Introduction

With the focus on payments modernization, M10's ledger addresses the problem of high speed - low latency transaction processing from end to end. M10's ledger is a custom pBFT ledger, capable of processing 1M+ payment transactions per sec. To achieve the high throughput, a ledger platform needs to be optimized to handle peak/spike volumes while also providing end to end security from a user's device to the ledger core.

Every transfer executed in our test environment is an M1 transfer, which consists of 3 debits and 3 credits. M1 transfers use M0 currency as the medium of exchange. The performance test will execute on payment transactions between two parties.

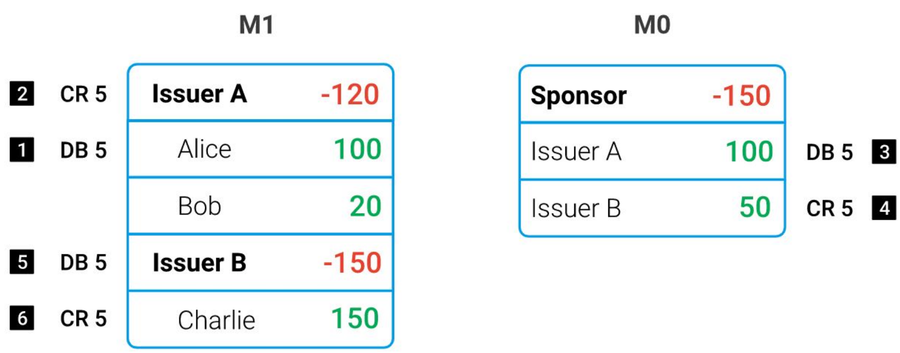

Figure 1: Payment from Alice to Charlie using M1 and M0 money.

Setup - test environment

Most ledger platforms specialize and focus only on the ledger core technology where it's developed as a general purpose ledger. The M10 ledger core is tuned and optimized for payments. The M10 ledger core in the test environment consists of four nodes which represents a single currency ledger. The four nodes consist of a proposer and three voters which form a committee that finalizes endorsed blocks of transactions.

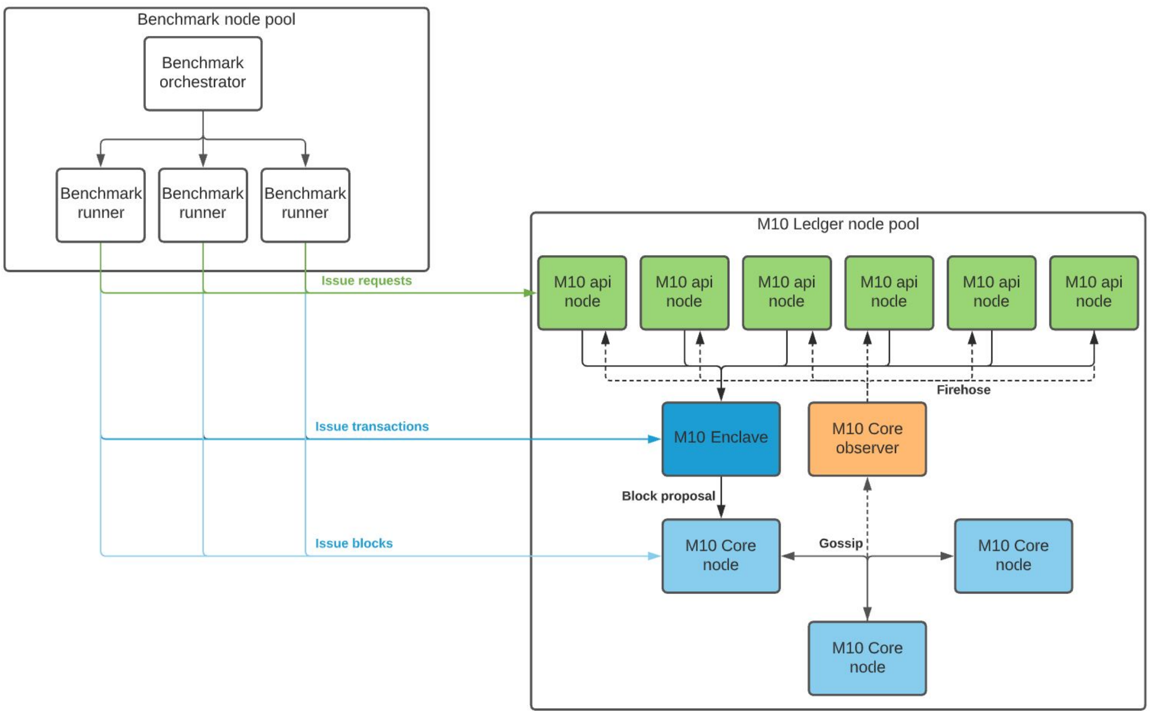

Figure 2: M10 test rig.

