

Distribution in Databases

CS 451 Lecture

ACID Properties of Transactions

- Atomicity
- Consistency
- Isolation
- Durability

Atomicity

- Wrt failures
 - Either all or none of a transaction is performed
 - Transaction aborted by user
 - Transaction recovery
 - Transaction failed due to system crashes
 - Crash recovery

Consistency

- Transaction does what it's supposed to do
 - Responsibility of the transaction programmer
 - Guarantee preconditions and postconditions

Isolation

- Atomicity wrt concurrent executions
 - Incomplete transactions does not reveal its intermediate results to other Trs.
 - Needed to avoid cascaded aborts
- Concurrency control

Durability

- Once the transaction commits, no system failure should result in loss of the event that this transaction took place
 - Database recovery

Serializability

- If several transactions are executed concurrently, the effect is the same as that of executing them in some serial order
- The process of guaranteeing serializability is concurrency control

Supporting Atomicity

- 2 Phase Commit
- Phase 1:
 - Coordinator asks all participants to prepare for commit
 - Each participant sends READY/ABORT
 - Coordinator also uses timeout
- Phase 2:
 - Coordinator sends the decision
 - All participants Acknowledge

Logging States

- Coordinator:
 - Write PREPARE before sending PREPARE to all participants
 - Write COMMIT/ABORT decision after receiving local decisions
 - Write COMPLETE after receiving ACKs
- Participant:
 - Write local decision before sending it to coordinator
 - Write received decision after it is communicated by the coordinator and before sending the ACK

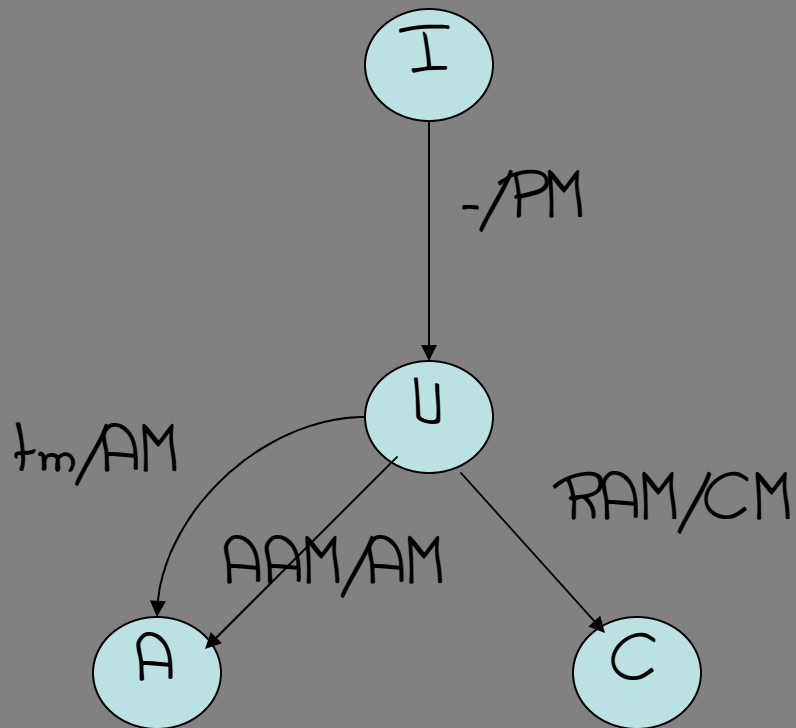
Participant Failure Analysis

- Participant fails before writing the ready record locally
 - What was the global decision taken?
- Participant fails after having taken the ready decision
 - What was the global decision taken?

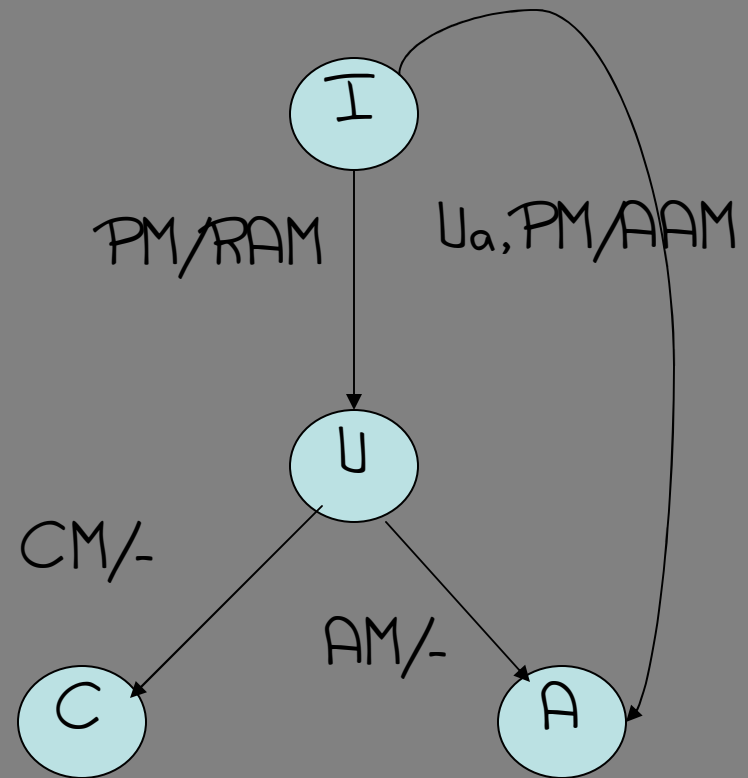
Coordinator Failure Analysis

- Coordinator fails after writing PREPARE record but before making the decision
 - What was the global decision taken?
- Coordinator fails after having taken a decision
 - What was the global decision taken?

