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1. The system establishes the corresponding physical location by:

   Paging:
   First it divides virtual memory into pages and physical memory into frames. Then, it uses page table to index these pages into frames using virtual page number.

   Converting to physical address:
   First the system collects VPN and offset of the virtual address. Then, gets the frame number from the VPN. Finally, creates assigns a physical address by using frame number and offset.

   Role of Software vs Hardware:

Software Role	Hardware Role
It maintains page table for every process.	It uses memory management unit to convert virtual address to physical ones.
It also is responsible for indexing pages to frames.	

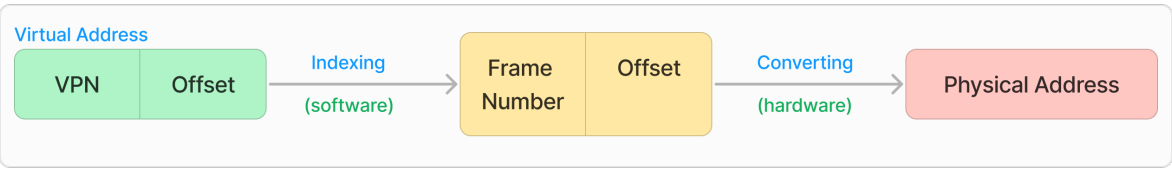
   MMU example:
   Virtual memory size = 2^{32} bytes
   Physical memory size = 2^{18} bytes
   Page size = 4096 bytes

   ⇨ Number of pages = $2^{18}/4096 = 2^{20}$
   ⇨ VPN = first 20 bits of the virtual address
   ⇨ Offset = remaining 12 bits of the virtual address

   For virtual address (hex) 11123456,

   Binary address = 00010001000100100011010001010110

   ⇨ VPN = 00010001000100100011
   ⇨ Offset = 010001010110



2. Time taken to service page Fault for modified page = 20 ms
   Time taken to service page fault for empty page/unmodified page = 8 ms
   Memory access time = 100 ns
   Effective Access time = 200 ns

$$Effective\ Access\ time \geq (1-p)\,(100) + p(100 + (1-0.7)\,(8ms) + (0.7)\,(20ms))$$

$$200 \geq 100 - 100p + 100p + p(2.4 \times 10^6) + p(14 \times 10^6)$$

$$200 \geq 100 + p(16.4 \times 10^6)$$

$$p \leq \frac{100}{16.4 \times 10^6}$$

   Thus, maximum page faults rate = 0.0000061