Computer Fundamental

UNIT-II

Add-on cards

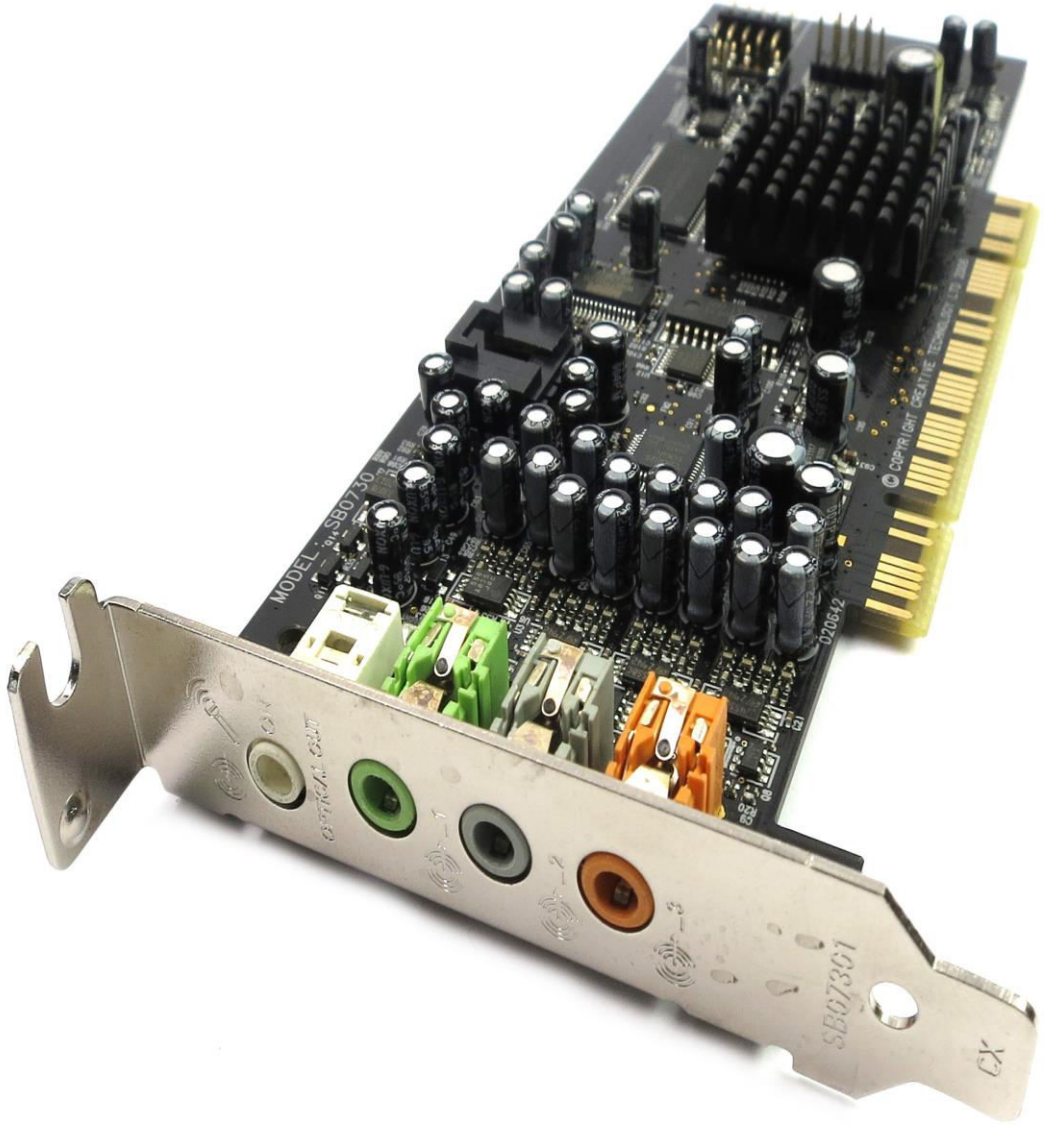
- A computer add-on card is an electronic card/board that is used to add extra functionality to a computer.
- Add-on cards are also known as expansion cards or interface cards.
- All add-on cards are used to enhance the quality of their specific function. For example, video graphics cards are used to enhance the video quality on a computer.
- The basic purpose of add-on cards is to enhance the existing abilities of the motherboard.

Types of expansion cards.

- Sound cards
- Video cards
- Network cards
- Serial and parallel cards
- USB cards
- FireWire cards
- Storage cards
- Modem cards
- Wireless/Cellular cards
- TV tuner cards
- Video capture cards
- Riser cards

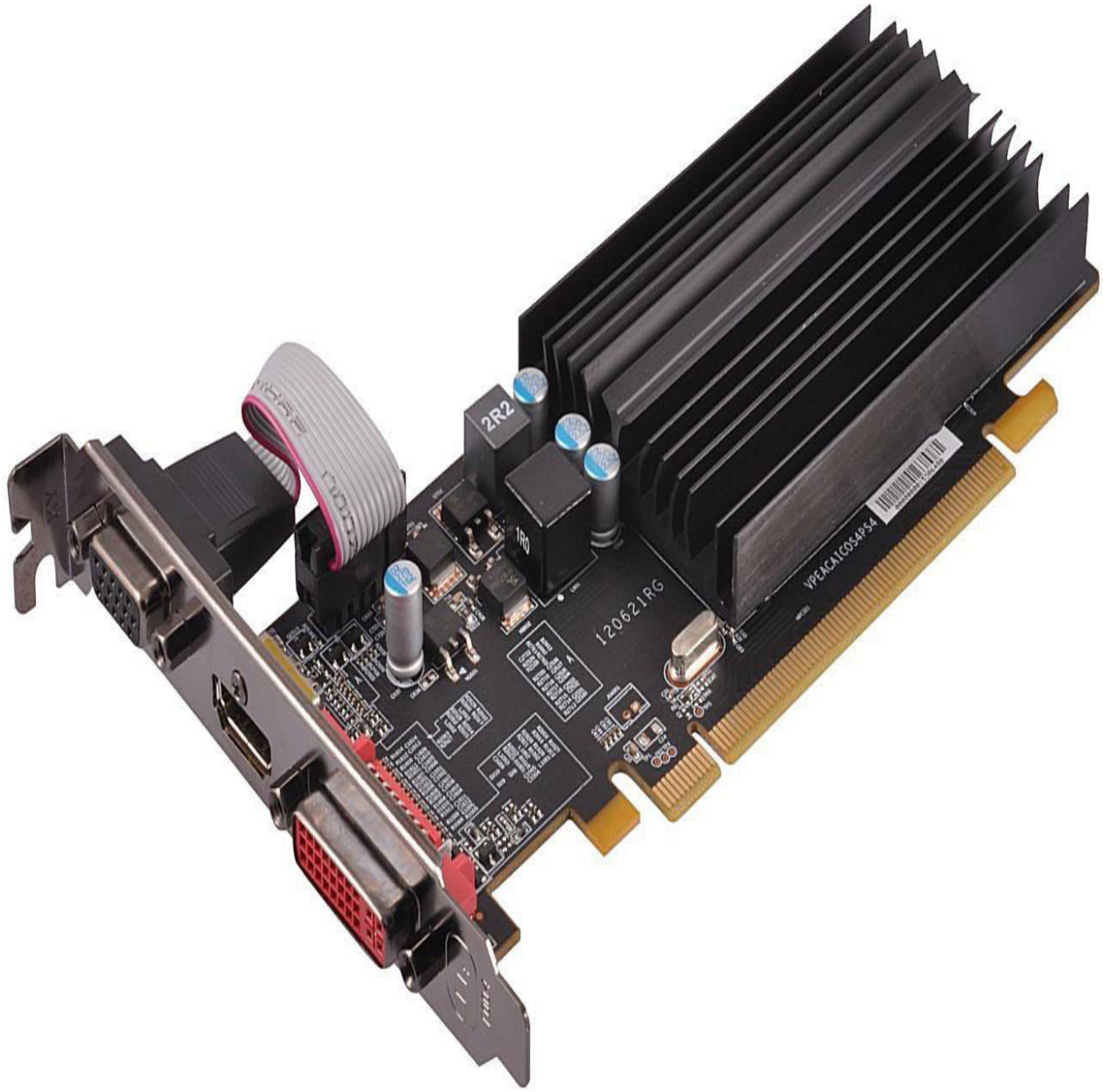
Sound cards

- Sound cards expand the sound capabilities of a PC.
- They are popular with gamers and those who watch videos, and/or television, on their PCs.
- With a sound card, a system can go from mono sound, to stereo sound, to surround sound.



