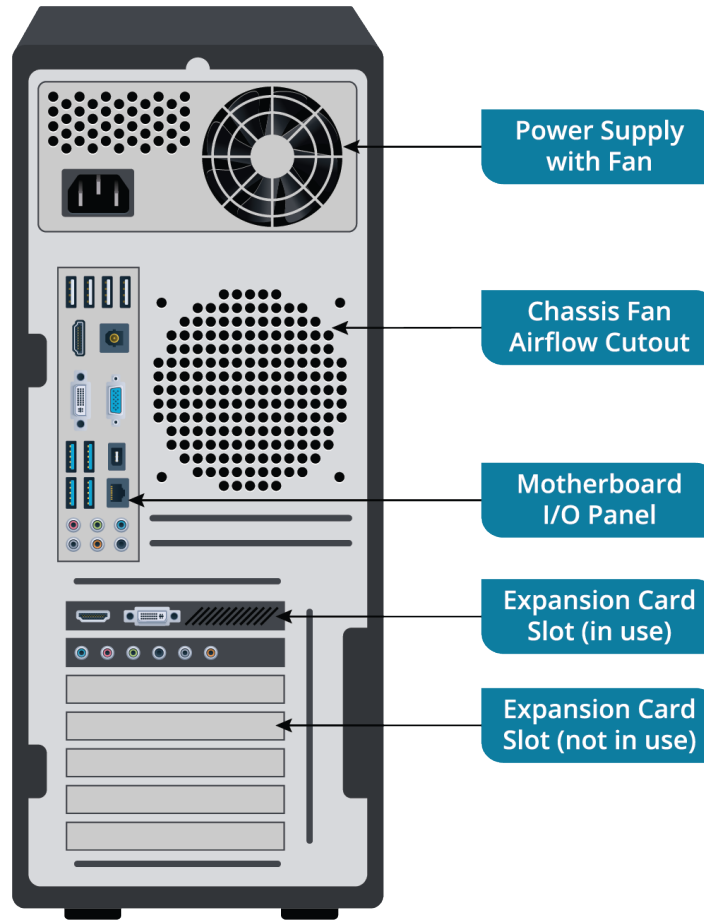


Rear panel: The portion of the system case with cut-out slots aligned with the position of adapter card slots.

Adapter card: Circuit board providing additional functionality to the computer system.

Blanking plate: Metal strips that cover unused adapter slots in the case so that proper air flow is maintained within the system case.

Parts of the System Case (Slide 4 of 4)

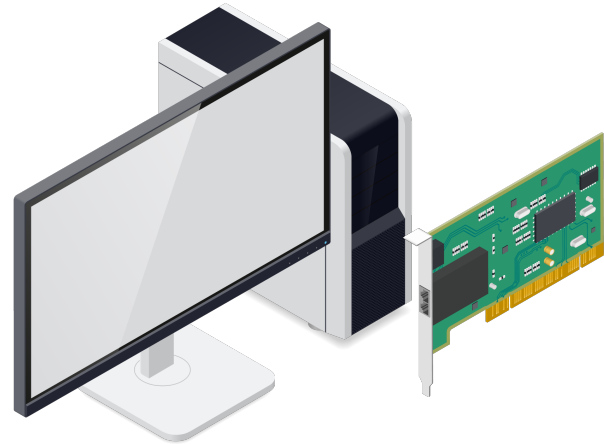
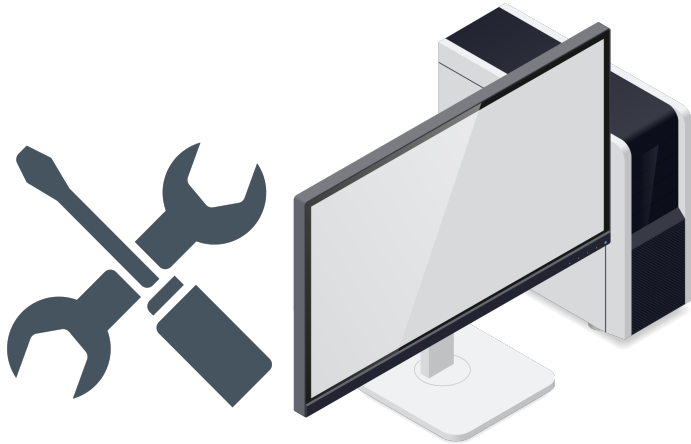


Repair or Replace?



Field replaceable unit (FRU): An adapter or other component that can be replaced by a technician on-site. Most PC and laptop components are FRUs, whereas the components of smartphones are not.

- Not all components are considered FRUs.
- More economical to swap out, or replace, with a new component.



Guidelines for PC Disassembly

- Back up all data stored on the internal drive(s).
- Create a clean work environment where you can work comfortably.
- Gather all necessary tools and equipment.
 - Notepad and pen
 - Digital camera
- Make sure that all devices are powered off and unplugged from the building power before disconnecting them.
- Take anti-static precautions.
 - Place static-sensitive components (CPUs and RAM) in anti-static bags.

Motherboards



Motherboard: Provides the basic foundation for all of the computer's hardware, including the processor, RAM, firmware, and expansion cards. Also referred to as **mobo**, **system board**, or **main board**.

- Motherboard type dictates speed and upgrade capabilities.
- Standoffs hold the motherboard in place within the system case.
 - Brass or plastic.

