

Hyperledger Sawtooth Blockchain for IoT-Blockchain Based Ecosystem

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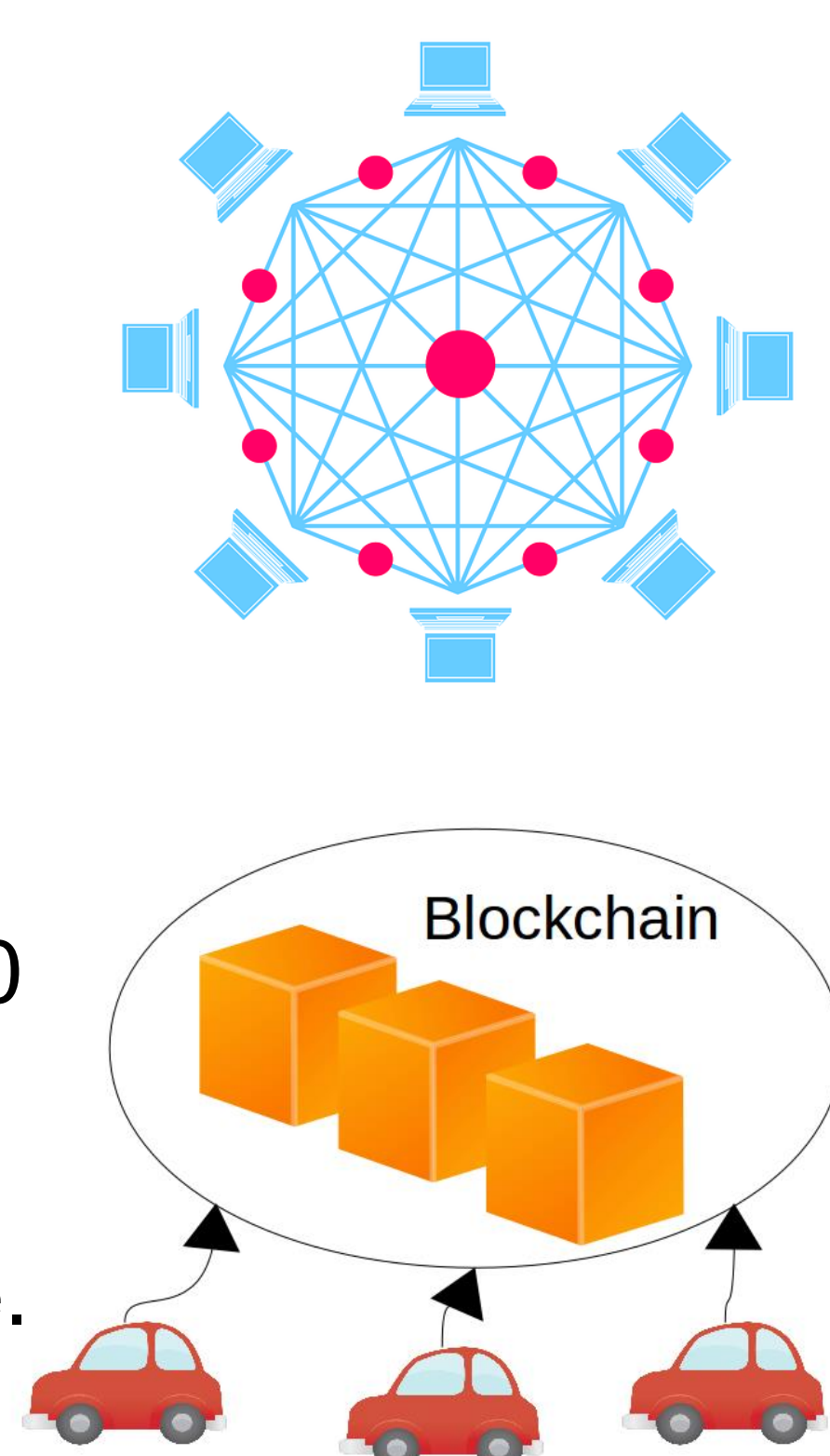


Resume

We present Hyperledger Sawtooth performance results using an industrial use case implementation, which contains blockchain as the immutable data storage and IoT devices sending transaction to the blockchain. Throughput and transaction execution latency is extracted from a benchmark on a local blockchain setup. An API is also implemented to enable communication between the IoT devices and the blockchain. The API's behavior is also studied.

CONTEXT

- Blockchain is a decentralized network containing a distributed ledger with immutable data storage.
- Smart contracts deployed on the blockchain allows the execution of custom business logics.
- High interest in blockchain technology: 140 companies listed in 2019 [1]
- Use case: Renault's car accident use case. Vehicle data is sent when an accident occurs. Vehicles contain IoT devices.

