



HYPERLEDGER  
**GLOBAL**  **FORUM**

PHOENIX, AZ | MARCH 3-6, 2020





# Hyperledger Sawtooth

## A Step by Step Guide to Advanced Smart-Contract Development



**Arun S M**  
Senior Software Engineer  
Walmart Labs



**Manjunath A C**  
Software Development Engineer  
Intel



PHOENIX, AZ | MARCH 3-6, 2020

NAMASTE PHOENIX  
Greetings!

# AGENDA

## Recap

What is Blockchain?

Demystifying the **Hyperledger Sawtooth** – Essentials

Heading Towards Sawtooth 2.0

## Sawtooth Smart Contracts

Design Patterns – Doing it the right way!

On-chain Smart Contracts – Sabre

Batch Injection

## Hands On!

Build and Deploy your own “Smart Contract”



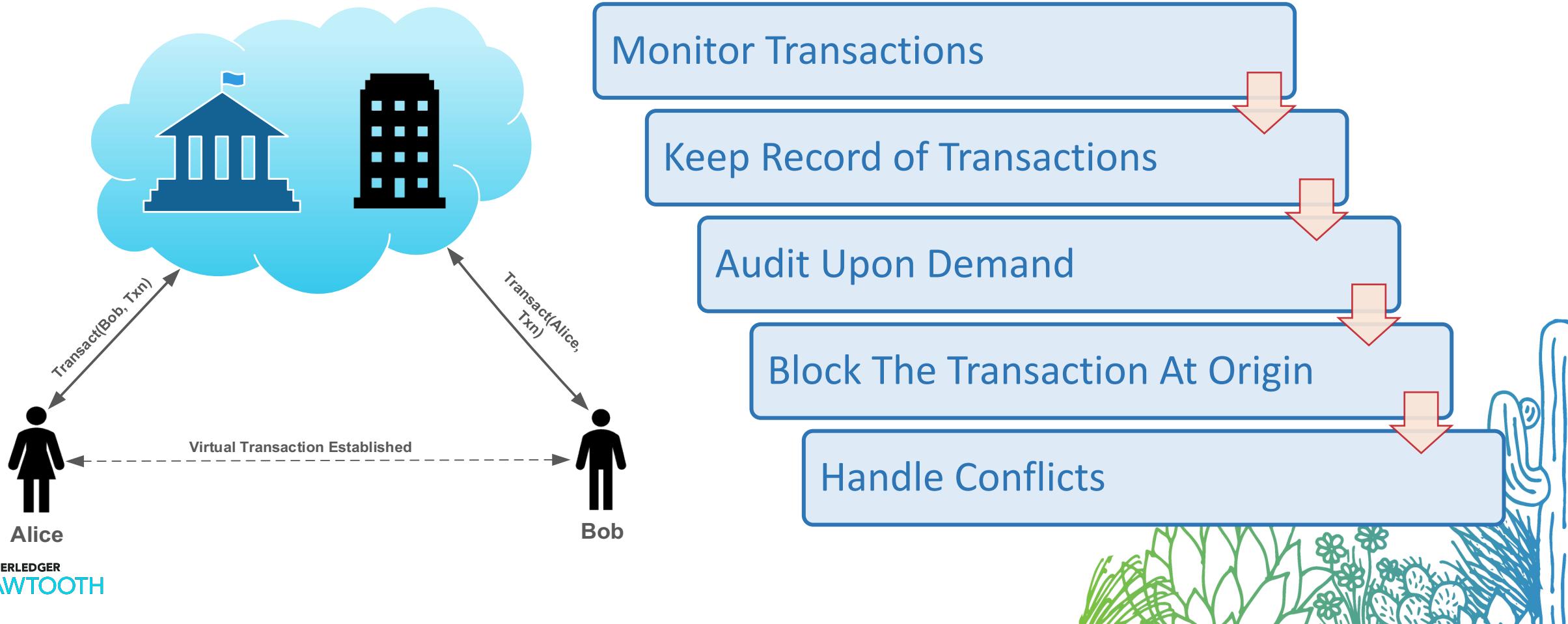


PHOENIX, AZ | MARCH 3-6, 2020

## Blockchain Recap



# Transaction in Presence of Trusted Third Party

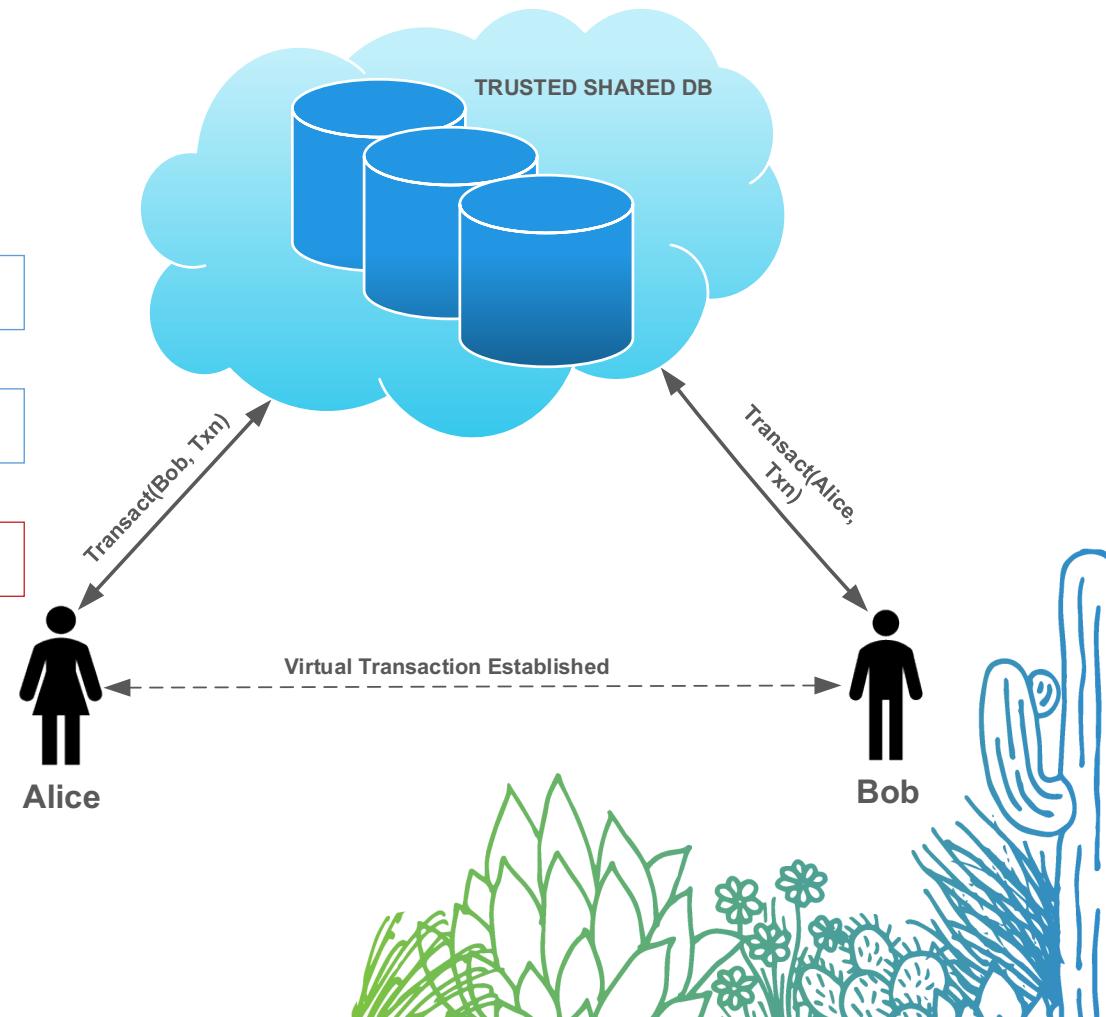


# Transaction in Presence of Trusted Third Party

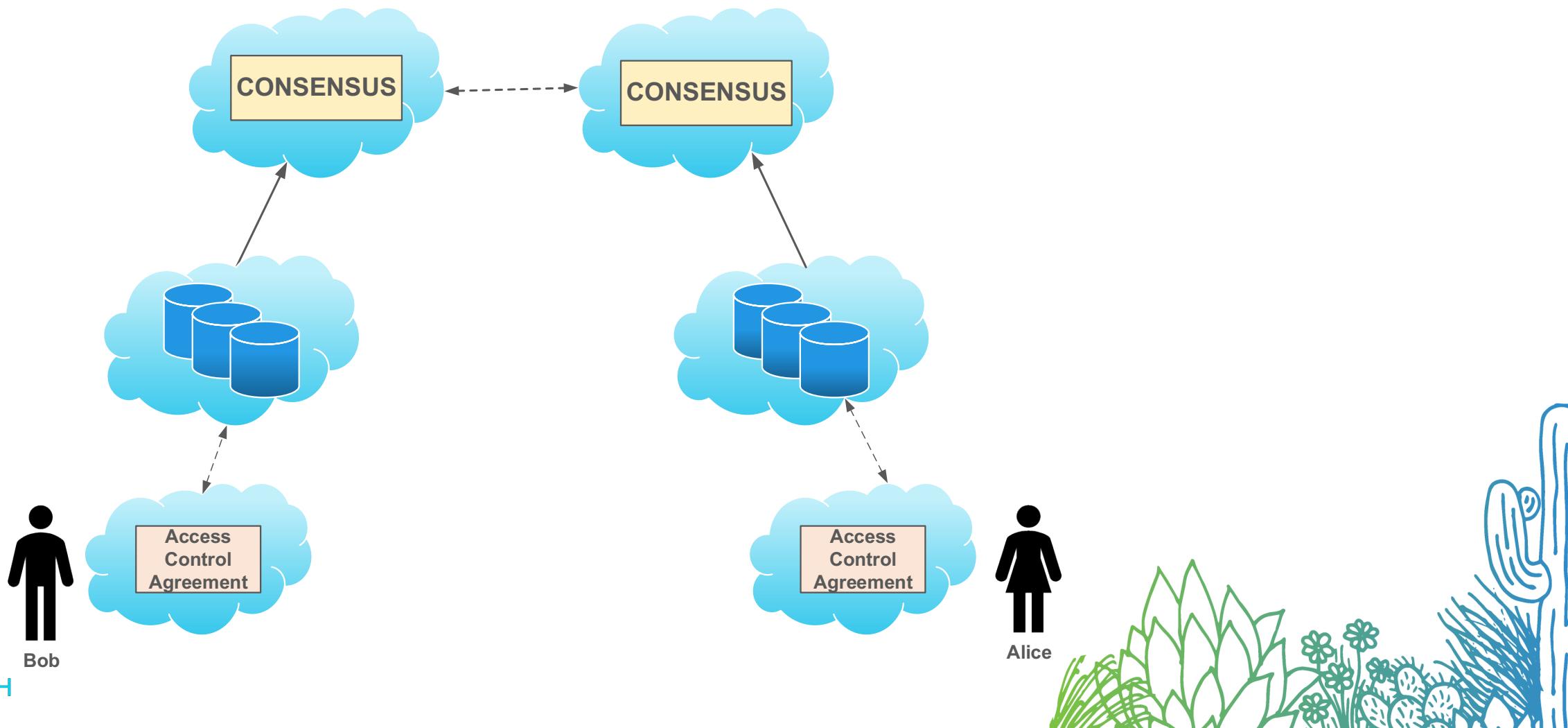
Both Parties Agree to Use Common Database

Access to Database is Restricted Through a Software

Question: Who Maintains? What Happens if Compromised?