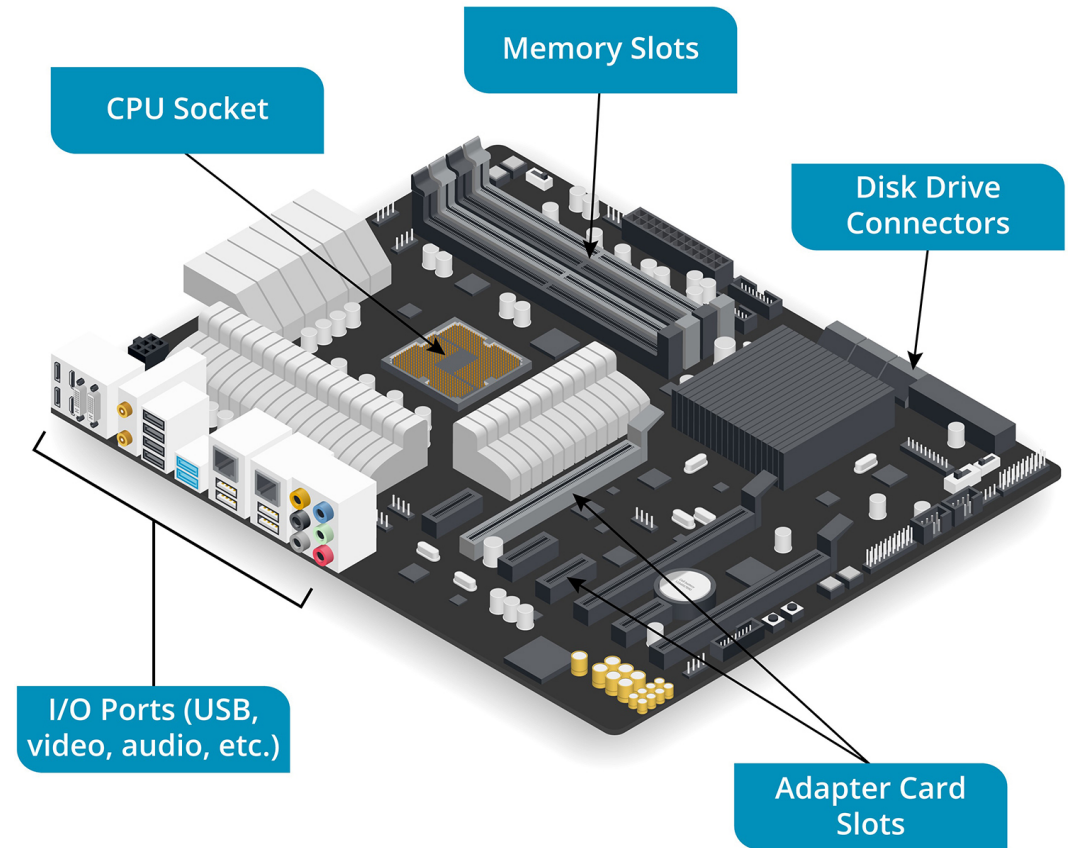


Motherboard Form Factors

Form Factor	Description
ATX	<ul style="list-style-type: none">• Developed in 1995 to replace legacy AT form factor.• 12 by 9.6 inches, 305 by 244 mm.• Up to seven expansion slots.
Micro-ATX	<ul style="list-style-type: none">• 9.6 inches (244 mm) square.• Up to four expansion slots.
Mini-ITX	<ul style="list-style-type: none">• Used in SFF PCs.• 6.7 inches (170 mm) square.• One expansion slot.
Other ITX-based form factors	<ul style="list-style-type: none">• Smaller than mini-ITX.• Used for embedded systems and portable computers.

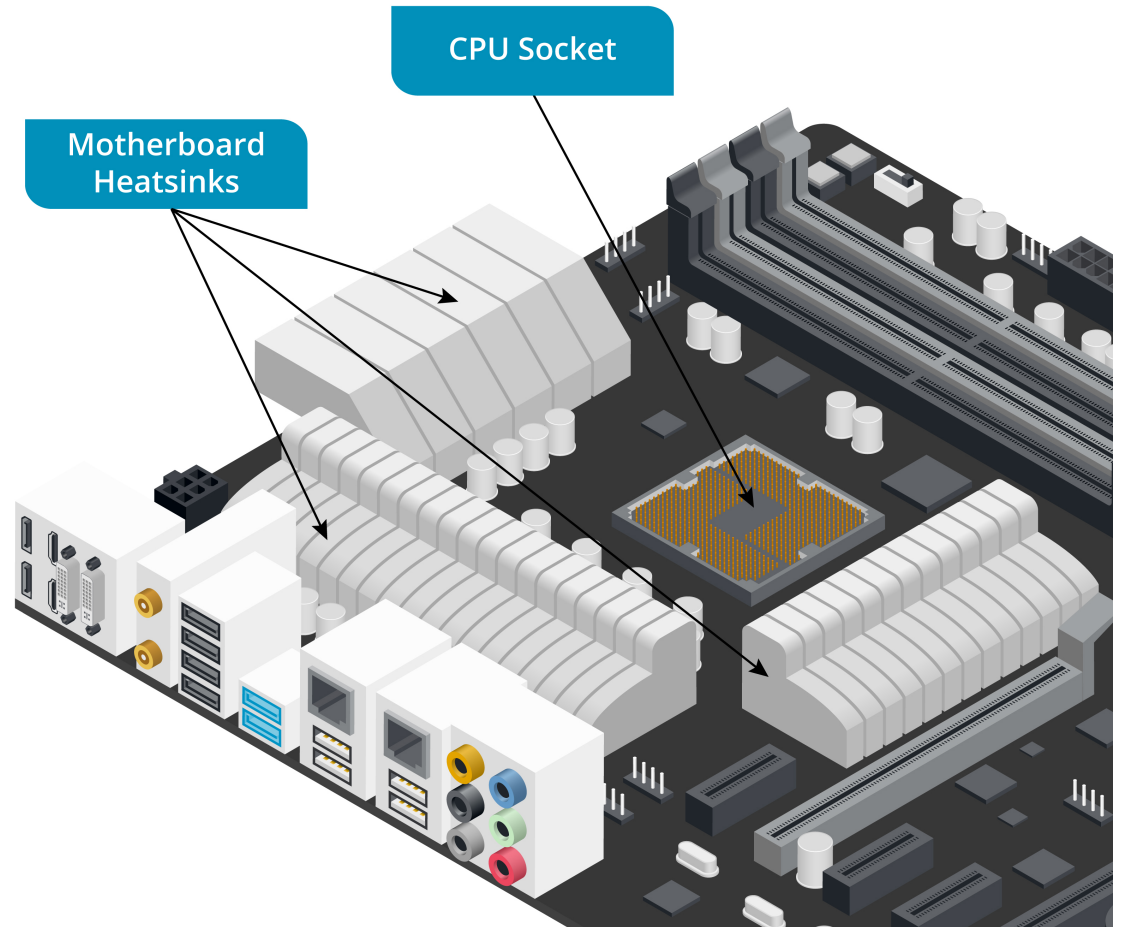
Motherboard Connector Types

- Base set of connectors for CPU, memory, disk drives, peripherals, etc.
- Type and number depend on the motherboard model.



CPU Sockets

- Socket type depends on CPU manufacturer.
- Usually a square socket near the memory banks.
- Often covered by a heatsink and fan.

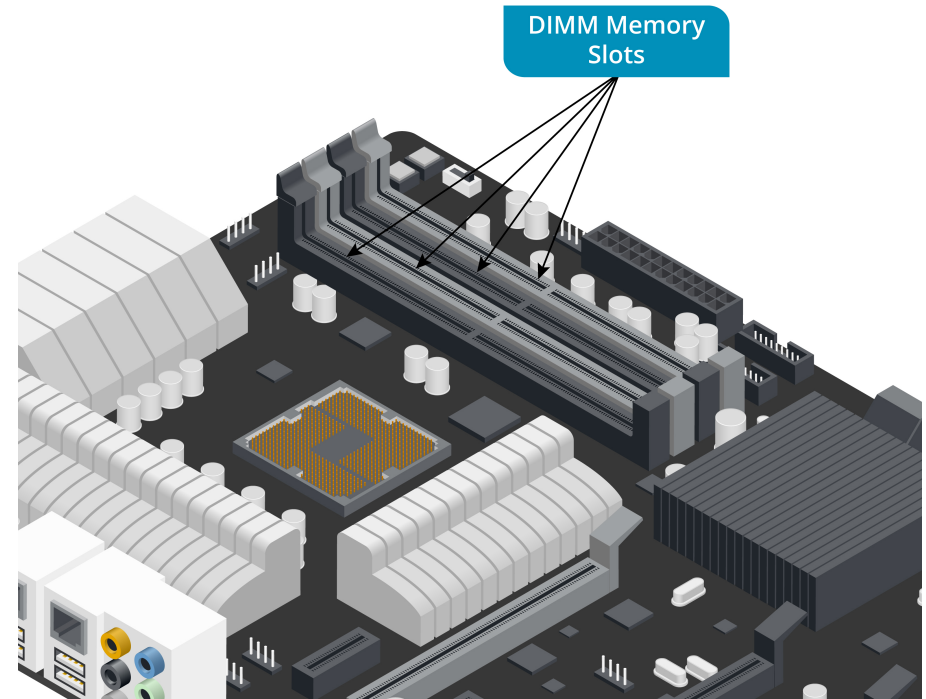


Memory Slots



Random access memory (RAM): The principal storage space for computer data and program instructions. Volatile memory that loses data when there is no power.

- Volatile memory.
- Normally packaged as DIMMs.



Chipset and Memory Architecture



Chipset: Provides communications between different components by implementing various controllers.