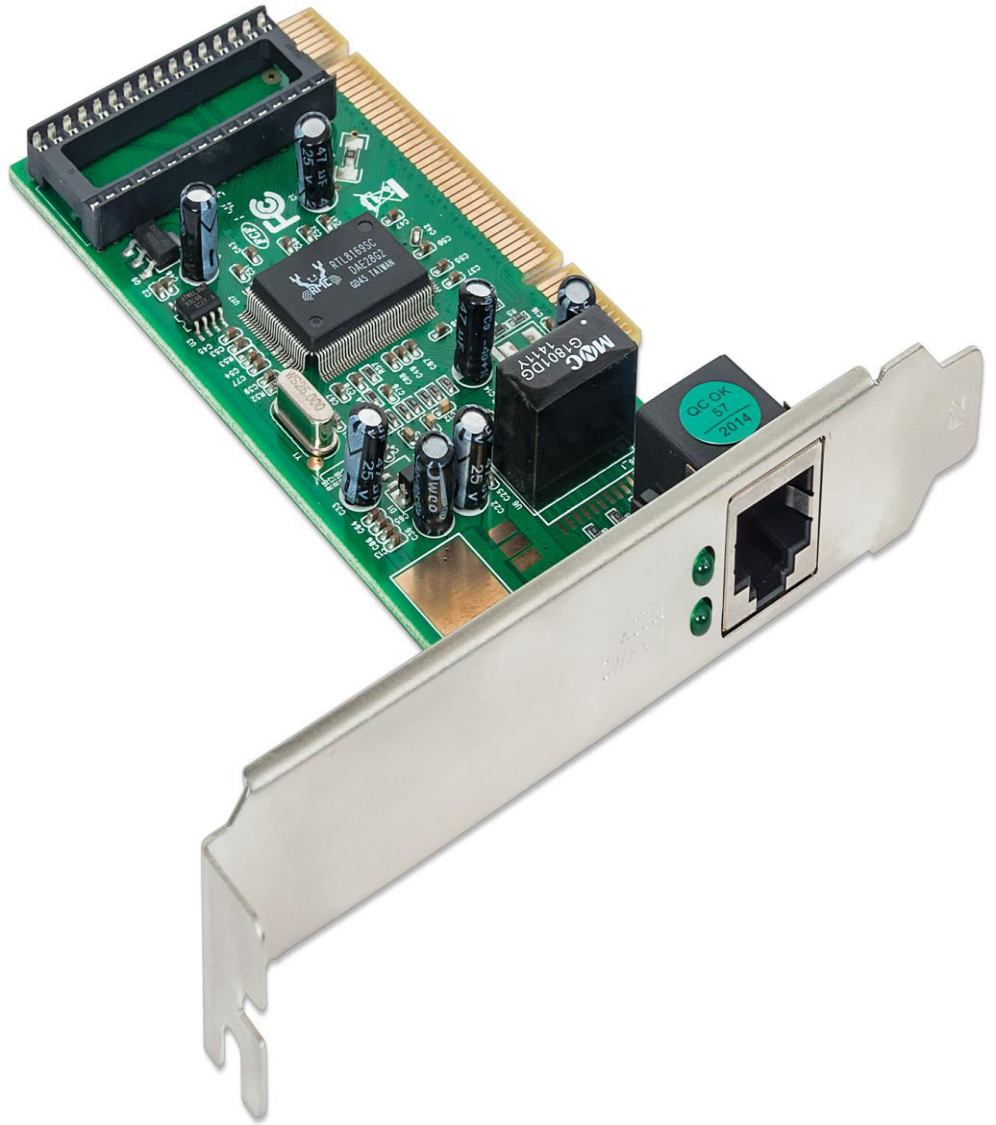
Video cards

- Video cards can increase the overall performance of a system, depending upon the card that is installed.
- They can also allow the addition of multiple monitors.
- One of the ways that they increase performance is by taking the workload off of the CPU and transferring it to the video card.



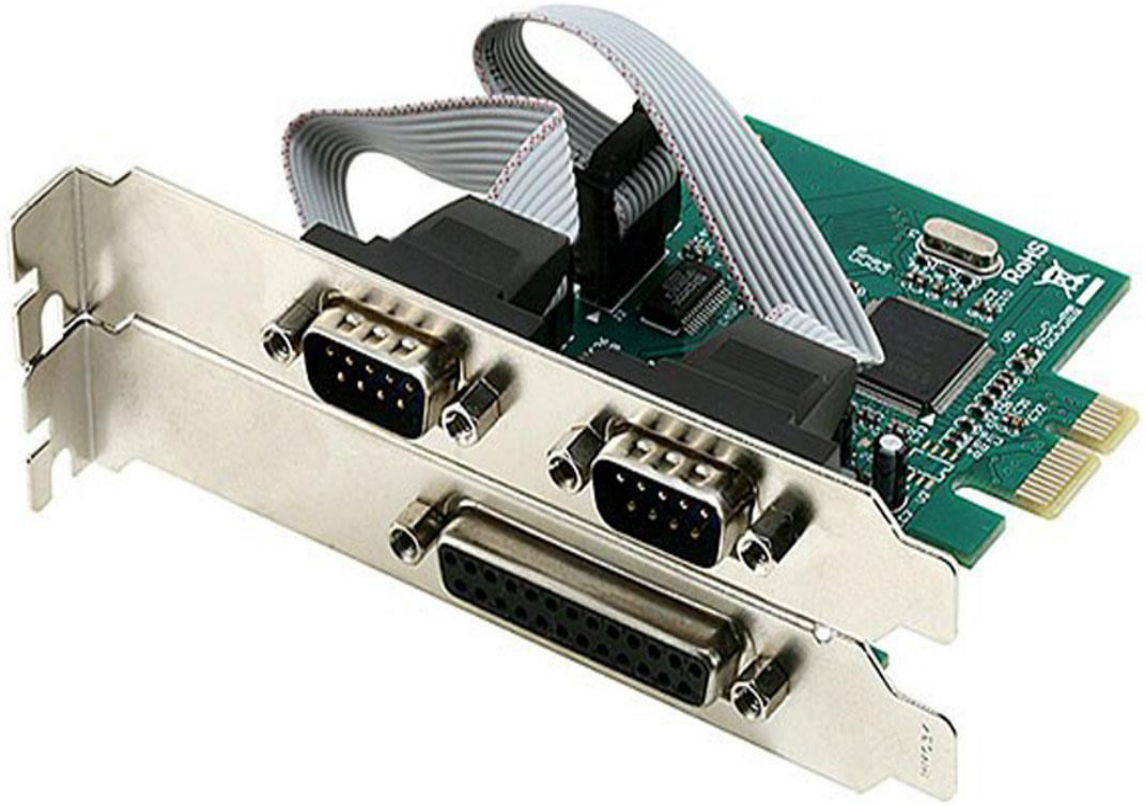
Network cards

- Most motherboards have built in network cards; however, they can fail or they might not connect to the right type of network in your situation.
- Additionally, you might need to connect with another or different type of network or make multiple network connections.
- Those are a few examples of situations where a network expansion card could prove useful.



