Distributed Commit

- Transaction: Group of operations to be applied completely or none at all
- Distributed transaction: Transaction to be applied by a group of processes
- Distributed commit: Operation should be applied everywhere or nowhere
  - Operation originates at one process
  - Commit: All processes apply operation
  - Abort: No process applies operation

One-Phase Commit

- Coordinator: Informs all participant processes about each operation
  - Asks each participant to locally commit the operation
  - Does not ask for any feedback
- Problems?
Two-Phase Commit

- Phase 1 (Voting):
  - Coordinator sends Vote Request to all participants
  - Each participant responds with Commit or Abort
- Phase 2 (Decision):
  - If all participants vote to Commit, Coordinator sends Global-Commit message to all, otherwise sends Global-Abort
  - Participant that had voted to commit will wait until Global-Commit or Global-Abort

Two-Phase Commit: Problems

- Works fine if no failures
- Problems in presence of failures:
  - A participant can indefinitely wait if a participant/coordinator crashes
  - Can use timeouts to limit waiting time
  - What action can be taken on a timeout?

Two-Phase Commit: Waiting Scenarios

- Participant crash:
  - Coordinator waiting in Voting phase: Can Abort transaction
- Coordinator crash:
  - Participant waiting for Vote request: Can Abort transaction
  - Participant waiting for Decision: Cannot Abort
    - Why?

Two-Phase Commit: Coordinator Crash

- Participant P waiting for decision:
  - Can ask another participant Q about decision
- Possibilities:
  - Q state is Commit => P can commit
  - Q state is Abort => P can abort
  - Q is waiting to vote => P can abort
  - Q is waiting for decision => P has to wait
- Worst case: All participants may be waiting for decision from coordinator
Three-Phase Commit

- Prevents participants from blocking in presence of coordinator crashes
  - Can always make a Commit/Abort decision
- Phase 1 (Voting): Same as 2PC
- Phase 2 (Pre-Commit): Same as 2PC if Abort, else Coordinator sends a Prepare-Commit message
- Phase 3 (Decision): Global-Commit if ACKs received from all participants

Three-Phase Commit: Participant Crash

- Coordinator waiting in
  - Voting phase: Can Abort transaction
  - Pre-Commit phase: Can send Global-Commit

Three-Phase Commit: Coordinator Crash

- Participant P waiting after voting:
  - Can ask another participant Q about its state
- Possibilities:
  - Q state is Commit => P can commit
  - Q state is Abort => P can abort
  - Q is waiting to vote => P can abort (No other process can be in Pre-Commit state)
- If all participants are waiting in voting phase: Abort transaction
- If all participants are in Pre-Commit state: Commit transaction