The test framework consists of a benchmark test client that injects "requests" through the different subsystems to measure performance at different levels. For this report, we are injecting transactions to the M10 Core node to measure the performance of the Ledger Core.

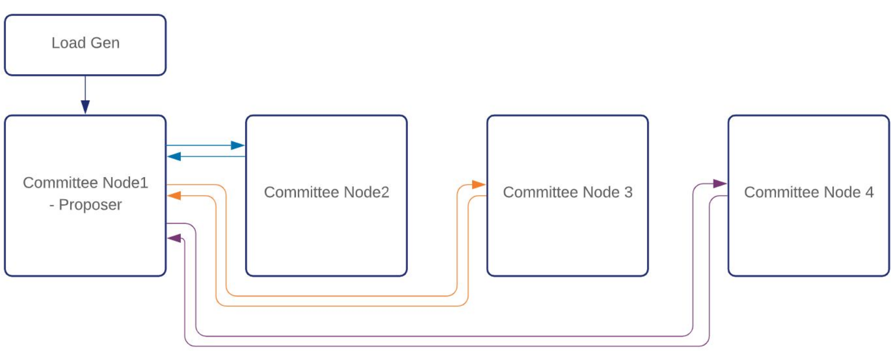

Figure 3: Proposer introducing new blocks (payment transfers) and Committee nodes voting on the blocks.

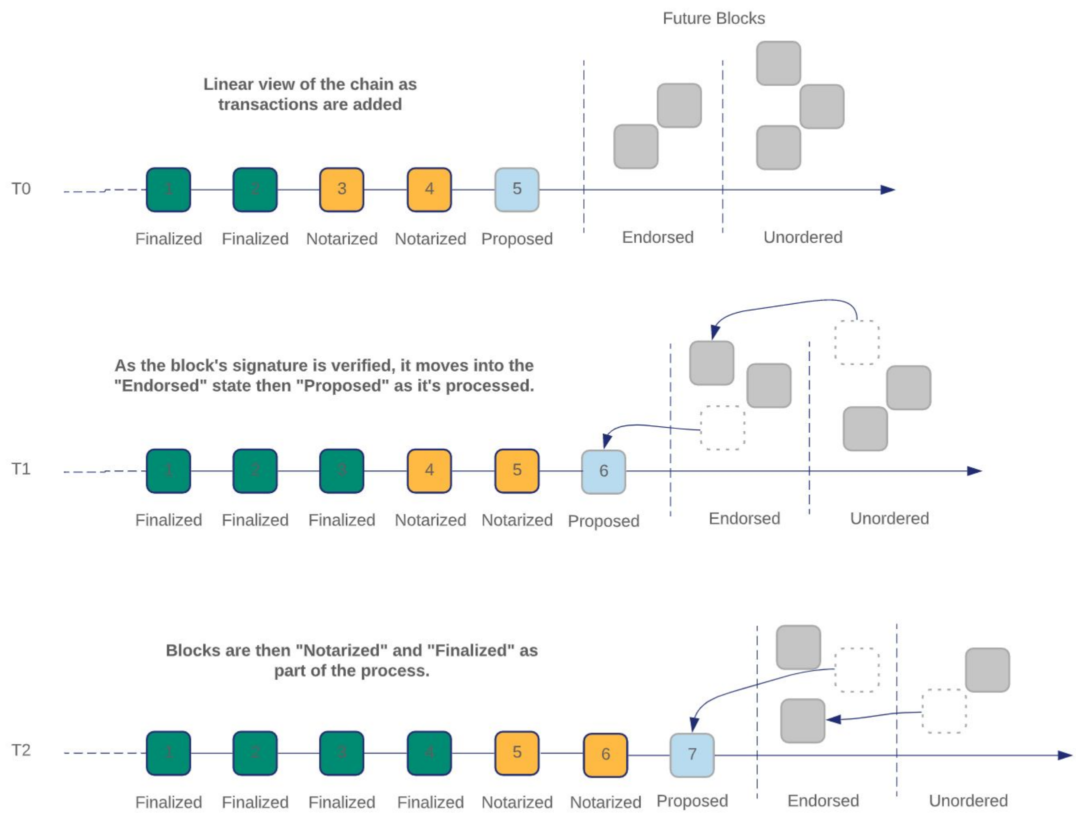

Figure 4: Sequence with Proposer introducing new blocks (payment transfers) and Committee nodes voting on the blocks.

