Lockless Transaction Isolation in Hyperledger Fabric

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Hyperledger and Motivation for this Paper

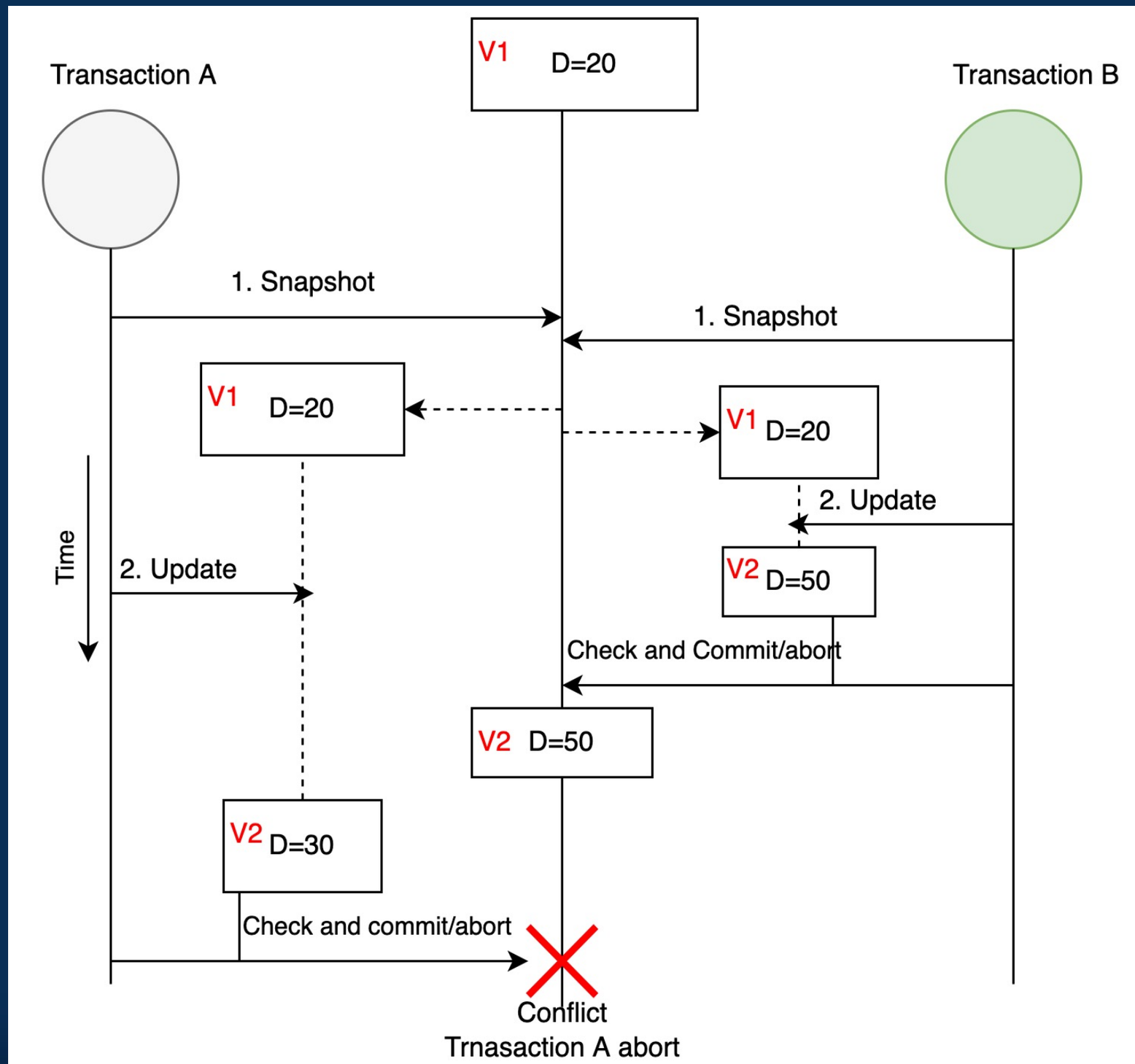
- Hyperledger Fabric platform is **an open source blockchain framework hosted by The Linux Foundation**
- In previous work, Transaction isolation is attained by locking the entire state database during simulation of transactions and database updates
- This lock is one of the major performance bottlenecks as observed by previous work

Main idea

- Provide lock-free approach for providing transaction isolation in Hyperledger Fabric
- Used the concept of multiversion concurrency control (MVCC); published in ACM; 1983
- Use savepoint as a boundary between transactions, and uses it to detect whether the simulated transaction is violating the transaction isolation
- When an isolation violation is detected, the transaction simulation is aborted

Multiversion concurrency control (MVCC)

- At any point in time, there will be multiple versions of the same data present for each concurrent process (transaction)
- But only one version is treated as the truth (let's call it the "master" data)



Proposed Algorithm

Algorithm 1 Simulation

```
1: savepoint ← ⊥

2: procedure BEGIN
3:     savepoint ← DB.GetSavePoint()

4: procedure GET(key)
5:     ⟨val,ver⟩ ← DB.GetState(key)
6:     if ⟨val,ver⟩ ≠ ⊥ then
7:         if ver > savepoint then return ERROR    ▷ abort
8:     return val
```

Simulation Example

Time	Tx	Op	Key	Val	Ver
1	tx1	read	savepoint	$\langle 100, 275 \rangle$	$\langle 100, 275 \rangle$
2	tx1	read	A	20	$\langle 100, 250 \rangle$
3	tx2	put	A	21	$\langle 101, 345 \rangle$
4	tx2	put	B	47	$\langle 101, 345 \rangle$
5	tx1	read	B	47	$\langle 101, 345 \rangle$
6	tx1	abort			

Example 1. Simulation abort

- tx1 performs a read of key A after which it performs a read of key B, while tx2 performs a put to key A and a put to key B
- read of key A returned before the commit of tx2, with an approved version, and the read of key B returned after, with a version definitely greater than the recorded savepoint
- So , in this proposed solution tx1 is aborted
- Only after the commit of the entire block, the savepoint is updated with the latest committed transaction number and block number.

Conclusion

- This work presented a new lock-free approach for providing transaction isolation in Hyperledger Fabric
- This solution outperforms the current implementation by 8.1x

Thank you!

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