- Controller types:
 - System memory.
 - I/O.
 - Integrated video, sound, and network interfaces.
- Chipsets are not upgradeable.
- CPU/memory link determines performance.
 - Northbridge/Southbridge is legacy architecture.
 - Different architectures now used, including on-die controllers.

CMOS and RTC Batteries (Slide 1 of 2)



Complementary metal-oxide semiconductor (CMOS): A type of integrated circuit with a wide range of applications, including static RAM (for firmware and flash memory) and imaging sensors.

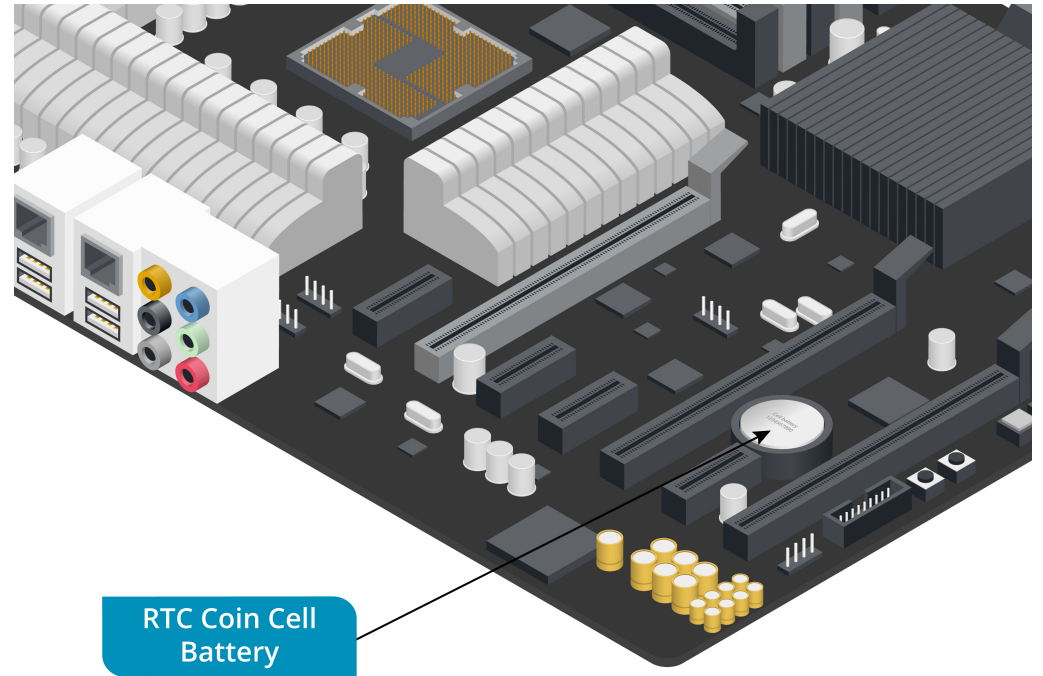
- Holds basic configuration information.
- Stores system firmware setup program settings.
- RTC stands for Real Time Clock

CMOS and RTC Batteries (Slide 2 of 2)



CMOS battery: Battery that powers the chipset that keeps track of date and time for the system. Also referred to as **RTC battery** or **clock battery**.

- Normally last 5 to 10 years.
- Powers the RTC, which keeps track of the system date and time.



Bus Architecture



Bus: Connections between components on the motherboard and peripheral devices attached to the computer.

Traces: Wires etched on to the motherboard to provide electrical pathways.

- Carries electronic signal along the motherboard.
 - Information being processed (data) and information about where data is located (address).
 - Power to components.
 - Timing signals for synchronizing data transfer.
- Usually refers to the expansion bus.

Internal and External Buses



Local bus: The internal bus that links components directly to the processor, resulting in the highest possible data speed as required by components such as the video display.

Expansion bus: The external bus that allows additional components to be connected to the computer.

- Internal bus connects core components.
- External bus connects peripherals. (Most common: Universal Serial Bus or PCI for pre-2004 computers, which are covered later)
 - Peripherals can be internal or external, too.
 - The bus can extend beyond the system case, but not always.

Expansion Slots (Slide 1 of 2)



Expansion slot: Connection slots on the motherboard in which adapter cards can be installed to extend the range of functions the computer can perform.

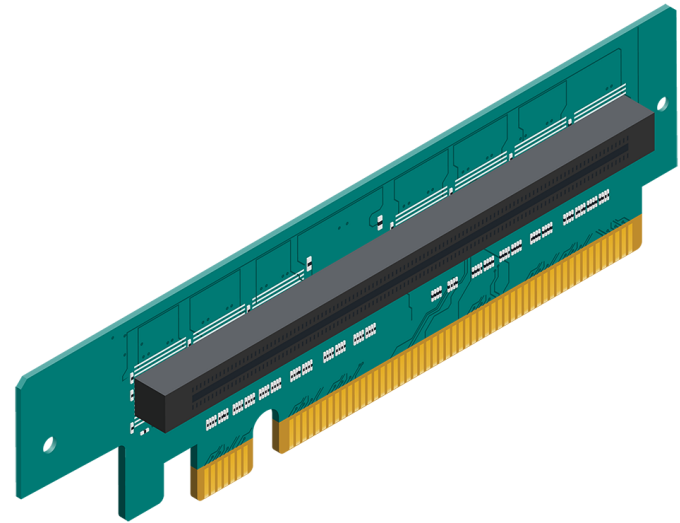
- Multi-bus design allows different expansion slots on a motherboard.
 - More plug types = Support for older technologies.

Expansion Slots (Slide 2 of 2)



Riser card: A space-saving feature of some motherboards that puts the PC's expansion slots on a separate board installed at right angles to the main board, allowing system components to fit within a slimline case.

- Expansion slots parallel to the motherboard.
 - Saves space.



System Clock and Bus Speed



System clock: The computer's timing mechanism that synchronizes the operation of all parts of the computer and provides the basic timing signal for the CPU.

- Clock speed measured in megahertz (MHz) or gigahertz (GHz).
 - Hertz are the number of times a CPU processes per second
 - May be faster or slower than actual **throughput** speed (Mbps, etc.). USB signals good example.
- Clock generator initiates timing signal.
- Clock multipliers adjust timing signal for different buses.

PCI Bus (Slide 1 of 3)