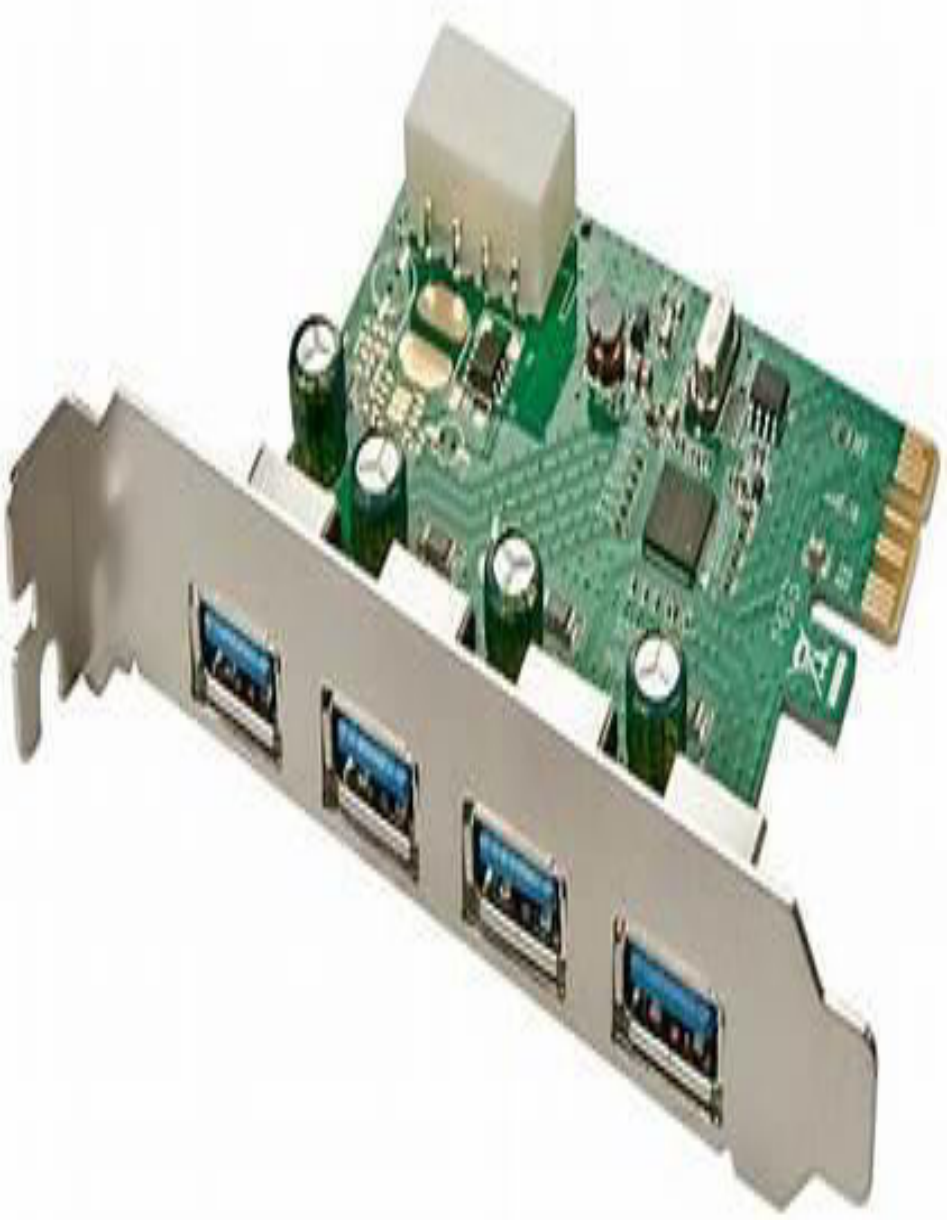
Serial and parallel cards

- Another reason to add expansion cards would be the need to expand the life of legacy applications.
- Most systems nowadays do not come with a serial or parallel port; however, some applications and situations still call for those types of connections.
- You can add an expansion card that has a serial and/or parallel port in your system.



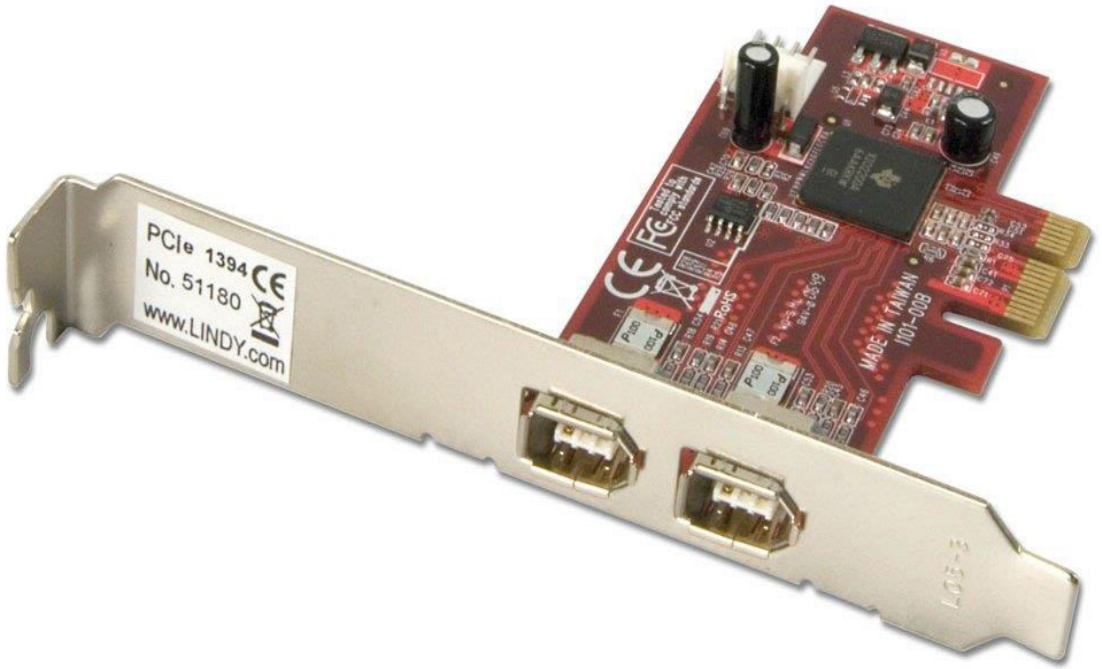
USB cards

- An expansion card will allow you to add more USB ports to a system.
- You can also add newer versions of USB by using an expansion card.



FireWire cards

- A FireWire card is an add-on card that enables a FireWire capable device such as a hard drive or a digital video camera to be connected to a PC or laptop.
- FireWire enables a high-speed data transfer rate which exceeds that of USB, Ethernet or wireless networks.



Storage cards

- A variety of storage solutions are available through the use of expansion cards.
- If you need to add a SCSI (Small Computer System Interface) tape array, you can add an expansion card that allows you to connect to SCSI devices.
- There are also expansion cards that are solid-state drives in their own right.
- They are an extremely unique solution for storage and they are very fast; however, they tend to be fairly expensive.

Modem cards

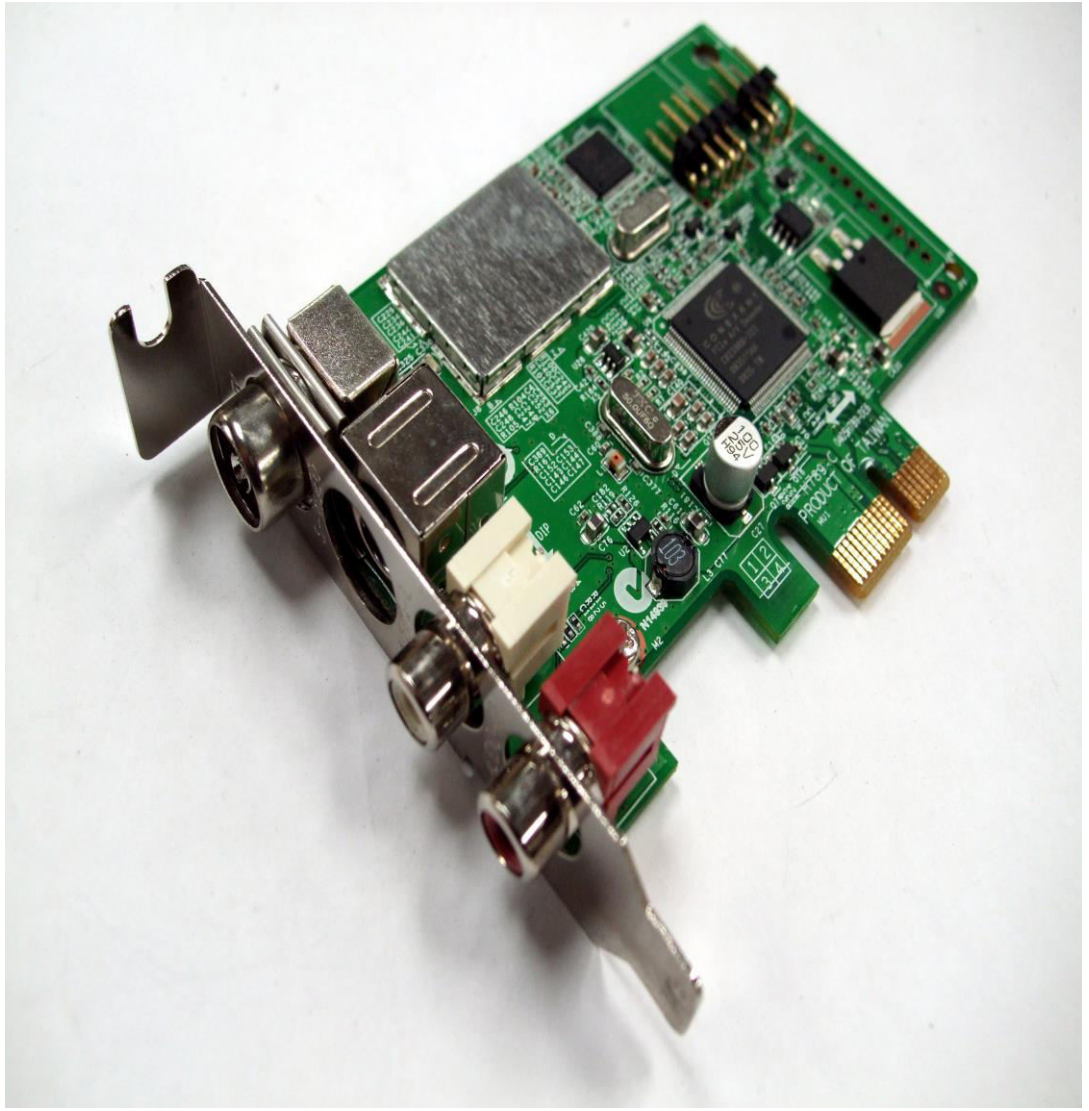
- Most systems no longer come with built-in modems.
- However, some virtual private networks require the client to dial-in in order to connect and a modem is needed to do so.
- An expansion card that has a modem built into it will resolve this problem.

