Easy Commit: A Non-blocking Two-phase Commit Protocol

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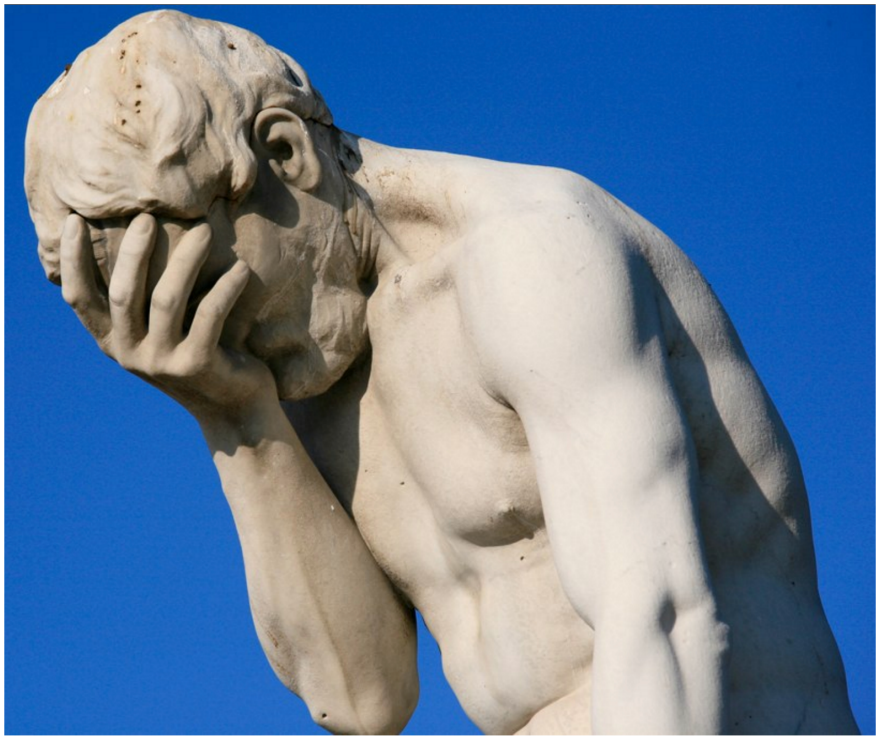

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Motivation

- Concerns of a Distributed Database Designer:
  - Availability
  - Consistency
- Lots of hardware, resources $\Rightarrow$ Availability Solved.
- If Not Consistent $\Rightarrow$ Correctness Compromised!

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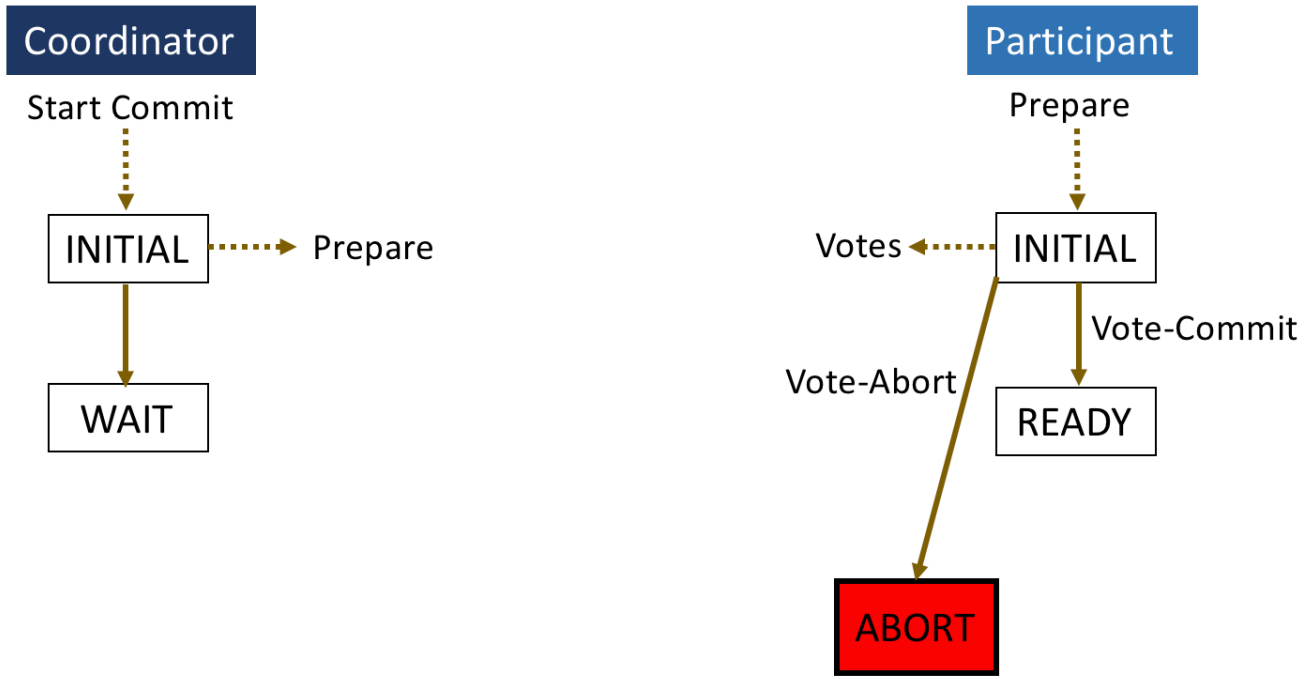
- **Easy Commit** ⇒ Two Phases! Non-Blocking!

Two Phase Commit Protocol

Two Phase Commit Protocol



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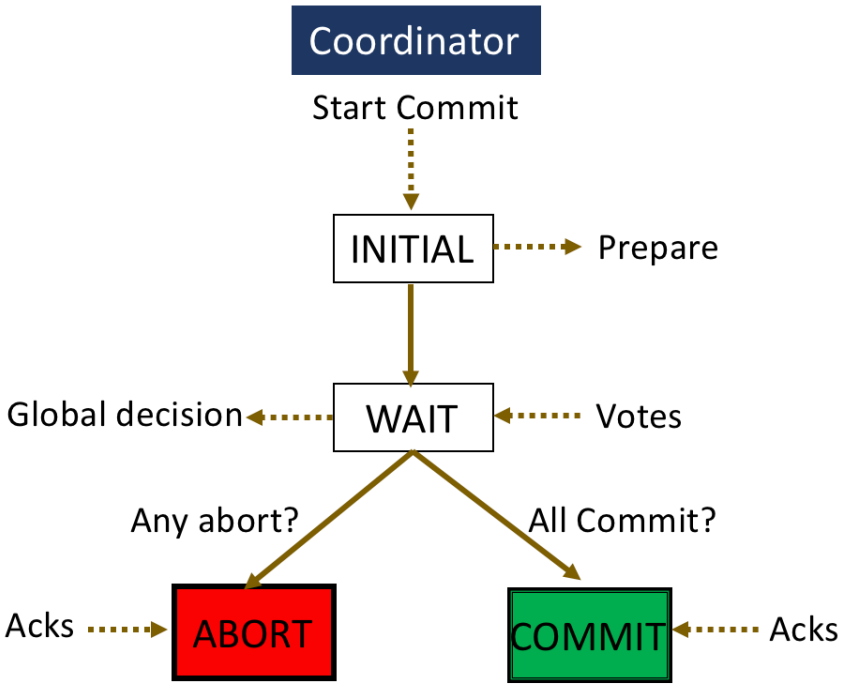
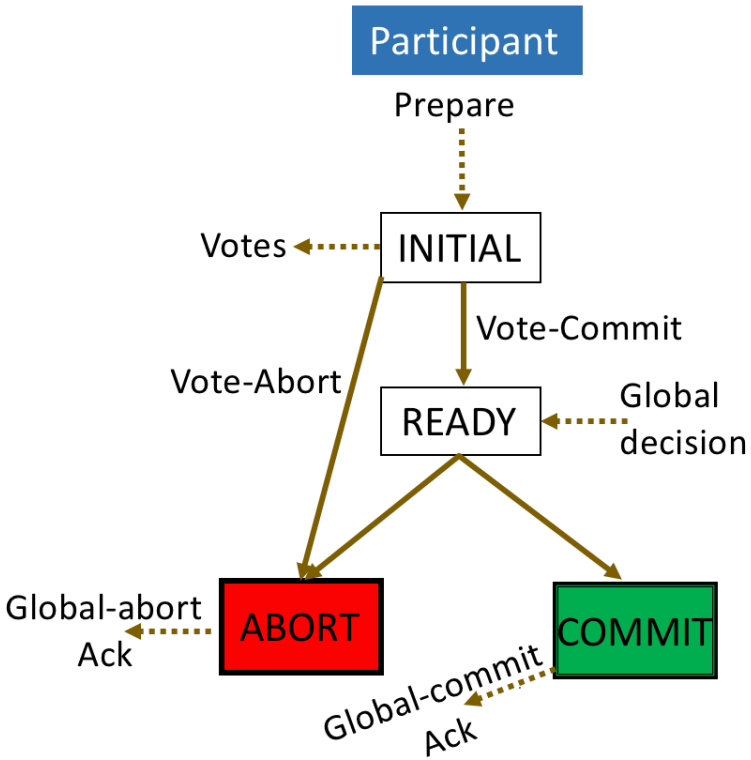
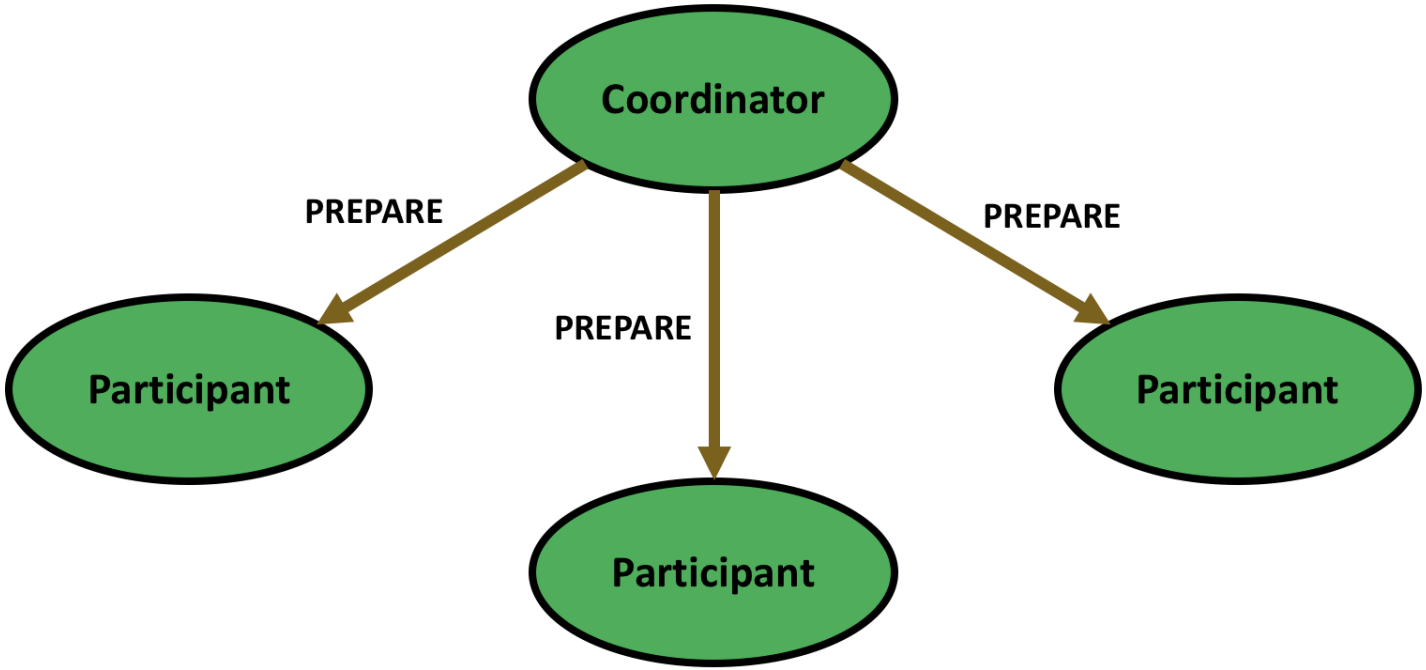




2PC is Blocking



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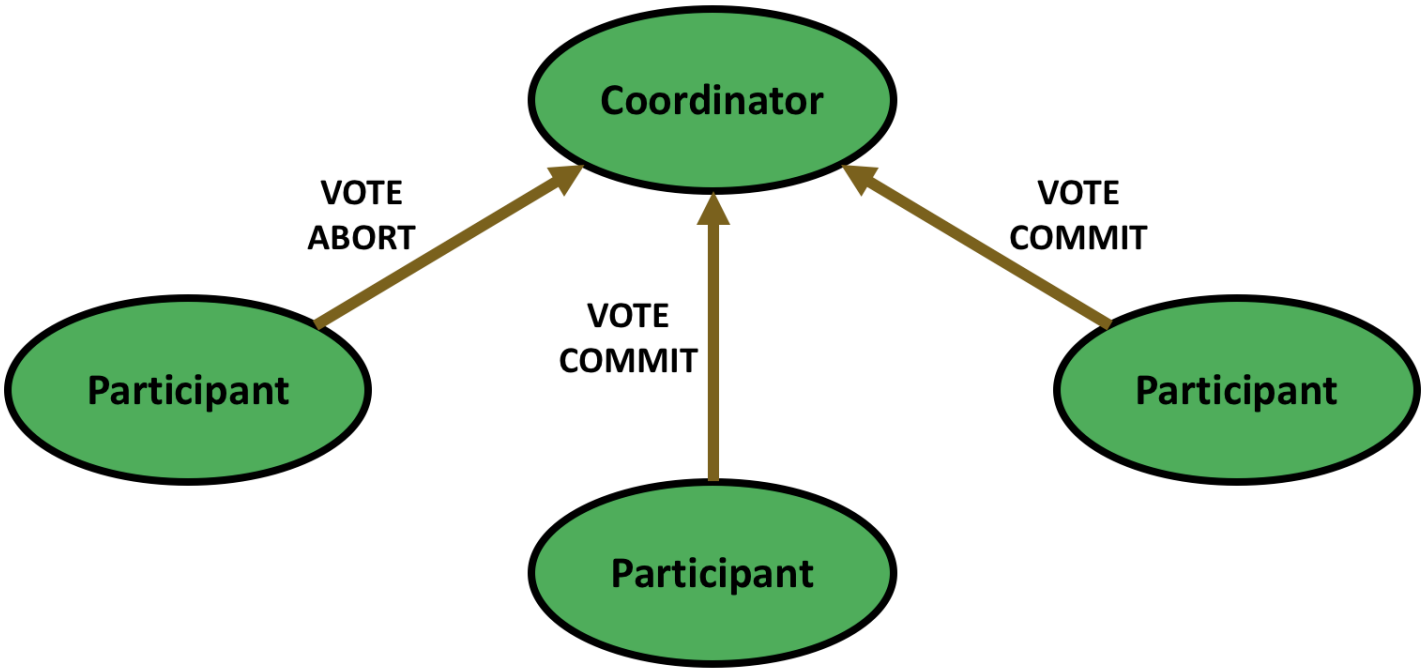

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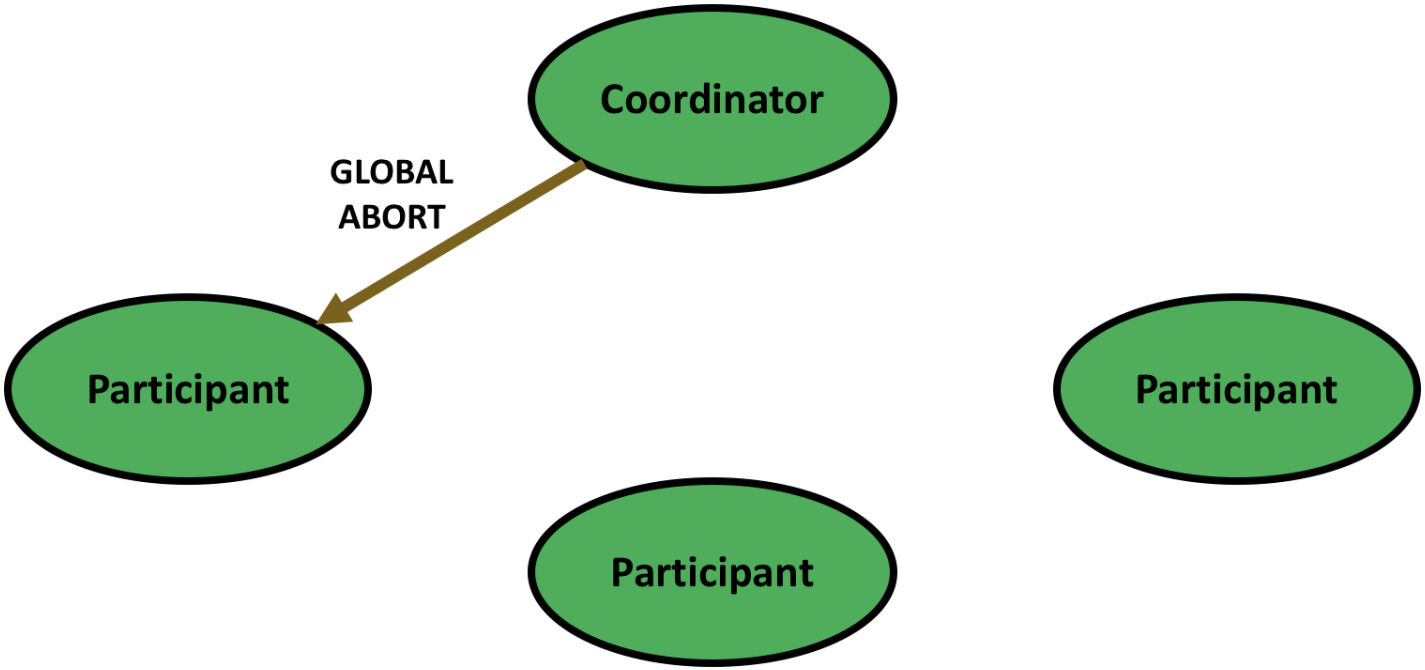