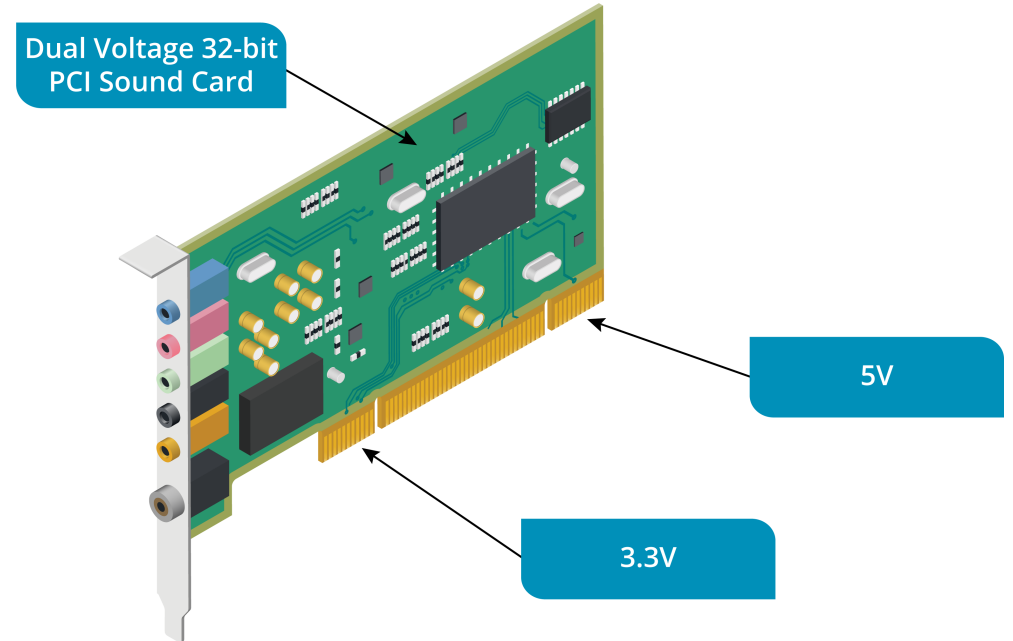
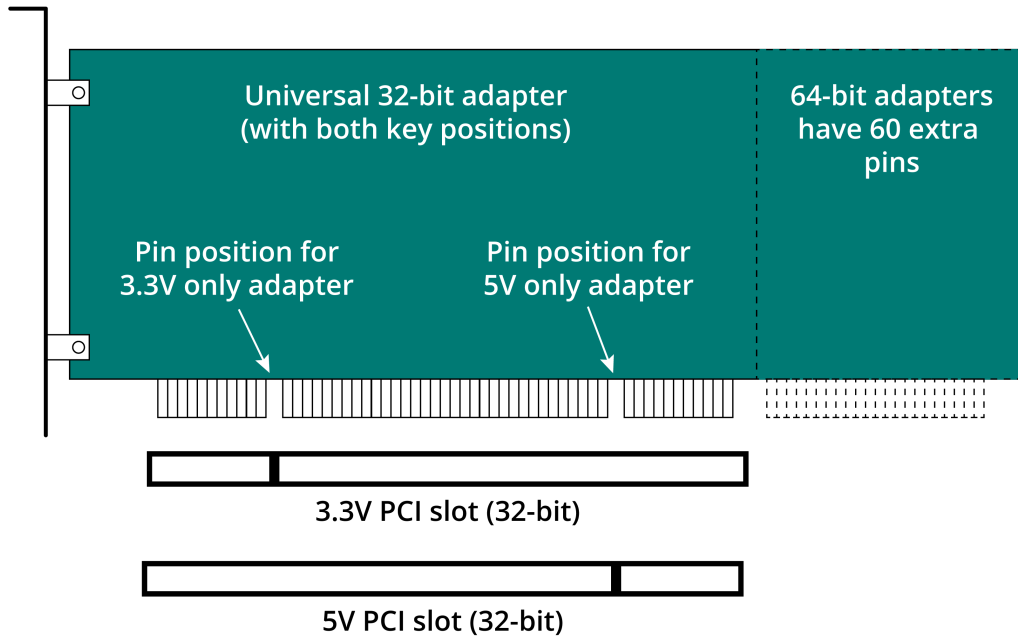
Peripheral Component Interconnect (PCI) bus: Introduced in 1995, it connects the CPU, memory, and peripherals. It supports bus mastering (direct memory access), IRQ steering (interrupt requests for resource prioritization), and Plug and Play (PnP). 32-bit works at 33 MHz. 64-bit works at 66 MHz.

- Slowly being replaced by PCI Express.
- First commercial version was 2.0.
 - Several revisions to the standard since then.
- Standards information: pcisig.com/specifications.

PCI Bus (Slide 2 of 3)

Feature	Description
Bus width and clock speed	<ul style="list-style-type: none">• Supports up to 5 devices via Plug-and-Play.• Shared bandwidth.• Supports bus mastering.• Architecture:<ul style="list-style-type: none">• 32-bit bus operating at 33.3 or 66 MHz (133 or 266 MBps).• 64-bit bus operating at 33.3 or 66 MHz (266 or 533 MBps).
Adapter card and slot form factors	<ul style="list-style-type: none">• 5V, 3.3V, and dual voltage supported by different form factors and keying.<ul style="list-style-type: none">• 5V cards are keyed at pins 50 and 51.• 3.3V cards are keyed at pins 12 and 13.• Dual-voltage cards are keyed at both.• 64-bit cards and adapters have 60 more pins.• All PCI slots deliver up to 25W of power.

PCI Bus (Slide 3 of 3)



PCI Express Bus (Slide 1 of 3)



Peripheral Component Interface Express (PCIe) bus: Serial communication with point-to-point links between I/O controller and devices.

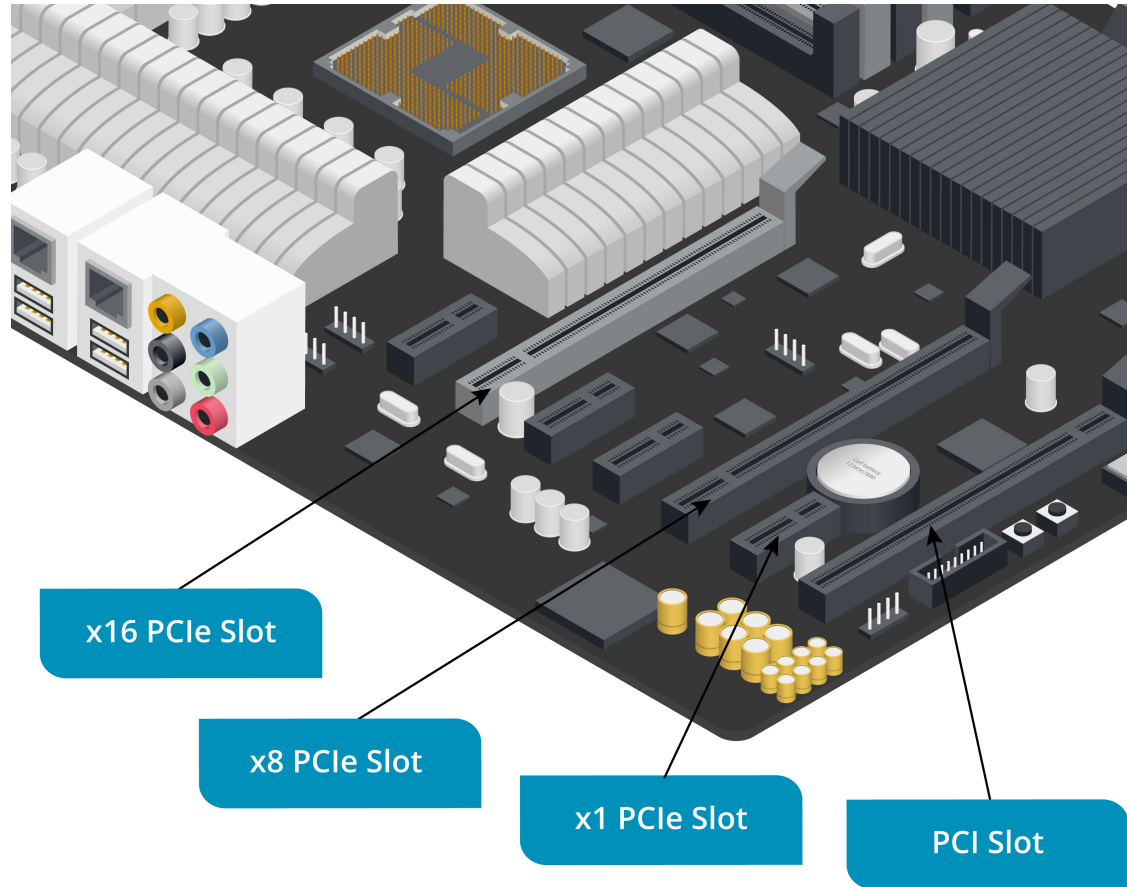
- Designed to replace PCI.
- Point-to-point serial communications for dedicated links (lanes) to all components.
- Switches make connections and provide QoS (for load balancing).
- Lanes are 2 sets of wire pairs—one pair for transmit, one pair for receive.
 - Each component supports a specific number of lanes.
 - Switch negotiates how many lanes to use (remember that QoS).
 - 250 MBps transfer rate.
- Software compatible with PCI.