Wireless/Cellular cards

- Wireless and cellular network cards allow you to take advantage of wireless networks and a cellular card can take advantage of LTE or 4G networks.

TV tuner cards

- A TV tuner card allows a PC to make a cable television connection.
- This is a popular option for a home theater PC. Cable television can be routed through, or watched, on the PC.

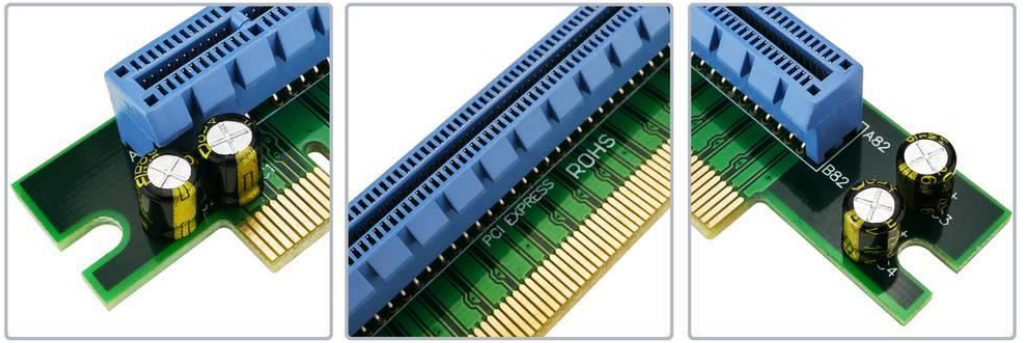


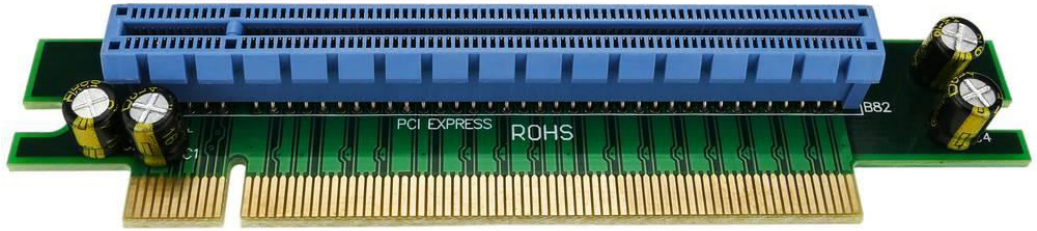
Video capture cards

- Video capture cards are used to capture video images.
- Specialized cards are used to capture video and/or still images that cross through the PC and they may be combined with a TV tuner card.

Riser cards

- The riser card is used as an adapter for other cards.
- They are plugged in and offer the ability to install another card at a 90-degree angle.
- They are used when space is tight.





BIOS

- BIOS (basic input/output system) is the program a computer's microprocessor uses to start the computer system after it is powered on. It also manages data flow between the computer's operating system (OS) and attached devices, such as the hard disk, video adapter, keyboard, mouse and printer.

The 4 functions of BIOS

- BIOS identifies, configures, tests and connects computer hardware to the OS immediately after a computer is turned on. The combination of these steps is called the *boot process*.
- These tasks are each carried out by BIOS' four main functions:
- **Power-on self-test (POST).** This tests the hardware of the computer before loading the OS.
- **Bootstrap loader.** This locates the OS.
- **Software/drivers.** This locates the software and drivers that interface with the OS once running.
- **Complementary metal-oxide semiconductor (CMOS) setup.** This is a configuration program that enable users to alter hardware and system settings. CMOS is the name of BIOS' non-volatile memory.

- **RAM (random access memory)** - Random access memory (RAM) is the hardware in a computing device that provides temporary storage for the operating system (OS), software programs and any other data in current use so they're quickly available to the device's processor.

Read-Only Memory (ROM)

- ROM stands for Read-Only Memory. It is a non-volatile memory that is used to store important information which is used to operate the system. As its name refers to read-only memory, we can only read the programs and data stored on it. It is also a primary memory unit of the computer system. It contains some electronic fuses that can be programmed for a piece of specific information. The information is stored in the ROM in binary format. It is also known as permanent memory.

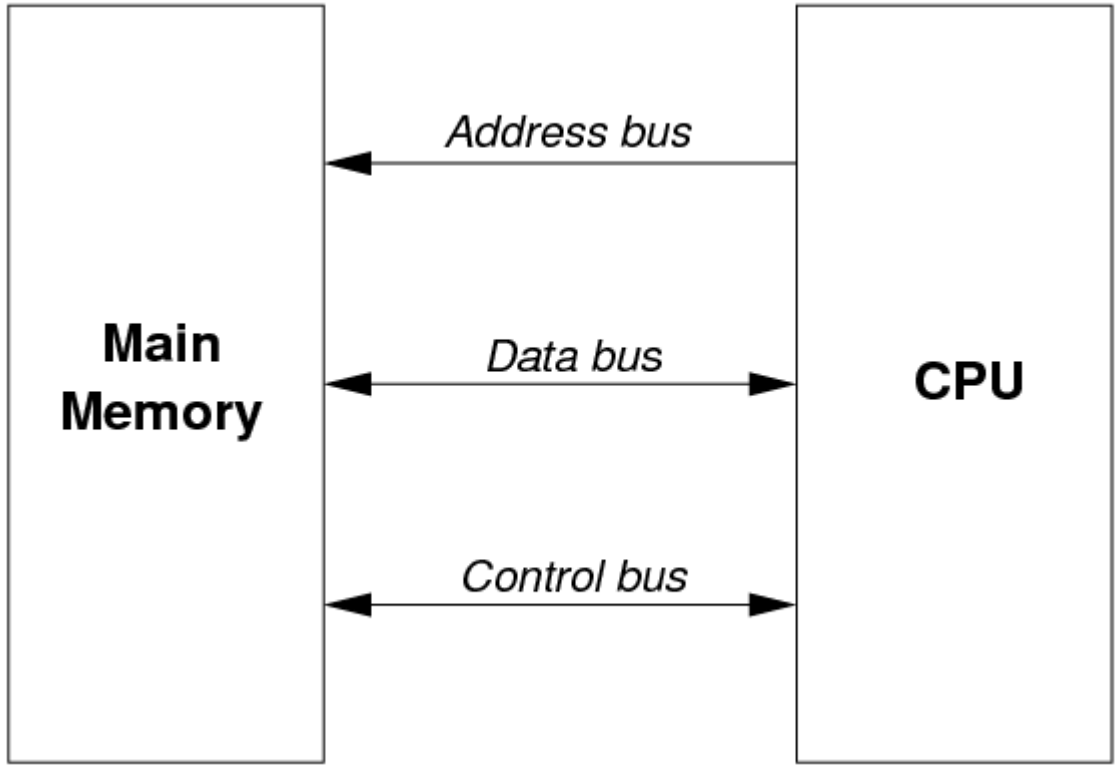
ROM

- ROM, which stands for read only memory, is a memory device or storage medium that stores information permanently. It is also the primary memory unit of a computer along with the random access memory (RAM).
- It is called read only memory as we can only read the programs and data stored on it but cannot write on it. It is restricted to reading words that are permanently stored within the unit.

