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Memory Organization in Computer Architecture

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Abstract- **This article presents give an general idea of the memory organization in computer architecture .In this paper we will learn about type of memory and there memory organization in COA (computer application and architecture). Memory is employed for storing programs and knowledge that area unit needed to perform a particular task. A memory unit is that the assortment of storage units or devices along. The memory unit stores the binary data within the variety of bits. The classification of primary and secondary memory, the different types of ROM and RAM we will learn about direct mapping in the article.**

Keywords- **COA, of ROM and RAM etc.**

I. INTRODUCTION

Memory is like simply sort of a human brain. it's accustomed store information and directions. Hardware is that the cupboard space within the laptop, wherever information is to be processed and directions needed for process are hold on.

The memory is split into sizable amount of tiny components referred to as cells. every location or cell contains a distinctive address, that varies from zero to memory size minus one.

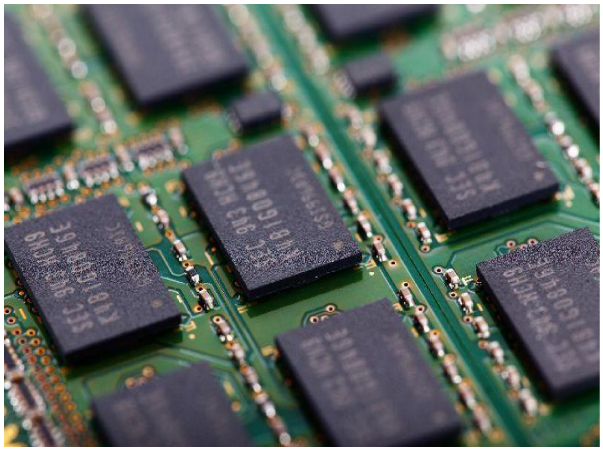

Fig 1. Memory.

1. Memory:

- The memory that communicates directly with central processor is termed main memory.
- Devices that has backup storage area unit referred to as auxiliary memory.
- Only program and knowledge presently required by the processor resides in main memory.
- All different data is keep in auxiliary memory and transferred to main memory once required.

II. CLASSIFICATION OF MEMORY

Memory hierarchy explains that the nearer the memory to the processor, faster it its access. But costlier the memory became when its goes to closer the processor.

The following sequence is the faster to slower.

- First is resistor that is inside of CPU (central processing unit).
- Internal memory that contain on or more memory .Ram and SRAM is internal memory for caches and where Dram is for main memory. Further we will learn more about SRAM, ram, dram and all these memory is primary memory.
- External memory like CDs, DVDs etc. this is secondary memory.

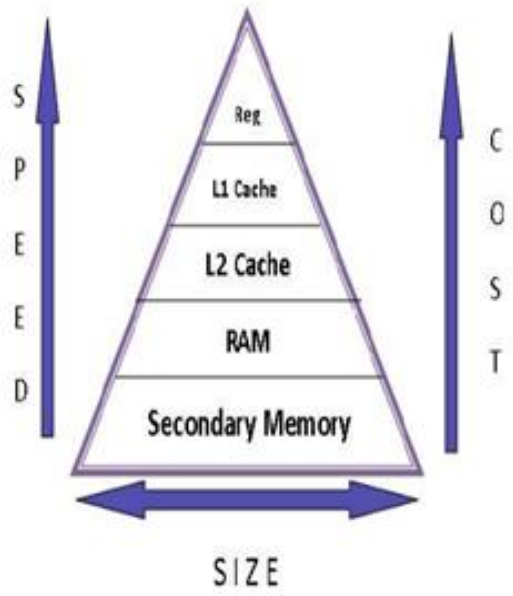

Fig 2. Memory Hierarchy.

Fig 2. shows the memory hierarchy based on the closeness to the processor. The first one which is resistor is close to the processor and the fastest while offline storage like magnetic tape are the farthest and also the slowest.

The list of memory's which is near and farthest is given as below:

- Register
- L1cache
- L2cache
- Main memory
- Magnetic disk
- Optical
- Tape

The faster memory is very costly and the memory at the different level gives the memory hierarchy.