PCI Express Bus (Slide 2 of 3)

- Power features:
 - Up to 75W supplied per device via motherboard slot.
 - Another 75W available through a PCIe power connector.
 - Power management functions available.
 - Hot swap and hot plug adapters supported (swap while things are on)
- Versions:
 - PCIe 2: 500 MBps transfer rates possible.
 - PCIe 2.1: Power draw up to 150W, plus 150W via connector.
 - PCIe 3: Transfer rates near 1 GBps per lane.
 - PCIe 4: Transfer rates near 2 GBps per lane.
 - PCIe 5: In development; projected transfer rates near 4 GBps per lane.

PCI Express Bus (Slide 3 of 3)

More lanes =
More bandwidth



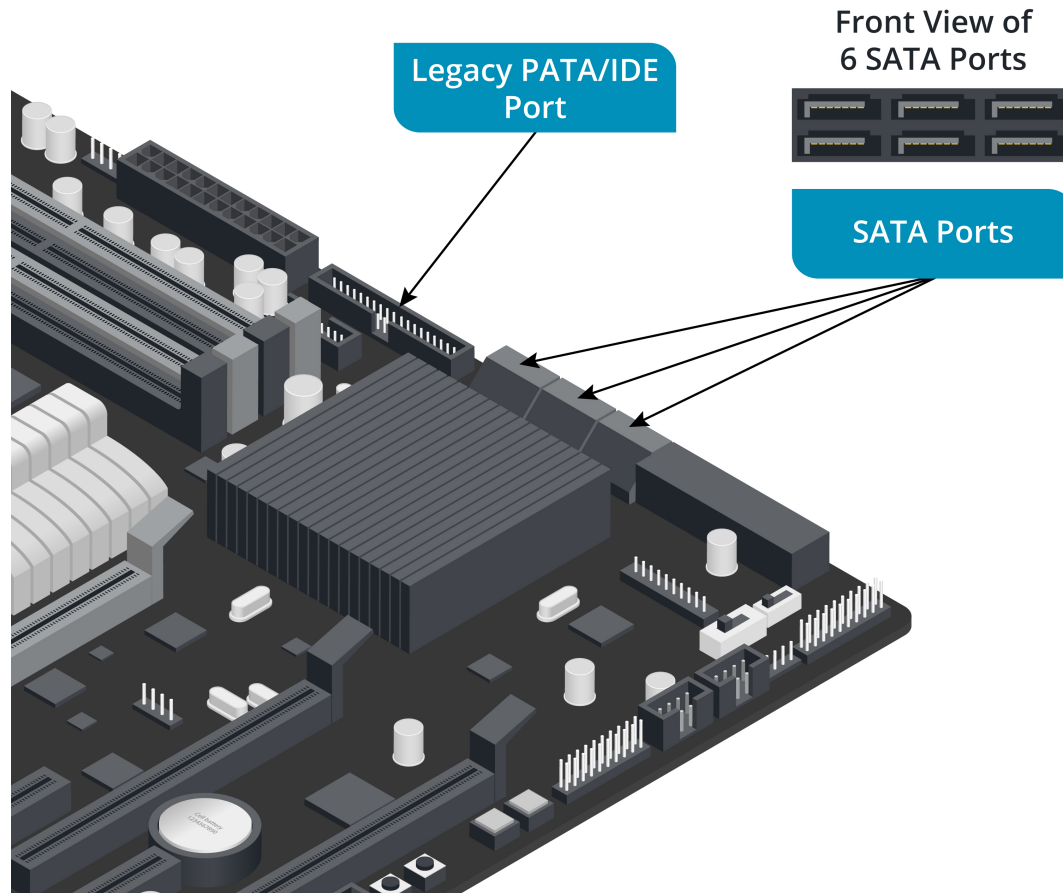
Storage Bus (SATA and IDE) (Slide 1 of 2)



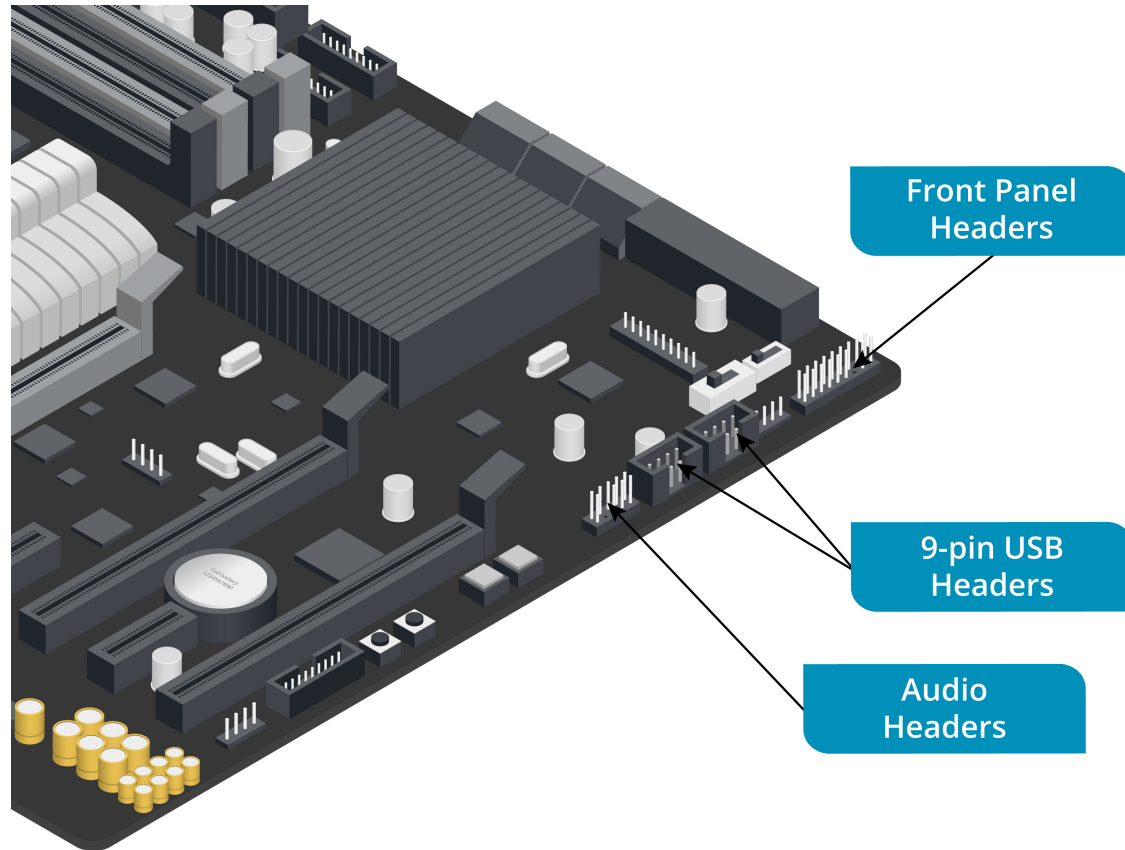
Storage bus: A special type of expansion bus dedicated to communicating with storage devices (hard drives or disk drives)

- Parallel ATA (PATA), IDE, and EIDE (legacy)
- SCSI.
- Serial ATA, or SATA:
 - Serial bus that is faster than PATA or SCSI.
 - Compact 7-pin connector.