# Distributed and Decentralized Approach to the Trust



# What is Blockchain?

## NETWORK

replicates a database (ledger) of transactions to all the participants with their consent

**DISTRIBUTED**

**DECENTRALIZED**

**IMMUTABLE**

**SECURE ACCESS**



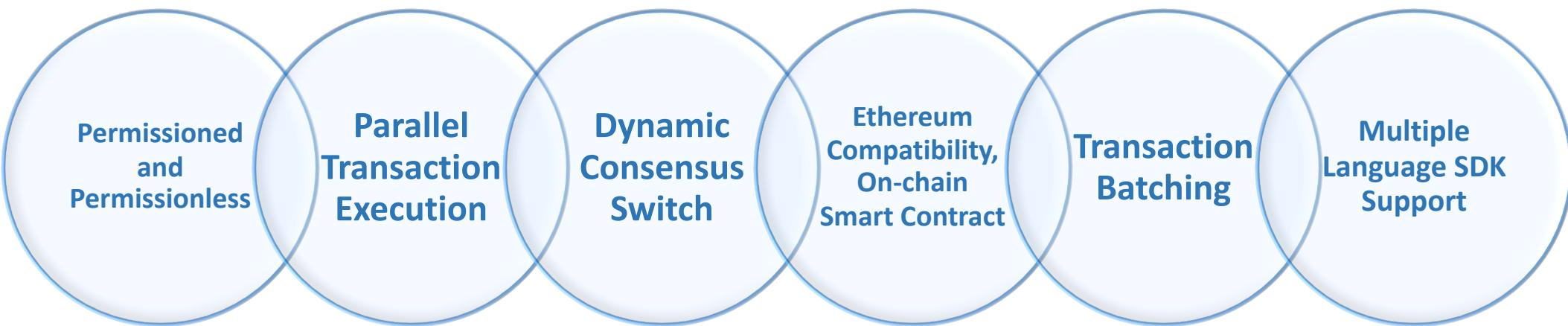


PHOENIX, AZ | MARCH 3-6, 2020

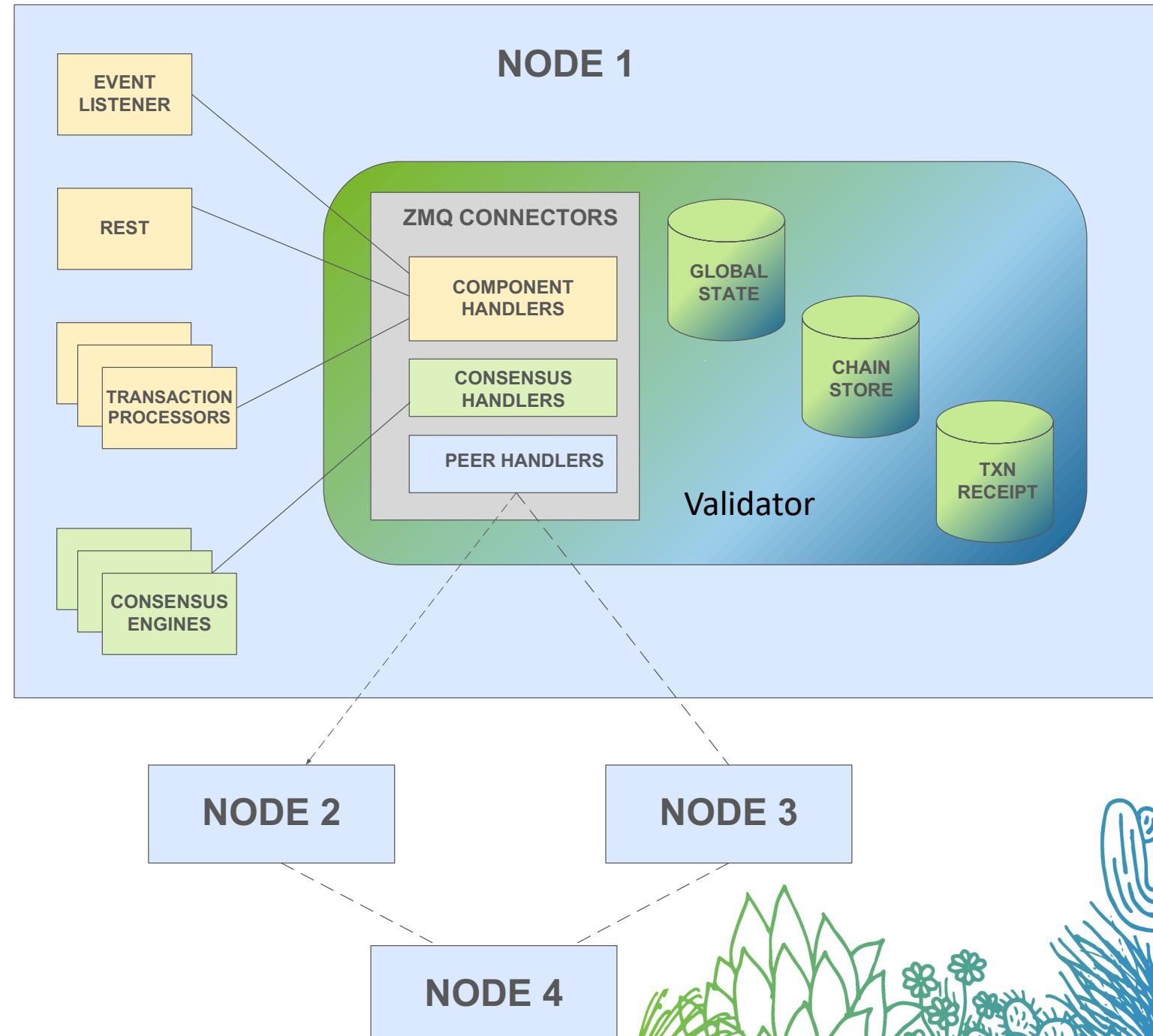
## Hyperledger Sawtooth



## Highly Modular Enterprise Blockchain Platform

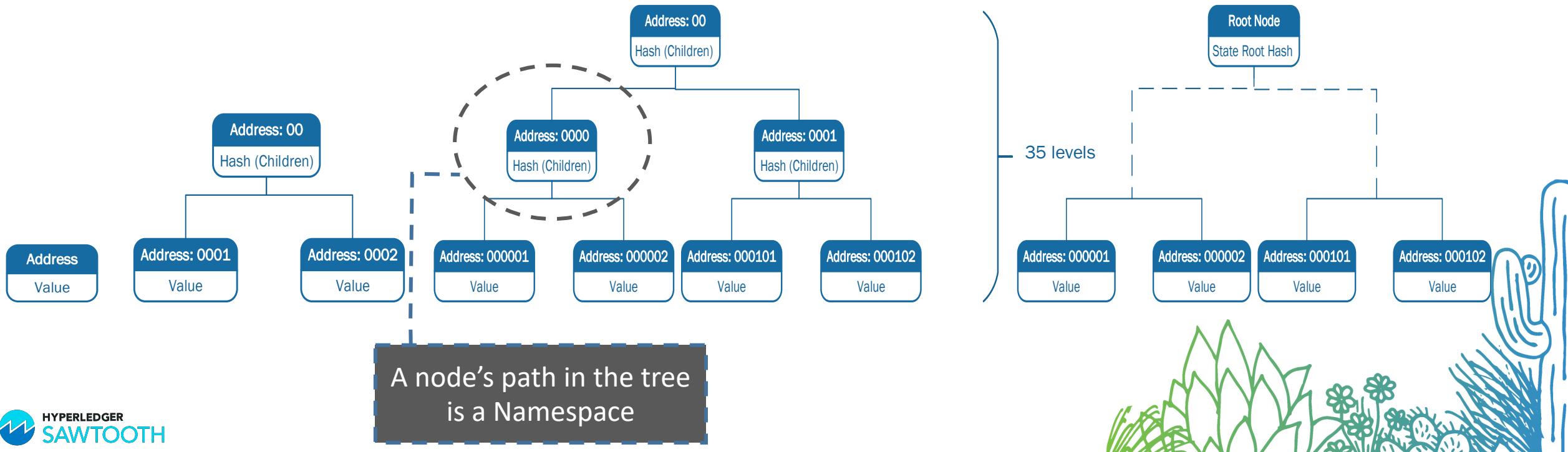


