# Transactions in shardman

Distributed transactions:

- Distributed atomicity
- Distributed isolation
- Profit! (distributed)

# Transactions in shardman

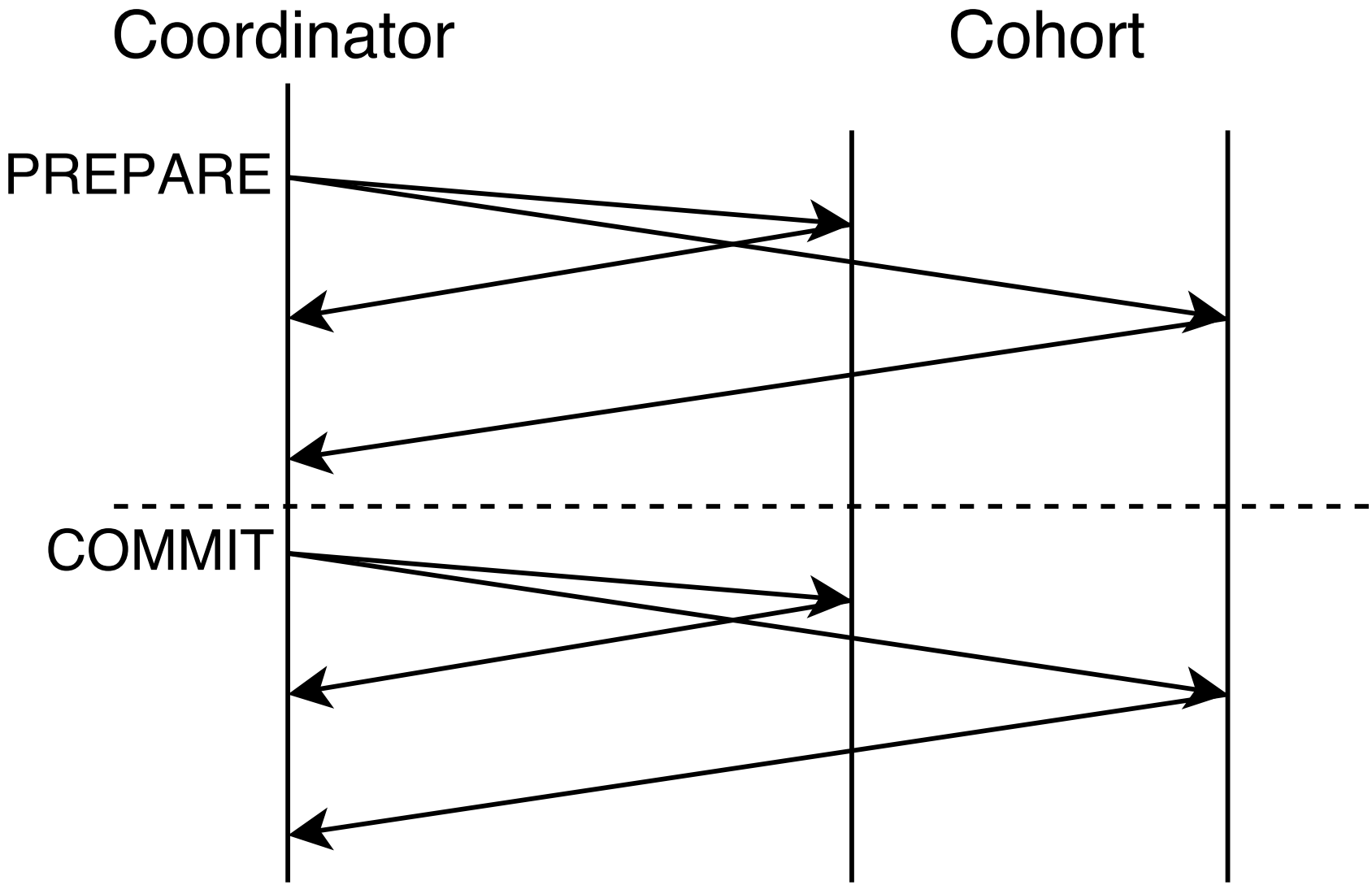
All reliable distributed systems are alike
each unreliable is unreliable in its own way.
Kyle Kingsbury and Leo Tolstoy.

# Transactions in shardman

Distributed transactions:

- Atomicity: 2PC
- Isolation: Clock-SI

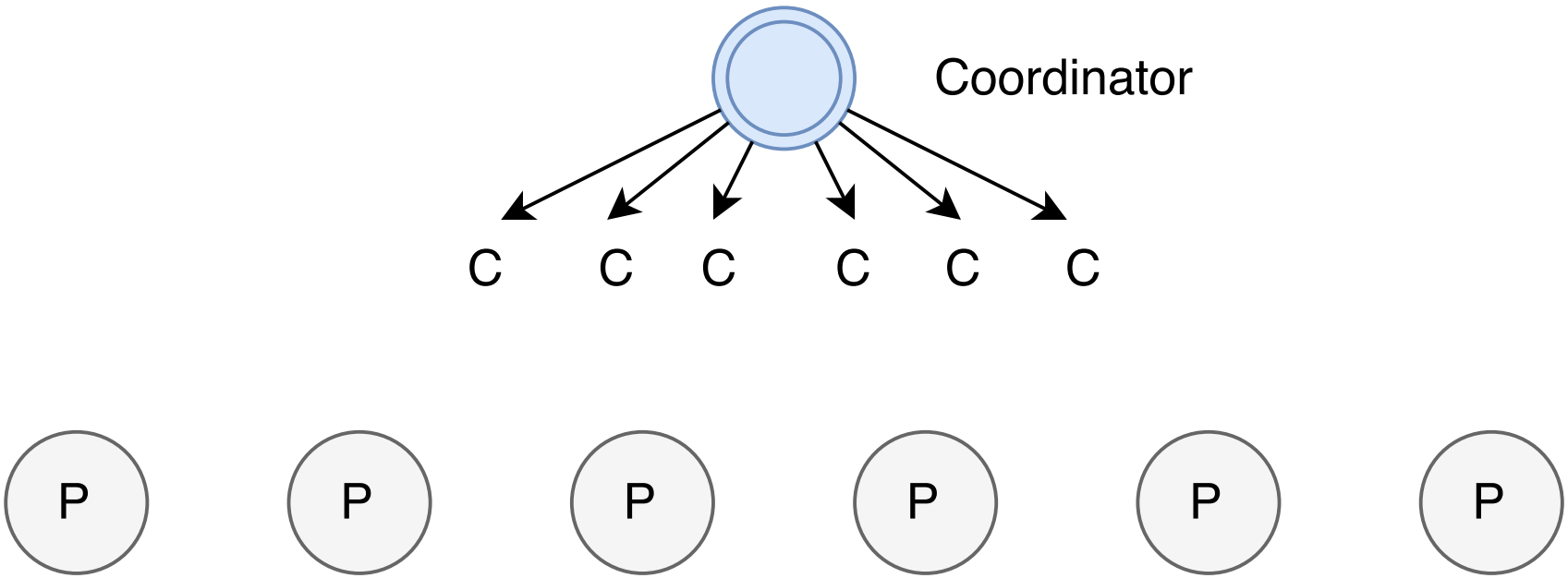
# Transactions in shardman: 2PC



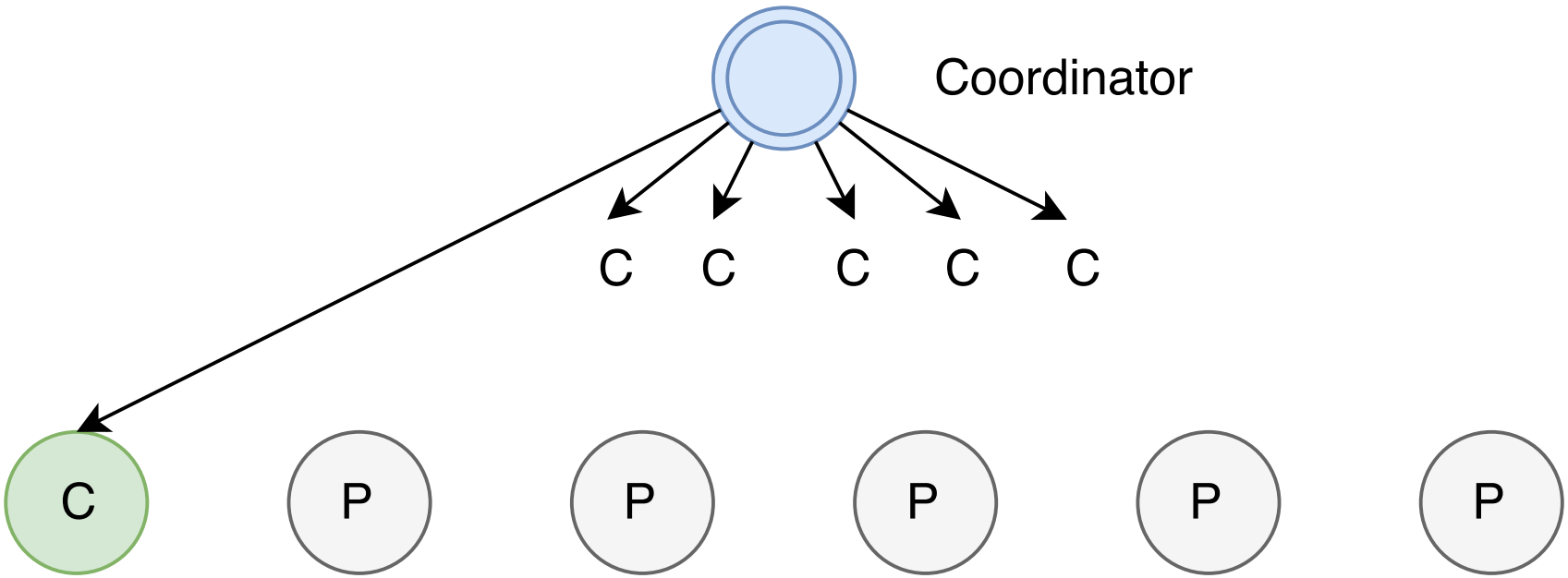
# Transactions in shardman: 2PC

Two-phase commit is the anti-availability protocol.
P. Helland. ACM Queue, Vol. 14, Issue 2, March-April 2016.