Storage Bus (SATA and IDE) (Slide 2 of 2)



Other Motherboard Connectors (Slide 1 of 2)



Other Motherboard Connectors (Slide 2 of 2)

Connector Type	Description
Front panel connectors	<ul style="list-style-type: none">• Power button.• HDD activity lights.• Audio ports.
Internal USB connectors	<ul style="list-style-type: none">• 1 or 2 USB ports on the front panel.• Several USB ports on the back panel.• 9-pin headers.
Power and fan connectors	<ul style="list-style-type: none">• Power connector is usually a 24-pin white or black block.• Fan connectors are smaller (1 for CPU, 1 for case fan).<ul style="list-style-type: none">• 3-pin Molex KK.• 4-pin Molex KK.• 4-pin Molex.

Activity



Discussing PC Components
PBQ Section 1

Interfaces, Ports, and Connections (Slide 1 of 2)



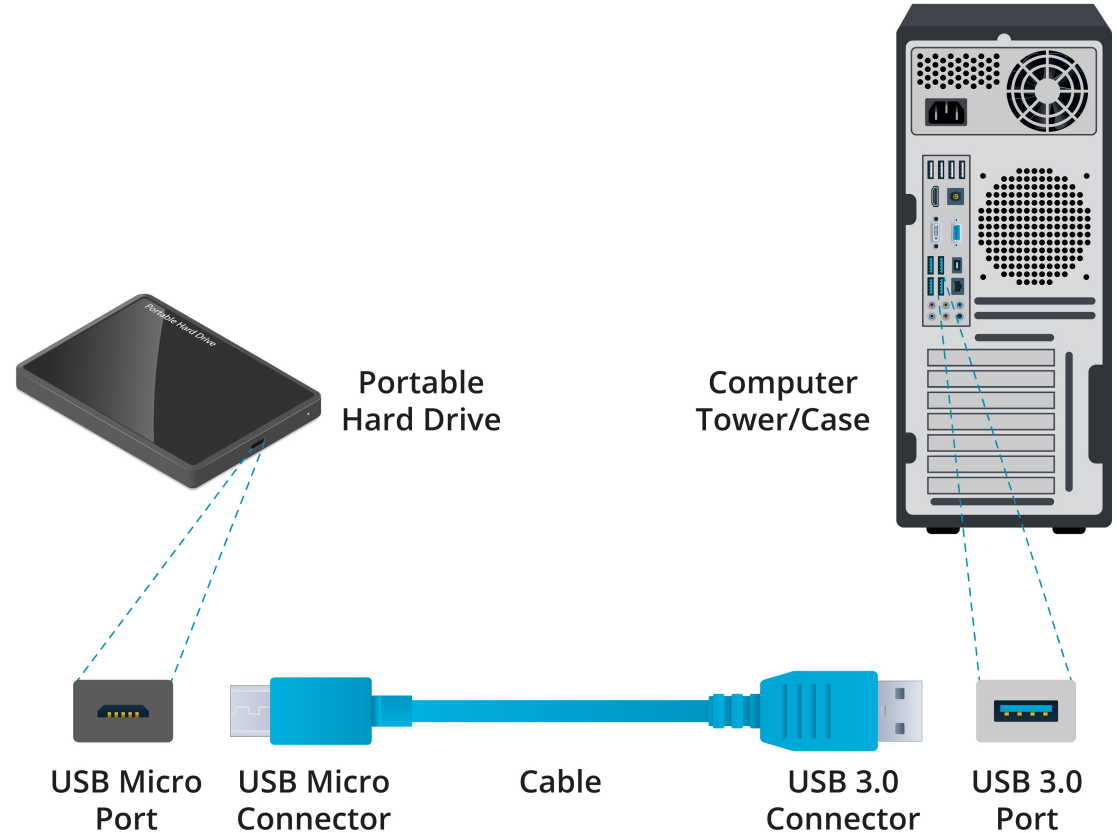
Interface: The point at which two devices connect and communicate with each other.

Port: An input-output port essentially describes a device connection through which data can be sent and received.

Connection: The physical access points that enable a computer to communicate with internal or external devices.

Interfaces, Ports, and Connections (Slide 2 of 2)

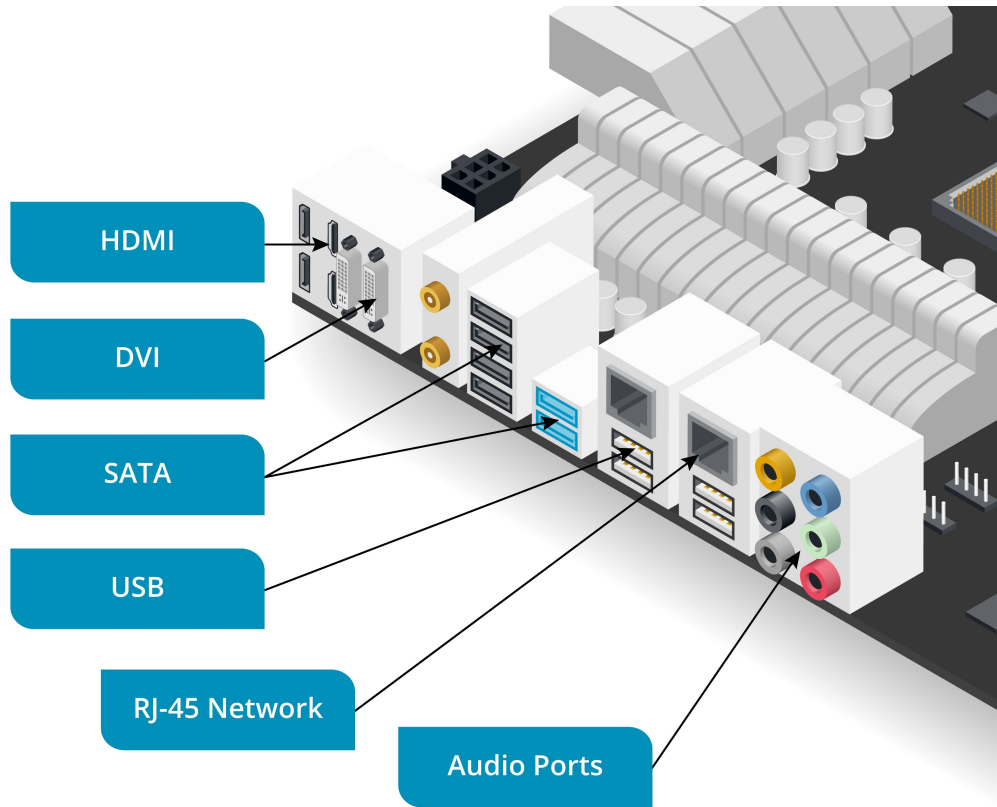
- Male and female ports.
- Keyed ports (can't be flipped around)
- Color codes for external ports.



I/O Ports and Cables



I/O port: A hardware connection interface on a personal computer that enables devices to be connected to the computer.



USB Connectors (Slide 1 of 4)



Universal Serial Bus (USB): A hardware interface standard designed to provide high performance connections for numerous peripherals with minimal device configuration.