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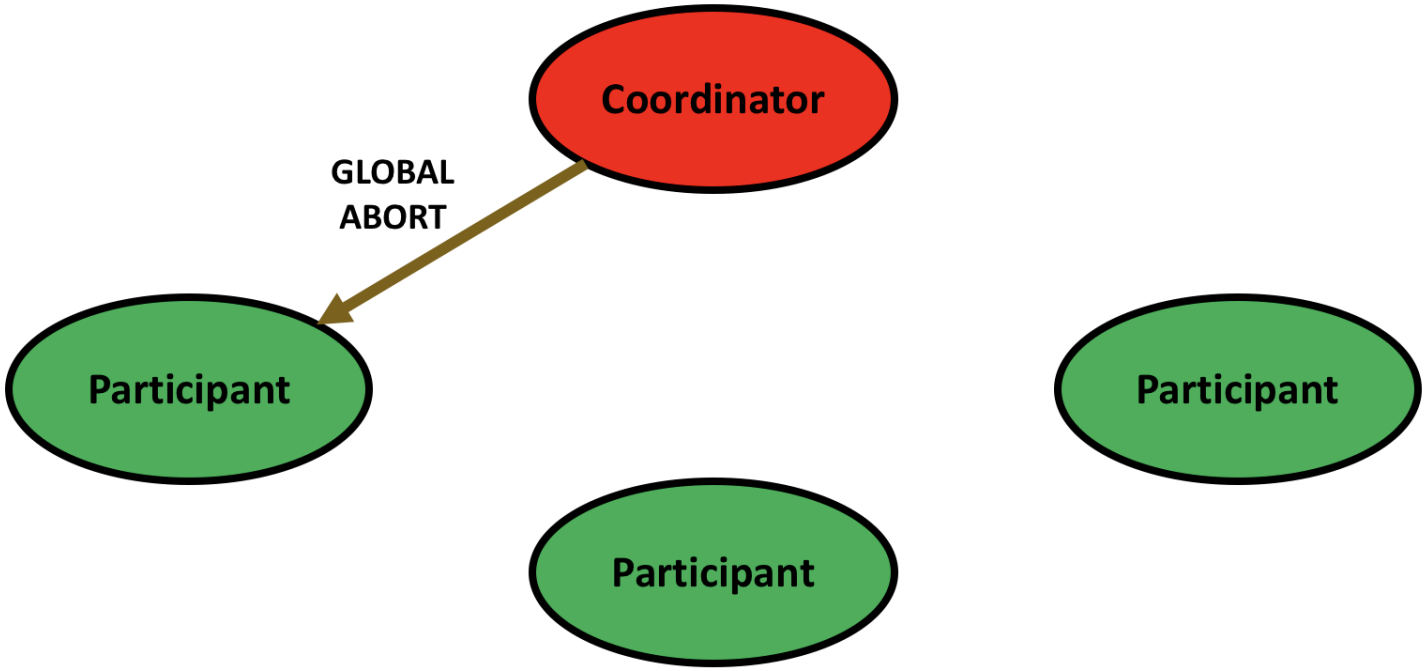

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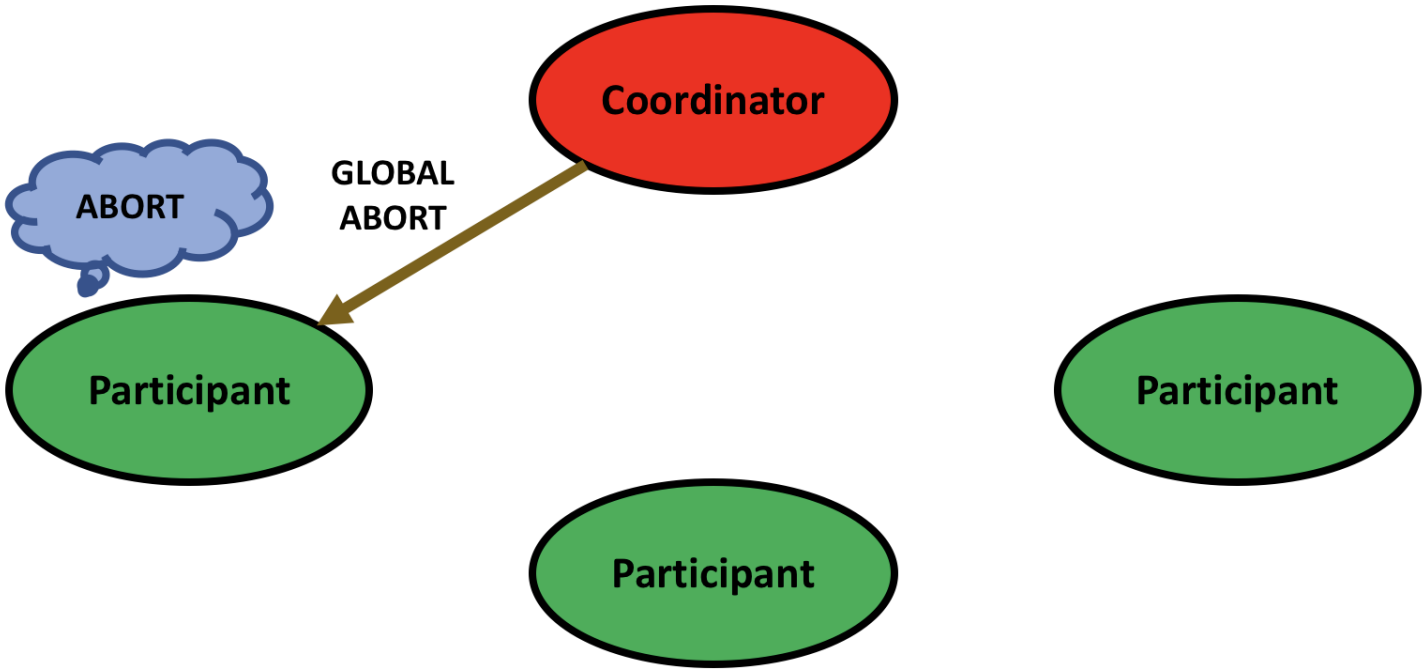

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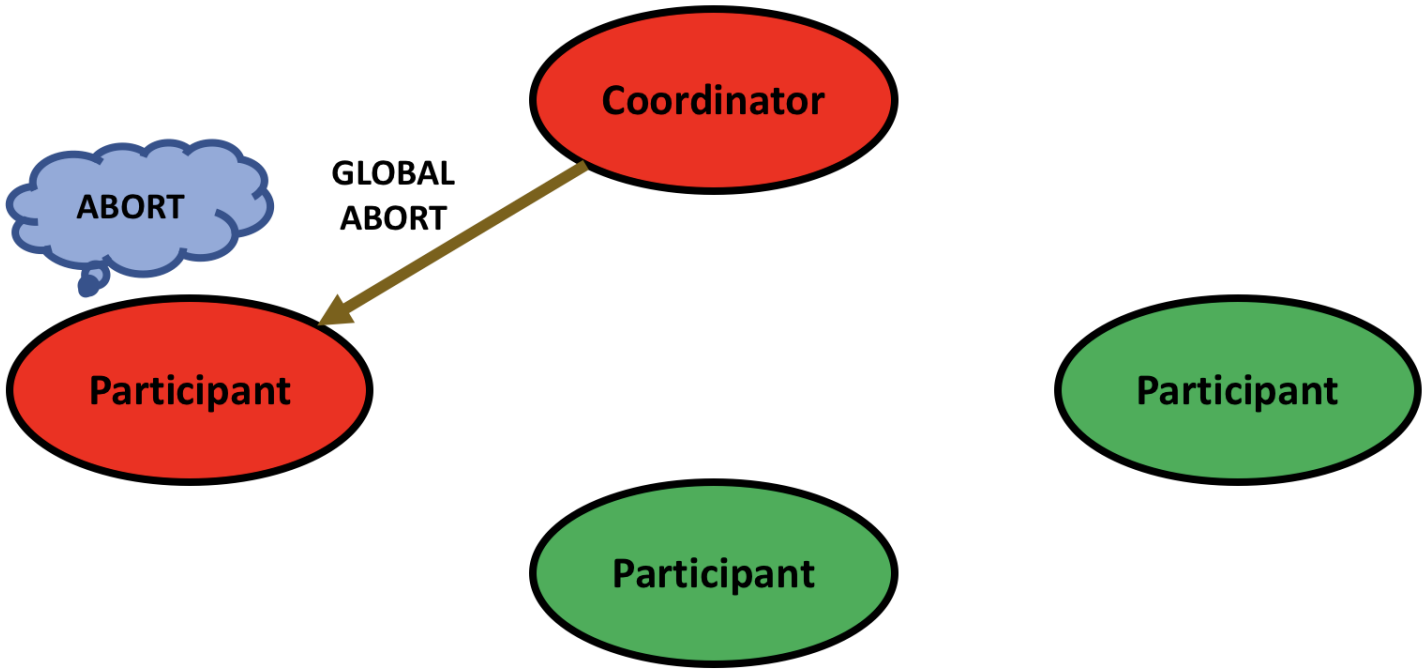

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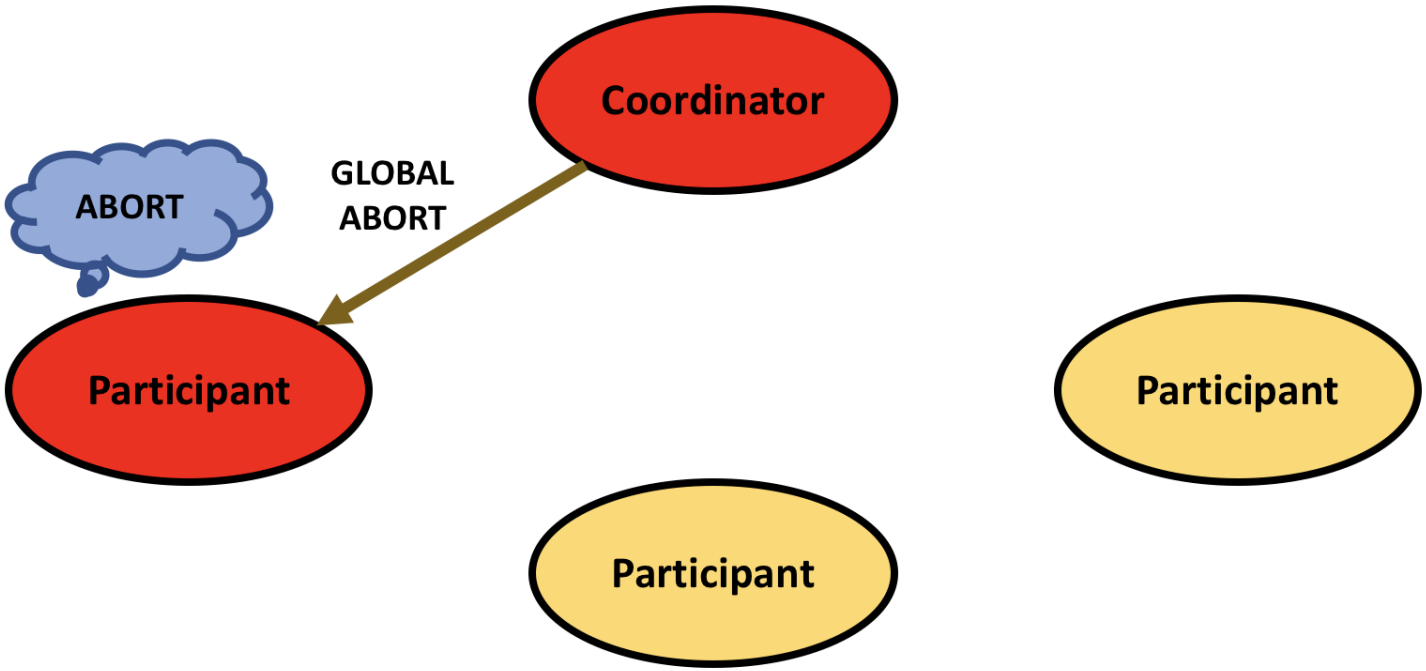

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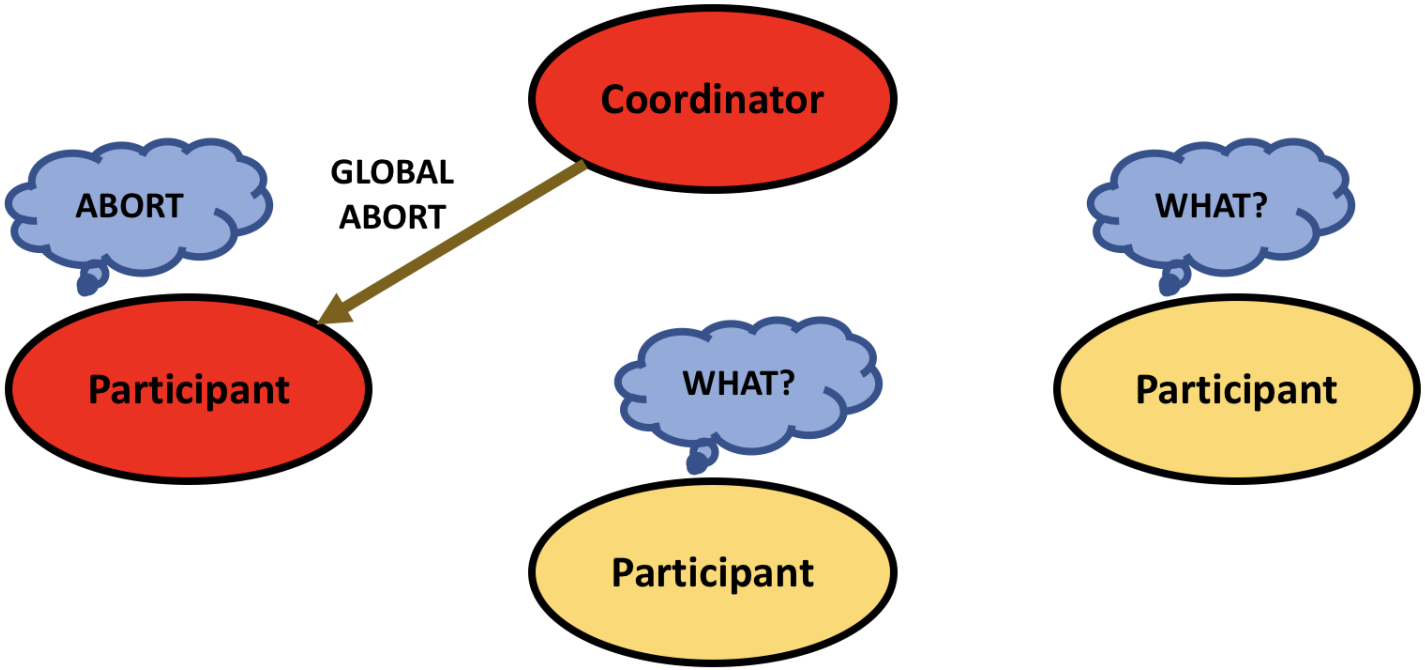
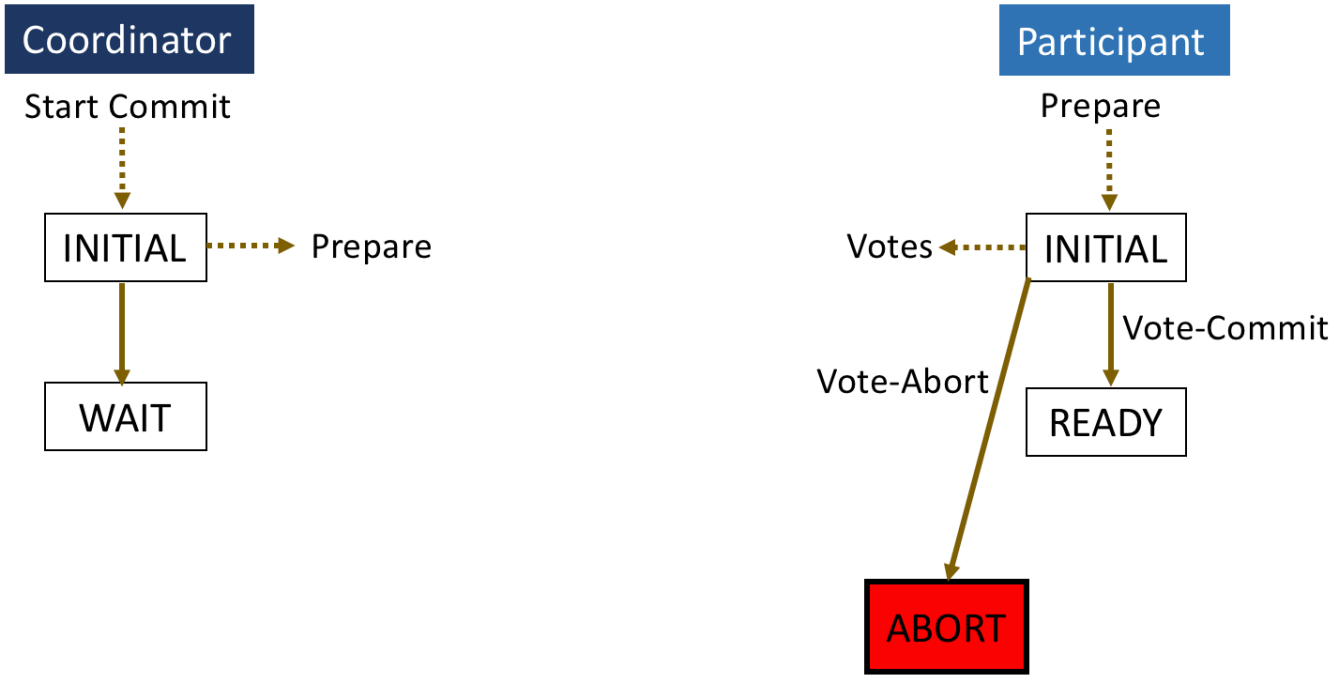


System is in an Unstable State.