Test Scenario

To simulate a high volume payment scenario, the ledger core was tested for sustained throughput both for performance and endurance. The parameters of the test scenario is shown below. For this ad-hoc test on February 24, 2021, we ran an unoptimized version of the ledger core software and was able achieve 450k payment transactions per sec. Previous tests have verified 1M+ tps using optimized software.

The M10 ledger was deployed to an AWS EKS cluster running on 3x i3en.6xlarge hosts.

Each host has the following resources available:

- 24x vCPU @ 3.1 Ghz (Intel Xeon)
- 192 GiB DDR4 RAM
- 2x 7.5 TB NVMe SSDs >=400K IOPs ea
- 25 Gbps over >= 2x dedicated NICs

Scenario	**Parameters**	**Results**
- Sustained throughput load test - Ledger core - Indexed transactions (for faster reference) - Single Benchmark Runner (load gen)	- 1000 user accounts - 1,000,000,000 transfers	Achieved a sustained 450k+ payment TPS with a total of 1B total transfers with a single test client.

The graph belows shows how the test was measured. In clockwise order from upper left corner:

A. Total Transactions for a single test
B. Transaction Rate (TPS) measuring the throughput rate
C. Memory Usage of the cluster nodes
D. Back pressure from the ledger

Once the transaction rate (upper right) reaches a plateau, that signifies that the ledger core has hit it's threshold limit. This can be verified by the back pressure (lower left) where the transaction queue has spiked signifying that the ledger can no longer keep up with the benchmark load generator.

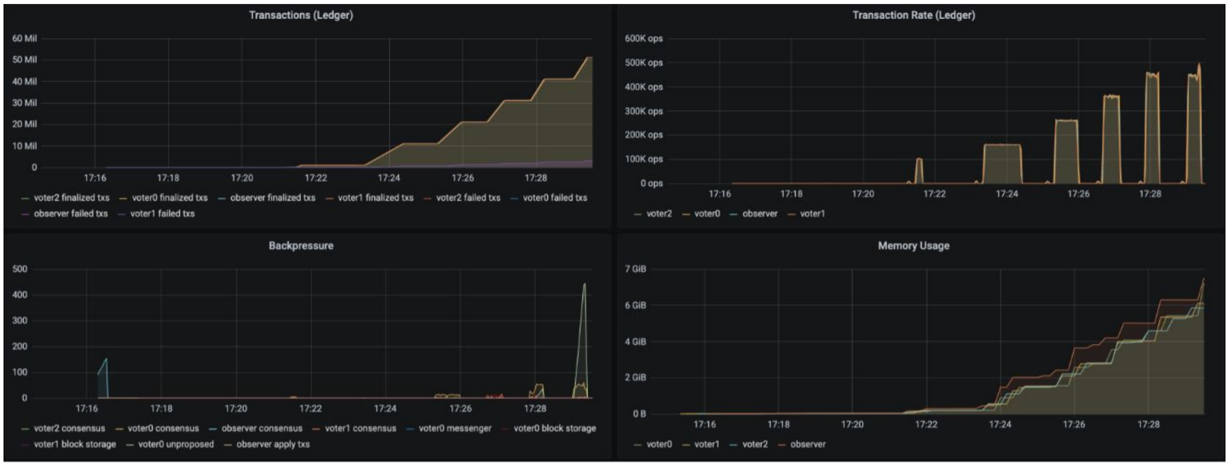

Figure 5: Grafana graphs of the performance test.

Conclusion

In our initial tests, the system was able to handle short bursts of load and also longer sustained loads. Using an unoptimized version of the software (for the sake of quickly validating high throughput), we were able to achieve a promising 450K+ payment transactions per second at the ledger core with a sustained load of 1B transactions created by the load generator. This sustained performance is proof that the ledger system is more than capable to handle all existing payment volumes today.