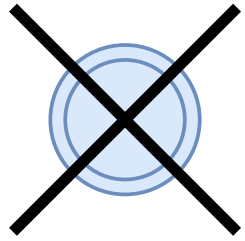
# Transactions in shardman: 2PC



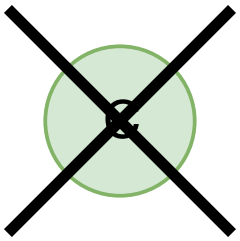
# Transactions in shardman: 2PC

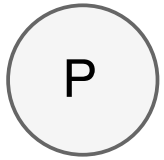


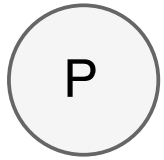
# Transactions in shardman: 2PC

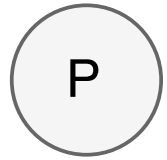


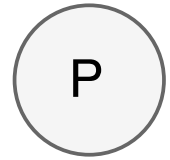
Coordinator

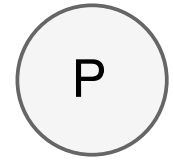




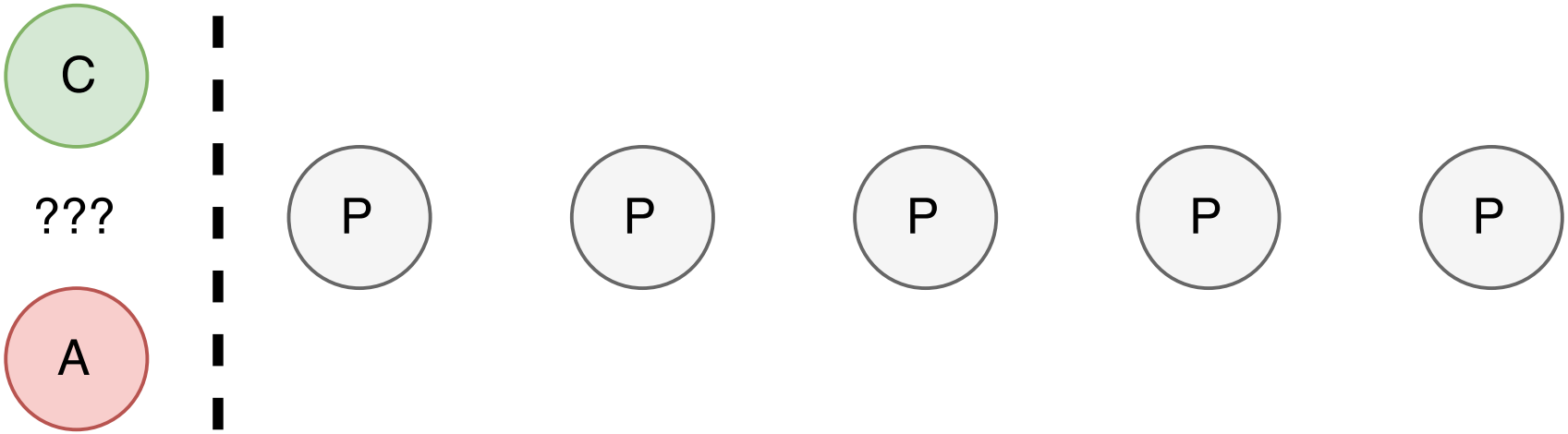



# Transactions in shardman: 2PC

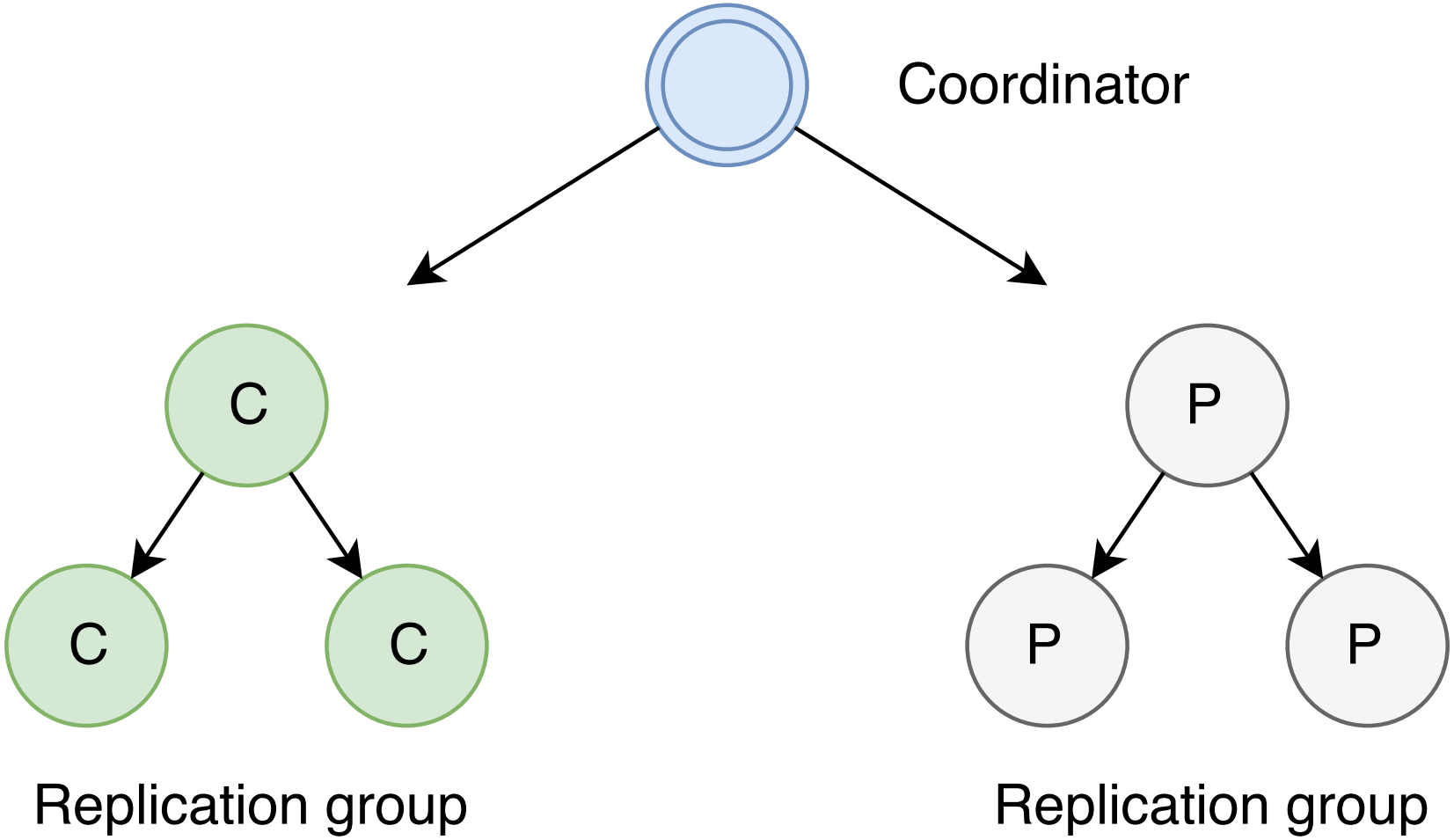


# Transactions in shardman: 2PC

So what we can do about it?

