Difference between CD-R and CD-RW

1. CD-R (Compact Disk – Recordable) **:**
   CD-R is a blank CD in which data can be stored once. After storing data it is converted into CD-ROM. It is made of a reflective metal disk with layer of green or opaque dye on top. It is cheaper as compared to CD-RW and CD-ROM also. In CD-R data can not be written over. The advantage with CD-R is that any version of CD players either it is older or newer it can easily read CD-R.
2. **2.** CD-RW (Compact Disk – ReWritable) **:**
   CD-RW is a type of CD which can be erased and it can be used multiple times. It is made of a reflective metal disk with a layer of special metal on top. It is the cheaper CD among all types. It is costly than both CD-R and CD-ROM. The disadvantage with CD-RW is that mostly older versions of CD players can not read it. In some properties it has some similarities too with CD-RW.
3. **Difference between CD-R and CD-RW :**

CD-R	CD-RW
It is made of reflective metal disk with layer of dye on top.	It is also made of reflective metal disk but it has special metal on top.
Data can be stored only once in CD-R.	Data can be stored multiple times in it.
It can not be erased.	It can be erased.
After storing data, it is converted into CD-ROM.	Even after storing data, it is CD-RW itself.
It is cheaper than CD-RW.	It is costly among all CD types.
Data can not be written over in CD-R.	Data can be changed after writing in it.
CD-R is more compatible.	CD-RW is less compatible.
It is effective for long term back-ups.	It is the best for data transferring.
All CD players i.e. older and newer can read CD-R.	Older CD players can not read CD-RW.

Digital Versatile Disc-Read Only Memory (DVD-ROM)

Digital versatile disc-read only memory (DVD-ROM) is a read-only digital versatile disc (DVD) commonly used for storing large software applications. It is similar to a compact disk-read only memory (CD-ROM) but has a larger capacity. A DVD-ROM stores around 4.38 GB of data. A CD-ROM usually stores 650 MB of data.

A DVD-ROM permanently stores data files which cannot be changed, written over or erased. A personal computer (PC) with a DVD-ROM or a DVD-RAM drive is designed to read a DVD-ROM disc. Generally a DVD-ROM disc is not equipped to be used with a DVD drive connected to a home theater system or television. But many DVD-ROM drives can generally read a DVD movie disc.

A DVD-ROM is one of the various types of DVDs. A blank DVD is generally a DVD-R or DVD+R, which has a read-write format. The +R or -R references the format standards and is a rewritable or recordable DVD.

Compared to a CD-ROM, a DVD-ROM has the same 5 inch diameter and 1.2 millimeter (mm) thickness. But because a DVD-ROM uses a shorter wavelength laser with tighter compacted pits, the disc capacity is increased. In fact, the smallest DVD-ROM can store approximately 7 times more data than a CD-ROM.

This term is also known as digital video disc ROM.

