**VIRTUAL MEMORY**

**\*** *Virtual memory :* Is a technique for using the secondary storage(hard disk) to extend the apparent limited size of the physical memory(main memory).

 **\*** If the segment of the program containing the word requested by the processor is not in the main memory at the time of the request, then such segment will have to be brought from the disk to the main memory.

**\***The address issued by the processor in order to access a given word does not correspond to the physical memory space is called a **virtual (logical)** address.

**\* (MMU)** is responsible for the translation of virtual addresses to their corresponding **physical addresses**.

**\***Three address translation techniques can be identified. These are direct-mapping, associative- mapping, and set-associative-mapping.

**Page:**

**\***Movement of data between the disk and the main memory takes the form of pages. A **page** is a collection of memory words, which can be moved from the disk to the MM when the processor requests accessing a word on that page.

**\*** A typical size of a page in modern computers ranges from 2K to 16K bytes.

**\***A **page fault** occurs when the page containing the word required by the processor does not exist in the MM and has to be brought from the disk ( like a cache miss).

**Page table:**

A page table It is a table which contains the mapping of virtual pages to physical pages and it is stored in the main memory. It contains:

**\*** Modification of a page

**\*** The authority for accessing a page.

**\*** A bit indicating the validity of a page( **The valid bit).** It is set if the corresponding page is actually loaded into the main memory.

Valid bits for all pages are reset when the computer is first powered on.

**\*** The other control bit that is kept in the page table is the **dirty bit**. It is set if the corresponding page has been altered while residing in the main memory. And reset If the page has not been altered.

This can help in deciding whether to write the contents of a page back into the disk (at the time of replacement) or just to override its contents with another page.

 **Translation Look-Aside Buffer (TLB) :**

**\***In most modern computer systems a copy of a small portion of the page table is kept on the processor chip. This portion consists of the page table entries that correspond to the most recently accessed pages. This small portion is kept in **the translation look-aside buffer (TLB)** cache.

**\*** A search in the TLB precedes that in the page table. Therefore, the virtual page field is first checked against the entries of the TLB in the hope that a match is found:

1-A hit in the TLB will result in the generation of the physical address of the word requested by the processor, thus saving the extra main memory access required to access the page table.

2-It should be noted that a miss on the TLB is not equivalent to a page fault.

**\***It is clear from the above discussion that as more requests for items that do not exist in the main memory (page faults) occur, more pages would have to be brought from the hard disk to the main memory. This will eventually lead to a totally filled main memory.