MEMORY BUS

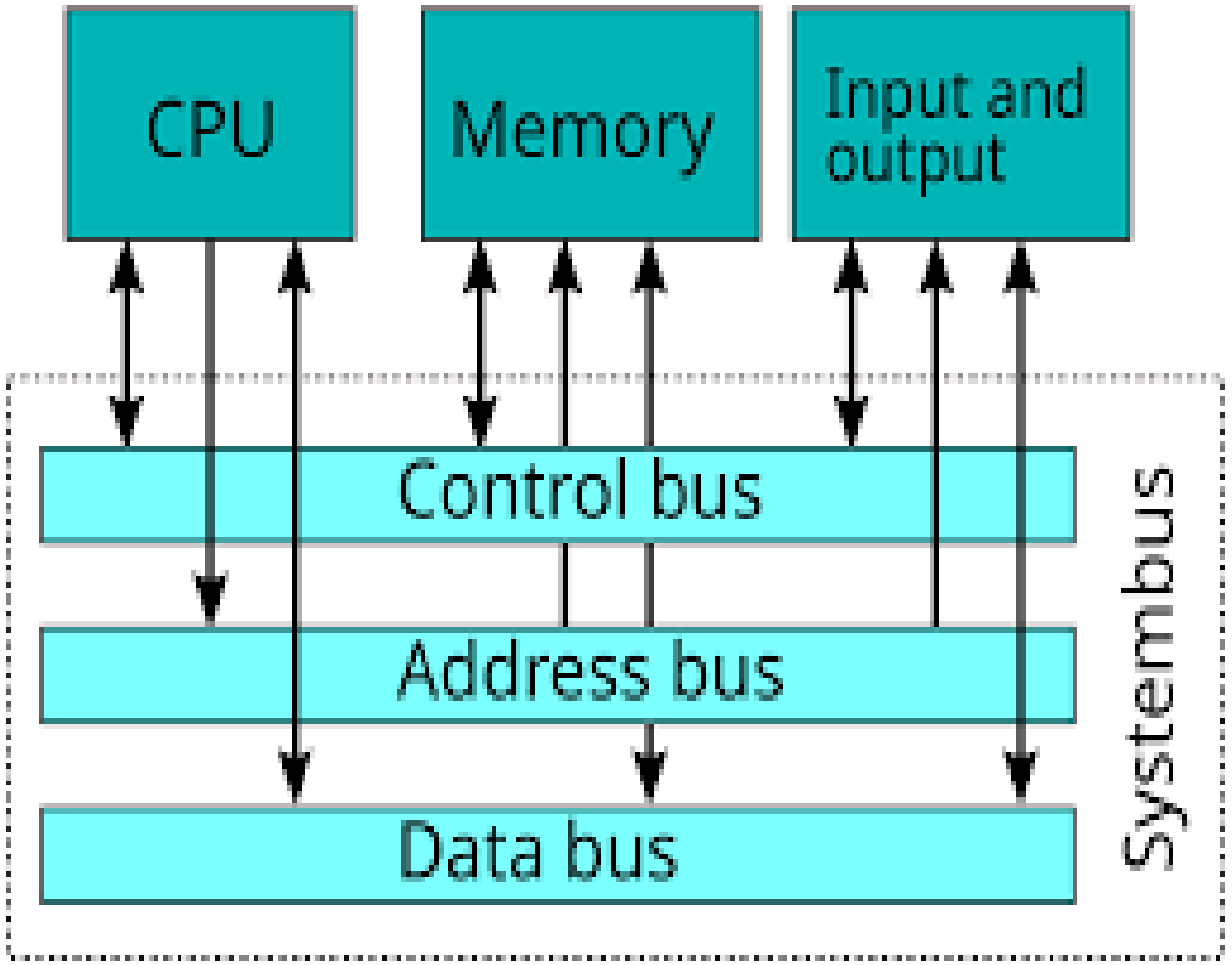
- A bus is a set of wires, which carries a group of bits in parallel and has an associated control scheme.
- The bus width is defined as the number of parallel lines (wires) in the bus.
- Every computer system has the following three types of buses for interconnecting the CPU and memory:
  - Data Bus
  - Address Bus
  - Control Bus

Three types of buses between CPU and Main Memory



Data Bus

- The data bus is used to transfer data between the CPU and memory.
- Each wire of a bus can transfer one bit at a time.
- An 8-bit bus can move 8 bits at a time, a 16-bit bus can transfer 2 bytes and a 32-bit bus can transfer 4 bytes.
- A wider data bus enables more bits of data to travel simultaneously resulting in faster exchange of data.


CPU
Memory
Input and output
Control bus
Address bus
Data bus
Systembus

Address Bus

- Every storage location in the memory has a unique address.
- The address of a location does not change but the data stored in it can change.
- In order to retrieve some data from memory, it is necessary to specify the address of the location where the data is stored.
- The address bus is used to carry the address of a memory location whenever data is to be transferred to or from memory.
- The width of the address bus must be equal to the number of bits in the memory address register of the system.

Address Bus

- The width of the address bus is an important parameter for a computer system because it determines the maximum number of memory locations that the computer system can have.
- Most systems have 32-bit wide address buses that can address 2^{32} bytes or 4 GB of memory.

Control Bus

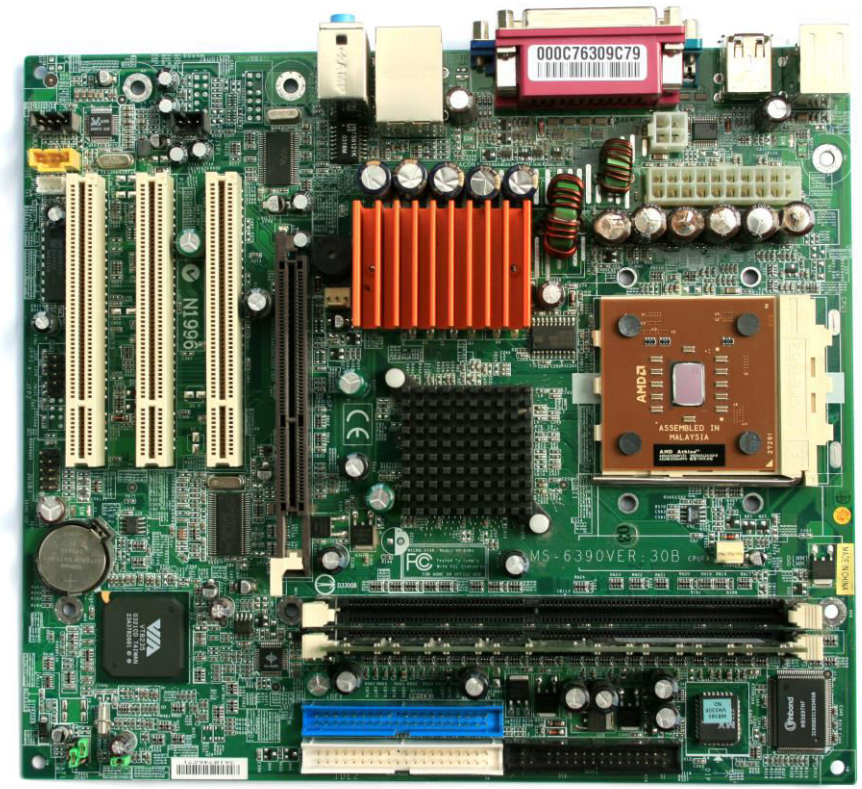
- In addition to sending addresses and exchanging data with the memory, the CPU also needs to send control signals to the memory to specify whether the data is to be read from or written to the specified address location.
- Signal which are in the form of READ/Write commands, are carried by the control bus.

Summary

- The memory access by the CPU involves all the three buses –
  - The memory access command is carried by the control bus.
  - The memory address is carried by the address bus.
  - The data to be transferred is carried by the data bus.

Motherboard

- A motherboard is the main circuit board inside a computer that connects the different parts of a computer together.
- It has sockets for the CPU, RAM and expansion cards and it also hooks up to hard drives, disc drives and front panel ports with cables and wires.