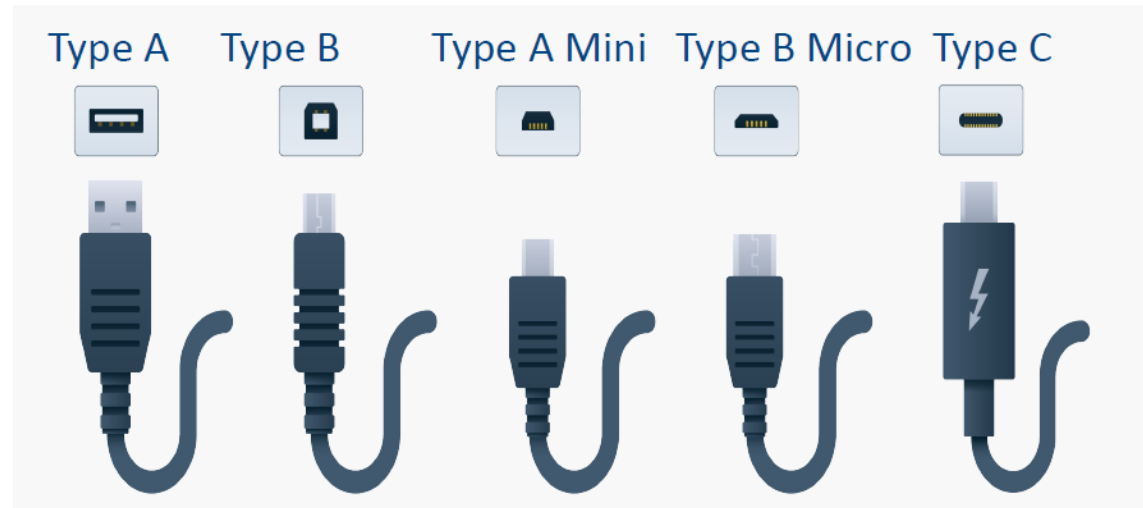
- Standard method for connecting peripherals.
- Bus is a host controller and attached devices.
 - Up to 127 devices.
- Devices are hubs or functions.
 - Hubs connect additional devices.
 - Functions are human interface, storage, printer, audio, etc.

USB Connectors (Slide 2 of 4)

- Standards:
 - USB 2.0: Data rate of 480 Mbps shared among all devices attached to a host.
 - USB 3.0:
 - SuperSpeed Mode provides bandwidth of 5 Gbps and a full duplex link.
 - Introduces dual subcontrollers to split SuperSpeed and legacy devices.
 - USB 3.1: SuperSpeed+ Mode provides bandwidth of 10 Gbps.
 - USB 3.2: 20 Gbps possible when using USB-C ports and cables.
- Power supplied by host:
 - USB 2: 2.5 W per device.
 - USB 3: 4.5 W per device.
- USB OTG

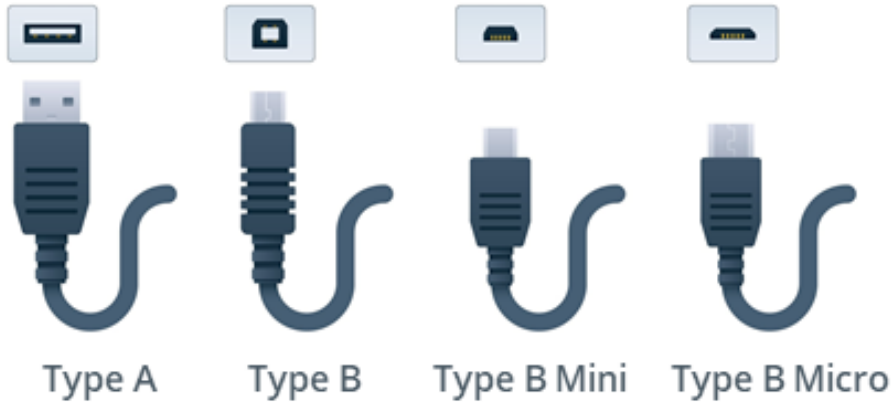
USB Connectors (Slide 3 of 4)

- Connectors and ports:
 - Type A (4-pin) connects to hosts.
 - Type B (4-pin) connects to devices. Includes B Mini and B Micro.
 - Type C connects to hosts and devices.
- Cable length:
 - LowSpeed and SuperSpeed: 3 m.
 - FullSpeed and HighSpeed: 5 m.

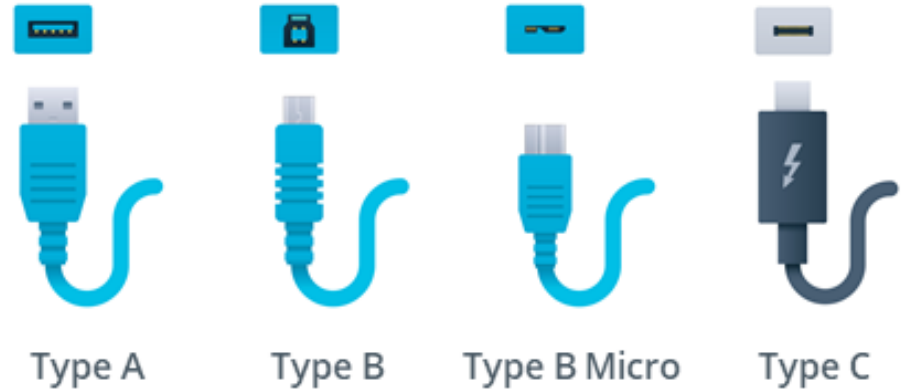


USB Connectors (Slide 4 of 4)




