Homework 2

March 13, 2006

In this homework, we will use the following terms as defined.

- A *synchronous* network refers to a network with a known bound δ on message delivery time.
- A *link failure* can cause any message to be dropped. An *unreliable* network is one that is prone to link failures. Unless otherwise specified, networks are reliable, e.g., a synchronous network means a reliable synchronous network.
- A *synchronous unreliable* network is one that either delivers each message within δ or drops it.
- An *asynchronous* network has no upper bound on message delivery time, but is guaranteed to eventually deliver a message. We will ignore asynchronous unreliable networks as they can be converted to asynchronous reliable networks using retransmissions.
- A *nonblocking* protocol is one in which an operational process never waits for failures in the system to be repaired before proceeding.

1. Answer true or false. You may give explanations, but they are not necessary. Assume any process can crash at any time.
   (a) 3PC with the termination protocol is nonblocking in a synchronous network.
   (b) 3PC without the termination protocol satisfies specifications AC 1-4 in an asynchronous network.
   (c) 3PC with the termination protocol satisfies specifications AC 1-5 in an asynchronous network.
   (d) A recovering process in 3PC with the termination protocol can again become the coordinator.
   (e) One can design an atomic commit protocol (that satisfies AC 1-5) over an unreliable network. Interpret AC5 to mean "after all links have been turned reliable".
2. More true or false.
   (a) A vector clock for an event occuring at real time t is a vector consisting of individual Lamport clocks at all processes at time t.
   (b) Vector clocks for two different events can be identical.
   (c) Suppose each process maintains its vector clock as a compressed list of pairs (i, v_i) where i is a process id and $v_i > 0$ is the i'th component of its vector clock. Zero valued components are not explcitly stored. If two processes i and j never send messages to each other, then the j'th component of the vector clock of i is never explicitly stored at i.
   (d) Definitely(ϕ) will return true if ϕ actually happened in the execution.
3. Give an algorithm to compute a global snapshot when the channels are not FIFO. Prove it is consistent.
4. Extend 3PC discussed in class to an unreliable network and show that it satisfies AC 1-4. Hint: use the majority protocol in the Bernstein et al paper.
5. If you solved the previous question, explain why it is does not contradict the Two Generals impossibility result.