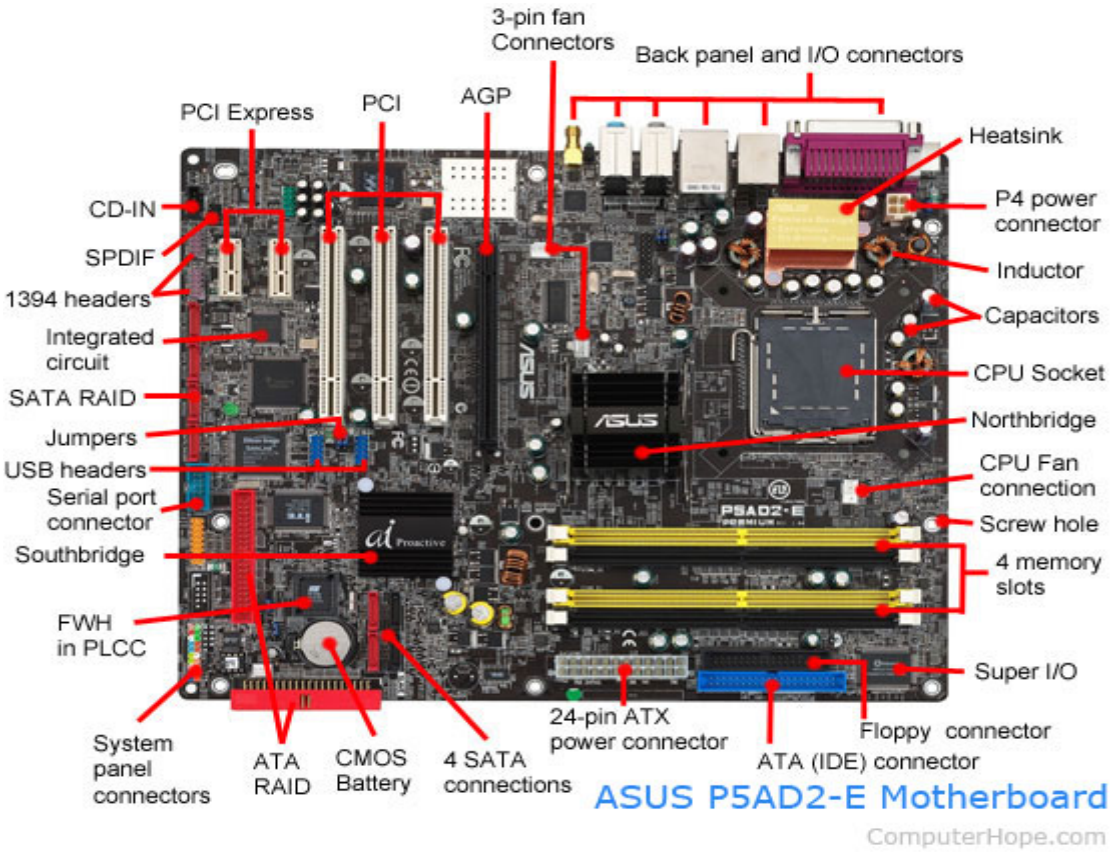
Alternatively known as a **bus slot** or **expansion port**, an **expansion slot** is a connection or port inside a computer on the motherboard or riser card. It provides an installation point for a hardware expansion card to be connected. For example, if you wanted to install a new video card in the computer, you'd purchase a video expansion card and install that card into the compatible expansion slot.

Computer expansion slots

Below is a listing of expansion slots commonly found in a computer and the devices associated with those slots. Clicking any of the links below provide you with additional details.

- **AGP** - Video card.
- **AMR** - Modem, sound card.
- **CNR** - Modem, network card, sound card.
- **EISA** - SCSI, network card, video card.
- **ISA** - Network card, sound card, video card.
- **PCI** - Network card, SCSI, sound card, video card.
- **PCI Express** - Video card, modem, sound card, network card.
- **VESA** - Video card.

Many of the expansion card slots above are obsolete. You're most likely only going to encounter AGP, PCI, and PCI Express when working with computers today. The picture below is an example of what expansion slots may look like on a motherboard. In this picture, there are three different types of expansion slots: PCI Express, PCI, and AGP.



How many expansion slots does my computer have?

Every computer motherboard is different, to determine how many expansion slots are on your computer motherboard identify the manufacturer and model of the motherboard. Once you've identified the model of motherboard, you can find complete information about the motherboard in its manual.

- How do I find what computer motherboard I have?

Adding additional expansion slots for older motherboards could be accomplished using a riser board, which would add several ISA or PCI slots. Today, riser boards are rarely used with motherboards, as there is limited need for additional expansion slots with modern motherboards.

What type of expansion slots are on my motherboard?

As mentioned above, every motherboard model is unique, so to determine the type of expansion slots on the motherboard, consult the board's specifications and owner's manual. You can also open the computer case and visually examine the motherboard.

- How do I open my computer case?

Why do computers have expansion slots?

Computers have expansion slots to give the user the ability to add new devices to their computer. For example, a computer gamer may upgrade their video card to get better performance in their games. An expansion slot allows them to remove the old video card and add a new video card without replacing the motherboard.

What is the most common expansion slot today?

Today, the most commonly used expansion slot used and found on computer motherboards is the PCI Express expansion slot.

Does a laptop have an expansion slot?

Laptops do not have expansion slots like a desktop computer. However, some laptops do have PC Cards that can be inserted into the side of the laptop. They may also have a Cardbus slot for an ExpressCard to be added.

