1997 Paper 10 Question 8

Operating System Functions

A computer is equipped with a CPU with a 32-bit virtual address space, a 32-entry TLB with access time 10ns and 32 Mbyte DRAM with access time 100ns. Its secondary storage is provided by an IDE hard disc with transfer rate 1 Mbyte/s, and which rotates at 3600 revolutions per minute and has an average seek time of 10ms. The computer uses demand paged virtual memory with 1 kbyte pages.

(*a*) Explain the function of the TLB with the aid of a diagram.   [4 marks]

(*b*) Design a page table structure which the operating system can use to implement virtual memory on this system and describe how a virtual address is translated using it. Are there any drawbacks of your approach?   [4 marks]

(*c*) What is *demand paging*? Briefly describe a policy which the operating system can use to share the available physical memory between competing processes.   [3 marks]

(*d*) Calculate the effective memory access time for the system if virtual memory is managed using the scheme described in your answer to (*b*), if page tables are kept locked in memory, the probability of finding a translation in the TLB is 98%, and the probability of a page fault is 10^{-6}. Exclude operating system overhead from your calculation, and briefly explain your answer.   [9 marks]