Module 2

IP addressing - public and private addressing

Private address- IP address that is used to communicate within the same network
- Only used by the devices communicating to each other on same network.
- Cannot connect to internet directly
- Special range for private (LAN)-
  Class A: 10.0.0.0 — 10.255.255.255
  Class B: 172.16.0.0 — 172.31.255.255
  Class C: 192.168.0.0 — 192.168.255.255
- Each IP can be used in different private networks.

Public IP- IP address which is used to communicate outside the network.
- Each IP addresses is unique
- User has no control over the IP address of device
- Can be of static, dynamic or shared or dedicated .
  - Static means IP address never changes within same provider or same server.
  - Dynamic means IP can change from time-time
  - Shared means other people can use your IP
  - Dedicated means no one else can use your IP

Virtual LAN(virtual Local area network)
- Where computers and network devices are logically connected independent of their locations.
- Purpose is to improve security, traffic management, easy transfer between the devices .
- Each VLAN can only discover themselves or discover other VLAN if it is shared to it.
- Purpose - traffic management
- Advantages- performance, formation of virtual groups, security, flexibility, cost reduction
- Disadvantages- complexity , limited scalability, limited security, limited interoperability, limited mobility, cost, limited visibility.
- Applications- VOIP, video conferencing, remote access, cloud backup and recovery, gaming, IoT

Memory Management

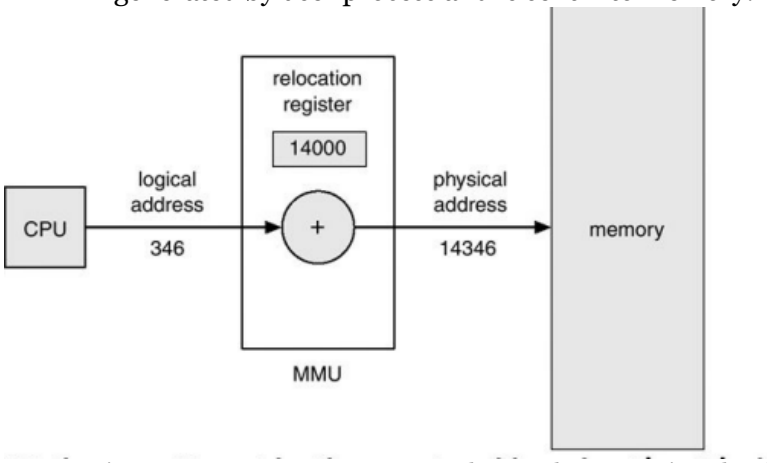
- " Logical vs. Physical address space: 1. Logical Address: generated by the CPU. Also called “Virtual Address”. 2. Physical Address: the address seen by the memory unit.

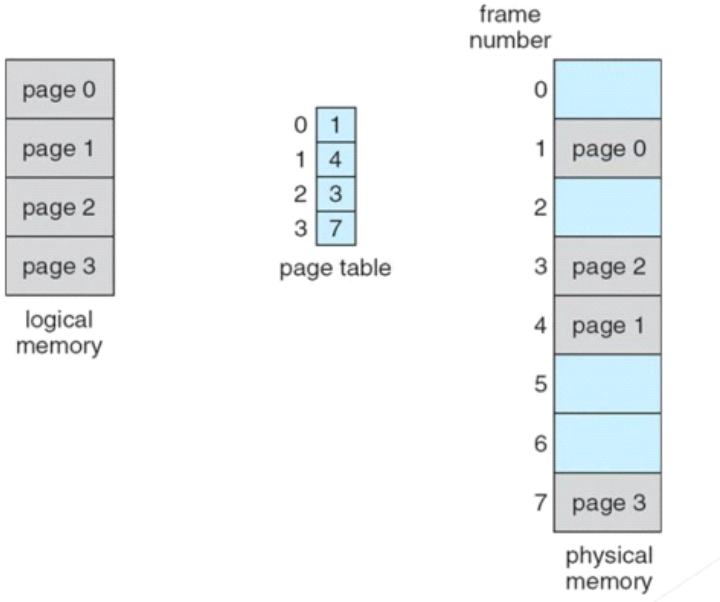
S.No	Logical Address	Physical Address
1.	Users can access the **logical address** of the Program.	User can never access the **physical address** of the Program
2.	The logical address is generated by the CPU.	The physical address is located in the memory unit.
3.	The user can access the physical address with the help of a logical address.	A physical address can be accessed by a user indirectly b ut not directly.
4.	The logical address does not exist physically in the memory and thus termed as a Virtual address.	On the other hand, the physical address is a location in the memory. Thus it can be accessed physically.
5.	The set of all logical addresses that are generated by any program is referred to as **Logical Address Space.**	The set of all **physical addresses** corresponding to the **Logical addresses** is commonly known as **Physical Address Space.**
6.	This address is generated by the CPU.	It is computed by the Memory Management Unit(MMU).