Three Phase Commit Protocol

Three Phase Commit Protocol



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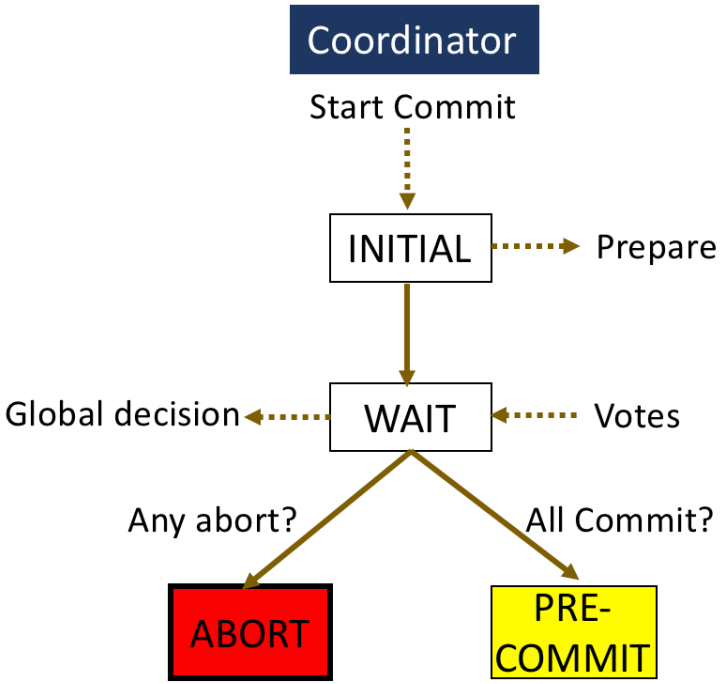

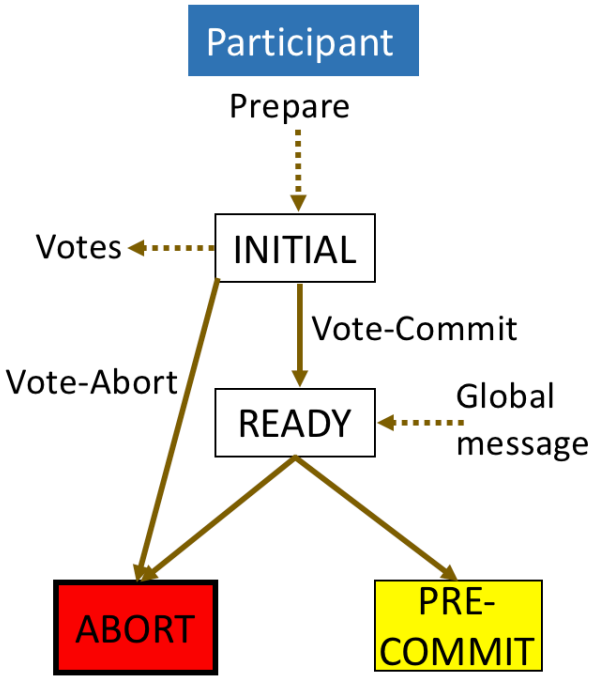

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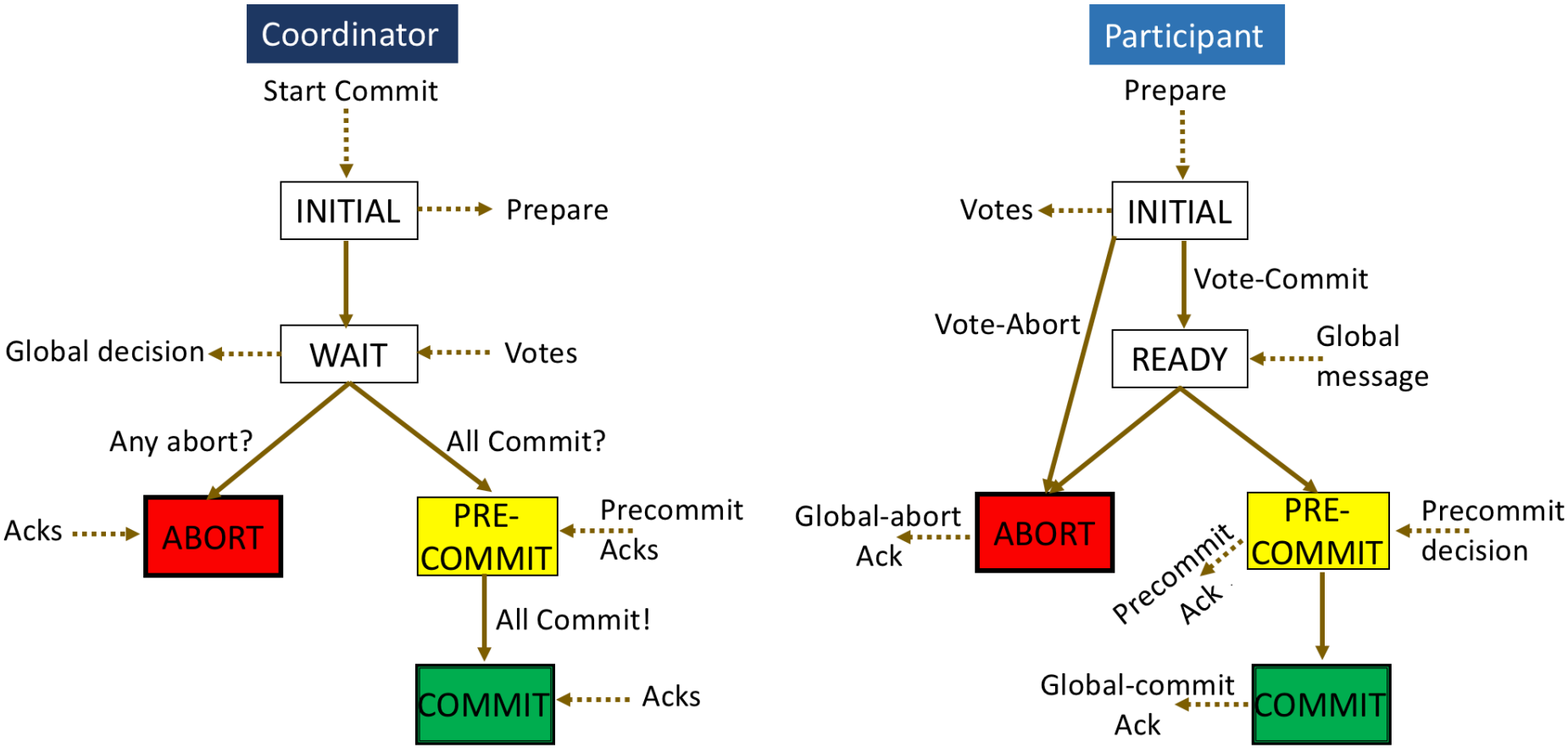
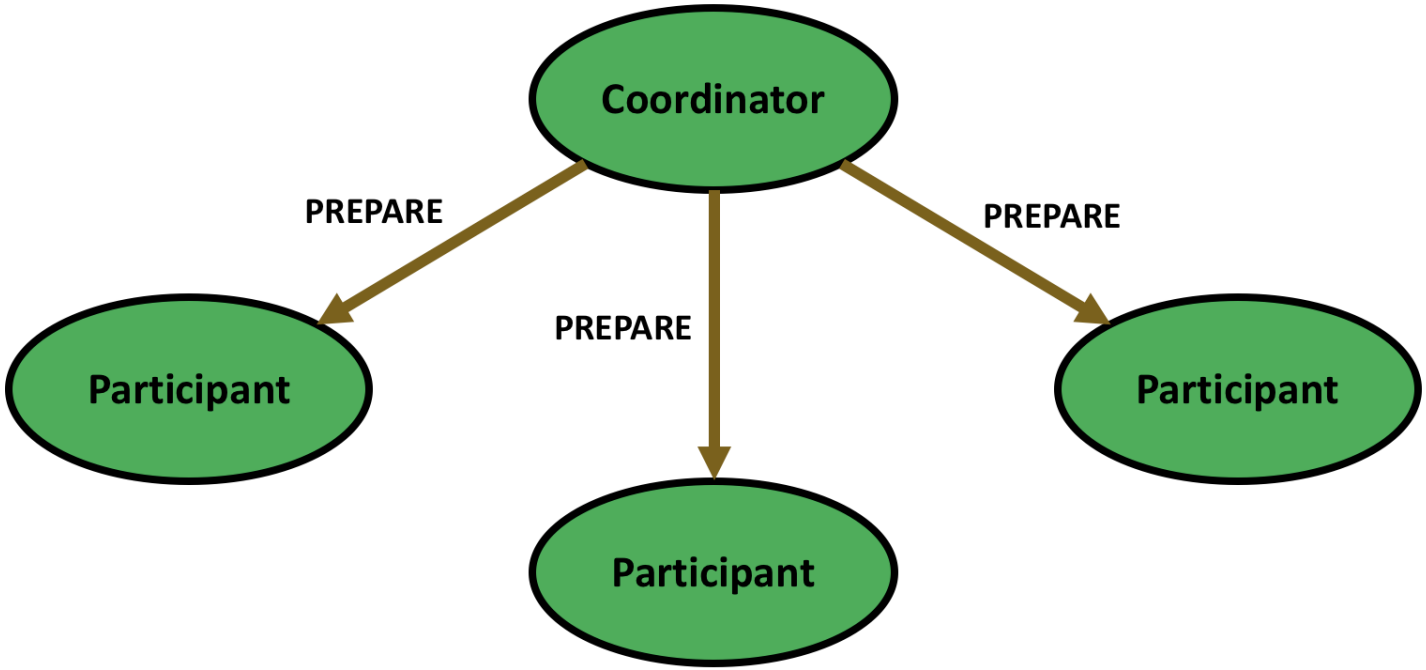


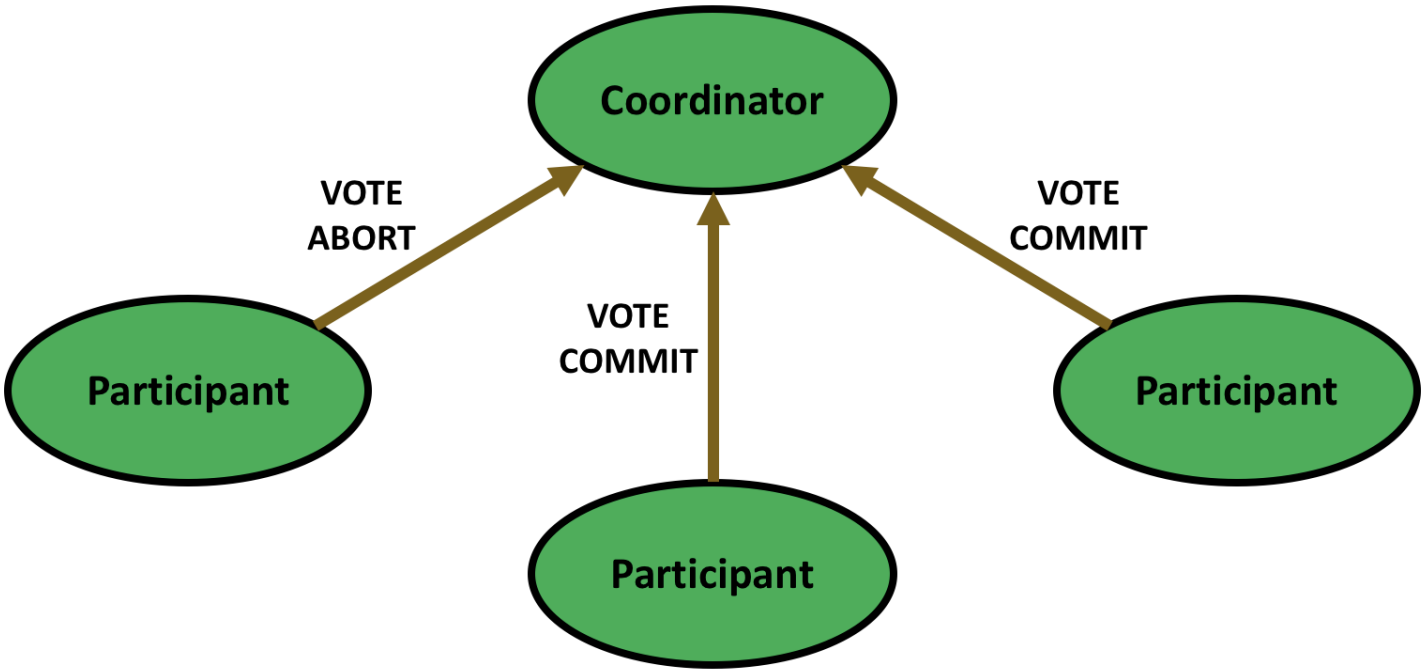
3PC is Non-Blocking

- **Dale Skeen's** Requirements [SIGMOD 1981]:
- No state adjacent to both Abort and Commit states.
- No non-committable state adjacent to the Commit state.

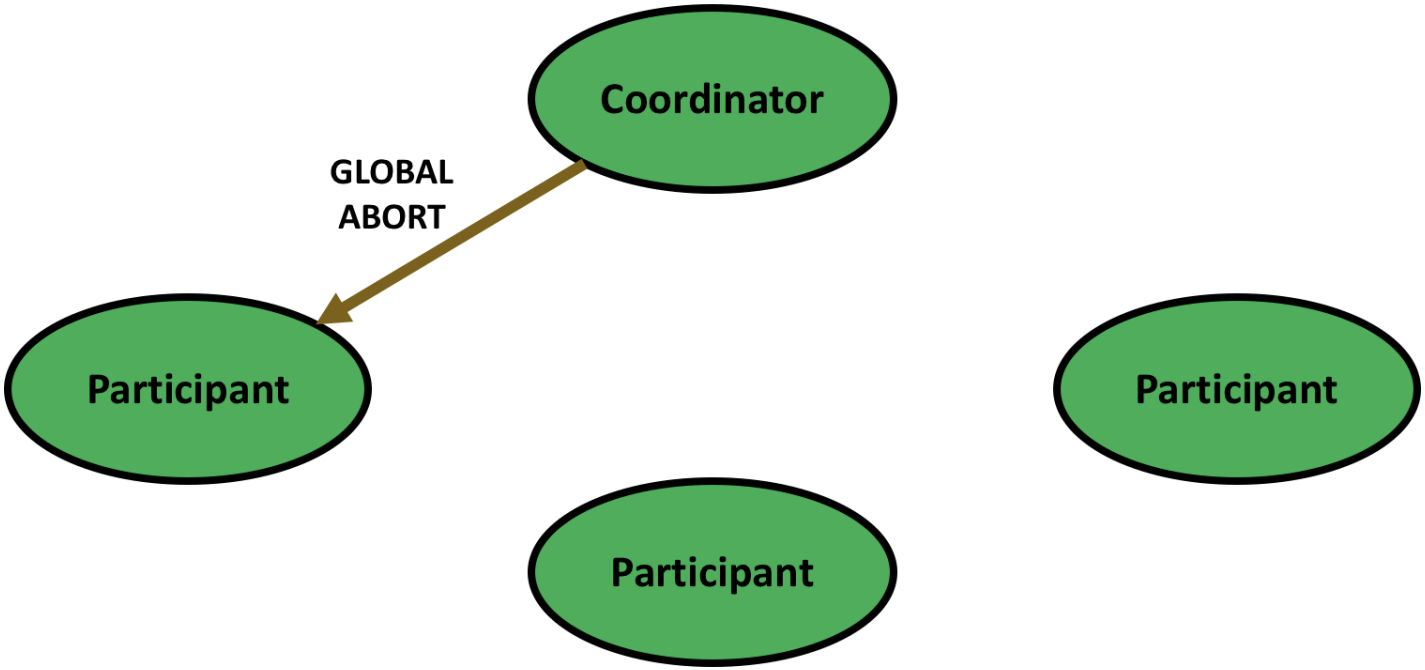
3PC Works


Coordinator
PREPARE
PREPARE
PREPARE
Participant
Participant
Participant

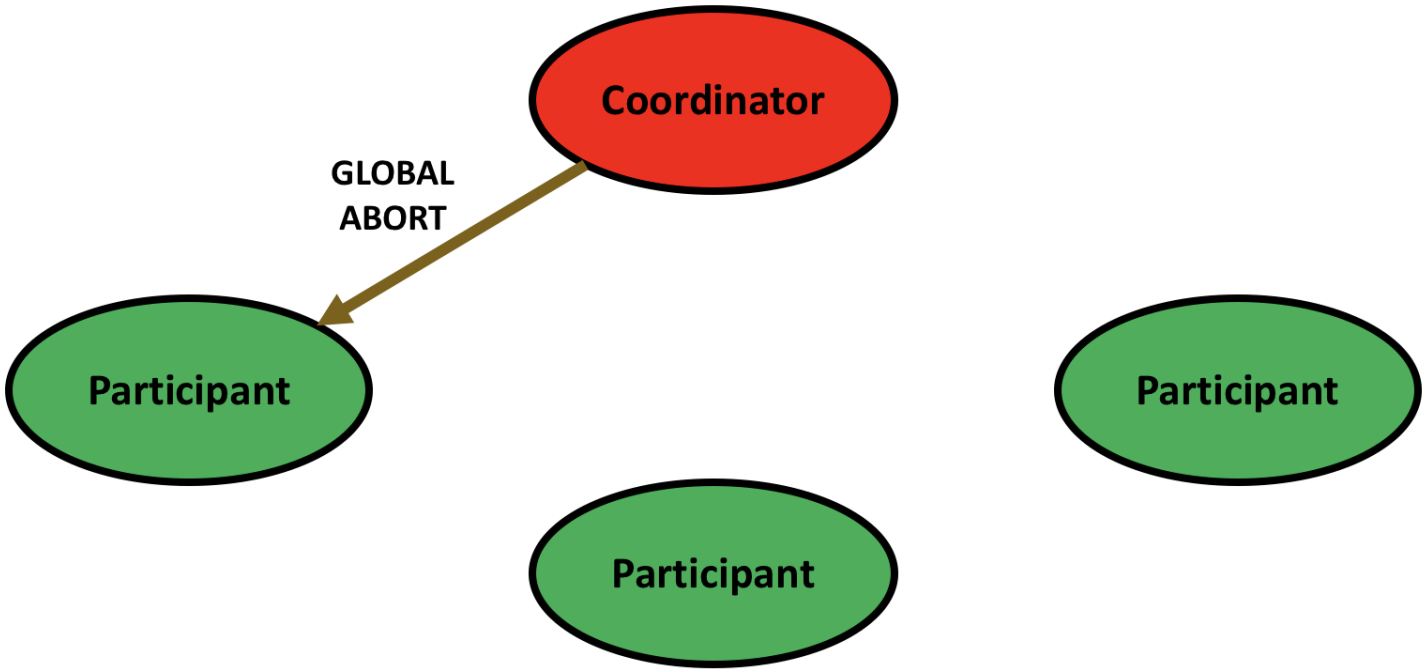
3PC Works


Coordinator
VOTE
ABORT
VOTE
COMMIT
VOTE
COMMIT
Participant
Participant
Participant