- Make 2PC fail-recovery tolerant: X3PC, Paxos Commit
- Back-up partitions!

# Transactions in shardman: 2PC



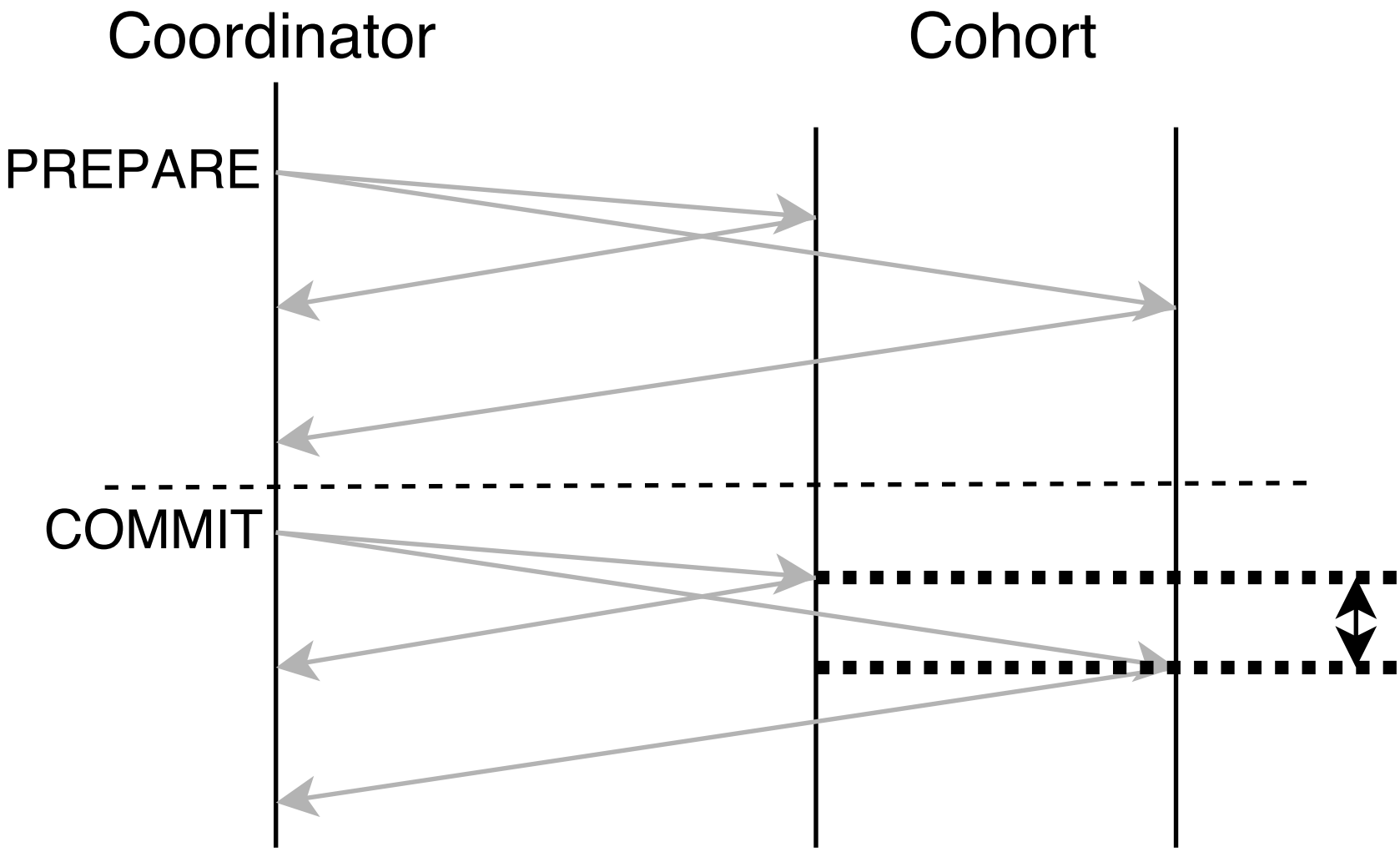
# Transactions in shardman: 2PC

Spanner mitigates this by having each member be a Paxos group, thus ensuring each 2PC "member" is highly available even if some of its Paxos participants are down.
Eric Brewer.

# Transactions in shardman: isolation

Profit? Not yet!

# Transactions in shardman: isolation



# Transactions in shardman: isolation

postgres_fdw.use_twophase = on
BEGIN;
UPDATE holders SET horns -= 1 WHERE holders.id = $id1;
UPDATE holders SET horns+= 1 WHERE holders.id = $id2;
COMMIT;
SELECT sum(horns_count) FROM holders;
-> 1
-> 2
-> 0
-> -2

# Transactions in shardman: isolation

MVCC in two sentences:

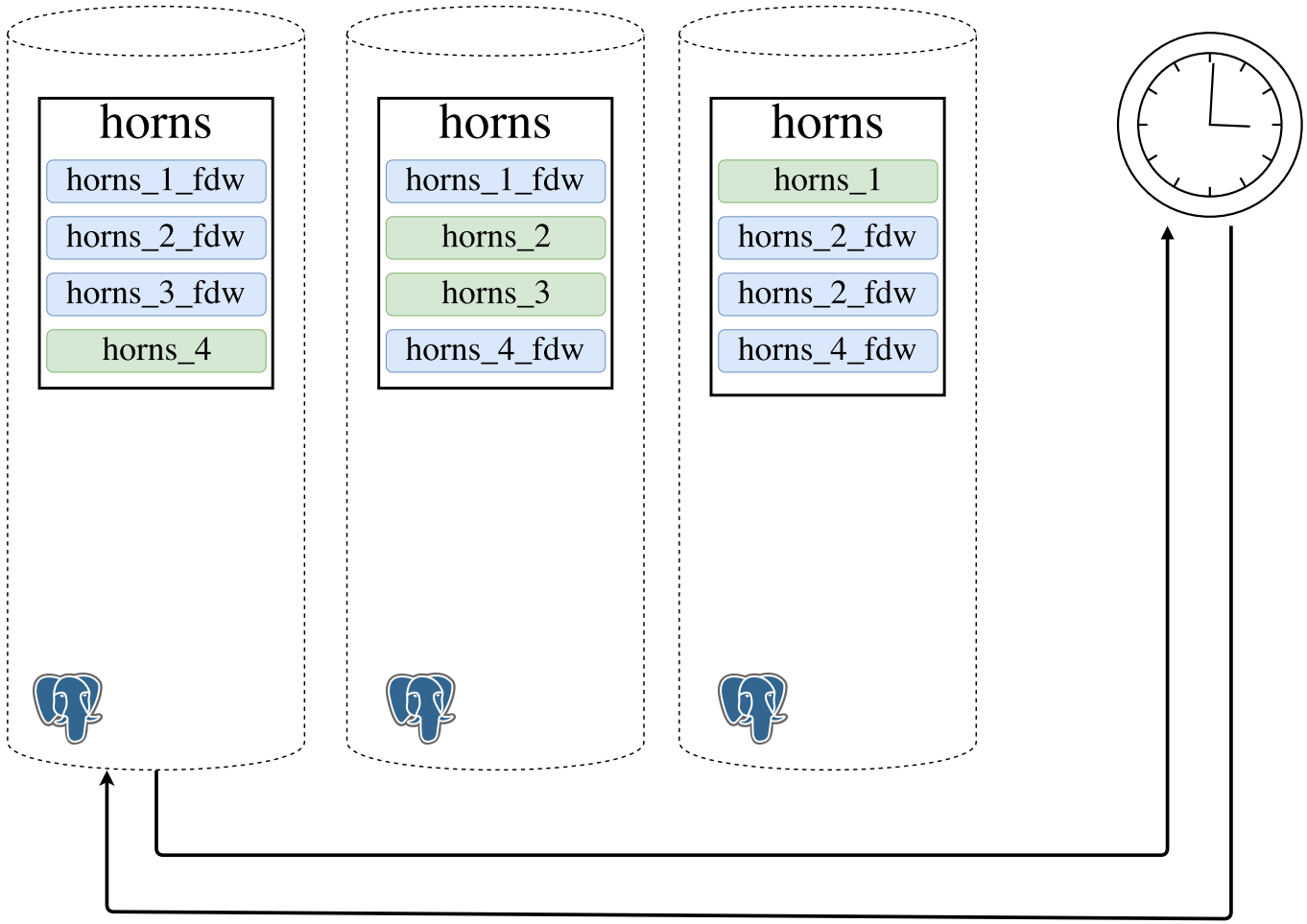
- UPDATE/DELETE create new tuple version, without in-place override
- Each tx gets current database version at start (xid, csn,timestamp) and able to see only appropriate versions.

$acc_1$

```
ver 10: {1, 0}
ver 20: {1, 2}
ver 30: {1, 4}
----- snapshot = 34 -----
ver 40: {1, 2}
```