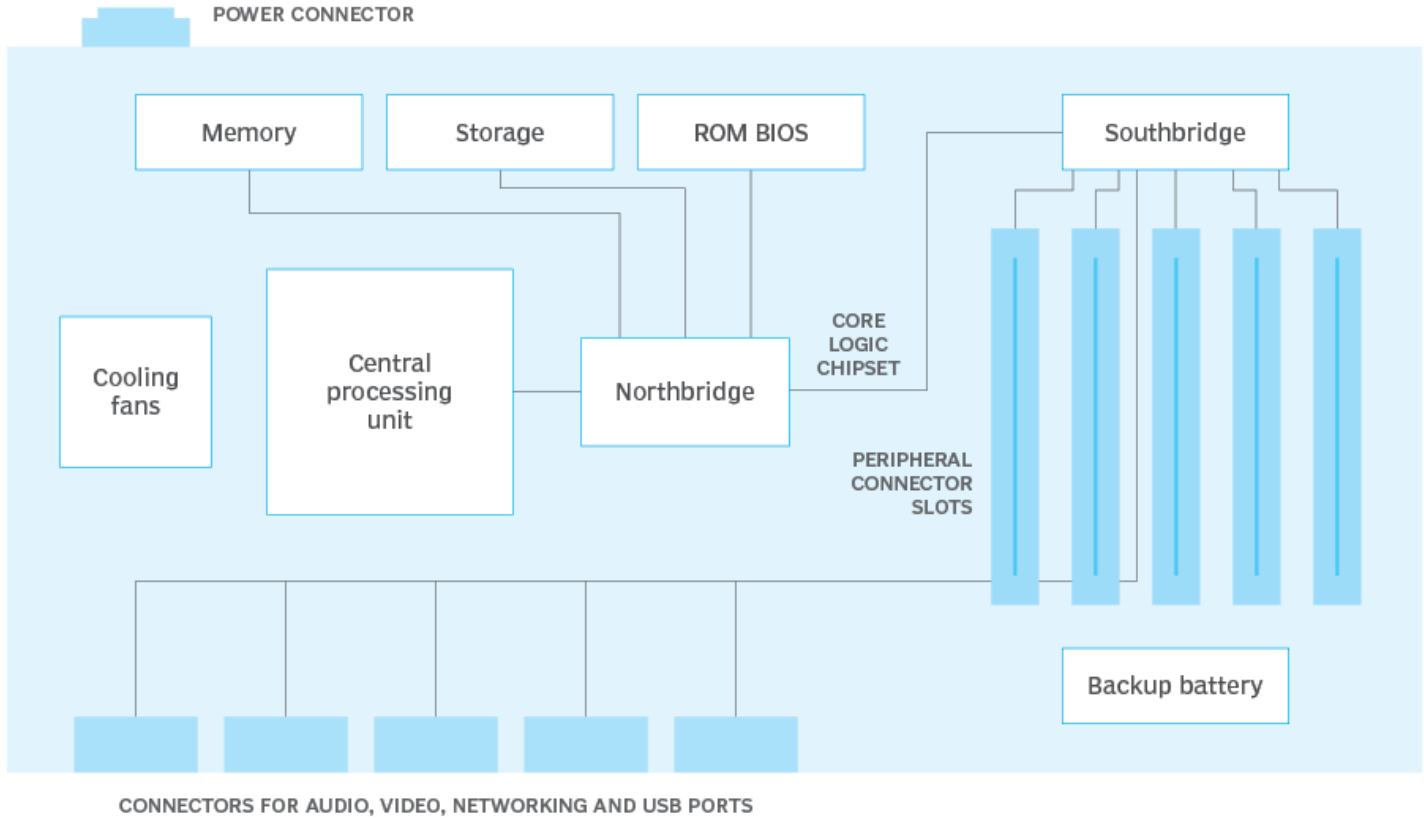
Components of motherboard

- CPU chip
- RAM slots
- Southbridge/Northbridge
- BIOS (Basic Input/Output System)
- I/O port
- USB (Universal Serial Bus)
- CPU slot
- PCI (Peripheral Component Interconnect) slot
- AGP (Accelerated Graphics Port) slot

Components of motherboard (Contd…)

- Parallel port
- FDC (Floppy-Disk Controller)
- IDE (Integrated Drive Electronics) controller
- CMOS (Complementary Metal-oxide-semiconductor) battery
- Power supply connector
- Mouse and keyboard ports
- DIP (Dual In-line Package) switch
- Jumper
- Heat sink/heatsink (cooling system)
- Clock generator

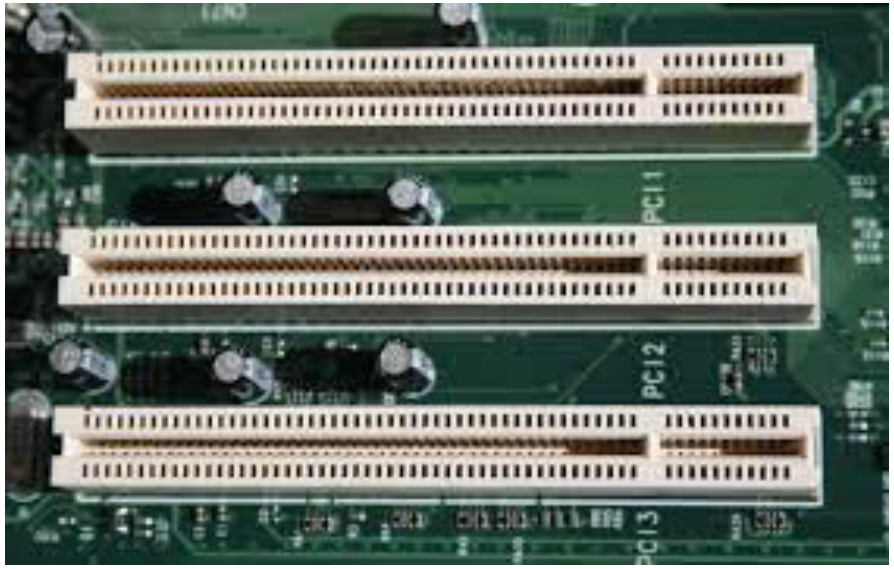
Typical motherboard configuration



SOURCE: PAUL KIRVAN

Peripheral Component Interconnect standard (PCI)

- Developed by Intel Corporation, the Peripheral Component Interconnect standard (PCI) is an industry-standard, high-speed bus found in nearly all desktop computers.
- PCI slots allow you to install a wide variety of expansion cards including:
  - Graphics or Video cards.
  - Sound cards.
  - Network cards.



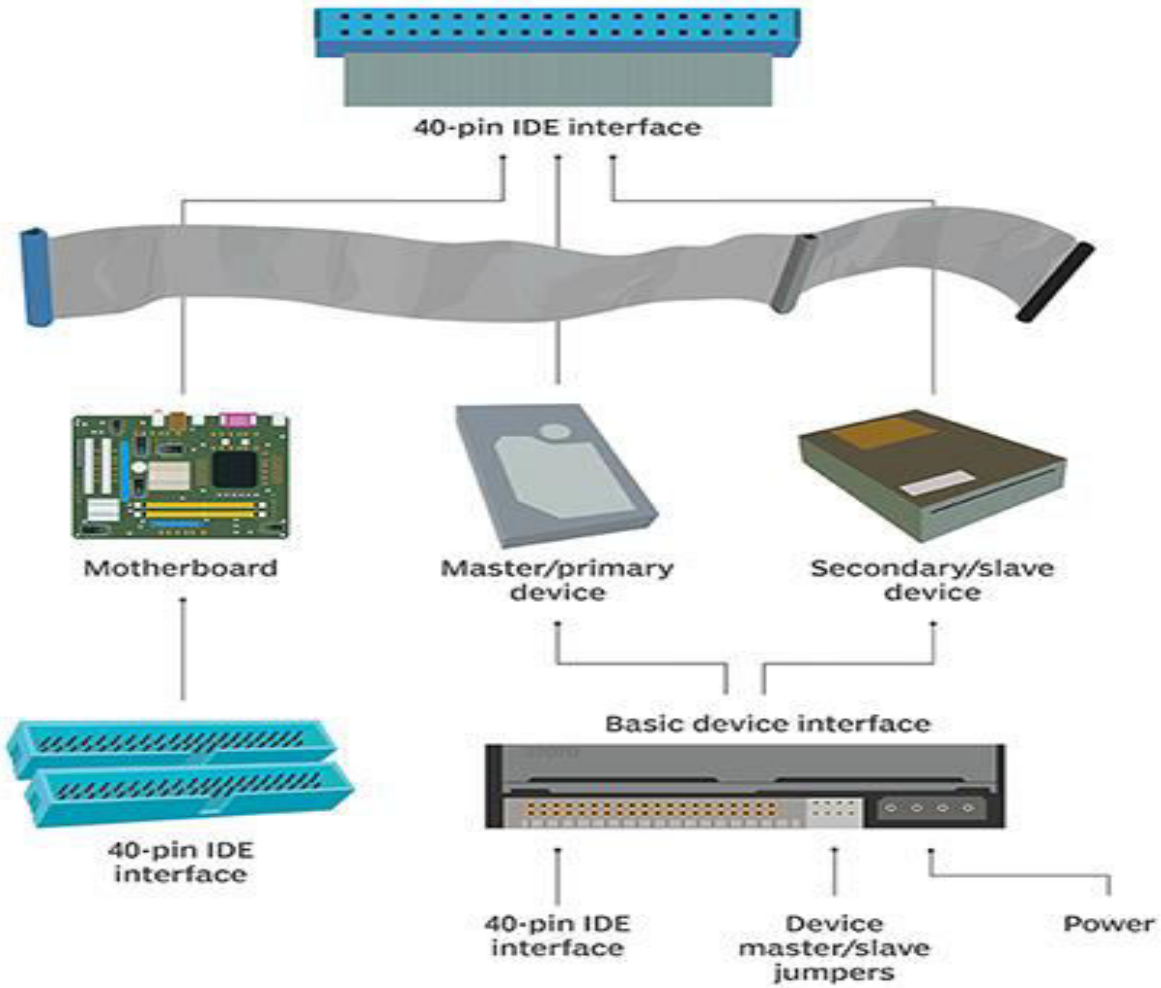
Accelerated Graphics Port (AGP)

- Accelerated Graphics Port (AGP) is a parallel expansion card standard, designed for attaching a video card to a computer system to assist in the acceleration of 3D computer graphics.
- It was originally designed as a successor to PCI-type connections for video cards.