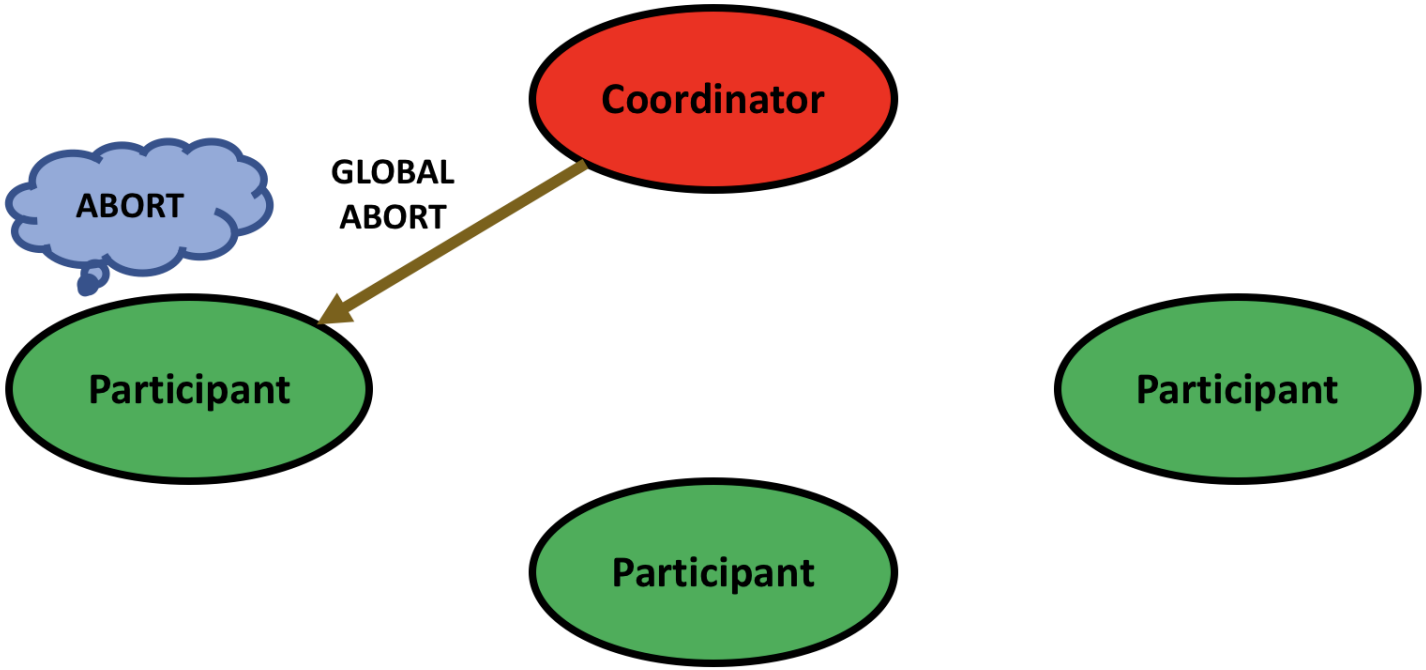
3PC Works


Coordinator
GLOBAL
ABORT
Participant
Participant
Participant

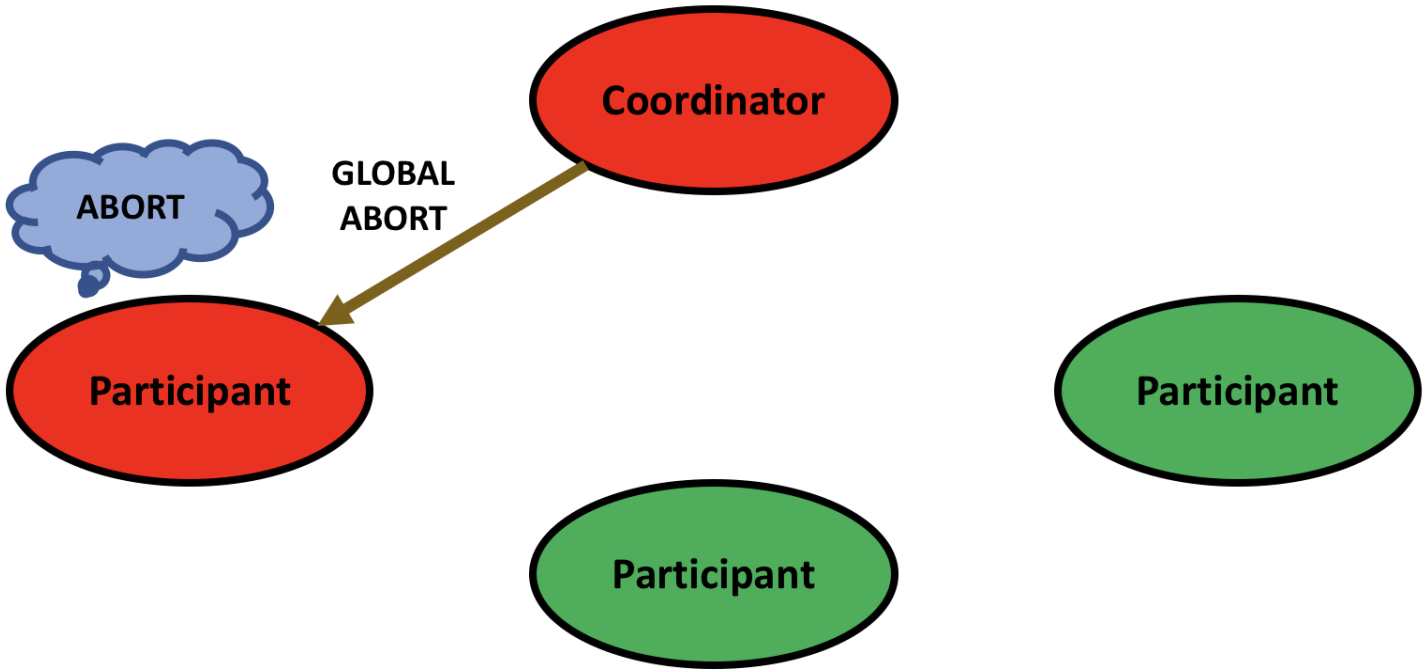
3PC Works


Coordinator
GLOBAL
ABORT
Participant
Participant
Participant

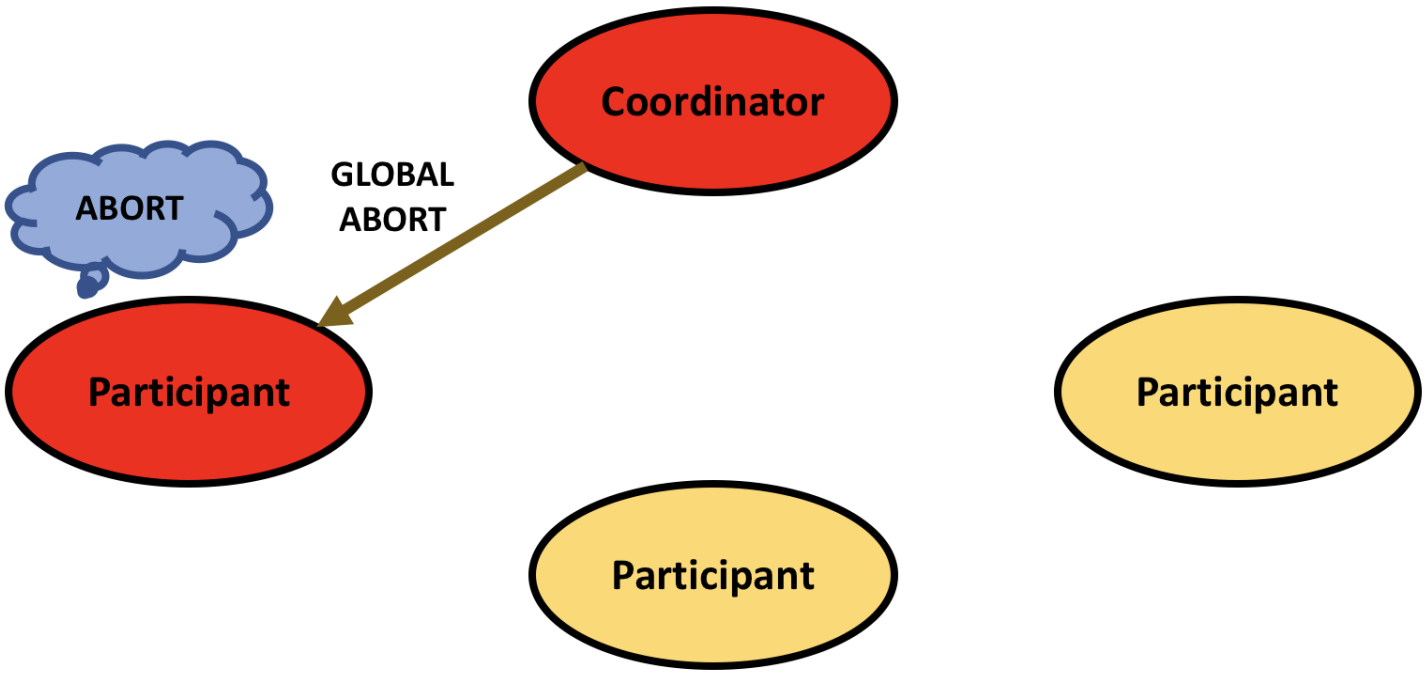
3PC Works


Coordinator
ABORT
GLOBAL
ABORT
Participant
Participant
Participant

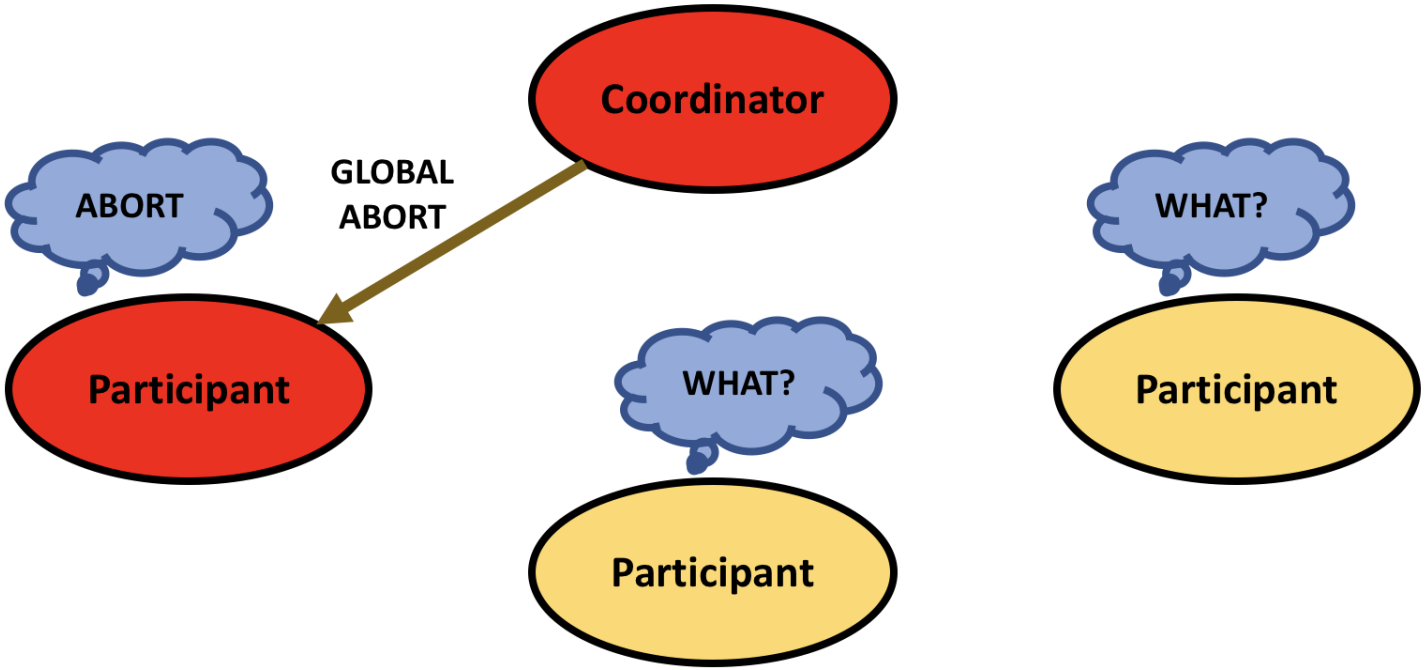
3PC Works


Coordinator
ABORT
GLOBAL
ABORT
Participant
Participant
Participant

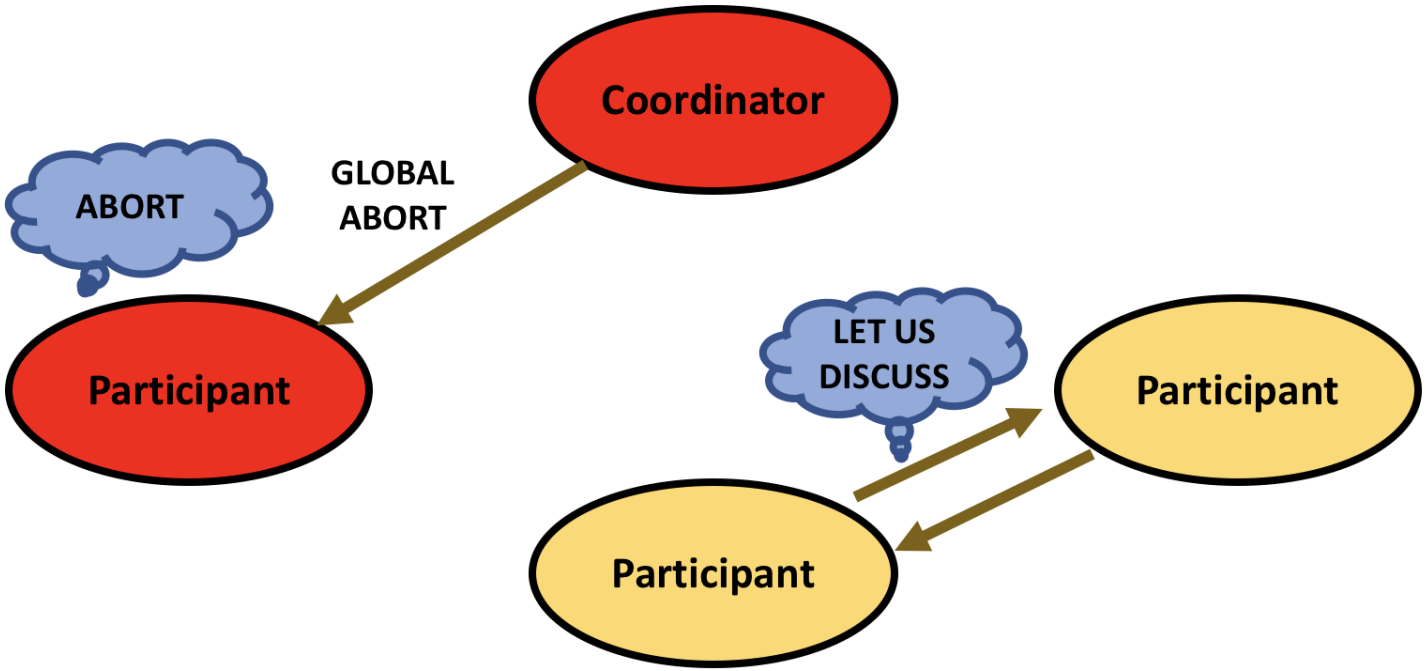
3PC Works


Coordinator
ABORT
GLOBAL
ABORT
Participant
Participant
Participant

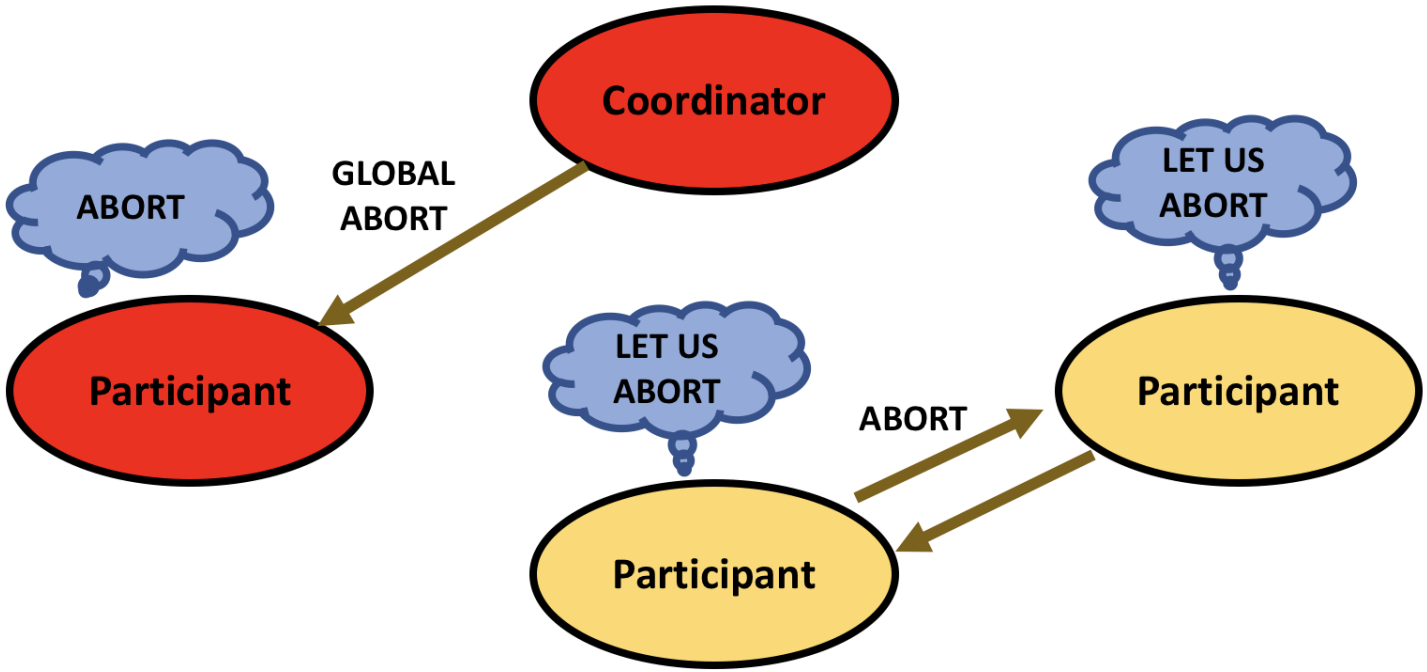
3PC Works


Coordinator
GLOBAL ABORT
ABORT
Participant
WHAT?
Participant
WHAT?
Participant

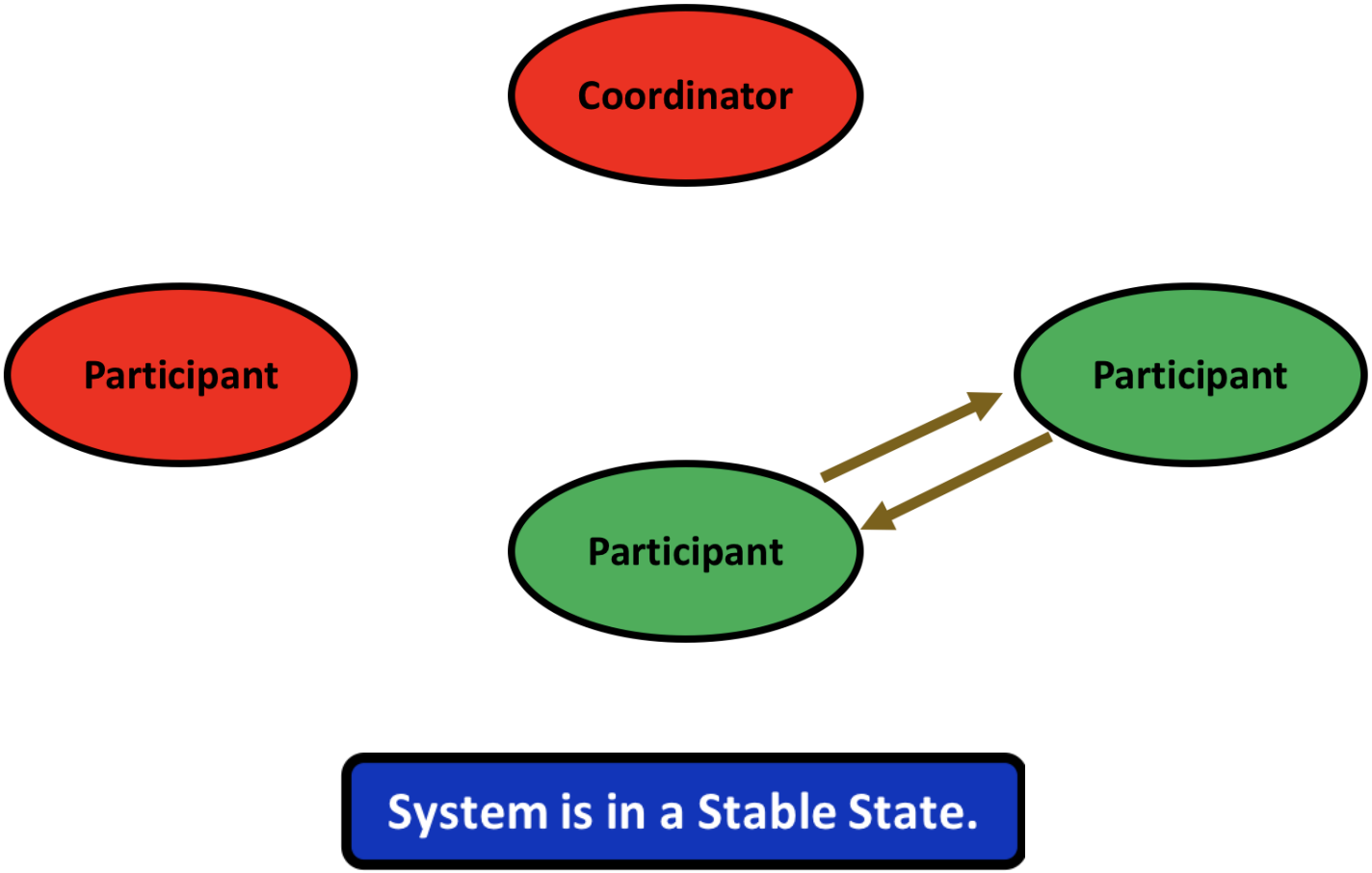
3PC Works


Coordinator
ABORT
GLOBAL
ABORT
Participant
LET US
DISCUSS
Participant
Participant

3PC Works


Coordinator
GLOBAL ABORT
ABORT
Participant
LET US ABORT
Participant
LET US ABORT
ABORT
Participant

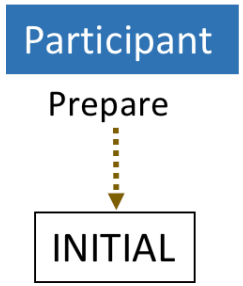
3PC Works


Coordinator
Participant
Participant
Participant
System is in a Stable State.

Easy Commit Principle

- First Transmit and then Commit
- Message Redundancy

Easy Commit Protocol



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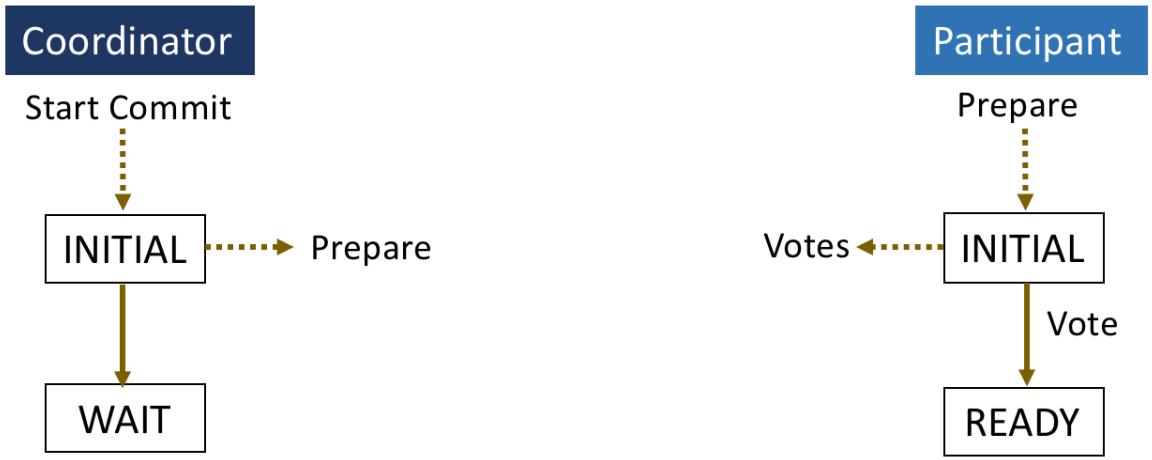