# Component Architecture

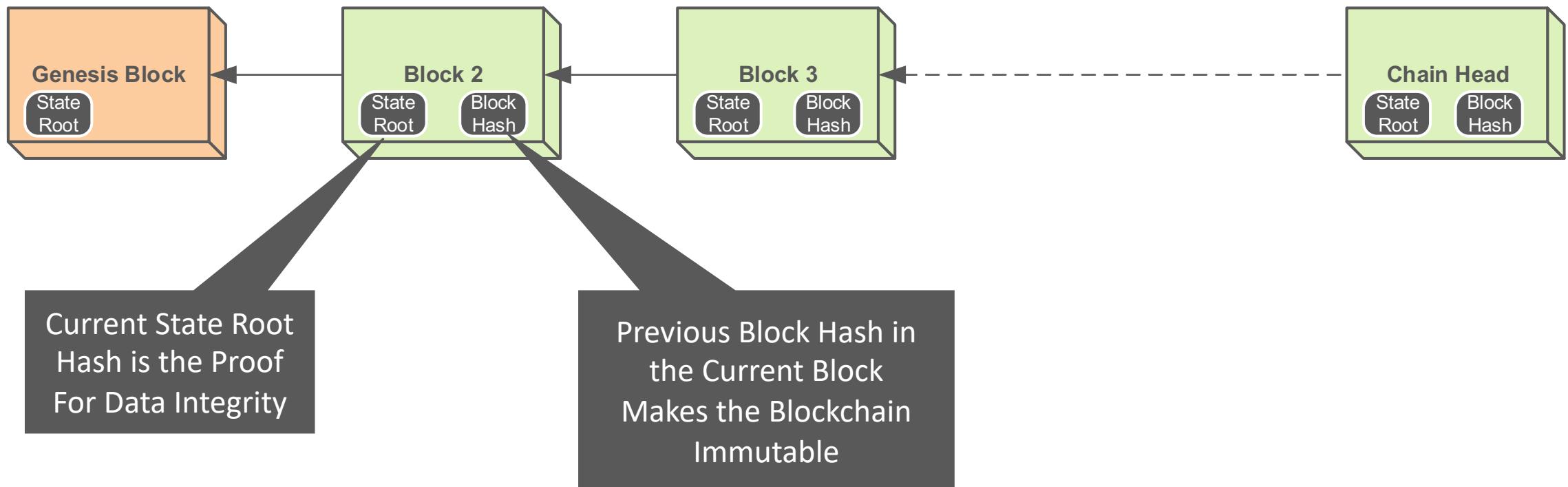


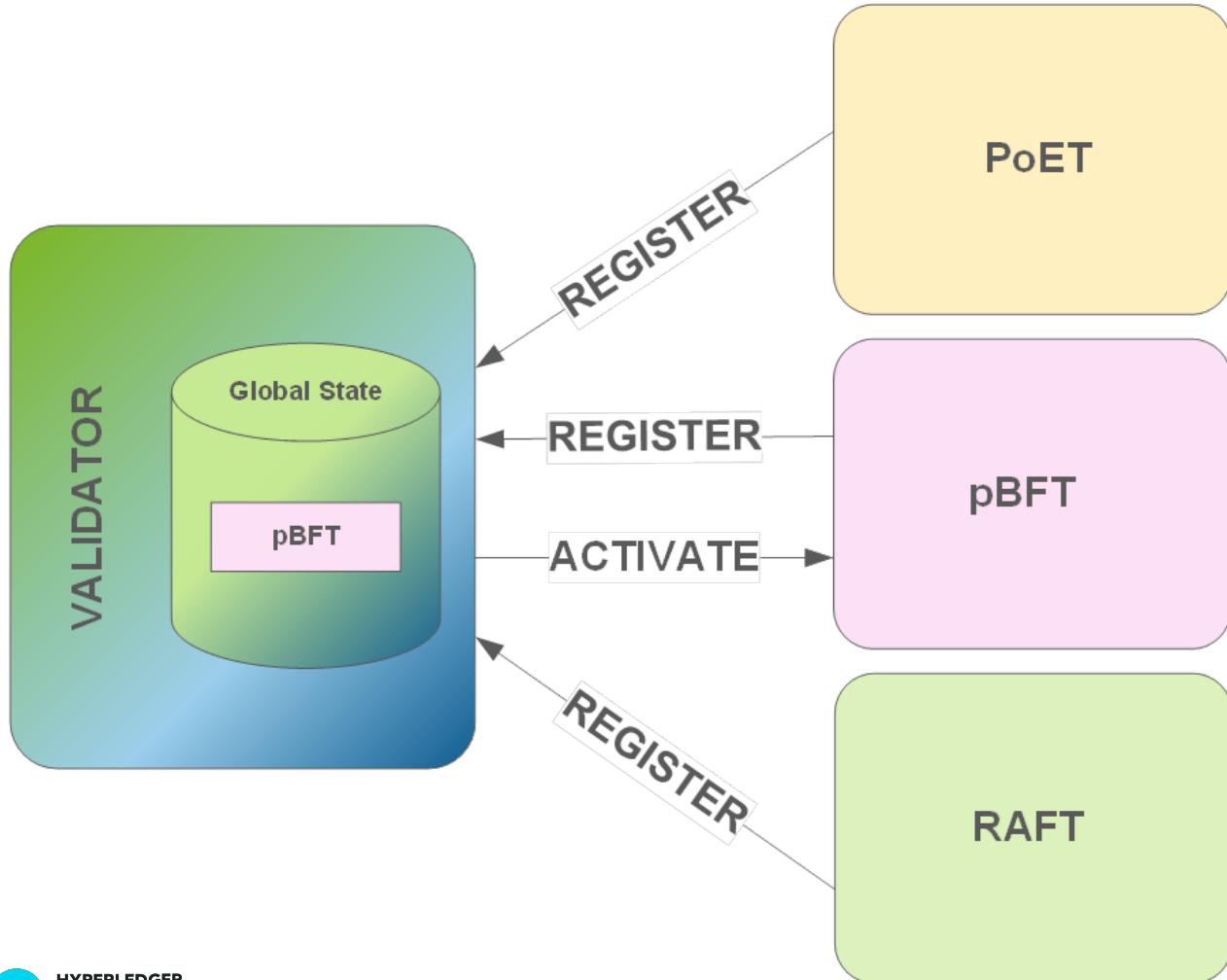
# Global State and Addressing

Data For All The Transaction Families Are Stored In  
A Single Instance Of **Merkle-Radix** Trie



# State and the Block



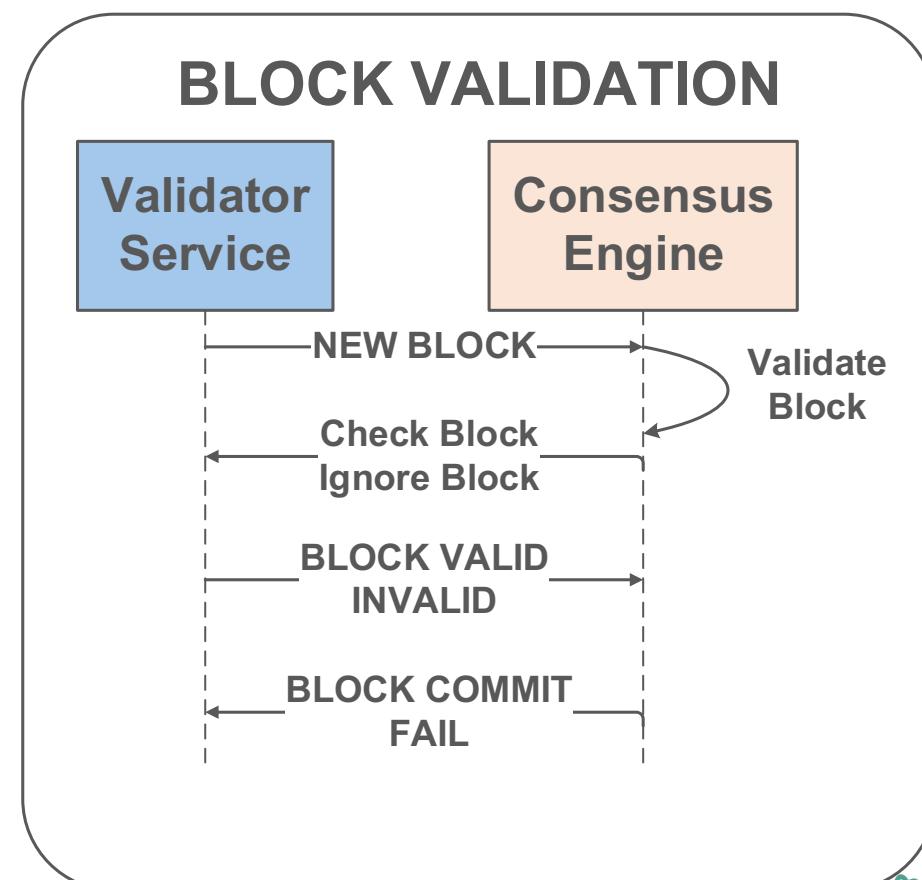
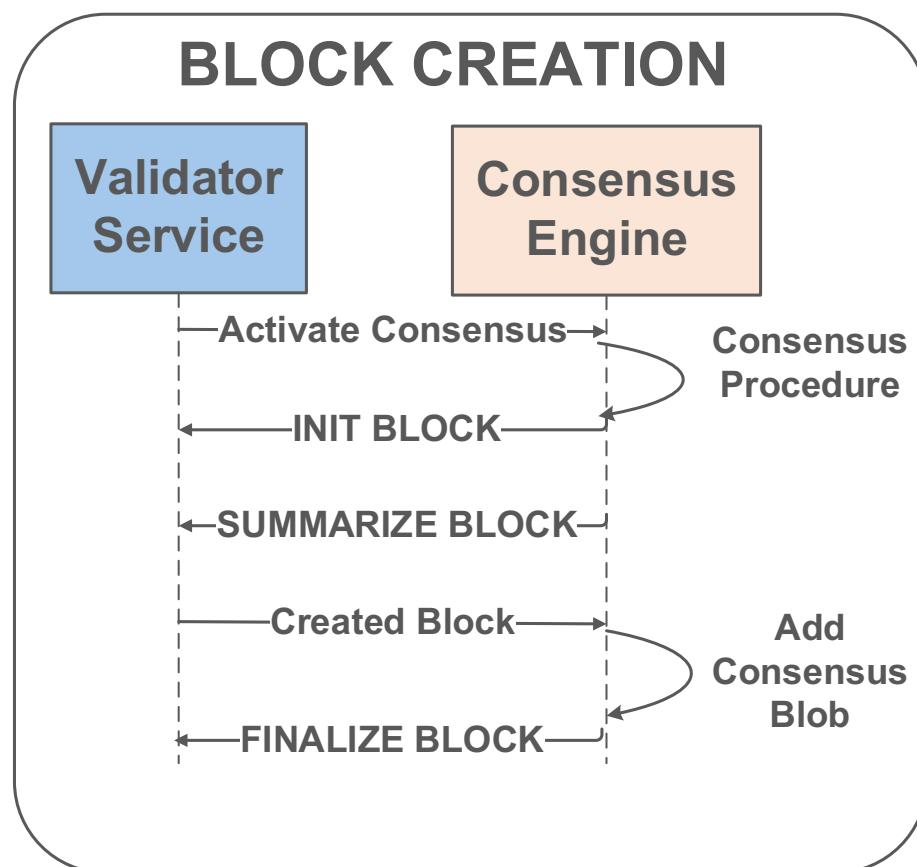


# Consensus Engine

Mechanism By Which Blockchain  
Nodes Agree Upon State

CFT	BFT
PoET SIM, RAFT	PBFT, PoET SGX
Forking	Fast Finality
PoET SIM, PoET SGX, Devmode	RAFT, PBFT

