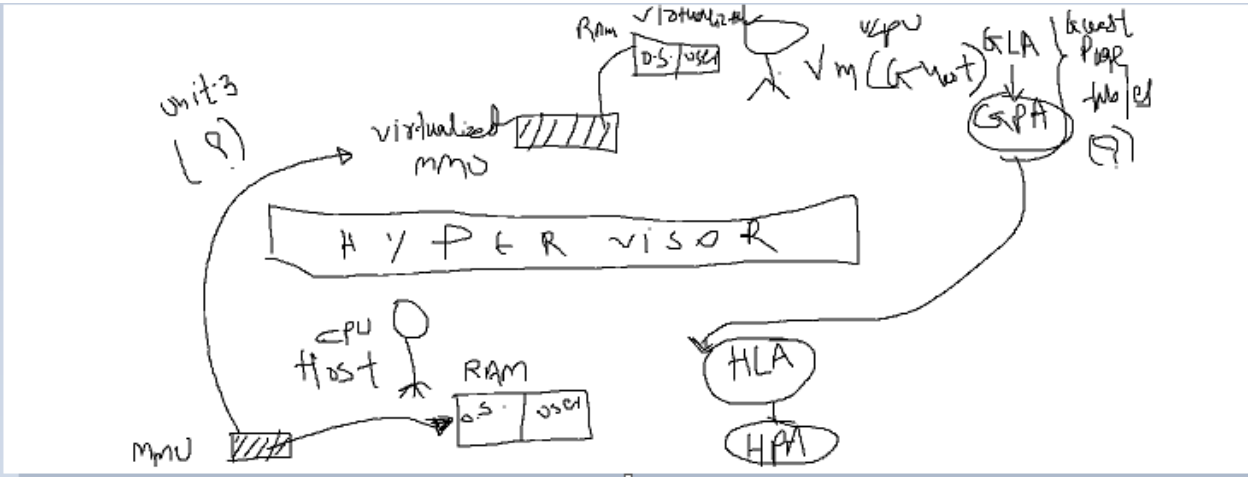
UNIT – 3 Memory Virtualization

23 August 2021

- RAM is on our central focus.
- **Virtualized Memory (Swap In / Swap Out – Page Replacement Algorithms)**. Example : SWAP partition (RAM Size(X) * 2)
- Memory virtualization, virtualization of Memory
- **What is to be virtualized in Main Memory virtualization? – Answer is The Unit or H/w who is responsible to perform memory mgt activities need to be virtualized – Who is that Unit?**



- A memory management unit (MMU) is a computer hardware component that handles all memory and caching operations associated with the processor. In other words, the MMU is responsible for all aspects of memory management. It is usually integrated into the processor, although in some systems it occupies a separate IC (integrated circuit) chip.
- A memory management unit (MMU) is a computer hardware component that handles all memory and caching operations associated with the processor. ... OS (operating system) memory management, which ensures the availability of adequate memory resources for the objects and data structures of each running program at all times.

- Why we need to virtualize Main Memory (RAM – Primary RAM)? → Because we ca not attach physical memory bank to VM & Guest OS needs memory address space to store instructions and data so that VCPU can read from and write in to main memory. So we need to tell hypervisor to pull memory resources/spaces from Host.
- **What is the role of Virtual Memory** in OS & for CPU? Compare Virtual Memory Vs. **Virtualized Memory?**

24 August 2021

Sr No	**Host Machine/OS/CPU**	**Guest Machine / VM/ VCPU/ Guest OS**
1.	Host Page Tables – HLA to HPA using TLBs(Hit/Miss)	Guest Page Tables – GLA to GPA(GPA = HLA)
2.	Guest OS is actually one of the user processes. So Virtualizaed MMU is responsible to convert GPA → HLA.	VCPU only responsible only to keep generating GLAs and Virtuialized MMY is doing GLA → GPA
3.	Host Page tables are kept in main memory of Host.	Guest Page tables are kept in virtualized Memory of Guest.
4.	Real PTBR	Virtual PTBR
5	HLA-> HPA=05 ns – Host OS	GLA -> GPA = 05 ns – Guest OS GPA-> HLA = 05 ns – Hypervisor (VMM) Total = 15 ns!!!

		Translation Overhead of 15 Ns.

- Can we reduce this overhead? - Yes
- Basic memory virtualization Design Vs memory virtualization Design
- Software based techniques (GLA→HPA)

26 August 2021

- Ultimate transition: Guest Logical Address finally need to be translated into Host Physical address.
- Software based techniques (GLA→HPA)
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