

TD 7 Operating Systems

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Problem 2) A machine has 48 bit virtual addresses and 32 bit physical addresses. Pages are 8 KB. How many entries are needed for the page table? a.) What is the size of its virtual address space?

$$8 \text{ KB} = 2^{13} \text{ B}$$

$$\text{Entries} = 2^{48}/2^{13} = 2^{35}$$

Problem 3) A computer with a 32-bit address uses a two-level page table. Virtual addresses are split into 9-bit toplevel page table field, an 11 bit second-level page table field, and an offset. How large are the pages and how many are there in the address space?

$$\text{Page size} = 2^{(32-(9+11))} = 2^{12} = 4\text{KB}$$

$$\text{There are } 2^9 * 2^{11} = 2^{20} \text{ pages.}$$

Problem 4) We give above an extract of the segment table of a process:

Segment number	Segment size	Position in memory
1	30ko	
2	16kp	32ko
3		105ko
4	8ko	58ko

a) Give the physical address corresponding to the virtual address (2, 5703)

$$32 * 2^{10} + 5703 = 38471.$$

Its physical address is 38471.

b) We know the physical address of a data item in segment 4: 67502. Find its full virtual address.

$$67502 - 58 * 2^{10} = 8110$$

Its virtual address is 8110.

c) Complete the table knowing that the virtual address (1.2453) corresponds to the physical address 75157 and that the physical address of the last data in segment 3 is 128000.

$$x * 2^{10} + 2453 = 75157 \rightarrow x = (75157 - 2453) / (2^{10}) = 71 \text{ ko}$$

$$105 * 2^{10} + x * 2^{10} = 128000 \rightarrow x = (128000 - 105 * 2^{10}) / 2^{10} = 20 \text{ ko}$$

Problem 5) A machine has 32-bit address space and 8 KB pages. The page table consists of one 32-bit word per entry. When a process starts, the page table is copied to main memory at the rate of one word every 100 ns. If each process runs for 100 ms (including table load time), what fraction of the processor time is reserved for loading page tables?

The memory can store 2^{32} addresses, and each page size $8 \text{ KB} = 8 * 2^{10} = 2^{16} \text{ b}$.

There are $2^{32} / 2^{16} = 2^{16}$ pages.

$$t = 2^{16} * 100 \text{ ns} = 2^{16} = 6.5536 \text{ ms.}$$

6.55% of the processor time is reserved for loading page tables.

Problem 6) Complete the table below with the correct answers

Consideration	Paging	Segmentation
Need the programmer be aware that this technique is being used?	no	yes
How many linear address spaces are there?	one	severals
Can the total address space exceed the size of physical memory?	yes	yes
Can procedures and data be distinguished and separately protected?	no	Yes
Can tables whose size fluctuates be accommodated easily?	no	Yes
Is sharing of procedures between users facilitated?	no	yes
Why was this technique invented?	To have more addresses without more physical memory	So programs can be traited in different ways, and to have a better sharing and a better protection