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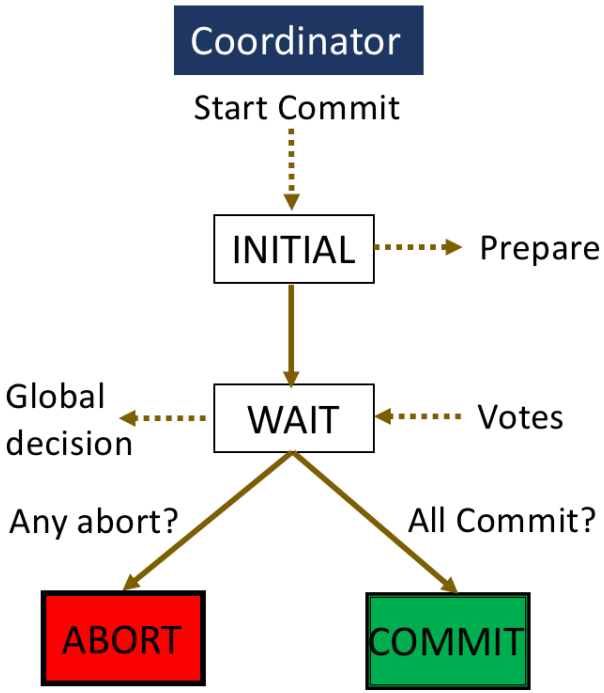

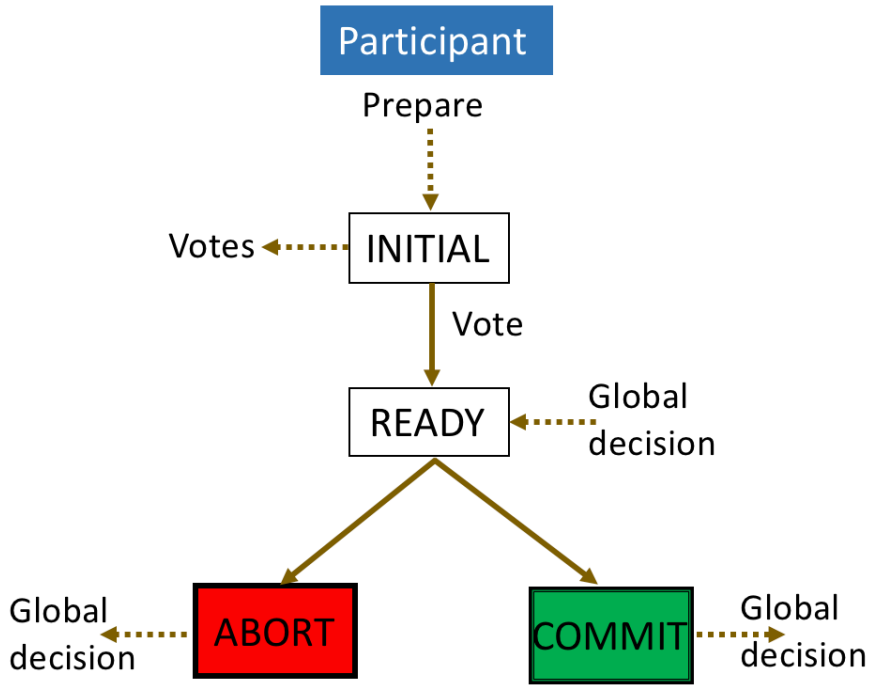

Easy Commit Observations

- Participant cannot directly transition from INITIAL to ABORT.
- Each participant forwards the global decision to every other node.
- Participant need not wait for global decision from coordinator.
- Existence of hidden states: **TRANSMIT-A** and **TRANSMIT-C**.

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Easy Commit Protocol – Logical Expansion

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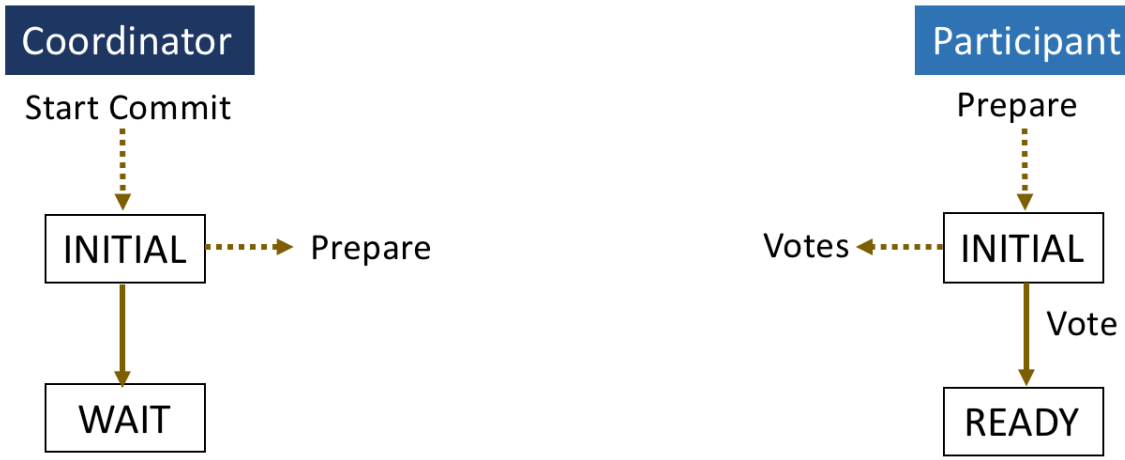

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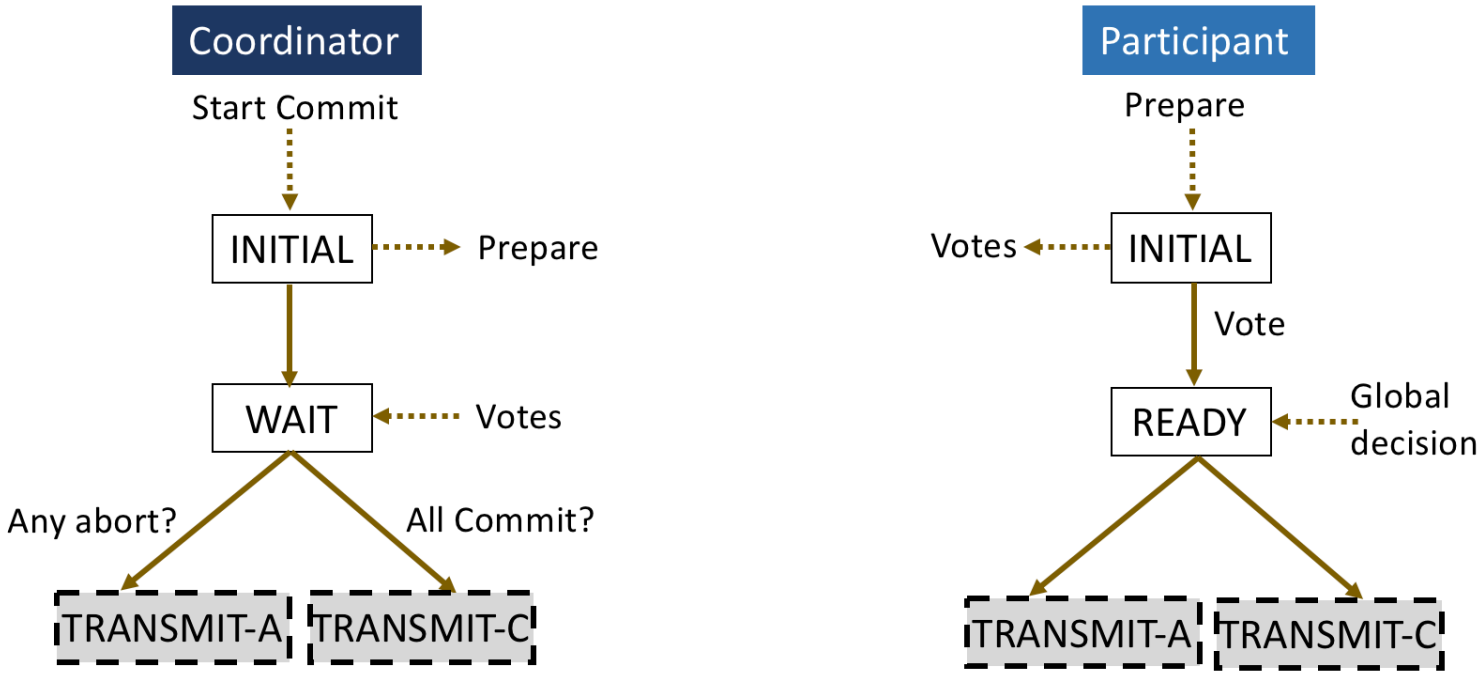

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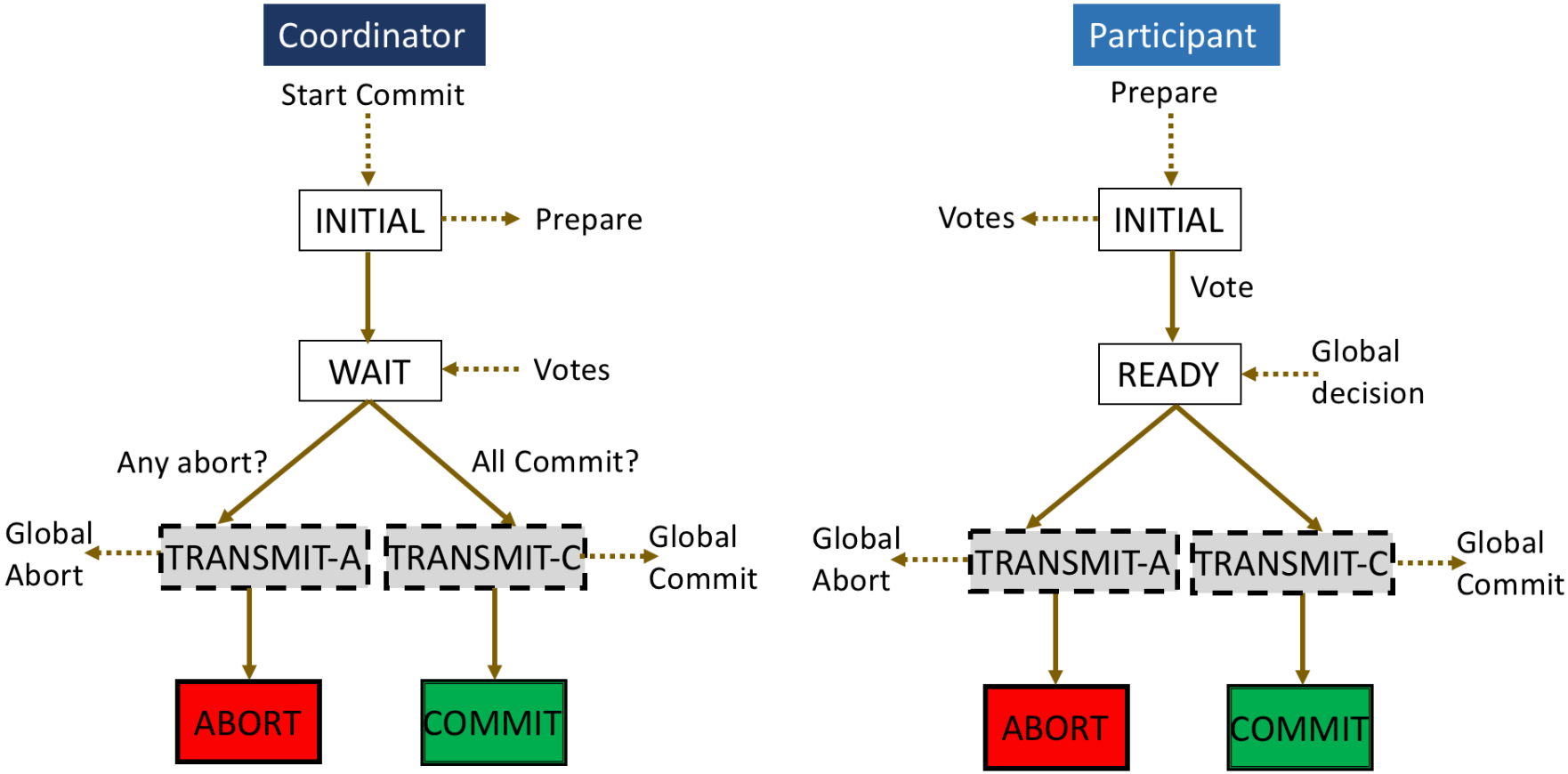

Easy Commit Termination Protocol

- **Coordinator Timeout in WAIT state**:
  - Coordinator didn't receive **Votes**.
  - Adds a log entry, Transmits **Global-Abort**, Aborts Transaction.
- **Participant Timeout in INITAL state**:
  - Participant didn't receive **PREPARE** message.
  - Communicates with other participants.
- **Participant Timeout in READY state**:
  - Participant didn't receive **Global Decision**.
  - Communicates with other participants.