# Consensus Engine Interaction

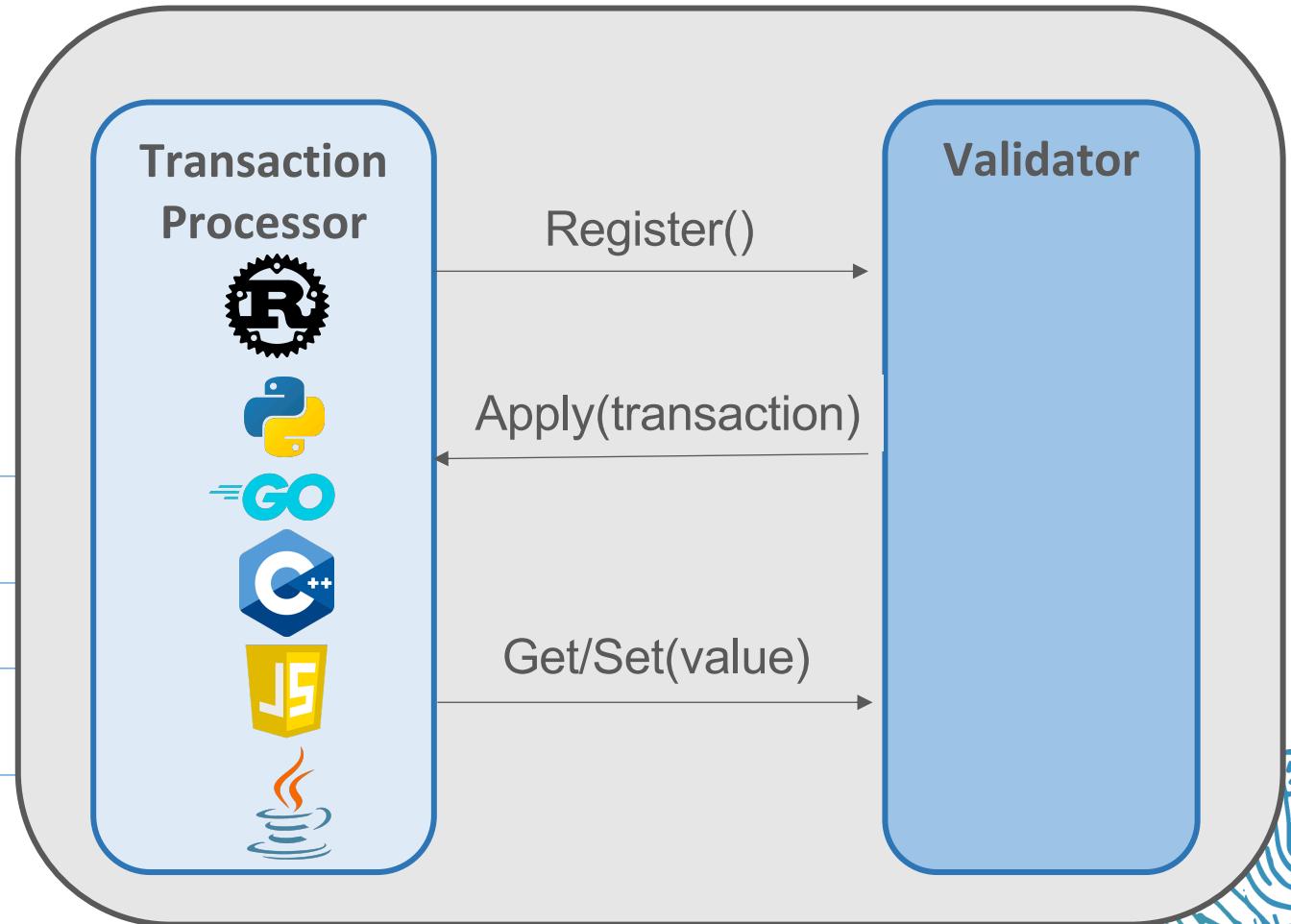


# Transaction Processor

An **Engine** that Executes Application Business Logic

Accepts the Context From the Validator

Read/Write the State As Per Contract

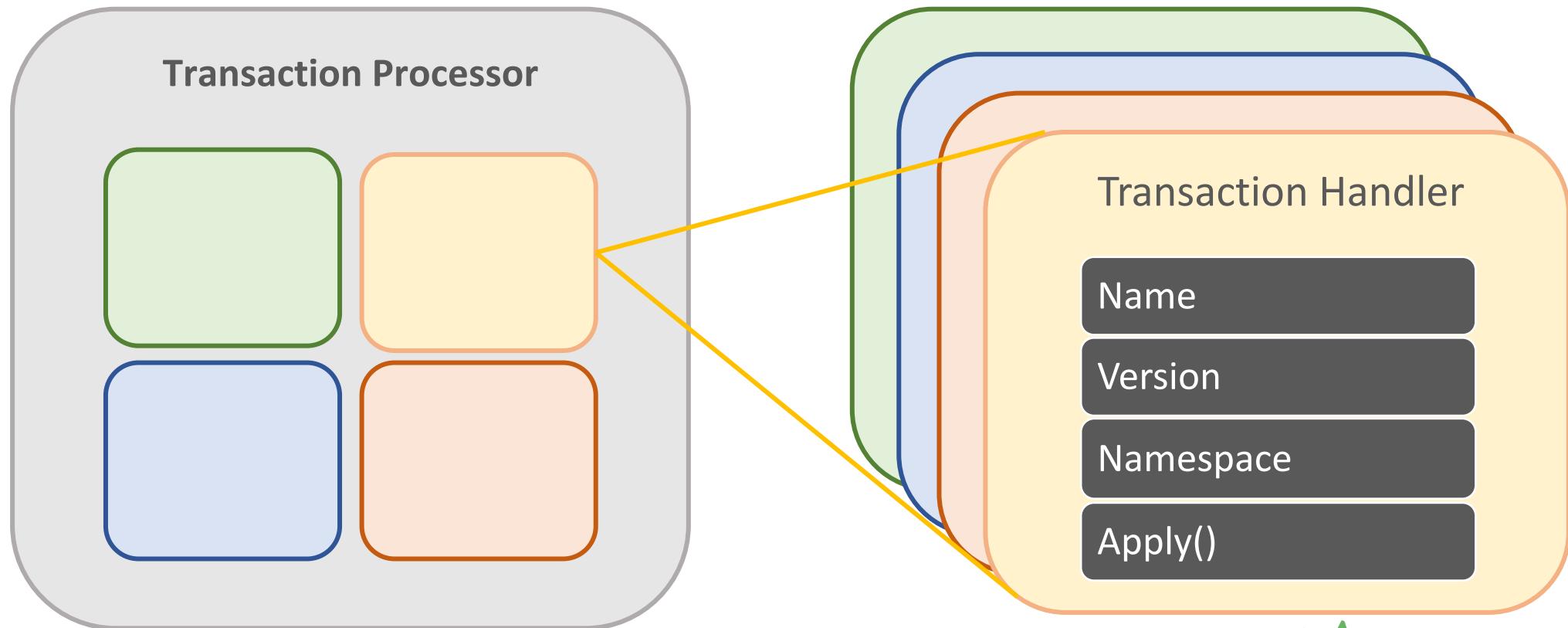




HYPERLEDGER  
**GLOBAL** FORUM

PHOENIX, AZ | MARCH 3-6, 2020

# Transaction Families

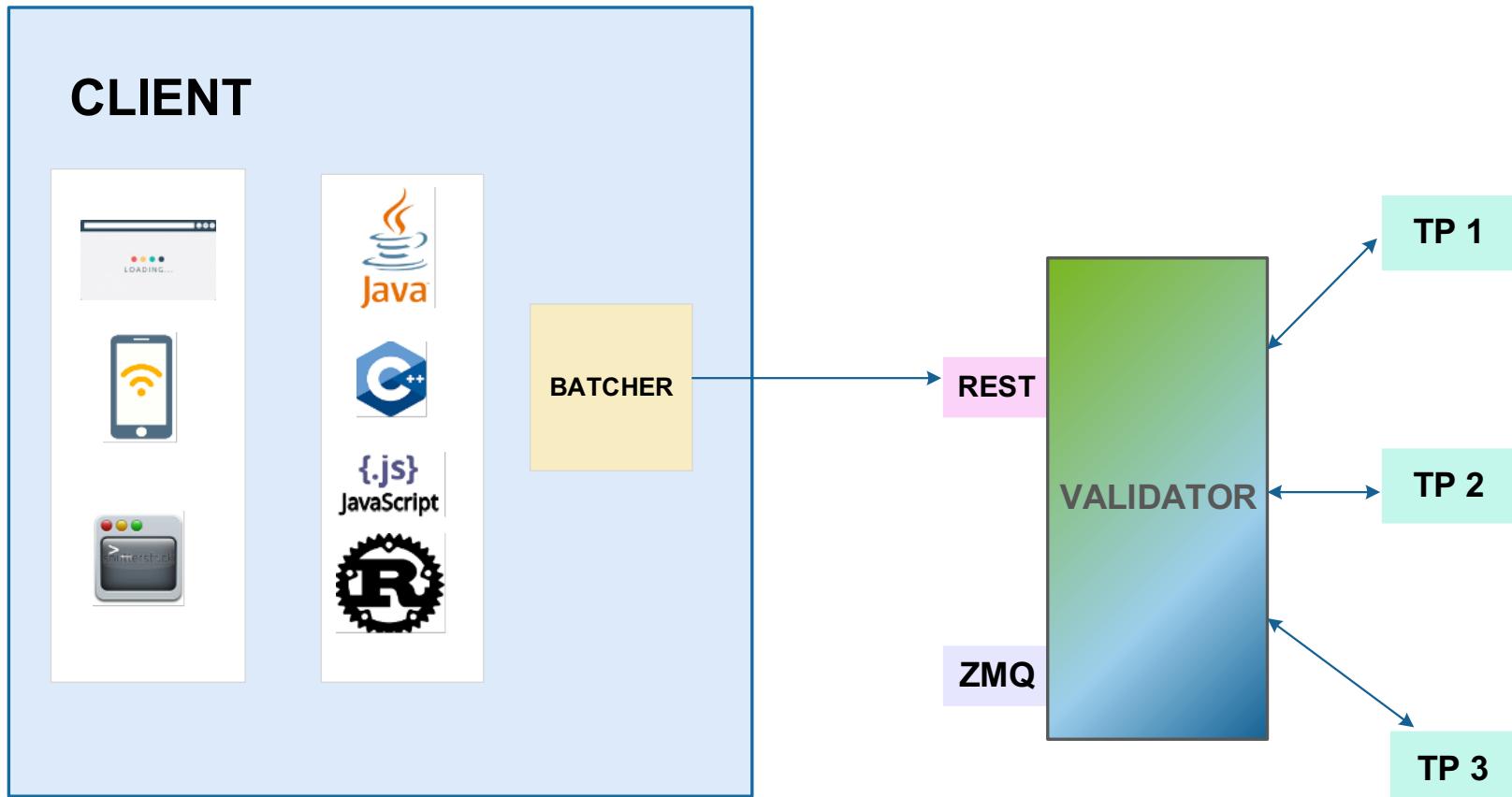




HYPERLEDGER  
**GLOBAL** FORUM

PHOENIX, AZ | MARCH 3-6, 2020

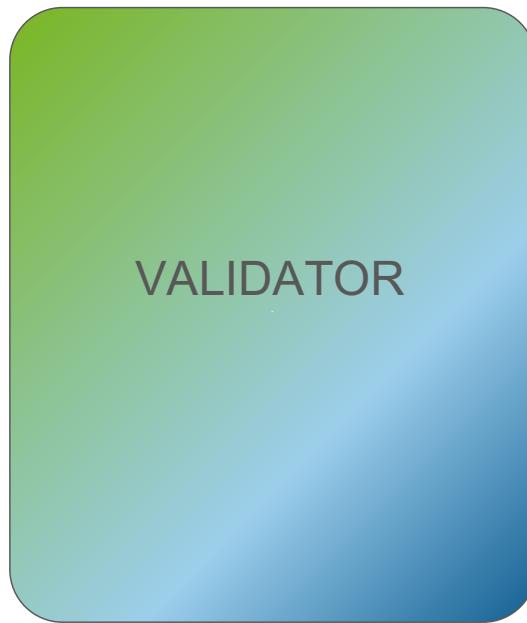