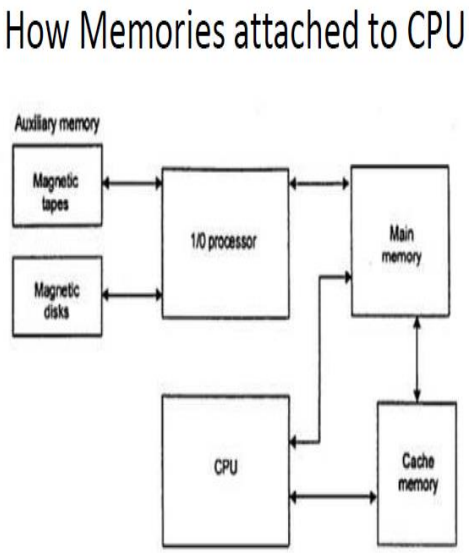

Fig 3. memories attached to cpu.

A computer system contains different type of memory

- Auxiliary memory,
- cache memory
- Main memory.

Let's see these three memories.
The main memory is at the second level of memory hierarchy. The main memory is direct connected with CPU shows in Fig.c.

The main memory contains data and programs that are used by cpu. The main memory is also known as central memory. The main memory made of integrated chips and having to type's ram and rom. Ram which is available in static and dynamic modes.

III. MAIN MEMORY

1. RAM (Random Access Memory):
RAM (Random Access Memory) is the internal memory of the CPU for storing data, and programs. We can read and write data in memory. Ram stores data until the machine is working. When the machine (example: CPU) is switched off, data will erased. RAM is volatile memory hence when power is switched off the data will erased from RAM. There are two types of RAMs. The SRAM and DRAM.

3. SRAM:
Static RAM (SRAM) is a type of random access memory that retains its in state for data bits .the SRAM can holds data as long as it receives the power when power is off the data will erased because of its volatile property. Ram made up of memory cells and is called a static RAM. The SRAM does not need to refreshed regular because it does not need the power to prevent leakage like DRAM So, that why SRAM is faster than DRAM.

It has a special arrangement of transistors that produces a flip-flop, a sort of memory cell. One memory cell stores one little bit of knowledge. Most of the trendy SRAM memory cells area unit manufactured from six CMOS transistors, however lack capacitors. The interval in SRAM chips is as low as ten nanoseconds. Whereas, the interval in DRAM sometimes remains higher than fifty nanoseconds.

4. DRAM:
Dram is made using capacitors, it requires less number of components to make a one bit cell, hence also requires less space on the silicon wafer. Thus it is also comparatively cheaper than SRAM but it is slower than SRAM, DRAM is slower because it has capacitor which requires time for charge and discharge. The capacitors losses charge in sometime and hence need to be recharged according to the data. This is called refreshing the DRAM

5. ROM:
ROM stands for read only Memory. The memory from that we are able to read data however cannot write data it. The ROM memory is non-volatile. The knowledge is keep for good in such recollections throughout manufacture. A ROM memory stores such directions that area unit needed to start out a laptop. This operation is stated as bootstrap. Memory chips don't seem to be solely utilized in the pc however additionally in alternative electronic things like TVs remote and microwave.

There are various types of ROM available based on whether or not it can be rewritten. They are known as ROM, PROM, EPROM and EEPROM.

The PROM (Programmable Read only memory) sometime PROM also refers as OTP (One Time Programmable)

Memory and EPROM as (Erasable Programmable Read Only Memory). In EPROM the data written can be erased by keeping the EPROM IC in the UV box.

IV. AUXILIARY MEMORY

The auxiliary memory is at very low and isn't connected with the central processor directly. However, being slow, it's present in massive volume within the system because of its low rating. This memory is essentially used for storing the programs that don't seem to be required within the main memory.

This helps in releasing the most memory which might be used by alternative programs that wants main memory. The most perform of this memory is to supply parallel searching that may be used for perform search on a complete word. Example is magnetic tape, magnetic disks.

In hierarchy slow magnetic tape are used to store removable files whereas at the top level magnetic disks used as backup storage.

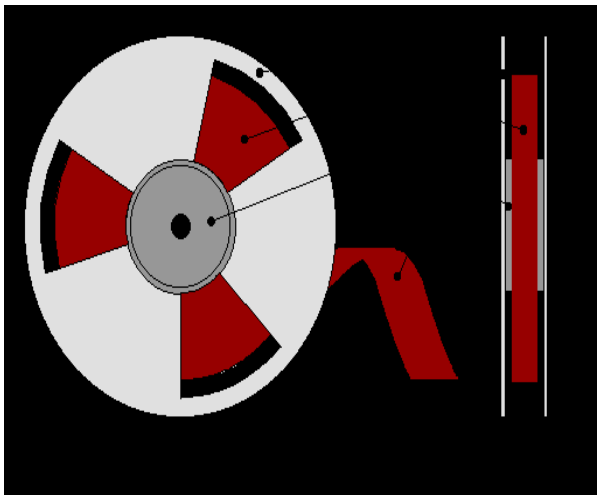

Fig 4. Magnetic disk.

