

1997 Paper 3 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]