# Client



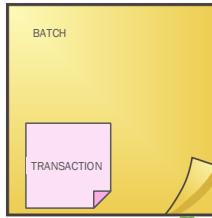
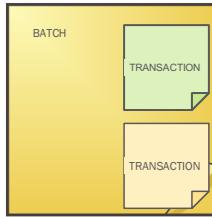
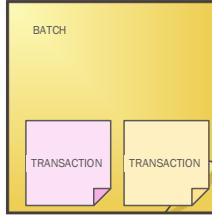
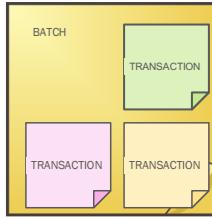
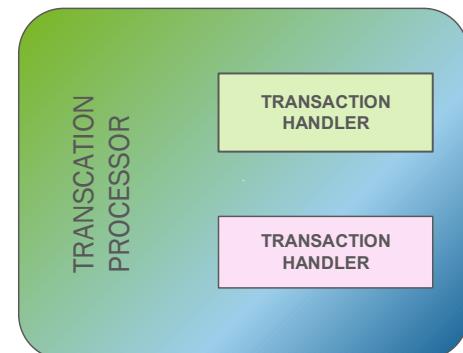
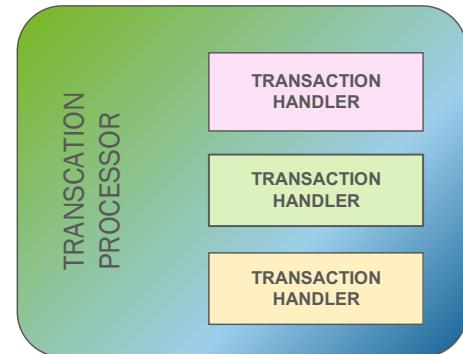
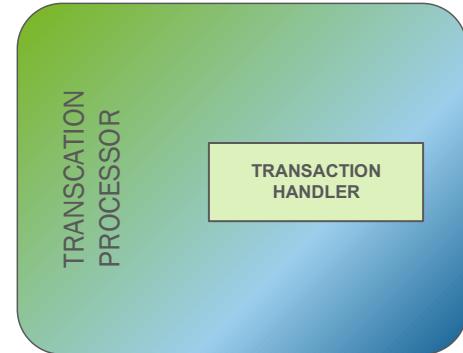


HYPERLEDGER  
**GLOBAL** FORUM

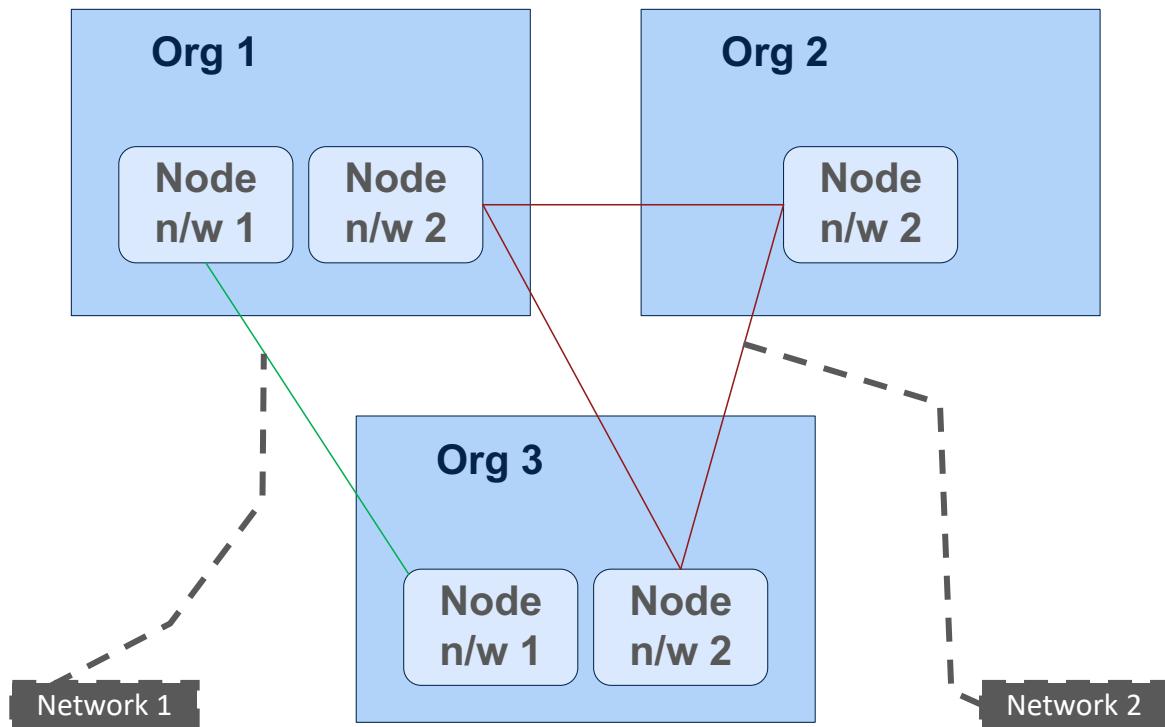
PHOENIX, AZ | MARCH 3-6, 2020



# Batches and Transactions



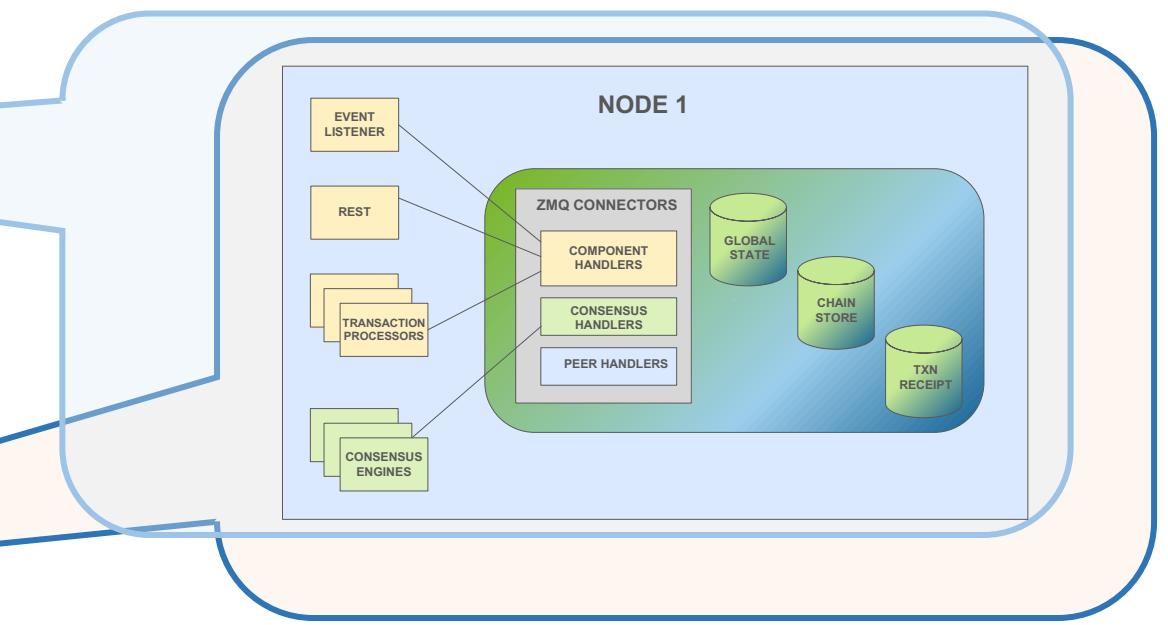
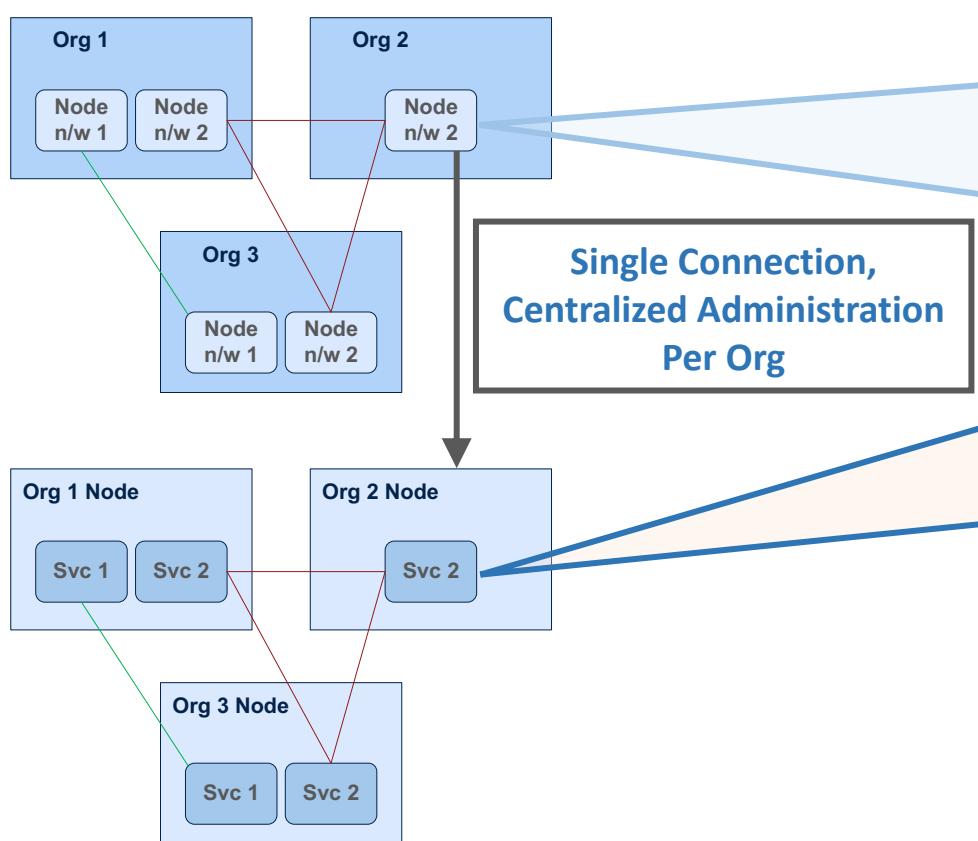
# Privacy in Sawtooth