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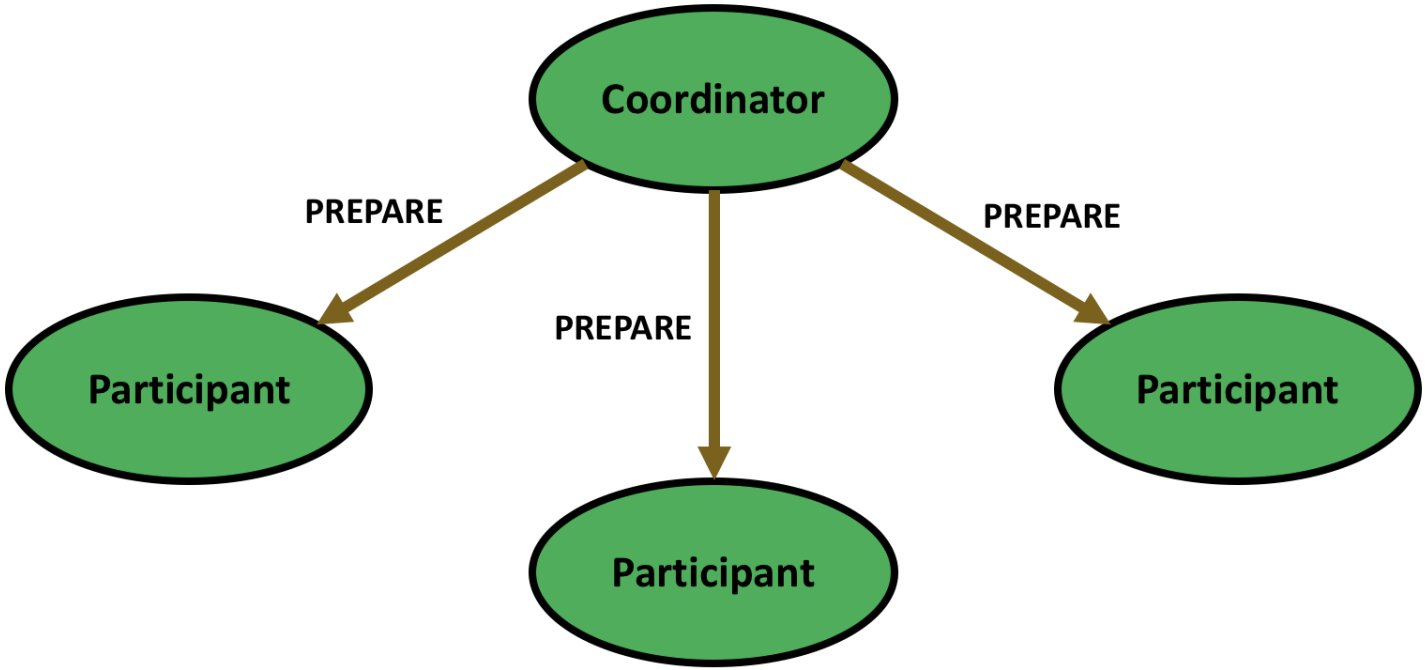
Easy Commit Works



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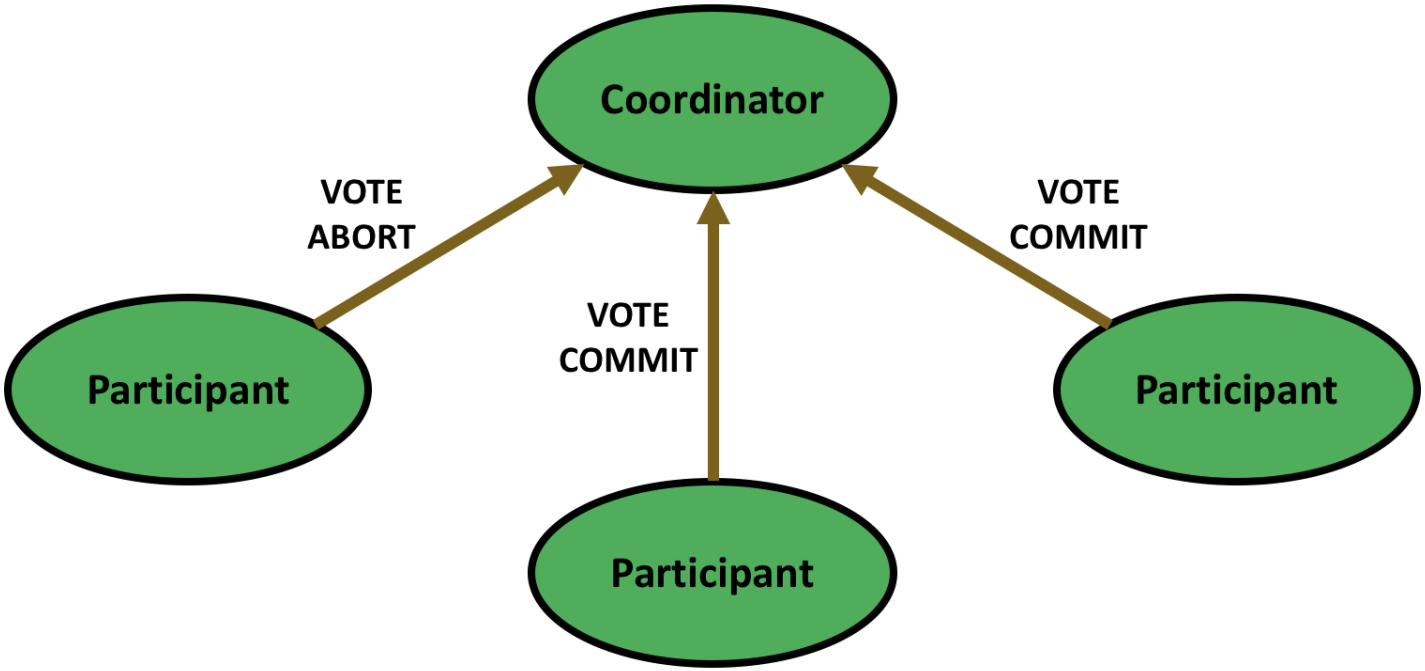

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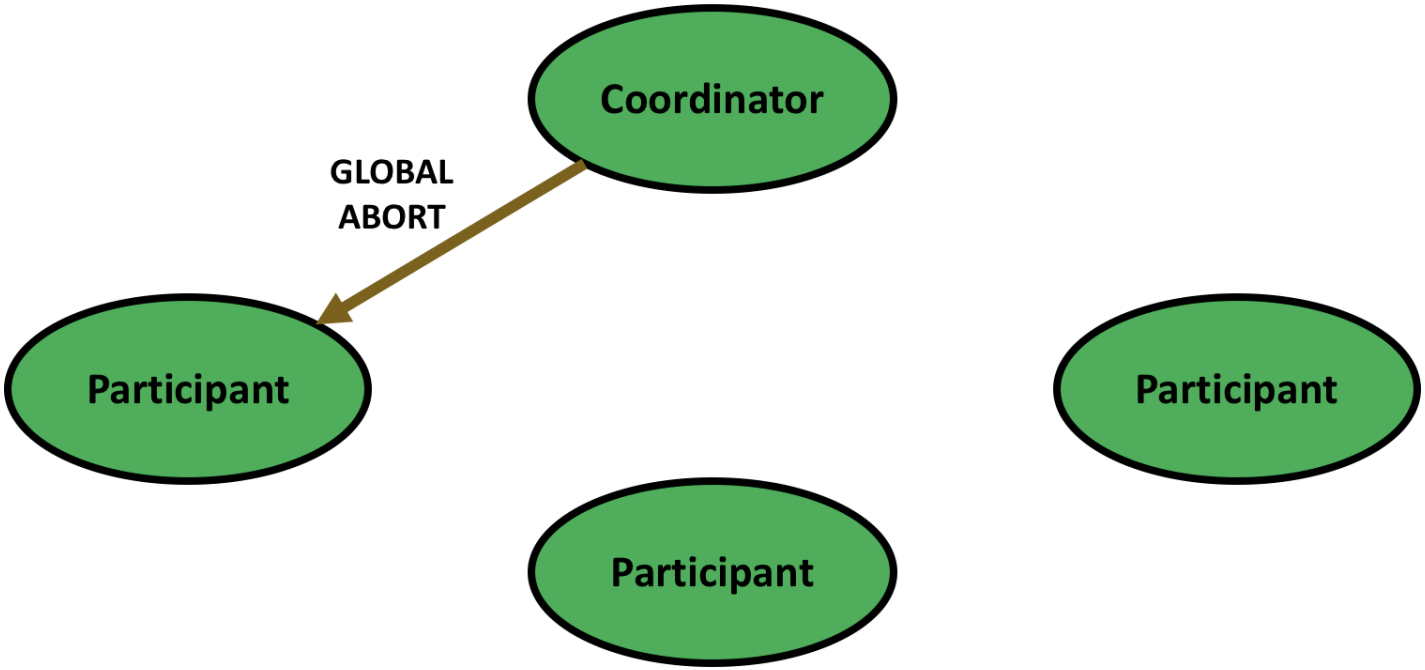

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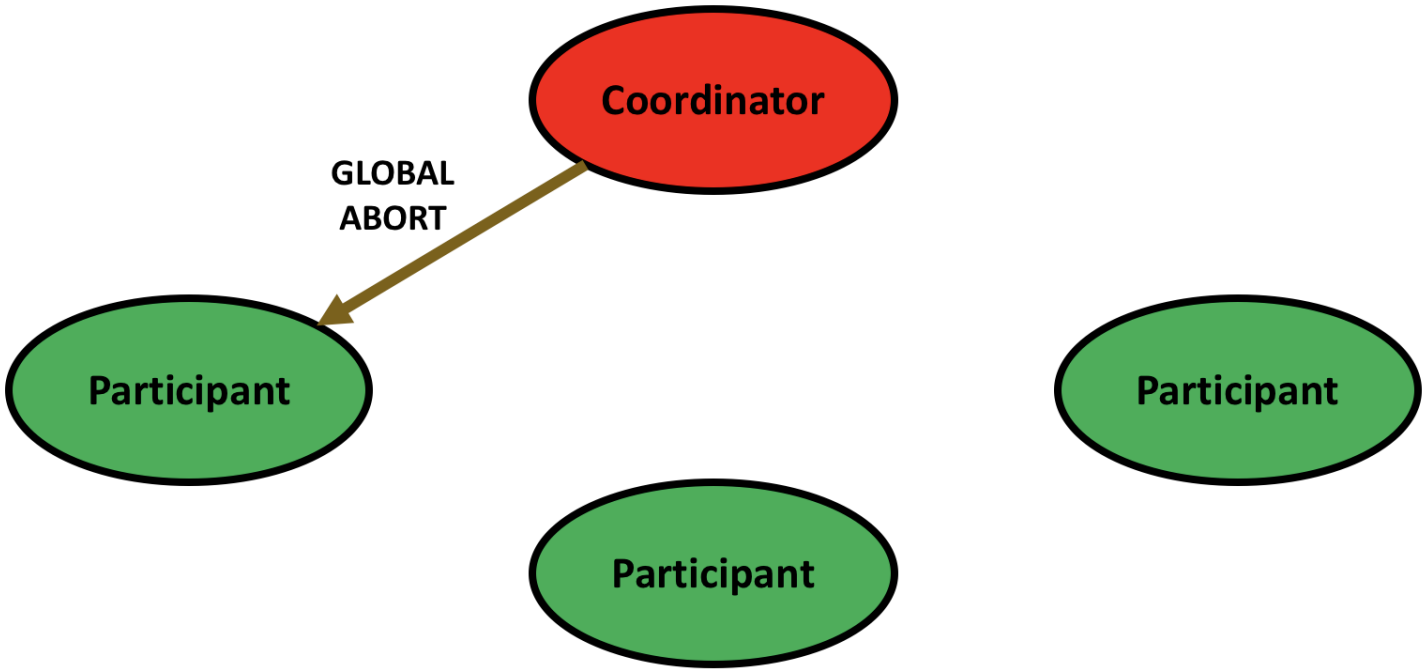

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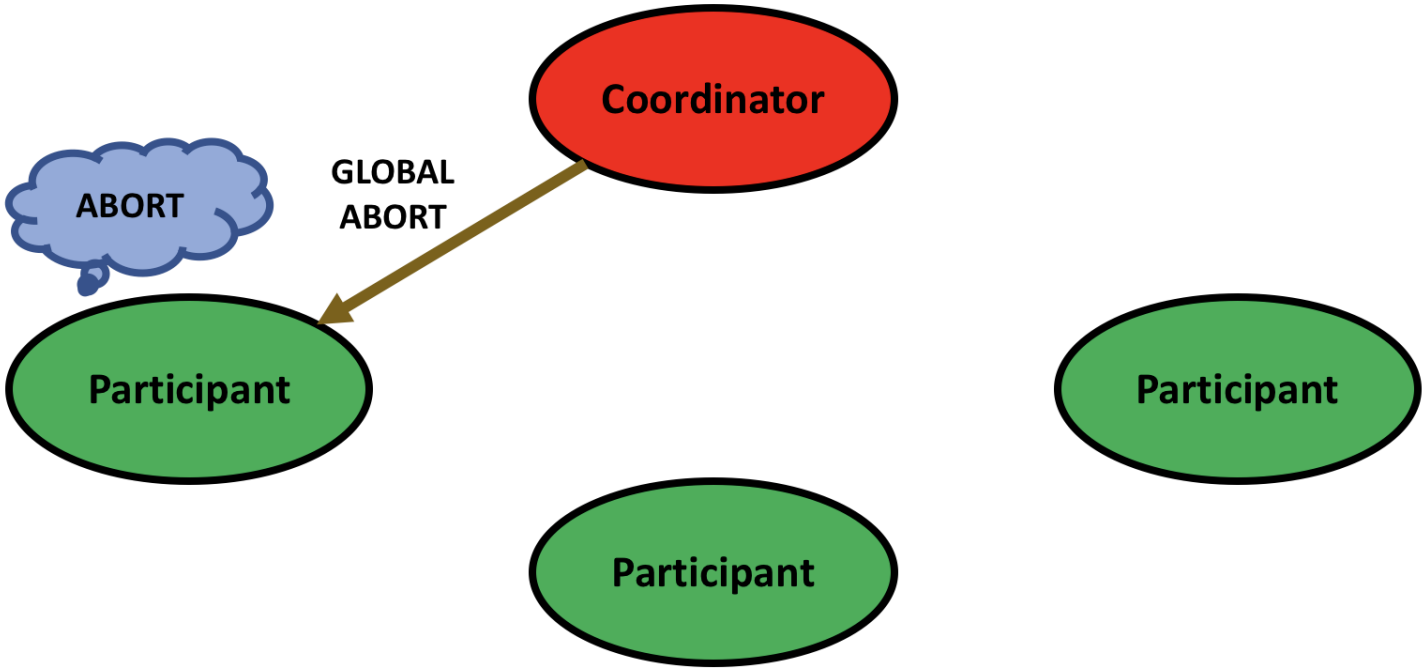