- Address can be represent at different stages- source code address- usually symbolic,

compiled code- relocatable address, linker or loader will bind this relocatable address to absolute addresses

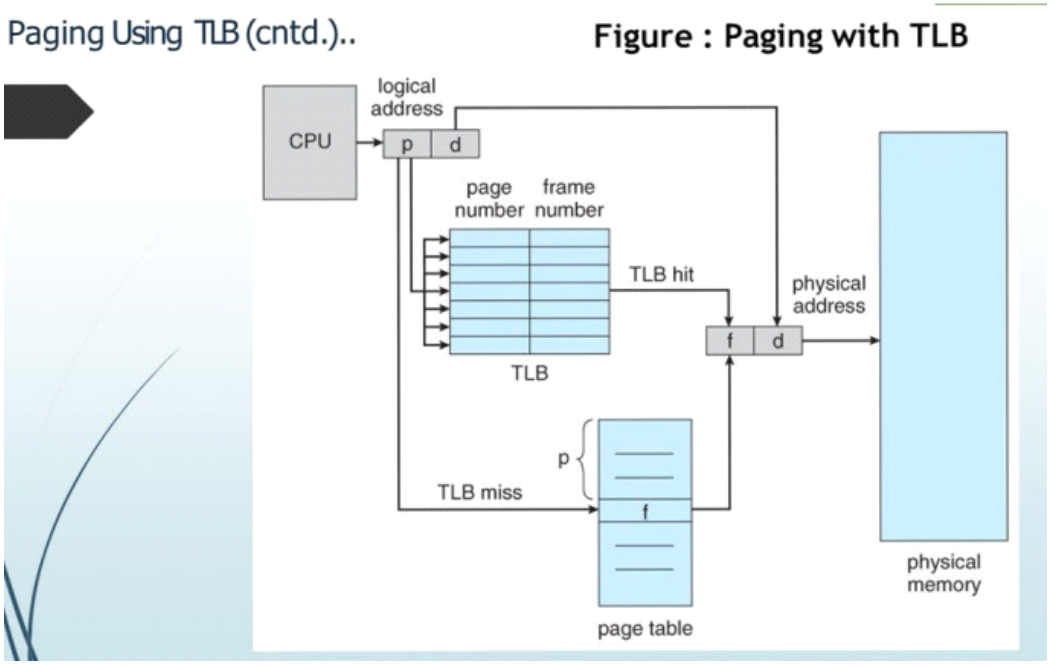
- Binding is the mapping from one address space to another , these binding can be done in three stages - compile time , load time, execution time
  - Compile time- done by compiler, performed before loading program into memory
  - Load time - dome by OS memory manager (loader), done after loading the program into memory.
  - Execution time or dynamic binding- done by processor , performed at time of program execution
- Memory Management Unit(MMU): hardware device that map logical address to the physical address located at CPU
  - Relocation register - contains smallest physical address(used for mapping the logical address to physical)
  - Physical address = logical address + relocation register
  - In MMU scheme the value in relocation register is added to the every address generated by user process and is sent into memory.