Permissioned Network, Known Participants Are Part of the Network

Read Protection Through A REST Proxy

# Heading Towards Hyperledger Sawtooth 2.0



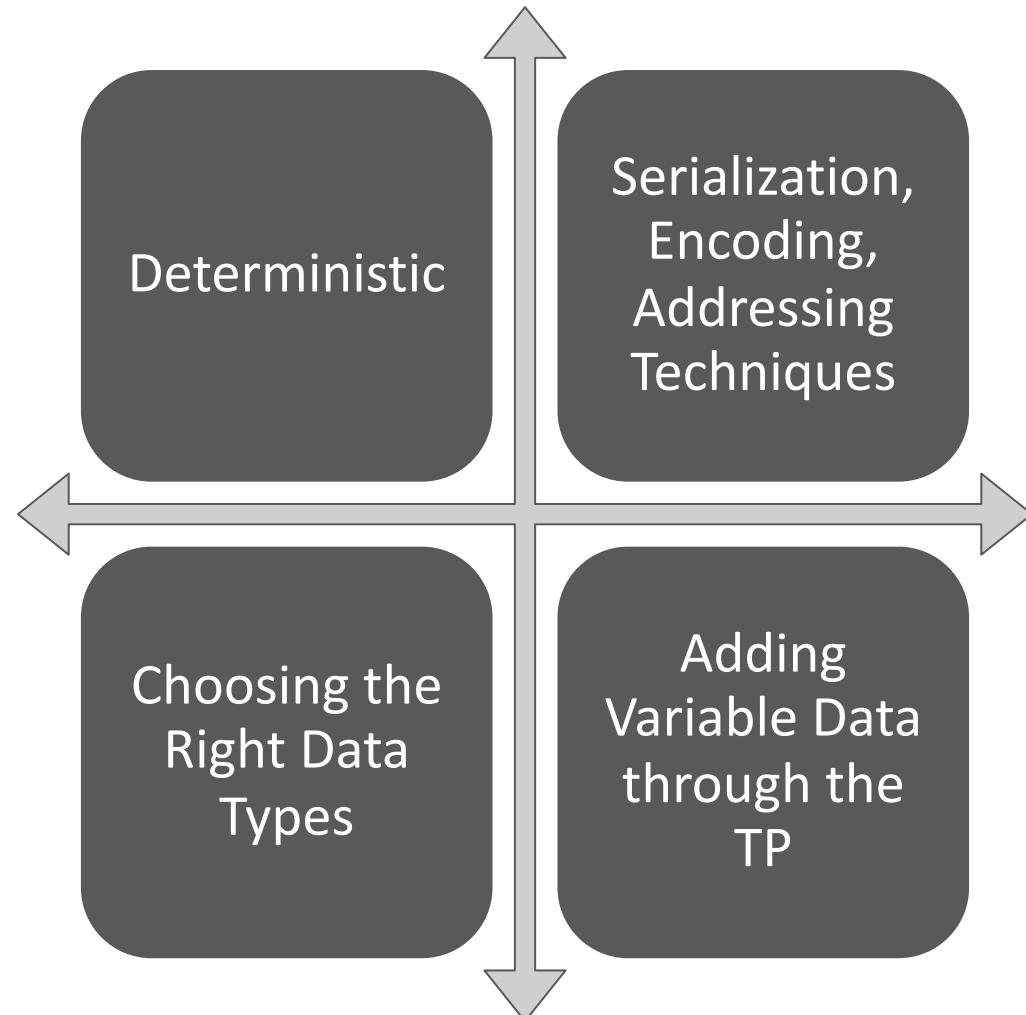


PHOENIX, AZ | MARCH 3-6, 2020

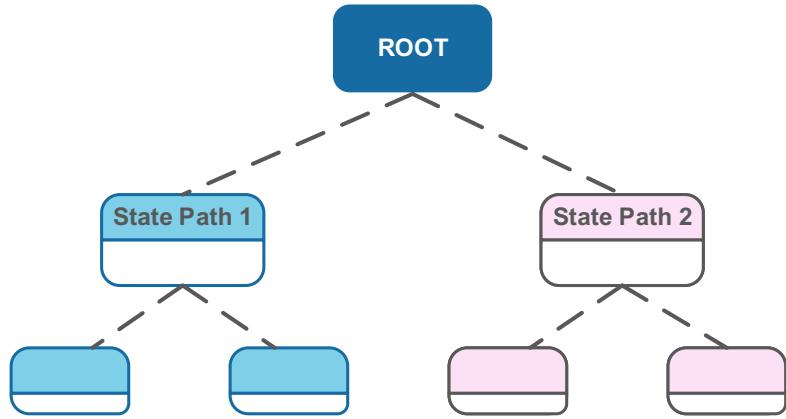
# Design Patterns Doing It the Right Way Make the Most Use Of Platform Capabilities



# Design Considerations

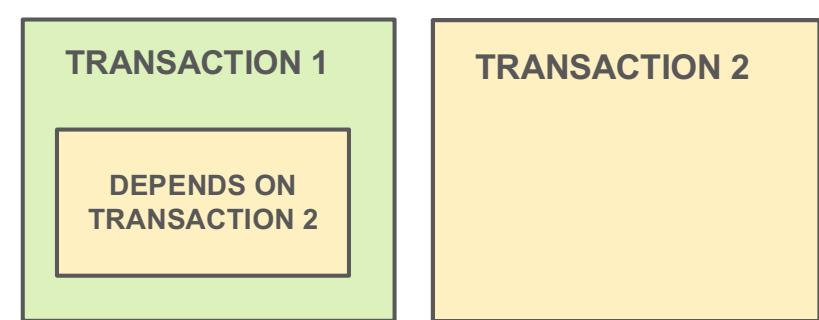


# Parallel Execution

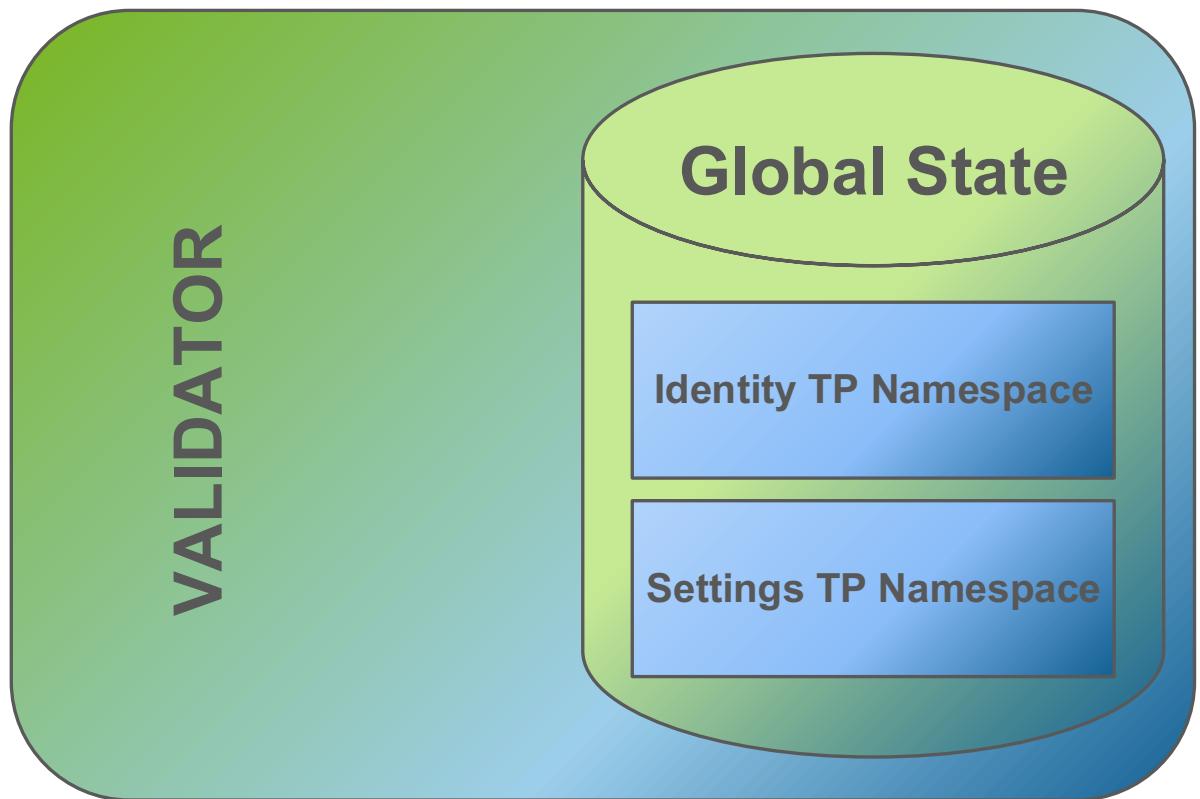


If transactions have overly broad input and output addresses,  
it impacts on performance of parallelism

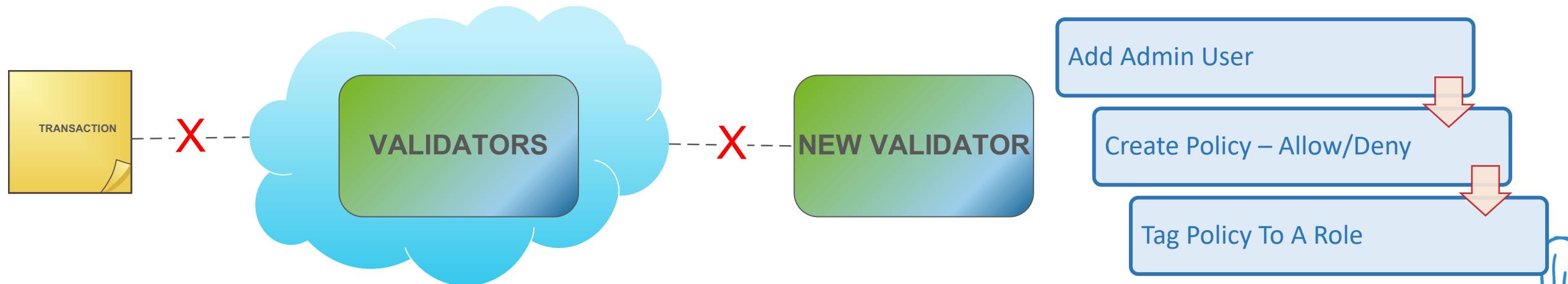
All predecessor transactions in batch must be executed before executing the transaction for which it's a predecessor