2-PC state diagram



Coordniator



participant

Note: ACK messages are not shown

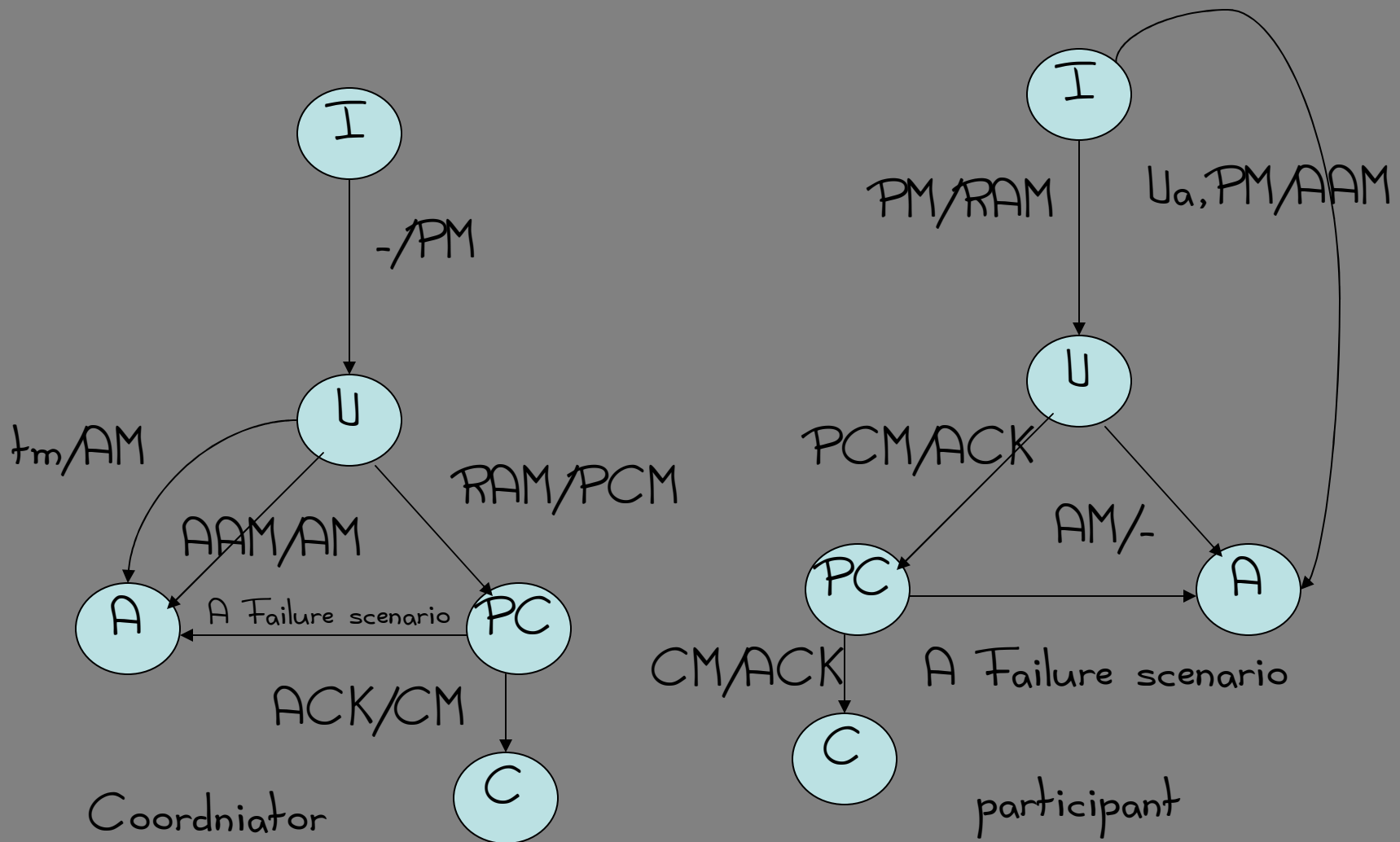
Terminating the transaction

- Can the transaction be terminated by all participants when failure of coordinator occurs?
- Possible in these cases:
 - At least one of the sites has received decision
 - None has received the decision, but only the coordinator has crashed

Blocking in 2 PC

- Termination impossible when
 - Case1:
 - No alive participant has received the decision
 - At least one participant failed and coordinator failed
- All must wait till coordinator/or the failed participant comes up

3-PC state diagram



Note: ACK messages are not shown