1 Two Phase Commit with Logging

1. In the two-phase commit protocol, suppose that the coordinator sends PREPARE messages and crashes before receiving any votes. Answer the following questions.

   (a) What is the sequence of operations at the coordinator after it recovers?

   (b) What is the sequence of operations at a participant that received the message and replied No before the coordinator crashed?

   (c) What is the sequence of operations at a participant that received the message and replied Yes before the coordinator crashed?

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?