Homework Assignment 5, Part b

Due: Thursday, November 18, 1999

Reading:

1. "Unreliable failure detectors for reliable distributed systems" by Chandra and Toueg;
2. "Fault-Tolerant Broadcasts and Related Problems" by Vassos Hadzilacos and Sam Toueg. Chapter 5 of DISTRIBUTED SYSTEMS. ACM Press and Addison-Wesley. Second Edition. 1993. Pages 97-145. Edited by SAPE MULLENDER.

Problems:

5. (MOVED TO HW6a) The Chandra-Toueg and Hadzilacos-Toueg papers show indirectly how one might implement a causal, FIFO, atomic broadcast tolerating f failures, where $f < \frac{n}{2}$, using an eventually-perfect failure detector $\diamond P$. However, the resulting algorithm consists of several layers and consequently may be more complicated and inefficient than necessary.

   Design an asynchronous algorithm that directly implements f-fault-tolerant, causal, FIFO, atomic broadcast ($f < n/2$), using $\diamond P$. Try to make the algorithm simple and efficient. Give precondition/effect code. Present key correctness and efficiency arguments.

6. Design an algorithm that solves the problem of k-agreement, $k \geq 1$ and tolerates f failures, $f < k$, Your algorithm should be asynchronous but should use a perfect failure detector (P, in the notation of Chandra and Toueg).
   (Hint: See Exercise 21.13 in the textbook.) Give precondition/effect code and argue correctness.

7. (Optional) Let $C(f, n)$ be the problem of consensus among n processes tolerating f stopping failures. (For the validity condition, use the strong one, as given in the Chandra-Toueg paper.)
   Of course, we know that $C(2, n)$ is unsolvable in asynchronous networks. Is it solvable with any number of copies of $C(1, m)$ (for any m)? Why or why not?