USB 2.0



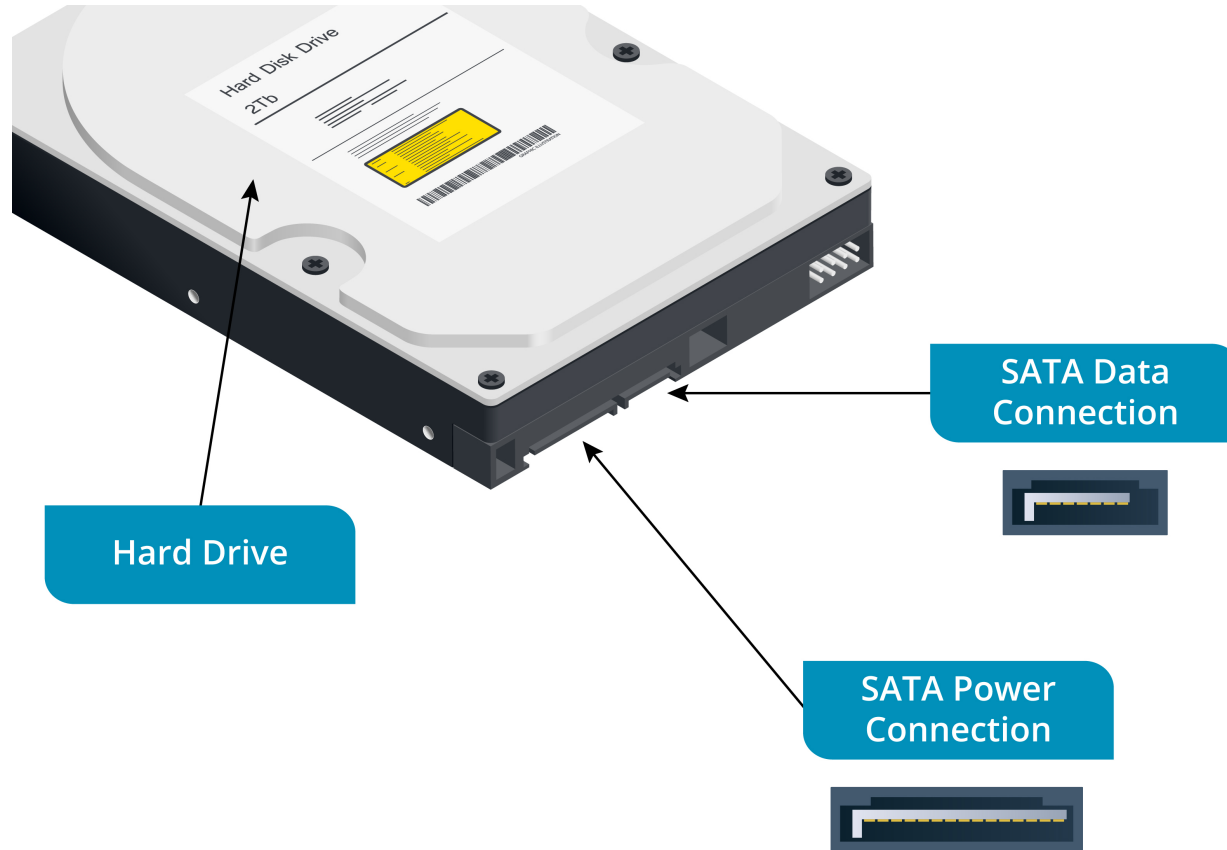
USB 3.0 and 3.1



Other

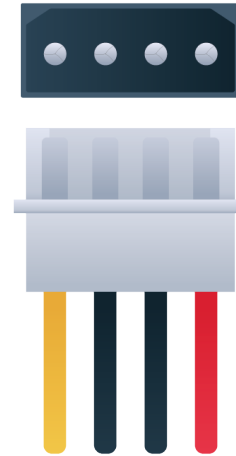
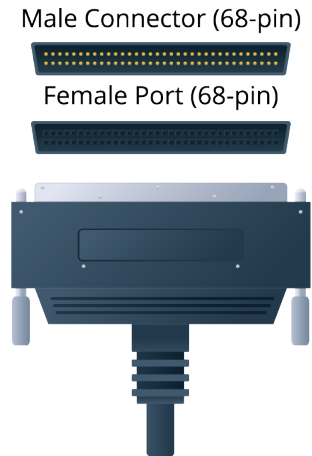
Port & Connector Type	Description
<p data-bbox="329 269 549 298">Thunderbolt</p>  <p>The image shows a Thunderbolt port icon, which is a small rectangle with a lightning bolt symbol. Below it is a black Thunderbolt cable with a lightning bolt symbol on the connector and a curved end.</p>	<ul data-bbox="832 266 1917 464" style="list-style-type: none">• Primarily used on Apple systems.• Display or general peripheral interface.• Lightning bolt icon.• TB 2 supports links of up to 20 Gbps and allows up to 6 devices to a port.• TB 3 uses same interface as USB-C.
<p data-bbox="329 597 497 626">Lightning</p>  <p>The image shows a Lightning port icon, which is a small rectangle with a horizontal line. Below it is a white Lightning cable with a reversible connector and a curved end.</p>	<ul data-bbox="832 593 1944 707" style="list-style-type: none">• Used on iPhone and iPad.• Reversible connector.• Restricted to mobile devices, so adapter cables needed to connect to a PC.
<p data-bbox="329 922 676 951">RD-232 and DB-9</p>  <p>The image shows a blue RD-232 port icon, which is a rectangular port with multiple pins. Below it is a blue RD-232 cable with a curved end.</p>	<ul data-bbox="832 918 1476 1078" style="list-style-type: none">• Connect to serial ports.• Data rates up to 115 Kbps.• Used for modems and network equipment.• Can be 25- pin or 9-pin interface.

Storage Connector Types (Slide 1 of 2)



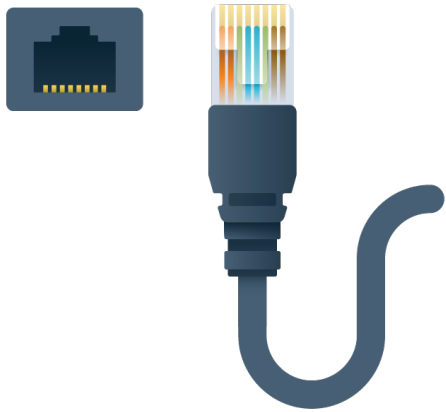
Storage Connector Types (Slide 2 of 2)

SCSI and Molex

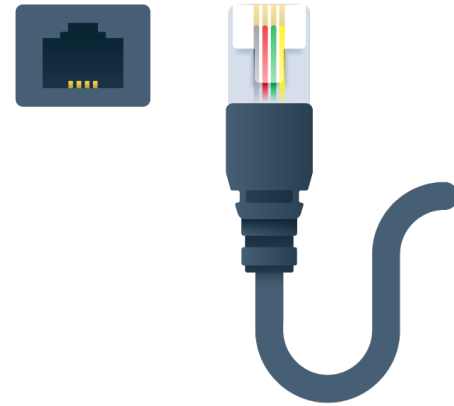


Network Connector Types

RJ-45 Port and Connector



RJ-11 Port and Connector

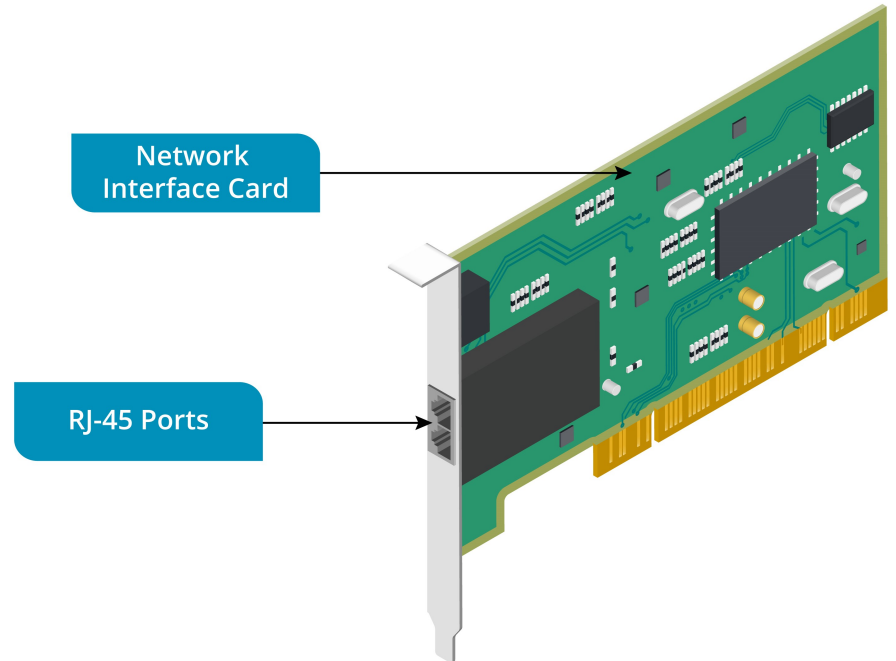


Expansion Cards



Expansion card: A printed circuit board that is installed in a slot on a system board to provide special functions for customizing or extending a computer's capabilities. Also referred to as adapter card, I/O card, add-in, add-on, or board.

- I/O adapters and storage cards
- NICs and adapters.



Activity



Identifying Connection Interfaces

30bird labs 2, 3

Activity



Demonstrating PC Disassembly and Reassembly