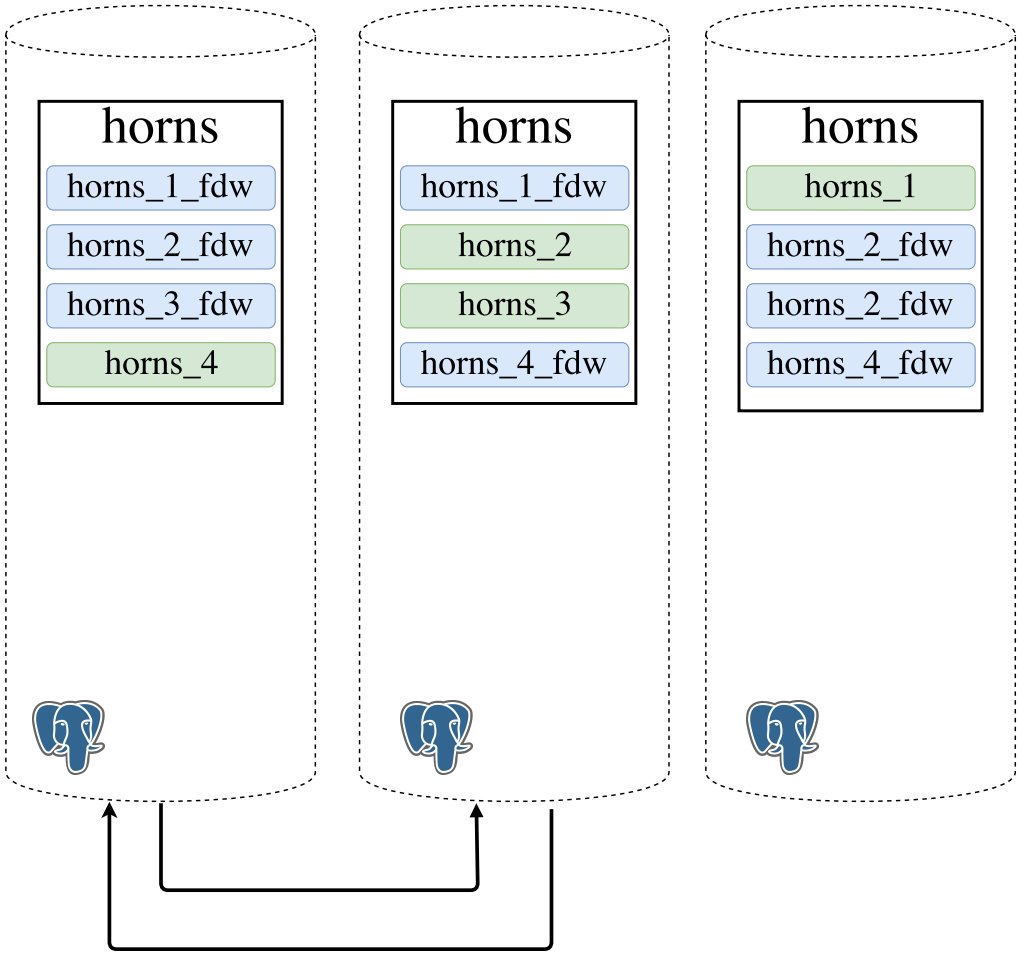
# Transactions in shardman: isolation

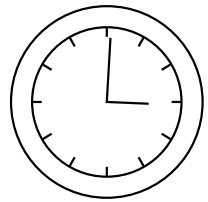
BEGIN



# Transactions in shardman: isolation

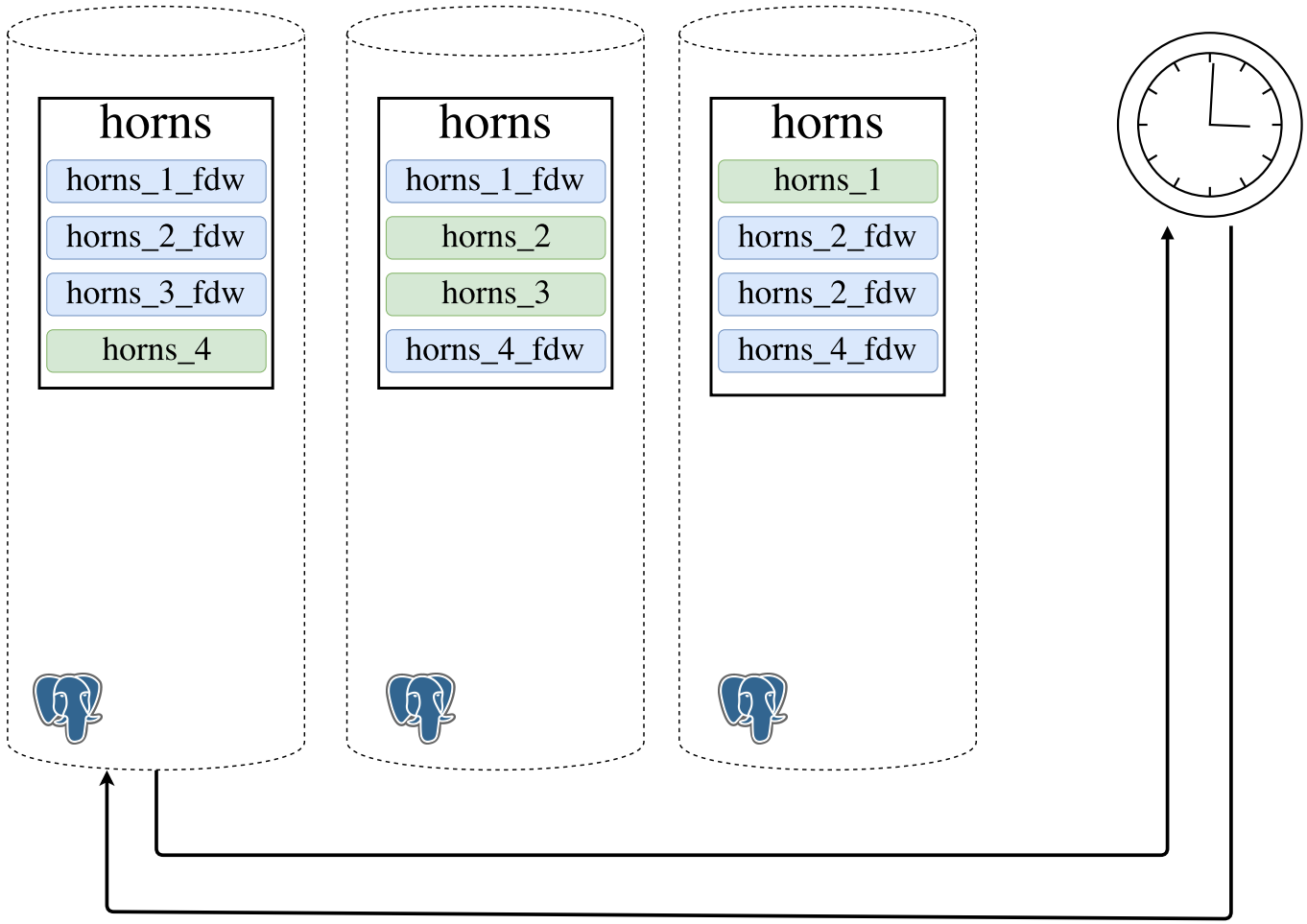
Do some serious stuff



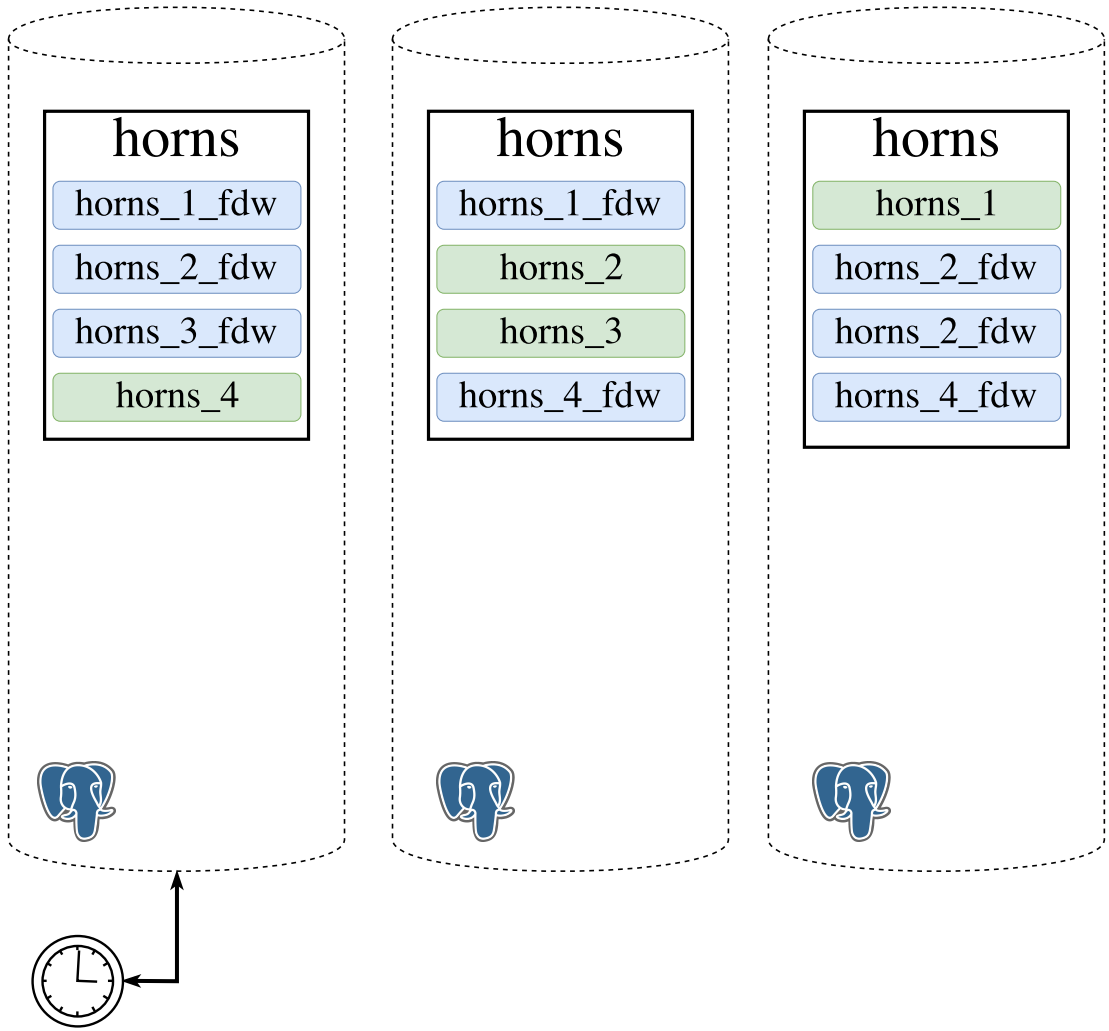
# Transactions in shardman: isolation

COMMIT