IDE (Integrated Drive Electronics) controller

- IDE is designed to provide a standardized interface between a computer's motherboard and its storage devices, such as hard drives and optical drives.
- By using IDE, you can easily connect and communicate with these devices, enabling data transfer and storage capabilities.

IDE interface components



DIP (Dual In-line Package) switch

- The role of DIP switches is to allow users to control the flow of electricity around a printed circuit board (PCB), expansion card or other electronics/computer peripheral, and therefore change the operating mode of a device.

Jumper

- In computer hardware, a jumper is a small device that can be connected or disconnected to change the settings or configuration of a particular component. It is often used to configure settings on motherboards, hard drives, or optical drives.

Motherboard

- Motherboard is also known as a mainboard, planar board or logic board, system board, moo or MB.
- It links all the individual parts of a computer together and also, allows the CPU to access and control these separate parts.
- Other than bridging internal components, the motherboard ports also allows you to connect external devices to the computer.
- Such external devices would include the monitor, speakers, headphones, microphone, keyboard, mouse, modem and other USB devices.

Functions of the Motherboard

- The functions of a computer motherboard are as follows**:**
- The motherboard acts as the central backbone of a computer on which other modular parts are installed such as the CPU, RAM and hard disks.
- The motherboard also acts as the platform on which various expansion slots are available to install other devices / interfaces.
- The motherboard is also responsible to distribute power to the various components of the computer.
- They are also used in the coordination of the various devices in the computer and maintain an interface among them.
- Some of the sizes in which the motherboards are available are: BTX, ATX, mini-ATX, micro-ATX, LPX, NLX etc..

Processor

Specification of Processor

- It is the most important component that determines the performance of your computer.
- It is installed in a socket on the motherboard.
- CPUs also have a heat sink and fan installed right over them, since they produce the most amount of heat out of all components.
- Most computer CPUs are manufactured by either Intel or AMD.
  - The mainstream Intel Core family of processors includes the i3, i5, i7, and i9 chips, while AMD Ryzen includes the Ryzen 3/5/7/9.

CPU Specifications and Features

- Core Count
- Hyper-Threading support
- Base Clock Speed
- Max Turbo Speed
- Overclocking Support
- L Cache Size (L1, L2, L3)
- Memory Support and Channels
- TDP Rating
- Generation and Micro-architecture
- Socket Type
- Chipset Compatibility
- Integrated Graphics

1. Core Count

- Most modern CPUs have multiple cores anywhere from 4,6,8 to upto 32 and 64.
- Each core is like a CPU within a CPU that can execute programs.
- Having multiple cores allows the CPU to run multiple programs simultaneously thereby making it faster.

2. Hyper-threading support

- Hyper-Threading feature when present on a CPU allows each core on the CPU to act somewhat as 2 cores.
- In other words, a 4 core CPU with hyper-threading support will appear to have 4 x 2 = 8 cores.

3. Clock Speed

- A processor is driven by a digital clock that runs at a certain frequency measured in Hz.
- A CPU can perform some task with every clock cycle, so higher the clock speed the more instruction the CPU can execute.

4. Max Turbo Frequency

- Both AMD and Intel allow CPUs to operate above their typical (base) clock frequencies for a temporary performance boost when needed.
- AMD calls it Boost Clock (Turbo Core) while Intel calls it Max Turbo Frequency (Turbo Boost).

5. Overclocking support

- Overclocking is the process of increasing the boost clock speed of a CPU beyond the limits set or specified by the manufacturer.
- This is basically done to make your CPU run even faster than the boost clock speed.
- There are various reasons to do so, but for most regular users overclocking is not an important and they should stay away from it.

6. L Caches (L1, L2, L3)

- Most modern CPUs have 3 Levels ('L') of caches to store data needed while executing program instructions.
- These are named L1, L2, and L3, with the capacity increasing with each level.
- If the data the processor needs can't be found in the L1 cache, it 'seeks' this data from the L2 cache and then the L3 cache.

7. Memory Support

- Any CPU supports only specific types of RAM modules upto a certain size and speed.
- Modern systems are equipped with either DDR4 or DDR5 RAM modules with DDR5 being the newer technology standard that supports higher bandwidth at lower speed.

8. TDP (Thermal Design Power)

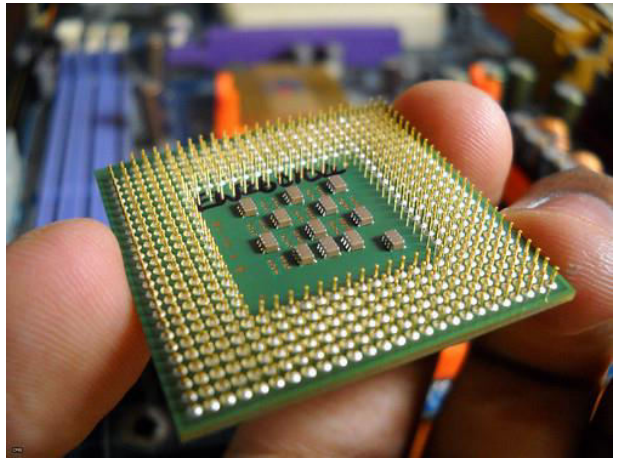
- TDP stands for Thermal Design Power, and measures in watts, the amount of power that a CPU will consume under load.
- A CPU with higher TDP value will need more power supply and more cooling.

9. Generation and Micro-Architecture

- Each CPU belongs to a certain "technology generation" with each newer generation being more powerful and efficient than the previous. The CPU model name usually indicate the generation as a number. For example:
- i9-13900K - 13th gen (Raptor Lake)
- i9-12900K - 12th (Alder Lake) generation (note the 12 in the "12900K")
- i7-11800H - 11th gen. (Rocket Lake) (note the 11 in the 11800H)
- i5-10400 - 10th gen. (Comet Lake)
- With AMD, these are called series instead of generation.
- Ryzen 7 5800H - 5000 series
- Ryzen 5 3600 - 3000 series

10. Socket Type

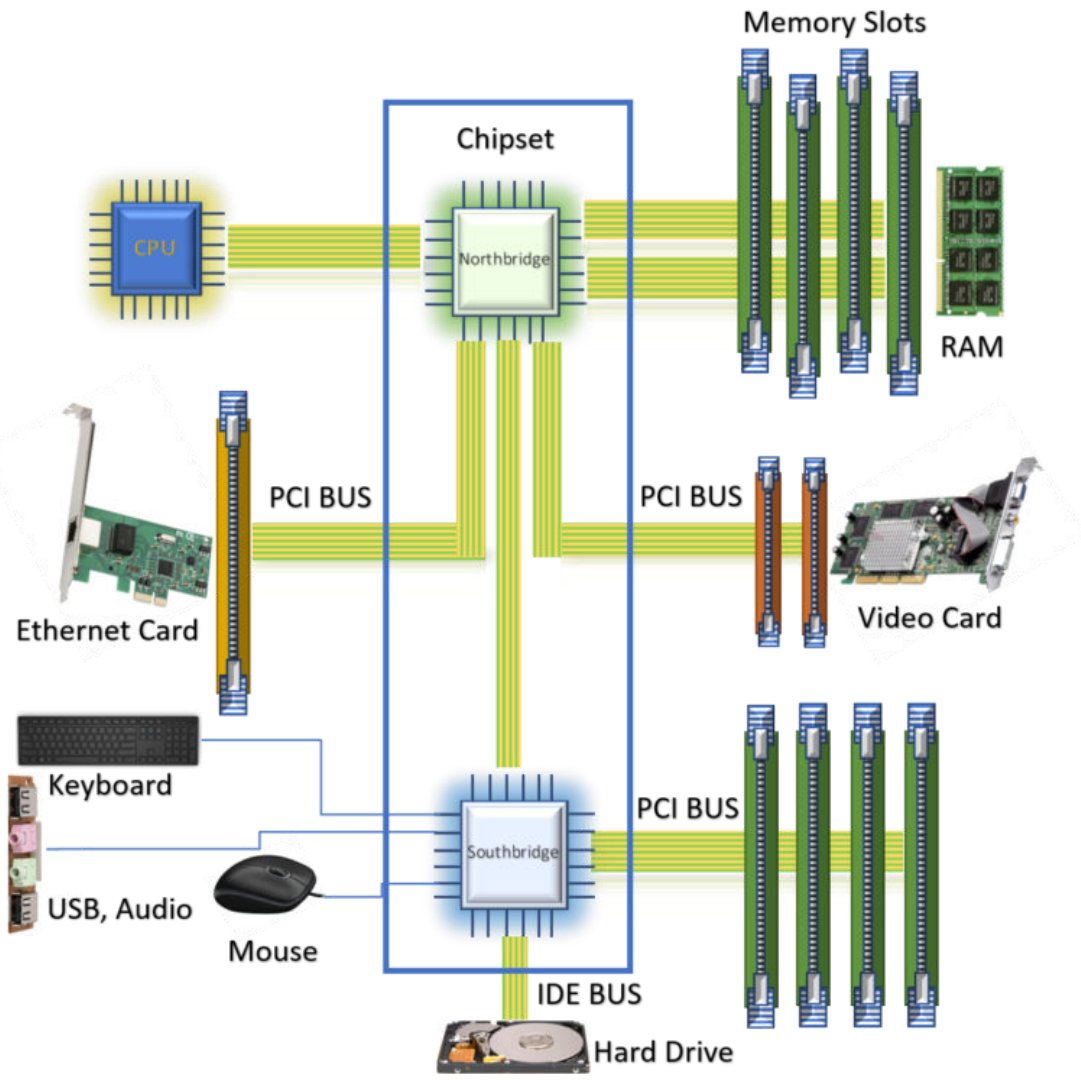
- A CPU socket is a physical interface on a motherboard in which a processor is installed.
- AMD and Intel processors use their own specific socket types and CPUs from one brand will not fit into a socket of made for the other brand.
- So basically its the CPU socket that determines whether a motherboard is made for Intel CPU or AMD CPU.