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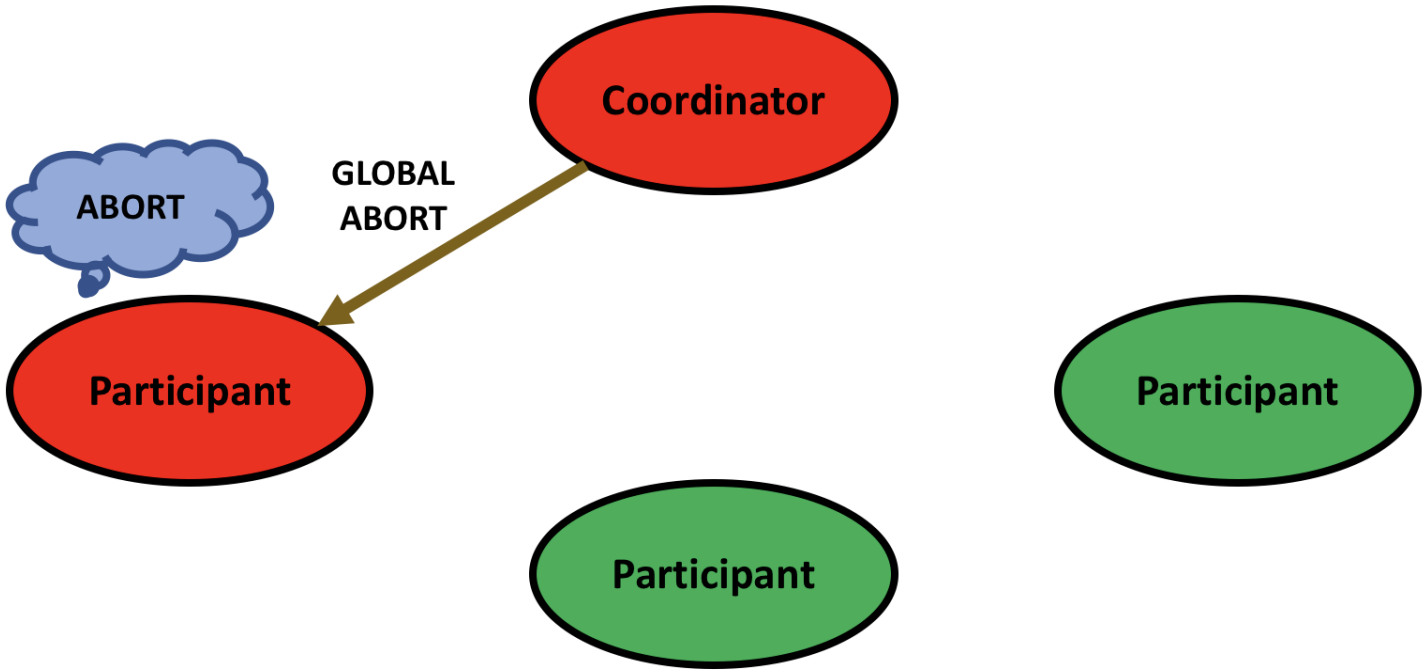

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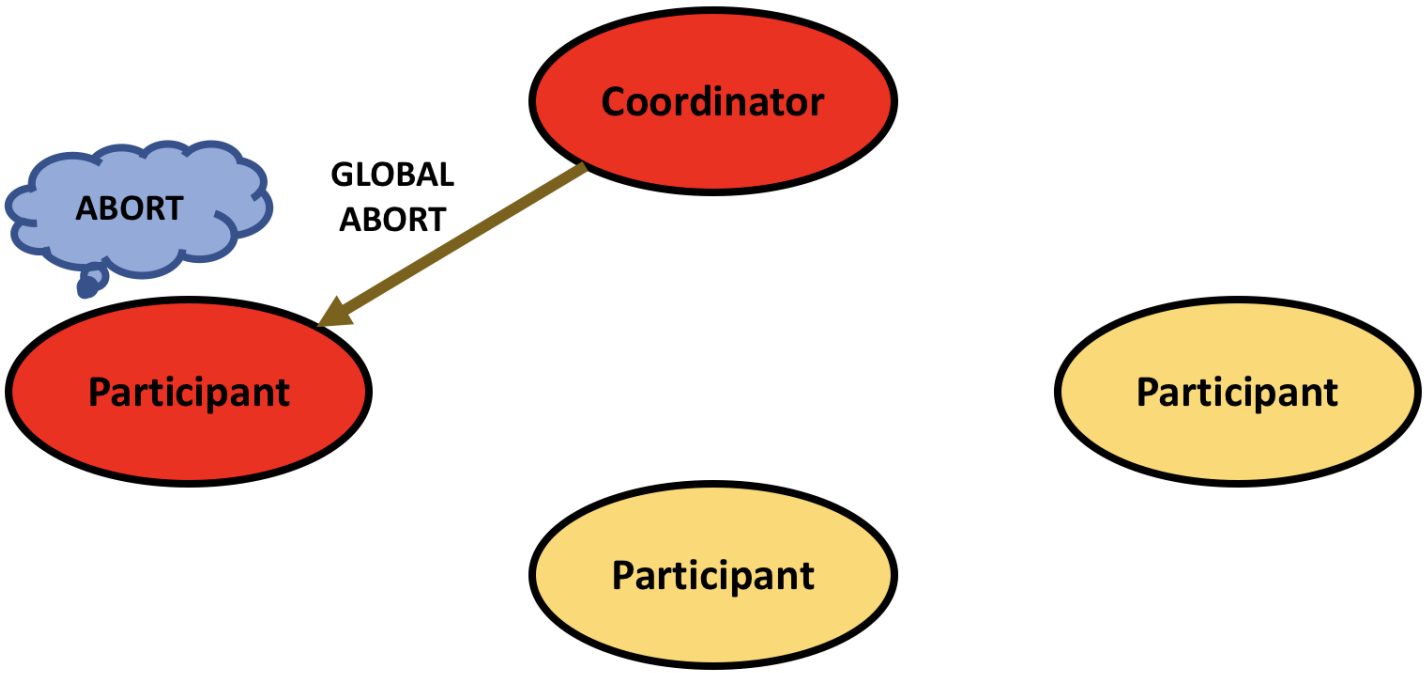

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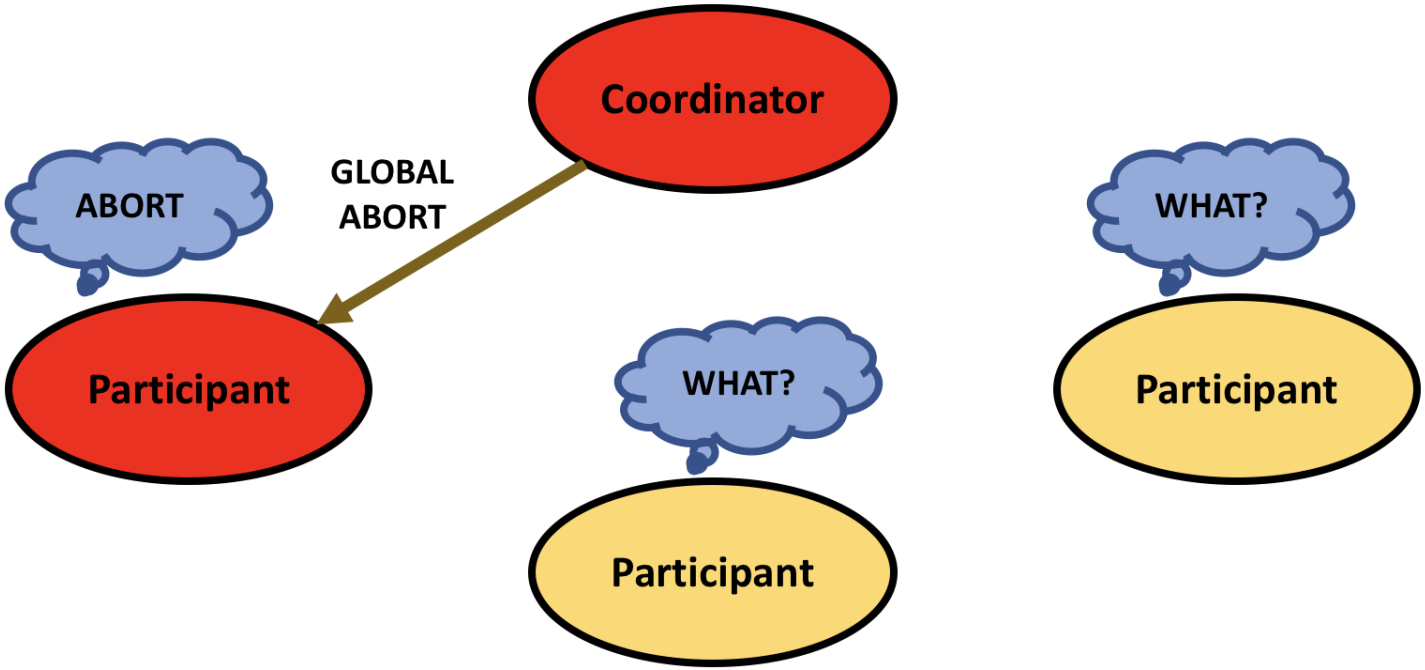

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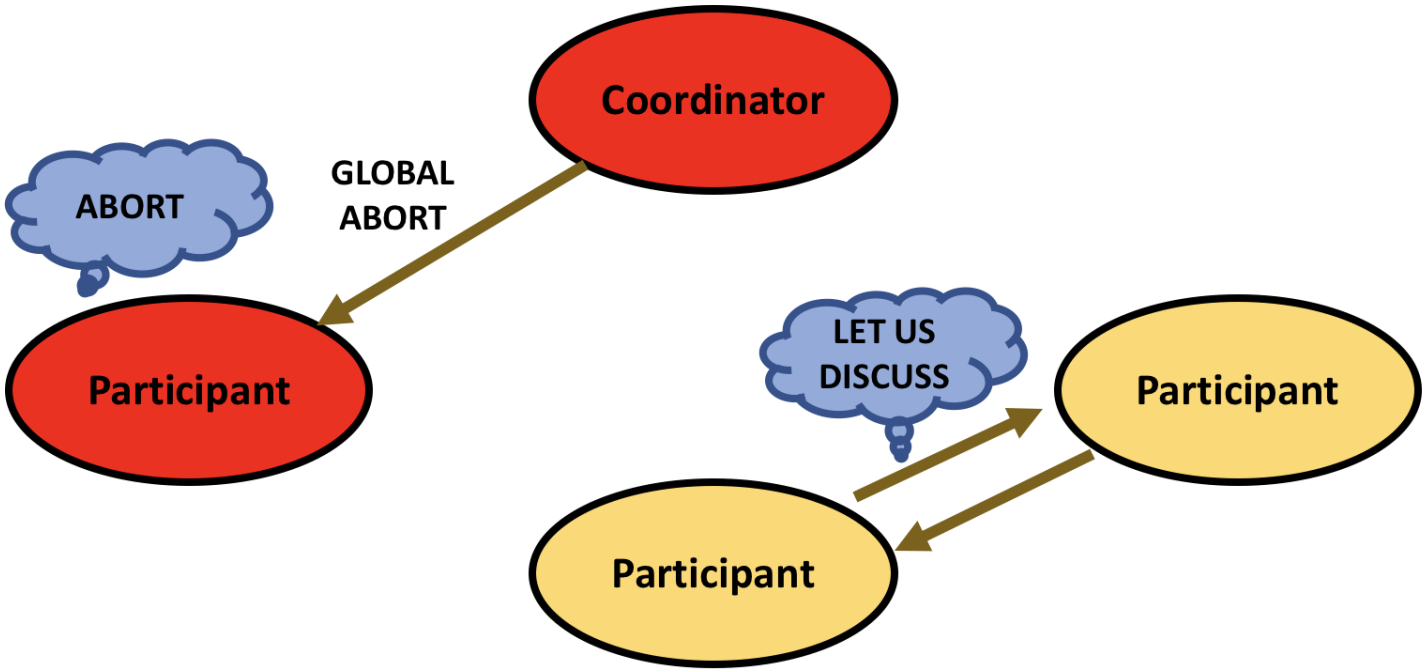

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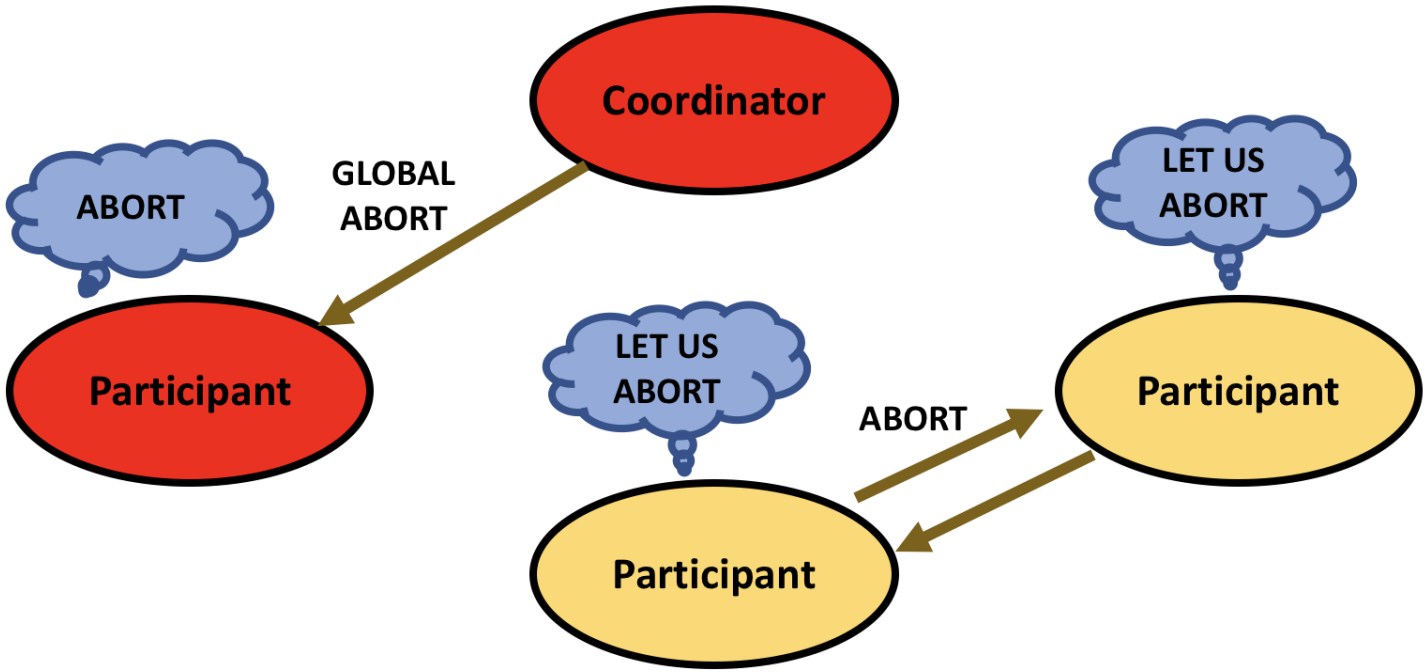

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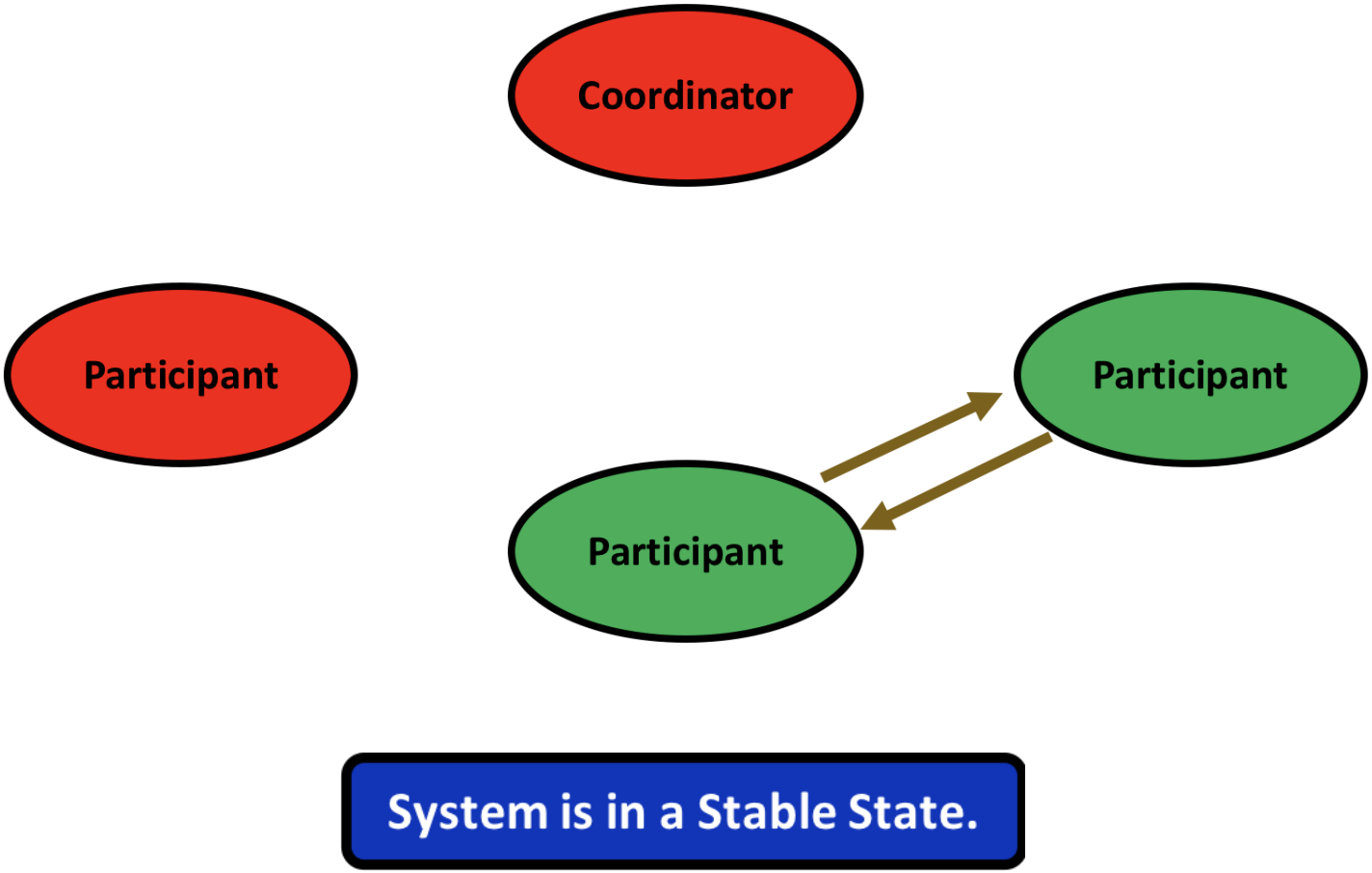
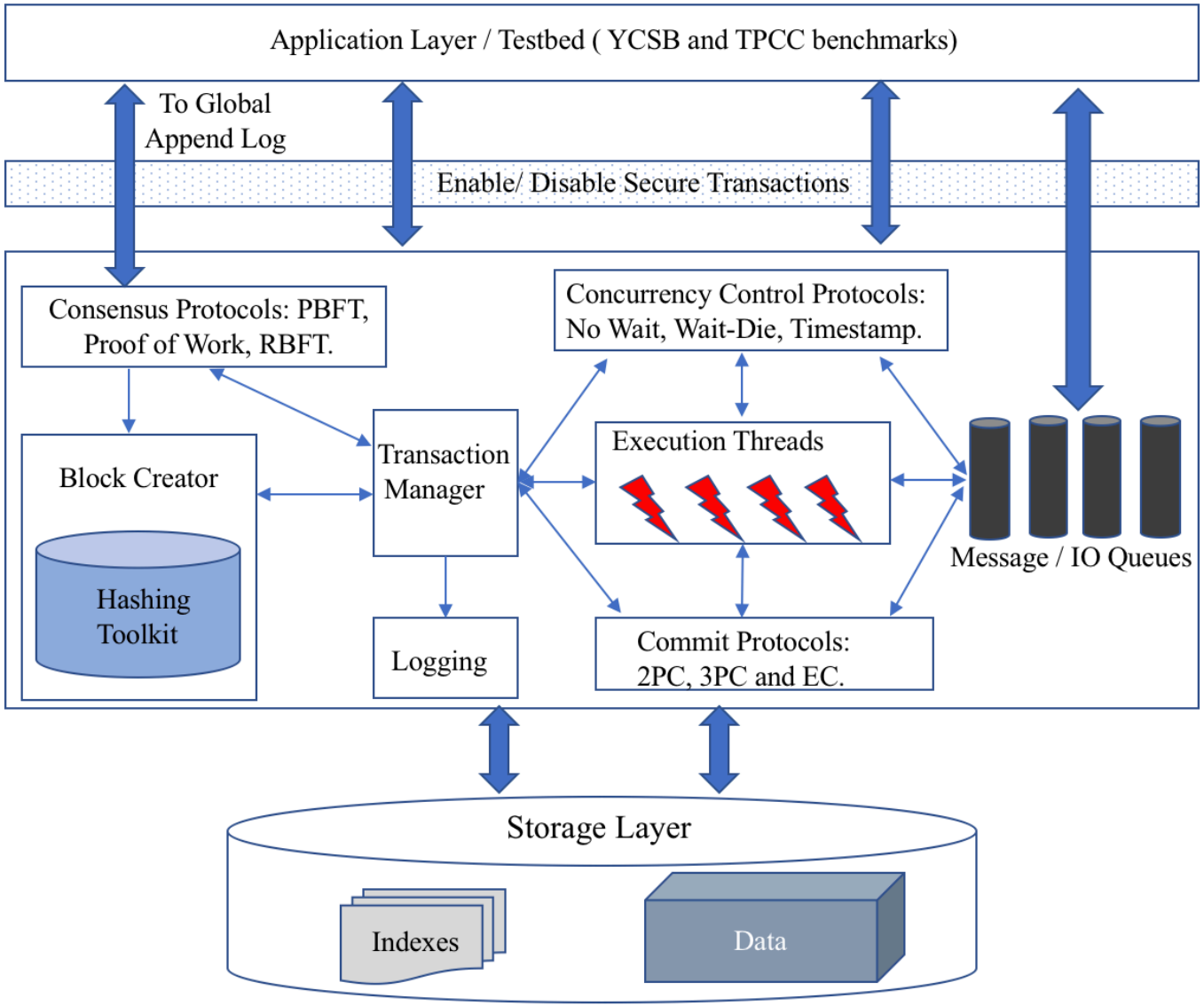