Introduction to Motherboard

The motherboard is also known as logic board, baseboard, system board, mainboard, main circuit board, planar board, and mobo in a short way. It is a nonconductive plastic sheet that has the necessary circuit and place holders like sockets/slots to connect components and provide logistics for all the components to work in a coordinated manner. Thin narrow layers of Aluminum or Copper printed on the plastic sheet of the board acts like a circuit that connects various components. It is a chassis in which all the components are fitted in the designated place and they are all powered and well interfaced with each other.

A typical Motherboard contains the following interfaces and components:

- CPU socket
- Memory slots
- SATA connector (Storage)
- Power connector
- Chipset
- Floppy connector
- IO Chip
- Rear fan connector

- Chassis fan connector
- IO connectors
- USB ports
- Audio connector
- IDE connector
- CMOS battery header
- PCI peripheral component interconnect slots
- Nonvolatile memory (ROM) to hold the Boot program
- Clock generator to synchronize with components
- Expansion card slot

The motherboard is comprehensive in all aspects and it contains provisions to connect any kind of components to meet application requirements. The motherboard is self-sufficient to meet all requirements and it is a single board to manage all the functions, unlike backplane which has provision to connect to multiple extension boards to hold more components. The name mother in the motherboard is attributed to its character as it takes a leadership role to manage all the components connected to it.

Mouse, keypads are connected to USB ports on the motherboard. Apple computers motherboard has minimum provisions to connect to peripheral devices. Many boards have a provision of expansion to connect to additional devices. Heat sinks and fan points are available in the modern motherboard to transfer excess heat.

Types of Motherboard

Motherboards are present in Desktop, Laptop, Tablet, and Smartphone and the components and functionalities are the same. But the size of the components and the way they are accommodated on the board varies due to space availability. In desktops, most of the components are fitted inside the sockets provided on the board and it is easy to replace each of them separately, whereas in Laptops/Smartphones some components are soldered on the board, hence it is difficult to replace/upgrade.

Though different motherboards have varying capabilities, limitations, features, Physical size/shapes (form factor), they are identified/grouped/categorized mostly by their form factors. Each manufacturer has come out with its form factor to suit the design of computers. Motherboard manufactured to suit IBM and its compatible computers fit into other case sizes as well. Motherboards built using ATX form factors were used in most of the computers manufactured in 2005 including IBM and Apple.

Below are the six different types of Motherboards:

1. AT Motherboard

These motherboards have bigger physical dimensions of hundreds of millimeters and hence they are not the right fit for the mini desktop category of computers. Bigger physical size also inhibits installing new drivers. Sockets and six-pin plugs are used as power connectors in these motherboards. These power connectors are not that easily identifiable and hence users face difficulties in connecting and using it.

This type of motherboard was in vogue in the 1980s and it enjoyed a substantial self-life.

2. ATX Motherboard

ATX denotes Advanced technology extended, it was developed by Intel during the 1990s and it was an improved version over an earlier version of AT motherboard. It is smaller in size when compared to AT and it provides interchangeability of the connected components. There is a marked improvement in the connector aspects.

3. LPX Motherboard

This board had two improvements over earlier versions. The first one is Input and Output ports were taken to backside and the second one was the introduction of Riser card to facilitate more slots and easier connection. Some of these features were deployed in the AT motherboard. The main disadvantage in this board is the lack of Accelerated Graphic Port (AGP) slots which led to a direct connection to PCI. Issues in these motherboards were addressed in NLX boards.

4. BTX Motherboard

BTX denotes Balanced Technology Extended, intended to manage demands of new technologies in terms of more power requirements hence generation of more heat. Intel stopped further development of BTX boards during the mid-2000s to concentrate on low power CPU.

5. Pico BTX motherboard

These boards are smaller in size and hence the word Pico. Two expansion slots are supported in spite of being sharing the top half of BTX. Half-height or riser cards are its unique features and it supports the demands of digital applications.

6. Mini ITX motherboard

It's a miniature version of motherboard over its earlier versions. Designed in the early 2000s and its dimension is 17 x 17 cm. Mainly used in small form factor (SFF) computer due to its lower power consumption and faster cooling ability. This motherboard is the most preferred in the home theater domain due to its lower level of fan noise that will improve the quality of the theatre system.