# Identity and Access Management



# Transactor and Validator Permissioning





PHOENIX, AZ | MARCH 3-6, 2020

# Transactor and Validator Permissioning

HANDS ON – <https://github.com/arsulegai/hgf2020>

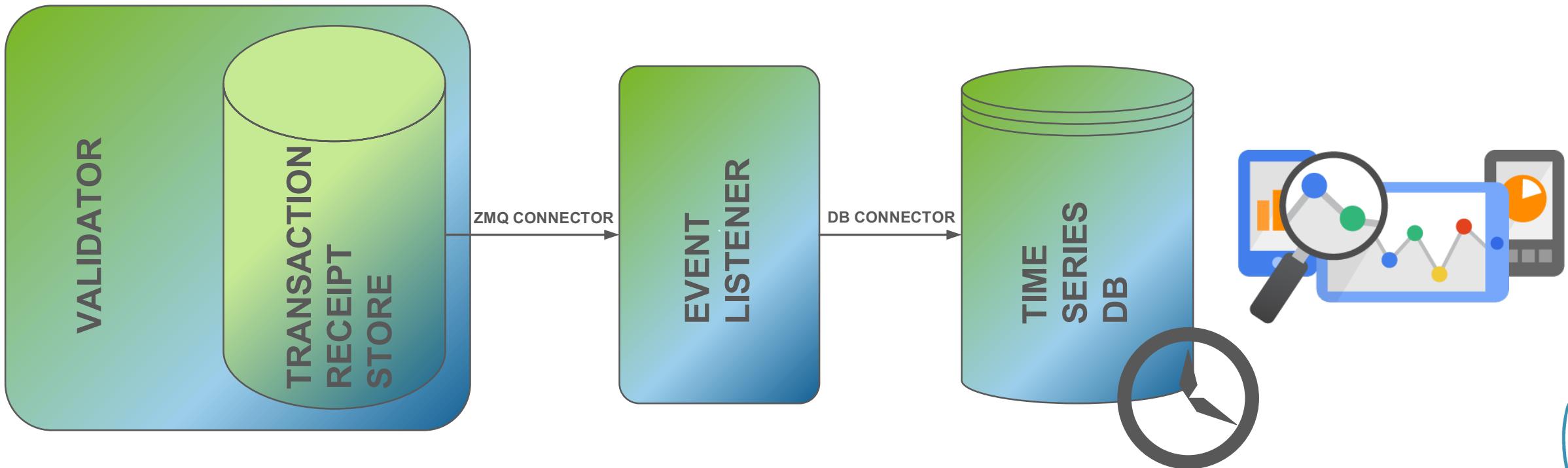




HYPERLEDGER  
**GLOBAL** FORUM

PHOENIX, AZ | MARCH 3-6, 2020

# Auditing Historic Transactions





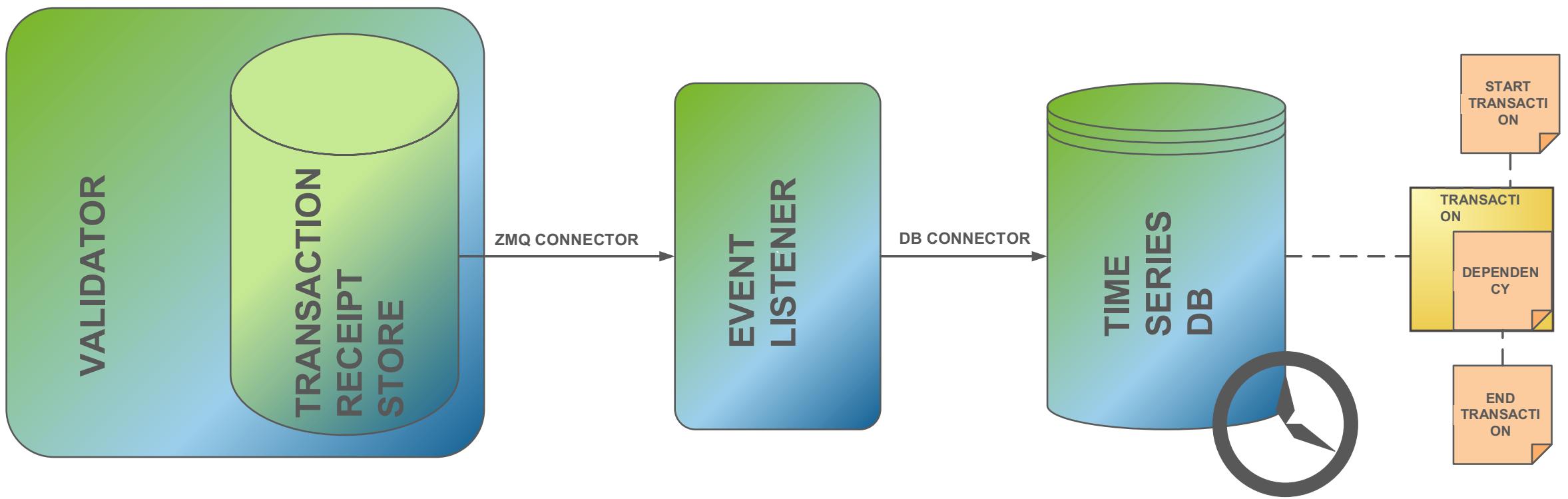
PHOENIX, AZ | MARCH 3-6, 2020

# Event Handling

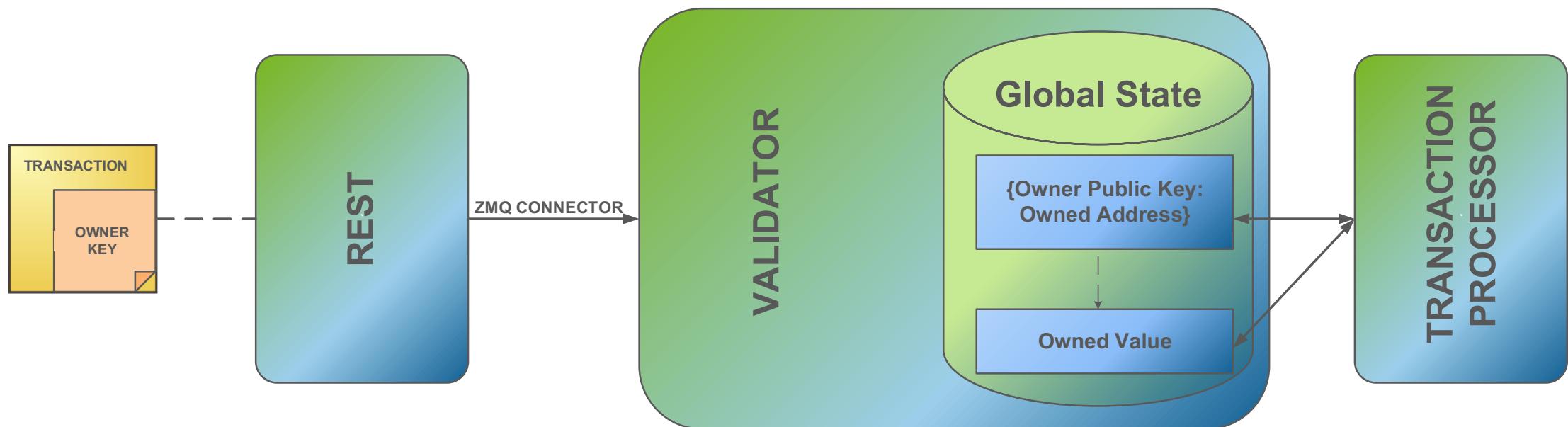
HANDS ON – <https://github.com/arsulegai/hgf2020>



