1 Two Phase Commit with Logging

1. In the two-phase commit protocol, suppose that the coordinator sends PREPARE messages to the participants and crashes before receiving any votes for parts (a)-(c). Assuming that we are running 2PC with presumed abort, answer the following questions.

(a) What sequence of operations does the coordinator take after it recovers?

(b) What sequence of operations does a participant who received the message and replied NO before the coordinator crashed take?

(c) What sequence of operations does a participant who received the message and replied YES before the coordinator crashed take?

(d) Let's say that the coordinator instead crashes after successfully receiving votes from all participants, with all participants voting YES except for one NO vote. Assuming the coordinator sees no records for this transaction in its log after coming back online, how does this affect the answers to parts (a)-(c)?

2. Now in the two-phase commit protocol, describe what happens if a subordinate receives a PREPARE message, replies with a YES vote, crashes, and restarts (All other participants also voted YES and didn't crash).

3. Suppose we have one coordinator and three participants. It takes 30ms for a coordinator to send messages to all participants; 5, 10, and 15ms for participant 1, 2, and 3 to send a message to the coordinator respectively; and 10ms for each machine to generate and flush a record. Assume for the same message, each participant receives it from the coordinator at the same time.

Under proper 2PC and logging protocols, how long does the whole 2PC process (from the beginning to the coordinator's final log flush) take for a successful commit in the best case?