Conclusion – Types of Motherboard

Form factor plays an important role as the computer takes many shapes due to digital application needs where computers need to be inbuilt in the machines, moving vehicles, and in any equipment on the earth. The nature and size of the motherboard will undergo continuous changes in the days to come.

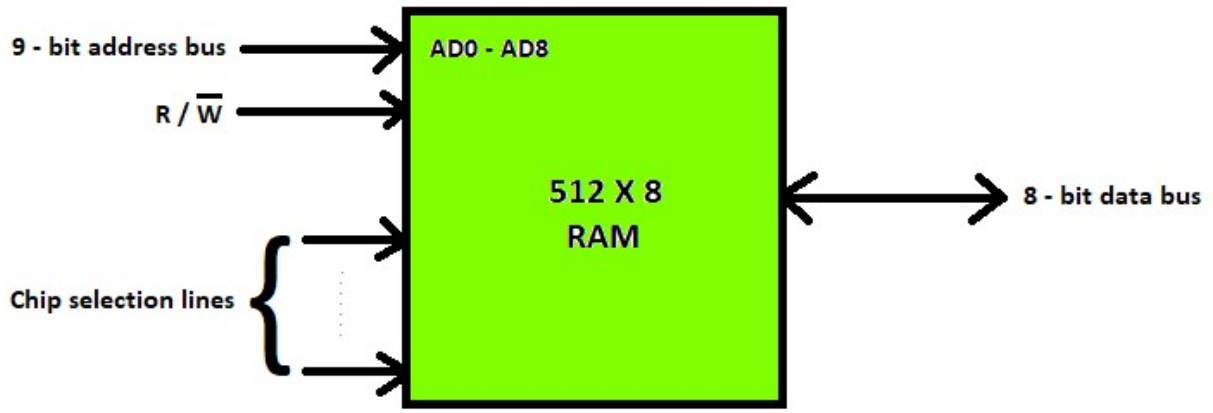
Different Types of RAM (Random Access Memory)

RAM(Random Access Memory) is a part of computer's Main Memory which is directly accessible by CPU. RAM is used to Read and Write data into it which is accessed by CPU randomly. RAM is volatile in nature, it means if the power goes off, the stored information is lost. RAM is used to store the data that is currently processed by the CPU. Most of the programs and data that are modifiable are stored in RAM.

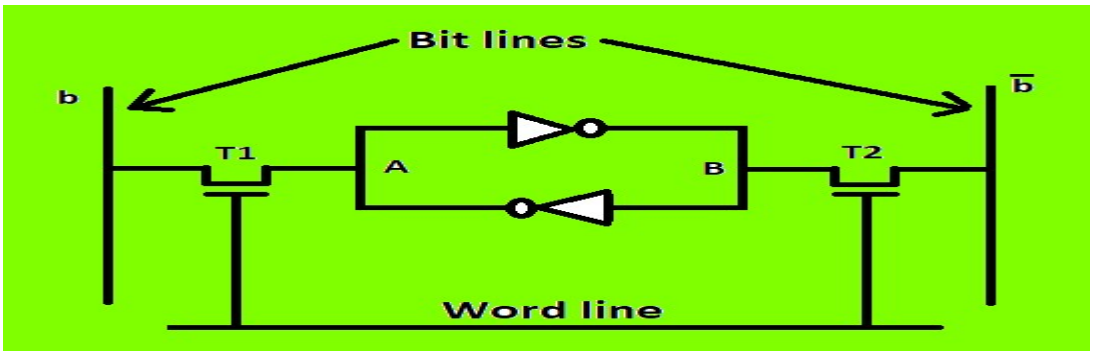
Integrated RAM chips are available in two form:

1. SRAM(Static RAM)
2. DRAM(Dynamic RAM)

The block diagram of RAM chip is given below.



