2005 Paper 8 Question 1

Comparative Architectures

(*a*) All modern processors provide support for memory access protection and translation. Describe the Translation Lookaside Buffer (TLB) architecture of a modern microprocessor, and hence what information a typical TLB entry would contain. [6 marks]

(*b*) Some architectures are described as having software-managed TLBs, whereas others have entries loaded entirely by hardware. Describe and contrast the two approaches. [6 marks]

(*c*) Why might a TLB that supports "superpages" (entries that cover multiple pages) benefit applications that use lots of memory? What steps must the operating system take to enable superpages to be used? [4 marks]

(*d*) Even hardware-filled TLBs usually rely on software to determine when entries should be invalidated. How might you design a hardware solution to automatically keep the TLB coherent with OS pagetables? What extra complications would Symmetric Multiprocessor Systems (SMP) pose? [4 marks]