11. Chipset

- The chipset is a special IC chip on the motherboard that handles data flow between the CPU and other components of your computer.
- It determines how fast your computer's components communicate with the CPU and each other.
- The chipset also determines support for overclocking your CPU, the speed of your RAM, and other things like number of USB ports and speed of each.

Chipset


Memory Slots
Chipset
CPU
Northbridge
RAM
PCI BUS
PCI BUS
Ethernet Card
Video Card
Keyboard
Southbridge
PCI BUS
USB, Audio
Mouse
IDE BUS
Hard Drive

12. Integrated Graphics

- Many CPUs come with integrated graphics on the chip itself, meaning you don't need a dedicated GPU (Graphics Processing Unit) to drive your monitor.
- While an integrated graphics solution is a solid option for casual users, other users add a discrete graphics card to their system for more powerful graphics performance.

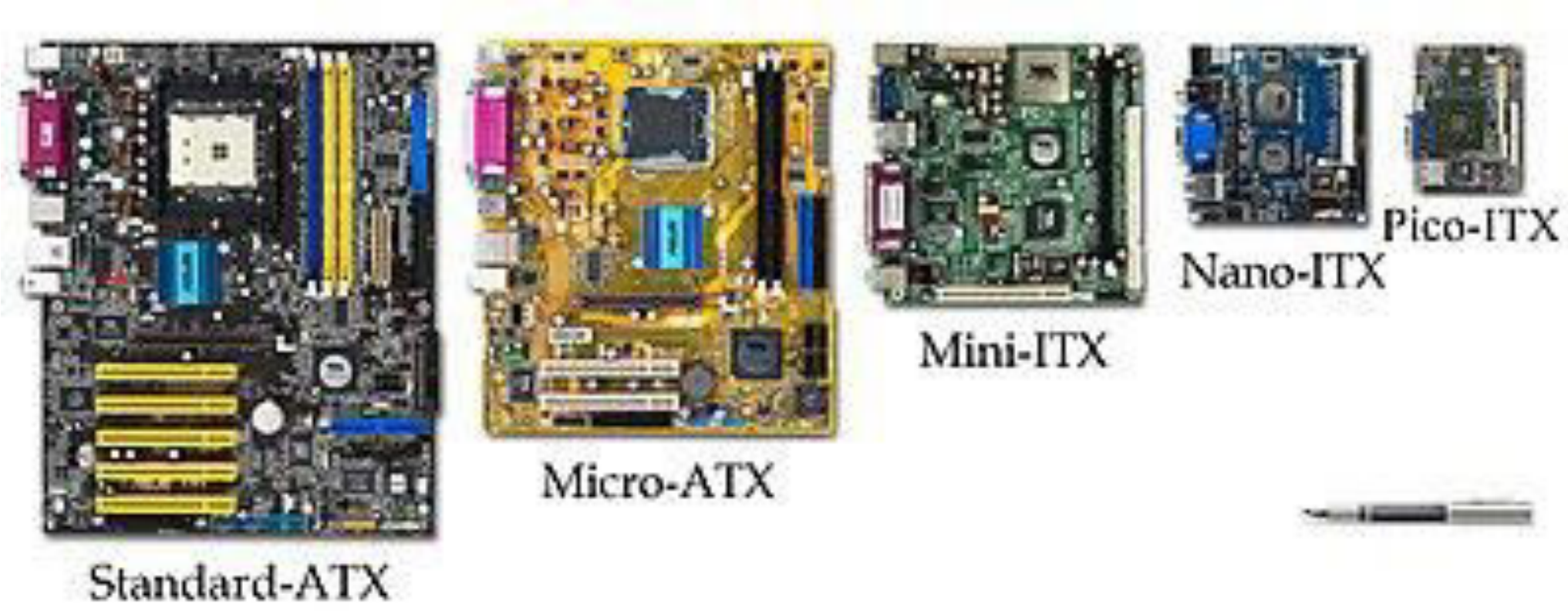
Motherboard

- A **motherboard form factor** is a standardized specification that defines the dimensions, mounting points, and layout of a motherboard.
- It dictates the physical size and shape of the motherboard, as well as the placement of components like the CPU socket, RAM slots, power connectors, and expansion slots.
- Choosing a motherboard form factor is important for compatibility with computer cases and other components.

The most common motherboard form factors include:

- **ATX (Advanced Technology eXtended)**
- **MicroATX (mATX)**
- **Mini-ITX**
- **Nano ATX**
- **Pico ATX**

Types of Motherboards



Types of Motherboards

1. Advanced Technology (AT) motherboard –

- **AT Motherboard** stands for **Advanced Technical Motherboard**. AT motherboard was very common in personal computers during the 1980s. AT motherboards are characterized by their physical size and layout, and can fit only in AT casing. The size of AT motherboard is about 305 mm × 280 mm.

2. ATX Motherboard

- **ATX Motherboard** stands for **Advanced Technology Extended Motherboard.** ATX motherboard is a type of motherboard which is extensively used in modern personal computers (PCs).

ATX Motherboard (Contd..)

- The ATX motherboard is basically an evolved version of the earlier AT motherboard and hence it offers many improvements and features.
- The ATX motherboard is characterized by its physical dimensions and layout. The size of a typical ATX motherboard is approximately 305 mm x 244 mm.

3.Micro ATX Motherboard

- In computer design, microATX (sometimes referred to as µATX, uATX or mATX) is a standard motherboard form factor introduced in December 1997.
- The maximum size of a microATX motherboard is 9.6 × 9.6 in (244 × 244 mm).

4.Mini ITX Motherboard

- Mini-ITX motherboards have been traditionally used in small-configured computer systems.
- Originally, Mini-ITX was a niche standard designed for fanless cooling with a low power consumption architecture, which made them useful for home theater PC systems, where fan noise can detract from the cinema experience.

Mini ITX Motherboard

- The Mini-ITX motherboard is suitable for almost every computing or embedded device that operates in a space-constrained environment, including the following: Toys. Musical instruments. Home devices.

5.Nano ITX

- Nano-ITX boards measure 12 × 12 cm (4.7 × 4.7 in), and are fully integrated, very low power consumption motherboards with many uses, but targeted at smart digital entertainment devices such as DVRs, set-top boxes, media centers, car PCs, and thin devices.
- Nano-ITX motherboards have slots for SO-DIMM.

Nano-ITX

- Nano-ITX is used in smart digital entertainment devices such as DVRs, set-top boxes, media centers, car PCs, and thin devices. Nano-ITX motherboards have slots for SO-DIMM.

6.Pico-ITX

- The PICO-ITX is an incredibly versatile embedded single-board computer (SBC) based on the 100mm x 72mm form factor, having been introduced as a more compact alternative to the larger Mini-ITX motherboard with the aim of maintaining a wide variety of interfaces on a more easily deployed board.

Pico-ITX

- Pico ITX motherboards are also found in retail applications, such as point-of-sale terminals, kiosks, and digital signage.

Form Factor Motherboard

- The form factor determines the specifications on how a motherboard is built, from the size, shape, casing, power supply, mounting holes, and the overall layout.
- The most common form factor is ATX, which evolved to mini-ATX, nano-ATX, pico-ATX, and further.