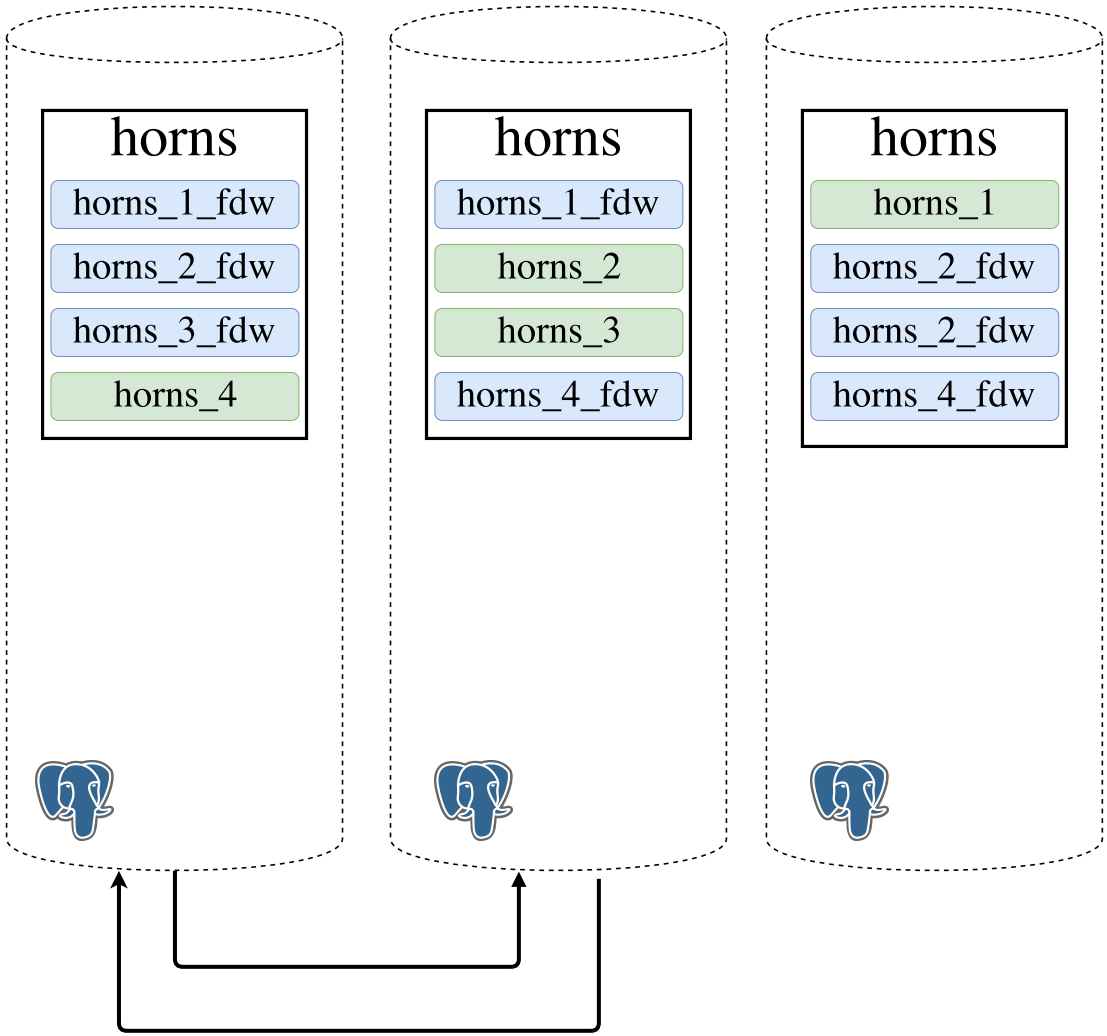
# Transactions in shardman: isolation

BEGIN



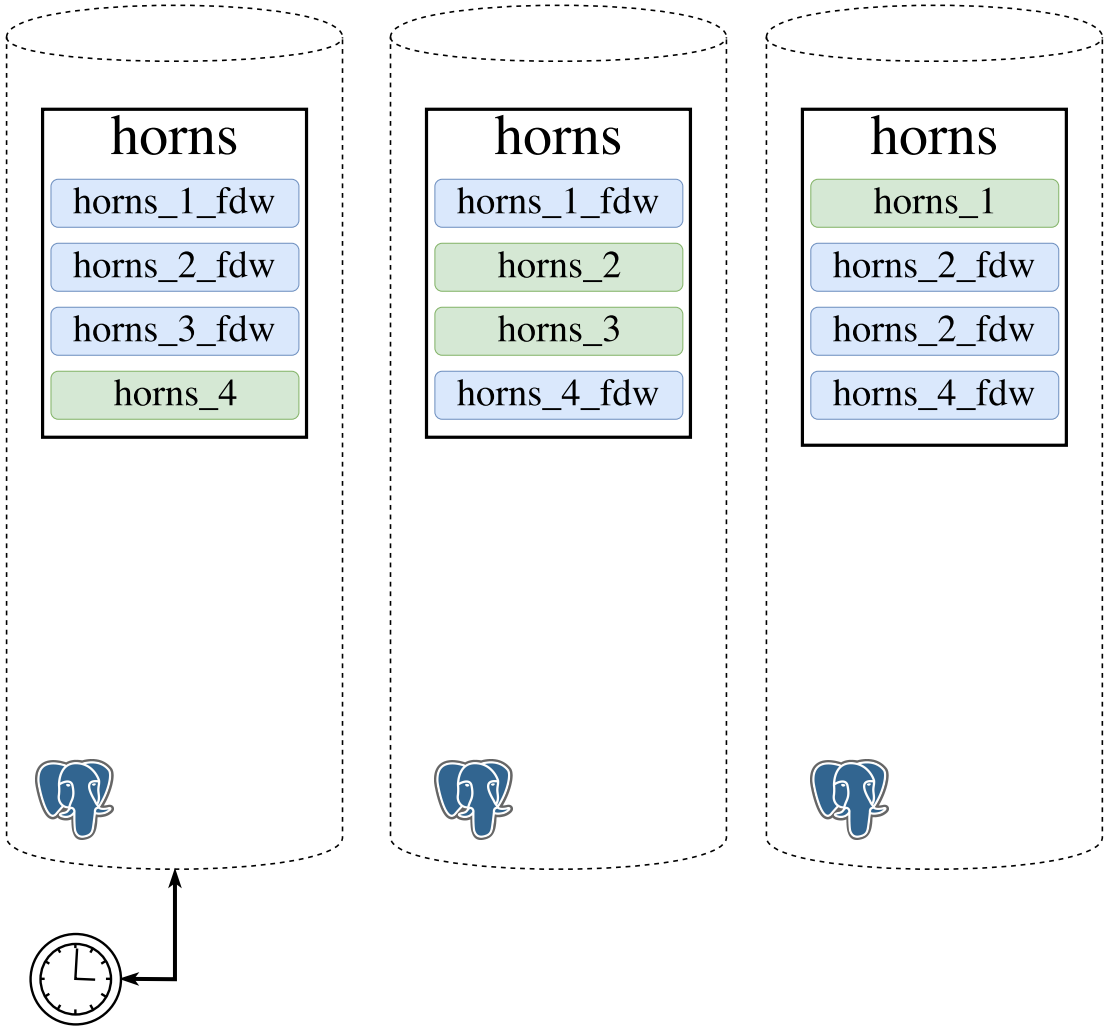
# Transactions in shardman: isolation

Do some serious web scale stuff



# Transactions in shardman: isolation

COMMIT



# Transactions in shardman: isolation

Clock-SI slightly changes visibility rules:
version = timestamp

- Visibility': Waits if tuple came from future. (Do not allow time-travel paradoxes!)
- Visibility'': Waits if tuple already prepared(P) but not yet commited(C).
- Commit': Receives local versions from partitions on Prepare and Commits with maximal version.

# Transactions in shardman

And that's it! Thank you.