1. Inter leaved Memory:
The interleaving method works by dividing the Memory into multiple blocks. There are two type or four type interleaving. We can access each block of memory by using different sets of control lines, which are merged together on the memory bus. When we read or write to one block then a read or write to other blocks can be overlapped with the first one. Consider you have a plate food with a fork.

The two-way interleaving like dividing the food onto two plates and eating using hand with two forks and the four–way interleaving would require two more hands.

Here the process is doing the “eating” and it is much faster than forks “Feeding” it . The two method of address the modules.

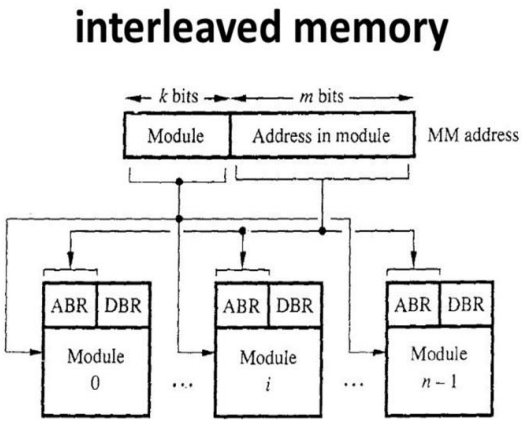

Fig 5. Consecutive words in a module.

The first case is the memory address which is generated by the CPU and decoded is shown in Figure .e. In the initial case, the memory address is generated by the central processor is decoded as shown partly a of the figure The high order k bits name one in every of n modules, and also the low-order m bits name a selected a word therein module. When consecutive locations a square measure has assessed, as happens once a block of information is transferred to a cache, just one a module is concerned At identical time, but devices with direct access (DMA) an ability is also accessing info in different memory modules.

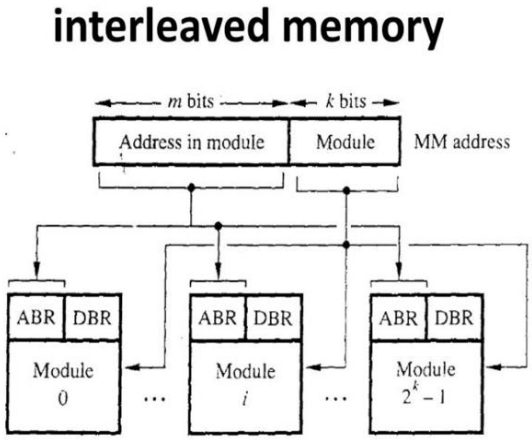

Fig 6. Consecutive words in consecutive modules.

The second and more practical way to address the modules is shown in Figure .f. it's referred to as memory interleaving The low-order k bits of the memory address select a module, and also the high-order m bits name a location at intervals that module In this method, consecutive addresses are placed in successive modules Thus, any element of the system that generates requests for access to consecutive memory locations will keep many modules busy at any one time. This leads to each quicker access to a block of information and better average utilization of the memory system.

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V. CACHE MEMORY

Cache memory is at the very high level of the memory hierarchy. This is a high speed memory and this is used to increase the speed of processing by making current programs and data available to the CPU at a fastest rate. A cache memory is a very fast And small memory, that contain the most recently used main memory or working data Cache memory is usually placed between the CPU and the main memory.

The Cache memory stores an affordable variety of blocks at a given time however this variety is little compared to the whole variety of blocks obtainable in Main Memory. The correspondence between main memory block and the block in cache memory is specified by a mapping function.

The cache is measured in quantity of hit ratio=hit / (hit + miss)

1. Mapping Function

1. Direct mapping is the simplest way to determine the cache locations in which to store memory blocks is the direct mapping technique. 2. Associative mapping In this technique, the most memory block is placed into any cache block position. 12 tag bits can determine a memory block once it's resolved within the cache. The tag bits of associate address received from the processor are compared to the tag bits of every block of the cache to visualize if the required block is present. this is often known as associative mapping This is called associative mapping. 3. Set-associative mapping. It is the mixture of direct and associative mapping. The blocks of the cache are grouped into sets and the mapping allows a block of the main memory to reside in any block of the specified set.