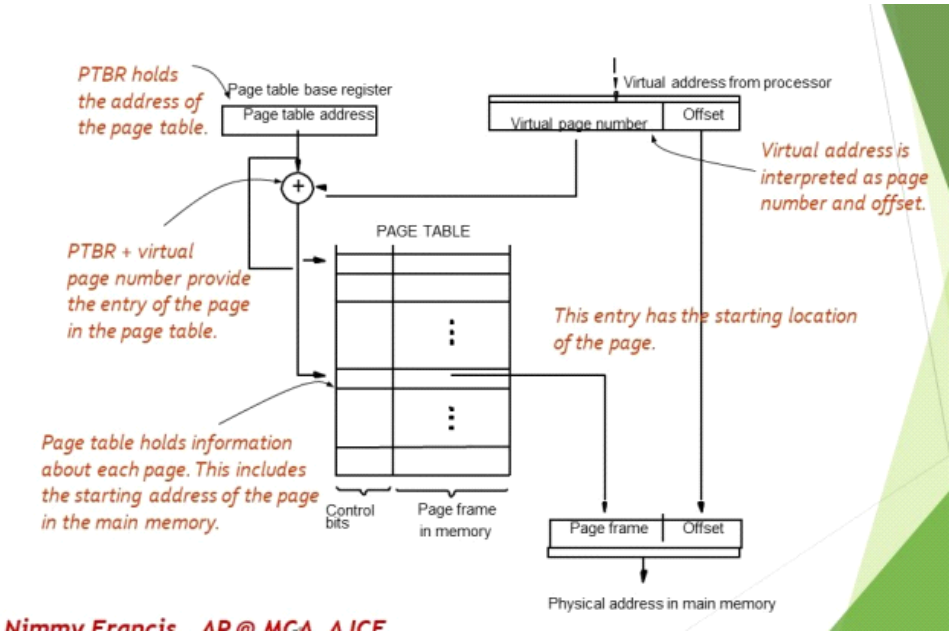


- Paging: memory management scheme that permits physical address space of process to non-contagious , that is avoiding the external fragmentation
  - Working: divide the memory into fixed sized blocks called frames, divide logical memory into blocks of same size called pages. When process is executed its pages are loaded into any available memory frames . Page table is used to translate logical address to physical address.
  - Removes external fragmentation but internal fragmentation exists.
  - Page table is implemented in register uses page table base register (PTBR) which points to paging map and page table length register(PTLR) indicates size of page table.
  - This double access problem can be solved using Translation Lookup Buffers(TLB)
  - 

  - Paging using TLB - TLB is small , fast hardware cache, consists of 2 parts - key and value

- When associative memory is presented with item the item is compared with the keys and item is found corresponding value is returned.
- Hardware is expensive and can only contain small number of entries.
- Working: TLB contain Few of page table entries , A page table is presented to TLB and if the page number is found the frame is immediately available and it used to access memory.
- If page number is found in TLB it is known as TLB hit if not found it is known as TLB miss





- Virtual memory: techniques that automatically move programme and that between main memory and secondary storage when they are required for execution or code virtual memory techniques
  - Two techniques : Paging and segmentation
  - When processor reference an instruction or data that is independent of size of the main memory the processor issues binary address for instruction and data this binary address is called logical or virtual address.
  - uses the physical memory and secondary memory as virtual memory on demand.
  - Algorithms used: first in first out algorithm , optimal algorithm, Least recently used page.
  - Advantages: speed , multiprogram environment, data can be shared among memories
  - Disadvantages: time to switch between applications, don't provide same

performance as RAM , reduces system stability

- Memory virtualization : sharing the physical memory and dynamically allocating to the physical memory of VMs
  The guest OS continues to control the mapping of virtual addresses to the physical memory addresses of VMs.
  But the guest OS cannot directly access the actual machine memory.
  The VMM is responsible for mapping the guest physical memory to the actual machine memory.

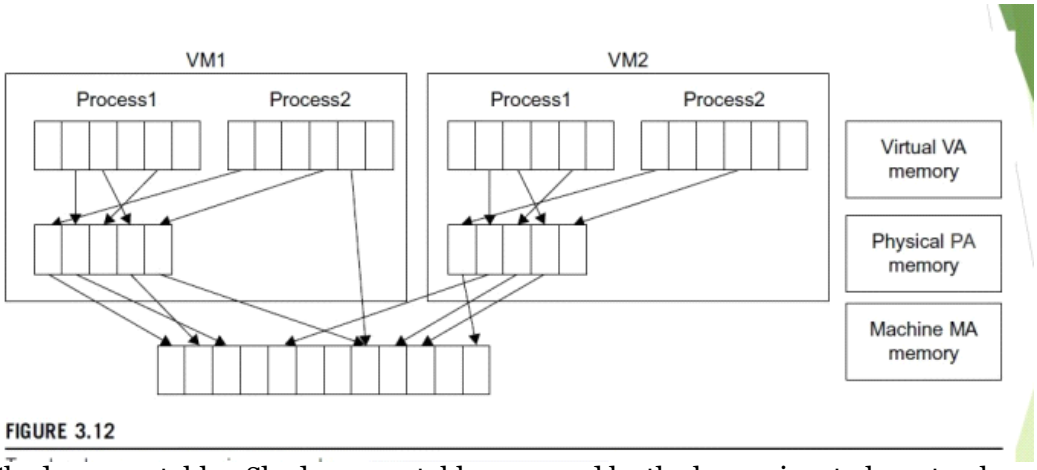


FIGURE 3.12

  - Shadow page tables-Shadow page tables are used by the hypervisor to keep track of the state of physical. memory in which the guest thinks that it has access to physical memory but in the real world, the hardware prevents it to access hardware memory .
    - VMM maintains shadow page tables that map guest-virtual pages directly to machine pages and any guest modifications to VP tables synced to VMM VM shadow page tables.
    - Disadvantages: VMM trap

  - Hardware support for nested page tables: nested page table by amd , extended page table by intel , so no software in needed to maintain shadow tables.