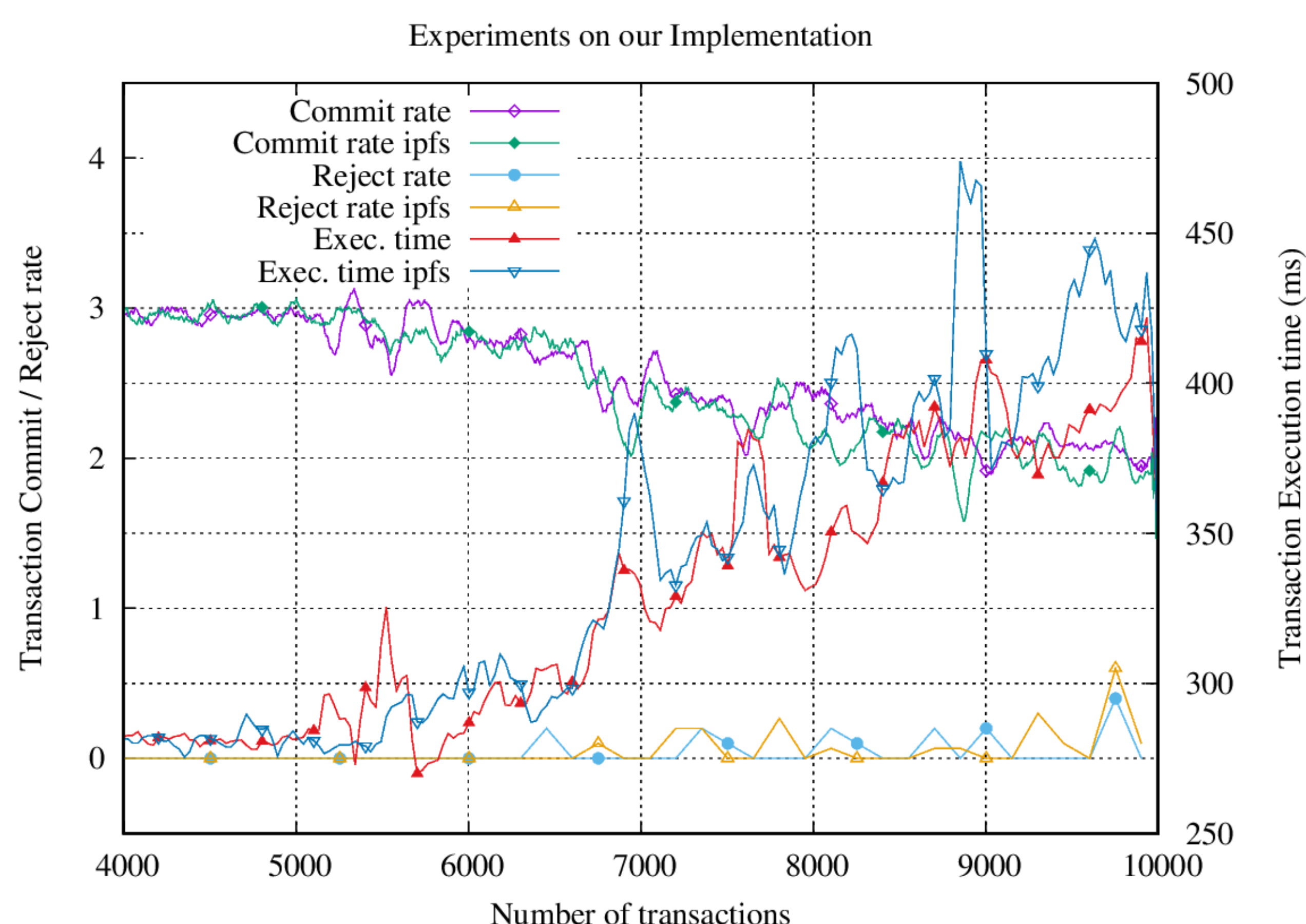


GOALS

- Implementation of the use case
 - A hash of the data and car's location is sent to the blockchain
 - The raw data is sent to InterPlanetary File System (IPFS) based on distributed ledger technology
 - Use the implementation in a future ecosystem with actors as car manufacturer, insurance company, police etc.
- Benchmark local Sawtooth network:
 - Transaction validation is based on a consensus rule
 - Measurement of the transaction validation rate according to Practical-Byzantine-Fault-Tolerance (PBFT) and Proof-of-Elapsed-Time (PoET) consensus rules

RESULTS

- Hyperledger Sawtooth [2] network of 5 validator nodes
- IoT devices sending transactions are Raspberry Pi 3 B+
- Simulation of 1 client sending crashes



Experiments on our implementation using PBFT consensus [3]

- Transaction Validation rate for **PBFT**: **2.7tx/s**
 - no tx reject until 6k transactions sending
- Transaction Validation rate for **PoET**:
 - blockchain crashes after 6k transaction sending
- With dedicated smart contract business logic and IPFS module added to the blockchain node all of the IoT devices can be authenticated in a more secure way.
 - Only ecosystem members are allowed to send data to the IPFS and to the blockchain.
- Data in IPFS are accessed by the hash of the data (stored on the blockchain)
 - Hash creation in the IoT device takes up to 34.1% to process 1M Byte data.
 - Hardware accelerator modules could be used in the next generation of IoT's connecting to blockchain and IPFS

CONCLUSION AND PERSPECTIVES

- Implementation of the use case
- Maximum throughput of 2.7tx/sec, sufficient for the use case requirements of 1tx/sec (based on French insurance)
- Next: benchmarks on cloud infrastructure using Sawtooth and other blockchain platforms

REFERENCES

- [1] M. Andoni et al., "Blockchain technology in the energy sector: A systematic review of challenges and opportunities," vol. 100, pp. 143–174
- [2] LinuxFoundation, "HyperledgerSawtooth", accessed:2019-06-14.
[Online] Available: <https://sawtooth.hyperledger.org/docs/core/releases/1.0/introduction.htm>
- [3] L. Gerrits, R. Kromes, and F. Verdier, "A true decentralized implementation based on iot and blockchain: a ve-hicle accident use case," in 2020 International Conference on Omni-layer Intelligent Systems (COINS), 2020, pp. 1–6.