# Set Interval For Transaction Acceptance

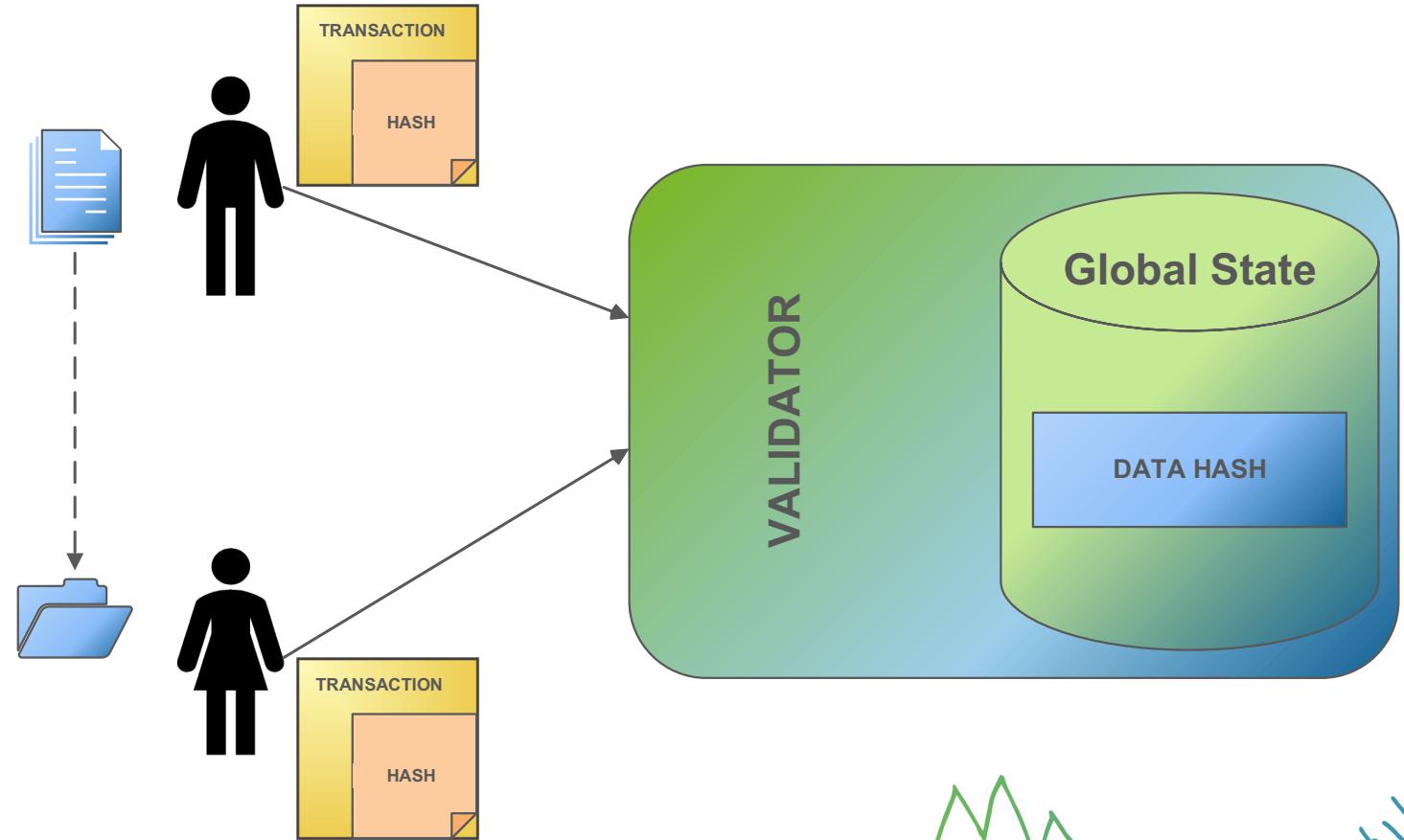


# Ownership Pattern

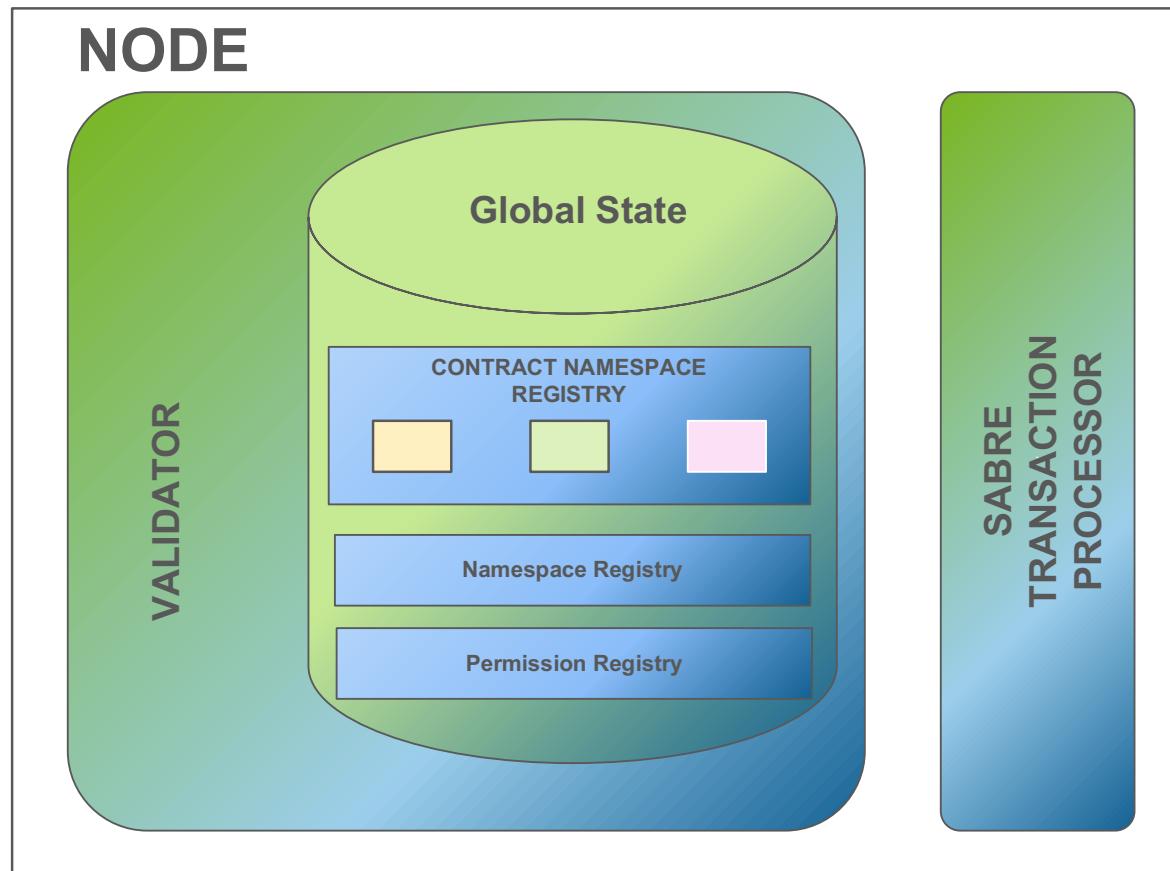


# Securing Digital Asset

Off-Chain Transfer,  
But On-Chain Integrity  
Check



# On-Chain Smart Contract Execution



CONTRACT 1

CONTRACT 2

CONTRACT 3

**Sabre-Smart Contracts**  
are like stored procedure  
in database but more  
powerful

**WASM**  
Stack Based Virtual Machine  
Lightweight



PHOENIX, AZ | MARCH 3-6, 2020

# Converting to Sabre Smart Contract

HANDS ON – <https://github.com/arsulegai/hgf2020>



# Testing Smart Contracts

## Test Network

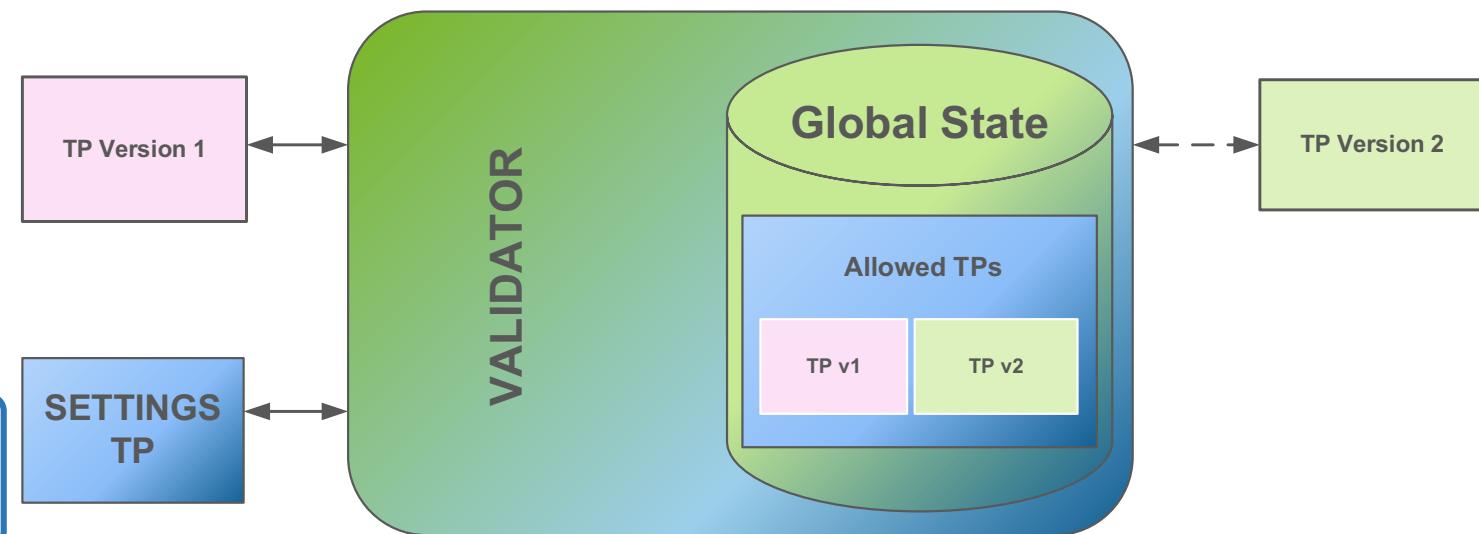
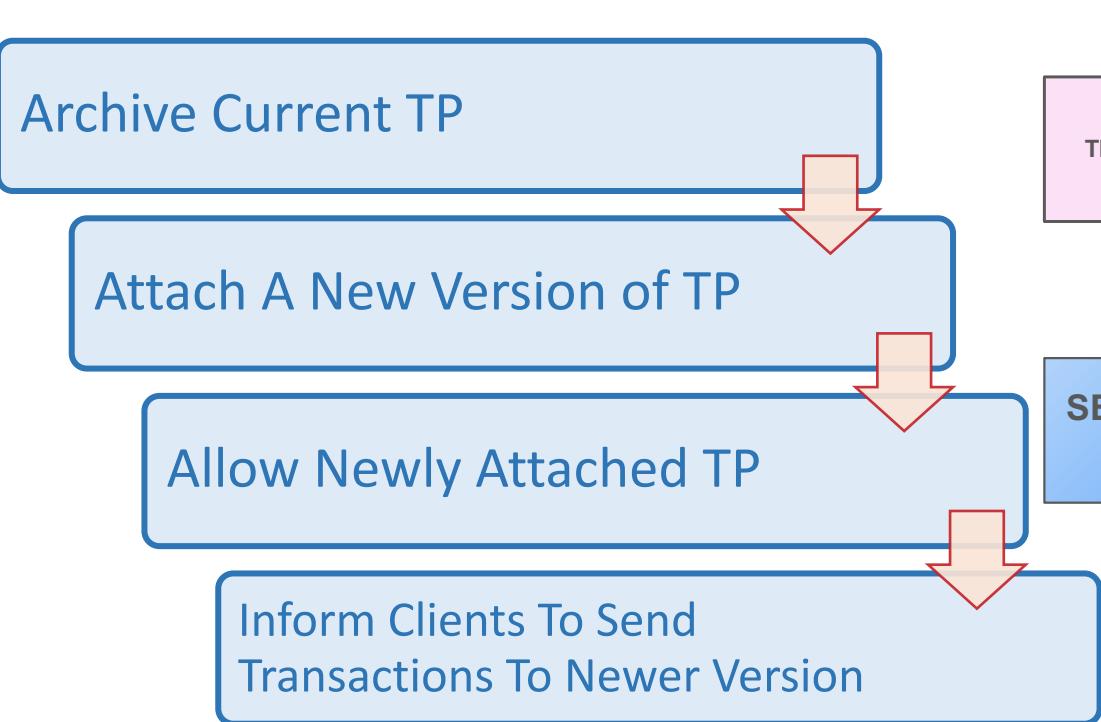
- A network setup to test Transaction Processor
- Useful for long running test setup

## Simulated Network Setup

- Python tests can make use of `sawtooth_processor_test`



# Transaction Processor Upgrade





PHOENIX, AZ | MARCH 3-6, 2020

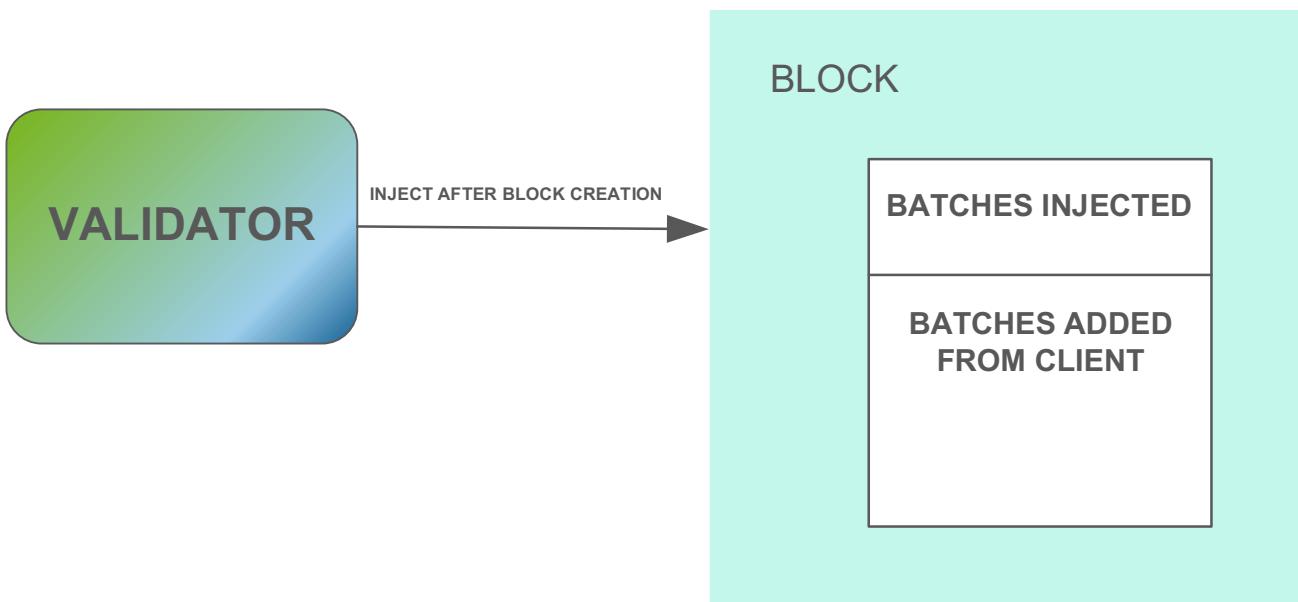
# Transaction Processor Upgrade

HANDS ON – <https://github.com/arsulegai/hgf2020>



# Batch Injection

## Feature of Injecting Transactions Directly Into The Block



### Use Cases

- Useful information for TPs, which cannot be set through Client transactions
  - Block Number
  - Timestamp
- Automatic transaction submission in response to a state



PHOENIX, AZ | MARCH 3-6, 2020

# BlockInfo Injector Out of the Box

HANDS ON – <https://github.com/arsulegai/hgf2020>





PHOENIX, AZ | MARCH 3-6, 2020

# Write Your Own Smart Contract

Template Available – <https://github.com/arsulegai/hgf2020>





PHOENIX, AZ | MARCH 3-6, 2020

ధన్యవాదగఱ  
Thank You