Implementation: ExpoDB



Evaluation

- 64 `Standard_D8S_V3` Azure instances, deployed in US East.
  - Each machine has 8 cores and 32GB memory.
- 4 Worker threads attached to a dedicated core.
- Load of 10000 open client connections per node.
- First 60s warmup and next 60s execution.
- Results averaged over three runs.
- NO-WAIT concurrency control algorithm used.
- Two benchmark suites: **YCSB** and **TPC-C**.

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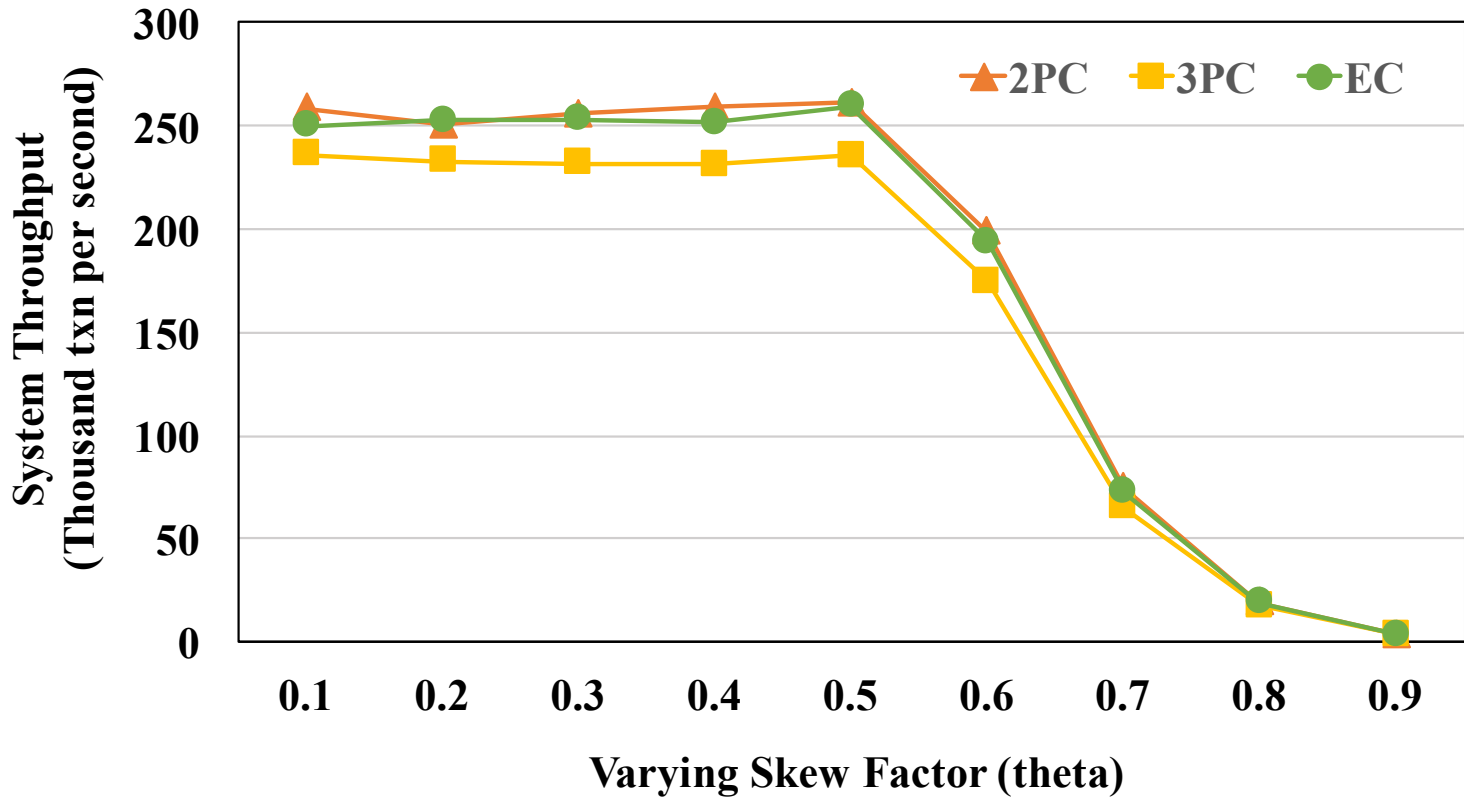
Varying Skew Factor – YCSB Zipfian Theta



Number of server nodes = 16 and partitions per transaction = 2.

On varying the YCSB skew factor, EasyCommit throughput is equivalent to 2PC.

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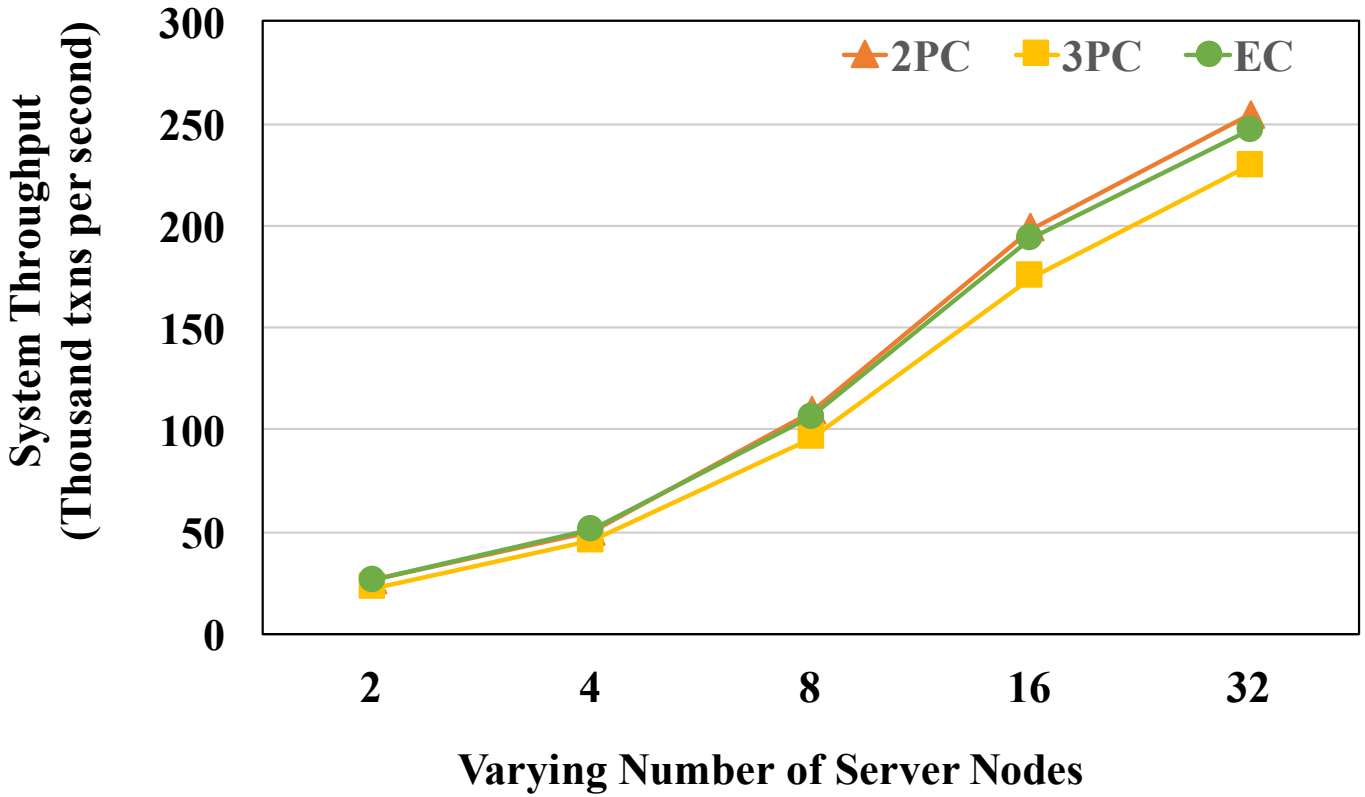
Varying Server Nodes



Partitions per transaction = 2 and Skew factor = 0.6.

EasyCommit is scalable as 2PC, on increasing the number of server nodes.

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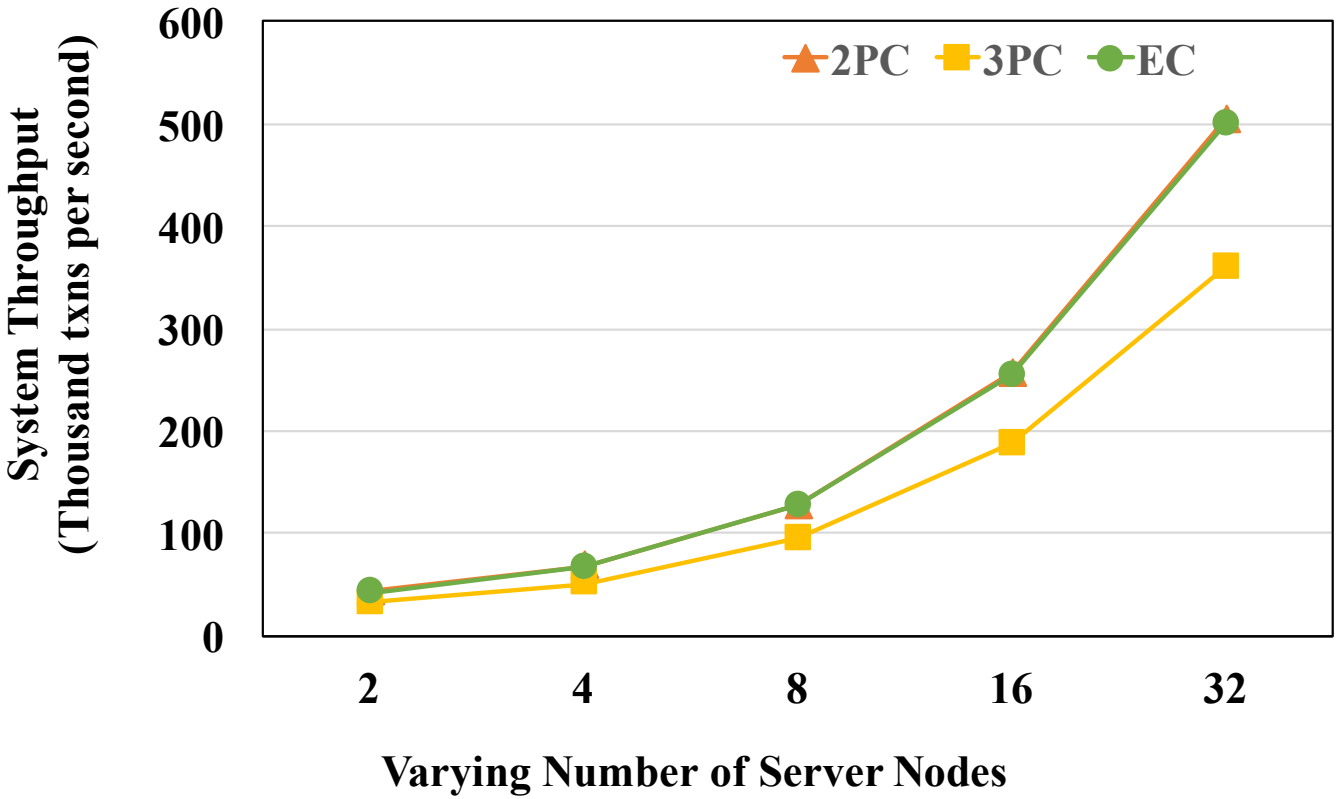
TPC-C Payment Transactions



Number of warehouses per server = 128.

EasyCommit is scalable as 2PC, on increasing the number of server nodes.

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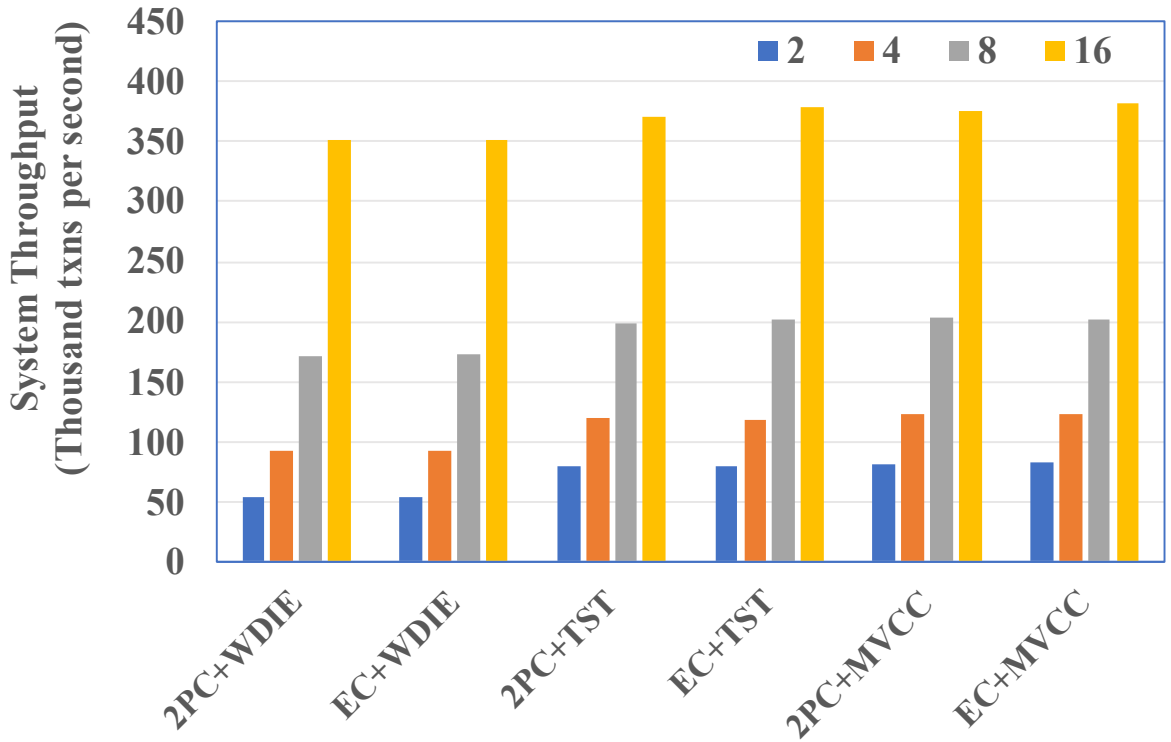
Varying Concurrency Control Algorithms



TPC-C benchmarking for 16 **servers,** 128 **warehouses per server and** 3 **CC algorithms: WDIE (**`WAIT-DIE`**) and TST (**`TIMESTAMP`**).**

EasyCommit design is orthogonal to underlying Concurrency Control.

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Conclusions

- We present novel commit protocol – **Easy Commit**.
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