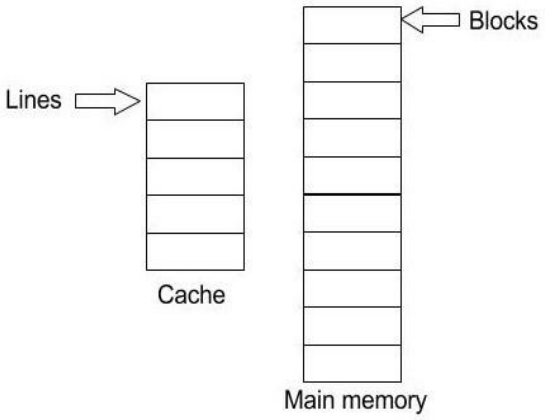
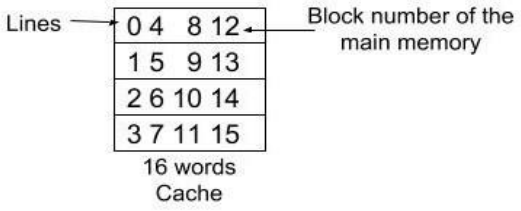


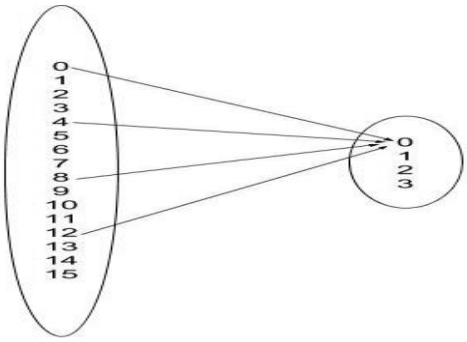
Fig 7. Direct Mapping.

Let's understand direct mapping using example take address 010110 this address in decimal is 22. First dividing the address in two part make easy to handle. First four bits give number 5 that means 5 lines. Last Two bits give us the which word it is then it is three and word is in 5th block and the third one in that line.

Next we have to find out is this is presented in the caches or not. lets see how main memory is mapped into cache memory. All blocks in the main memory is mapped to cache is shown in figure.g.



(a)



(b)

Fig 8. Direct Mapping

All the blocks are mapped to caches like this all 0,4,8,12 blocks are mapped to 0th line figure. h . show how address is divided.

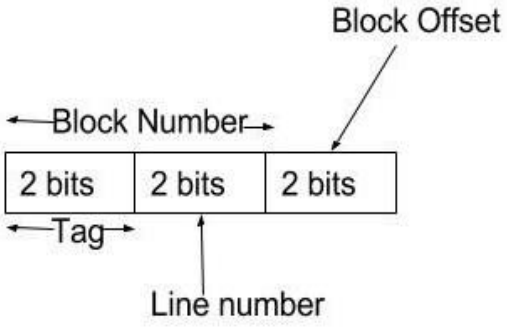


Fig 9. Address divided.

2. Associative Mapping and Set-Associative Mapping.

The disadvantage of direct mapping is that 2 words with constant index in their address however with completely different tag values cannot reside in cache memory at constant time. Set-Associative Mapping is associate degree improvement over the direct-mapping in this every word of cache will store 2 or additional word of memory beneath the same index address .Any main memory block

can be placed into any cache slot where in set-associative mapping.

The disadvantage of direct mapping is that 2 words with an equivalent index in their address however with totally different tag values cannot reside in cache memory at an equivalent time. Set-Associative Mapping is Associate over the improvement over the direct-mapping in this every word of cache will store 2 or a lot of word of memory beneath an equivalent index address.

VI. CONCLUSION

Memory management could be a style of resource management applied to memory device. The essential demand of memory management is to produce ways in which to dynamically apportion parts of memory to programs at their request, and free it for recycle once now not required.

This is often important to any advanced computing system. Wherever quite one process may be current at any time.in this paper we learned how memory management work and we also learned about type of memory and how memory effect on system and how memory take led role in computer system.

VII. ACKNOWLEDGMENT

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