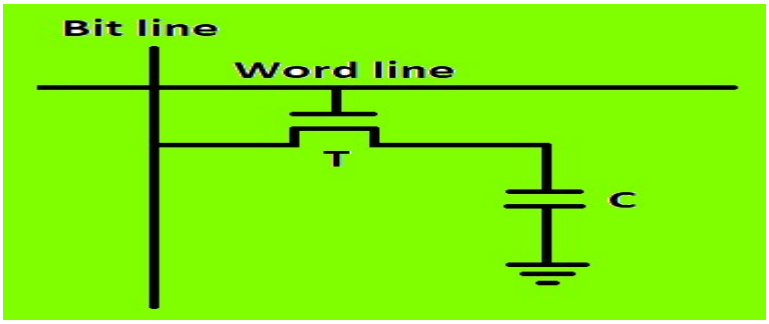
1. SRAM :
The SRAM memories consist of circuits capable of retaining the stored information as long as the power is applied. That means this type of memory requires constant power. SRAM memories are used to build Cache Memory.
SRAM Memory Cell: Static memories(SRAM) are memories that consist of circuits capable of retaining their state as long as power is on. Thus this type of memory is called volatile memory. The below figure shows a cell diagram of SRAM. A latch is formed by two inverters connected as shown in the figure. Two transistors T1 and T2 are used for connecting the latch with two-bit lines. The purpose of these transistors is to act as switches that can be opened or closed under the control of the word line, which is controlled by the address decoder. When the word line is at 0-level, the transistors are turned off and the latch remains its information. For example, the cell is at state 1 if the logic value at point A is 1 and at point, B is 0. This state is retained as long as the word line is not activated.



For **Read operation**, the word line is activated by the address input to the address decoder. The activated word line closes both the transistors (switches) T1 and T2. Then the bit values at points A and B can transmit to their respective bit lines. The sense/write circuit at the end of the bit lines sends the output to the processor.
For **Write operation**, the address provided to the decoder activates the word line to close both the switches. Then the bit value that is to be written into the cell is provided through the sense/write circuit and the signals in bit lines are then stored in the cell.

2. DRAM :
DRAM stores the binary information in the form of electric charges applied to capacitors. The stored information on the capacitors tends to lose over a period of time and thus the capacitors must be periodically recharged to retain their usage. The main memory is generally made up of DRAM chips.
DRAM Memory Cell: Though SRAM is very fast, but it is expensive because of its every cell requires several transistors. Relatively less expensive RAM is DRAM, due to the use of one transistor and one

capacitor in each cell, as shown in the below figure., where C is the capacitor and T is the transistor. Information is stored in a DRAM cell in the form of a charge on a capacitor and this charge needs to be periodically recharged.
For storing information in this cell, transistor T is turned on and an appropriate voltage is applied to the bit line. This causes a known amount of charge to be stored in the capacitor. After the transistor is turned off, due to the property of the capacitor, it starts to discharge. Hence, the information stored in the cell can be read correctly only if it is read before the charge on the capacitors drops below some threshold value.



Types of DRAM :
There are mainly 5 types of DRAM:

1. **Asynchronous DRAM (ADRAM) –**
   The DRAM described above is the asynchronous type DRAM. The timing of the memory device is controlled asynchronously. A specialized memory controller circuit generates the necessary control signals to control the timing. The CPU must take into account the delay in the response of the memory.

2. **Synchronous DRAM (SDRAM) –**
   These RAM chips' access speed is directly synchronized with the CPU's clock. For this, the memory chips remain ready for operation when the CPU expects them to be ready. These memories operate at the CPU-memory bus without imposing wait states. SDRAM is commercially available as modules incorporating multiple SDRAM chips and forming the required capacity for the modules.

3. **Double-Data-Rate SDRAM (DDR SDRAM) –**
   This faster version of SDRAM performs its operations on both edges of the clock signal; whereas a standard SDRAM performs its operations on the rising edge of the clock signal. Since they transfer data on both edges of the clock, the data transfer rate is doubled. To access the data at high rate, the memory cells are organized into two groups. Each group is accessed separately.

4. **Rambus DRAM (RDRAM) –**
   The RDRAM provides a very high data transfer rate over a narrow CPU-memory bus. It uses various speedup mechanisms, like synchronous memory interface, caching inside the DRAM chips and very fast signal timing. The Rambus data bus width is 8 or 9 bits.

5. **Cache DRAM (CDRAM) –**
   This memory is a special type DRAM memory with an on-chip cache memory (SRAM) that acts as a high-speed buffer for the main DRAM.

Difference between SRAM and DRAM :
Below table lists some of the differences between SRAM and DRAM:

SRAM	DRAM
1. SRAM has lower access time, so it is faster compared to DRAM.	1. DRAM has higher access time, so it is slower than SRAM.
2. SRAM is costlier than DRAM.	2. DRAM costs less compared to SRAM.
3. SRAM requires constant power supply, which means this type of memory consumes more power.	3. DRAM offers reduced power consumption, due to the fact that the information is stored in the capacitor.
4. Due to complex internal circuitry, less storage capacity is available compared to the same physical size of DRAM memory chip.	4. Due to the small internal circuitry in the one-bit memory cell of DRAM, the large storage capacity is available.
5. SRAM has low packaging density.	5. DRAM has high packaging density.

Difference between Cache Memory and Virtual Memory

Computer Memory is just like a human brain used to store data and instructions either temporarily or permanently. It is a physical device capable of storing information temporarily like RAM (Random Access Memory)

, or permanently, like ROM (Read Only Memory)

. The main memory refers to physical memory, and it is known as RAM

. In computer memory

, we can edit or update only the data that is in the main memory

. We can say that when we want to access the secondary storage media or any file that must be loaded into the main memory from the secondary device.

Cache Memory:
It is a faster memory used by the central processing unit (CPU). It is a memory that helps to reduce the access time for files or data that is recently used by the main memory. It is smaller in size, high-speed memory, and located near a processor core that stores the copies of the information or instruction frequently used by the main memory locations.

Furthermore, it behaves like a buffer between the CPU

and the main memory to hold those data or programs most frequently called by the CPU

. For example, whenever we execute a program by the processor, it fetches data from the main memory and fetched data to be copied to the cache memory. When the program's copy is already available to the cache memory, it directly calls the processor to execute it; otherwise, the program/files are fetched from memory. Hence, it reduces the access time of the data from the main memory.

Advantages of Cache Memory

1. The access time of files or instruction in the cache memory is less than the main memory.
2. It stores frequently used data by the main memory.
3. It is the faster computer memory as compared to the main memory.
4. Store the program in a cache memory that is executed within a short time.

Disadvantages of Cache Memory

1. It has limited space to store the data.
2. It is very costly as it is a fast memory to access the data.

Virtual Memory

Virtual Memory

is used in the computer memory to increase the storage capacity of the main memory. It is a logical storage unit of a computer that creates an illusion to execute a large program that may not be completely placed in the main memory. Furthermore, it allows the user to load or store the data program or files larger than the size of the main memory.

Advantages of Virtual Memory

1. Virtual Memory allows the users to run more than one application at once.
2. It enhances the degree of multiprogramming in the virtual memory.
3. Virtual Memory is a logical unit of computer memory that increases the main memory capacity by storing or executing a large size program than the main memory.
4. It does not require any fixed limit on the degree of multiprogramming.
5. It increases the CPU utilization in the virtual memory.
6. It is required whenever the system does not have much space to store any big programs or files.

Disadvantages of Virtual Memory

1. Virtual Memory can slow the process of application in the system.
2. It may take more time to switch between the applications.
3. It reduces the stability of the system.

4. It allows the user to lesser hard disk space for its use in the system.

Difference Between Cache Memory and Virtual Memory

S. N.	Parameter Difference	Cache Memory	Virtual Memory
1.	**Definition**	Cache Memory is the high speed of computer memory that reduces the access time of files or documents from the main memory.	Virtual Memory is a logical unit of computer memory that increases the capacity of main memory by storing or executing programs of larger size than the main memory in the computer system.
2.	**Memory Unit**	Cache Memory is defined as a memory unit in a computer system.	Virtual Memory is not defined as a memory unit.
3.	**Size**	Its size is very small as compared to Virtual Memory.	Its size is very large as compared to the Cache Memory.
4.	**Speed**	It is a high-speed memory as compared to Virtual Memory.	It is not a high-speed memory as compared to the Cache Memory.
5.	**Operation**	Generally, it stores frequently used data in the cache memory to reduce the access time of files.	The virtual memory keeps those data or programs that may not completely be placed in the main memory.
6.	**Management**	Cache Memory is controlled by the hardware of a system.	Whereas the virtual memory is control by the Operating System (OS).
7.	**Mapping**	It does not require a mapping structure to access the files in Cache Memory.	It requires a mapping structure to map the virtual address with a physical address.