NuoDB Performance Benchmark
The NuoDB CDMS Exceeds 1 Million YCSB OPS Per Second

The Cloud Data Management System (CDMS) Challenge

NuoDB started with a blank slate to design a brand new Cloud Data Management System and has written the rules for cloud databases. NuoDB features elastic scalability, SQL compliance and guaranteed ACID transactions. Developers no longer have to compromise on transactional consistency or resort to complicated hacks like clustering and sharding to bring your high-performance apps to the cloud.

This paper summarizes NuoDB’s latest YCSB performance results against a single logical NuoDB database distributed across several host machines.

- NuoDB delivered extremely high performance by crossing 1 Million transactions per second on 24 Hosts.
- NuoDB is the most cost efficient elastic cloud database offering in the market, generating 47,368,421 transactions for every $1 in spend.

Benchmark Results

For the past several months, NuoDB has conducted performance tests of its CDMS software in its in-house datacenter and has collaborated with major technology partners such as AMD and HP on validating its performance test results on their hardware. The benchmark results discussed in this paper are based on in-house tests conducted recently by NuoDB Engineering. All benchmark test data and results including a detailed description of the benchmark setup are available for independent validation by 3rd parties.

NuoDB performance was measured using the Yahoo Cloud Serving Benchmark (YCSB), an open source framework designed to characterize suitability for highly distributed, cloud-based apps. YCSB performance is most commonly associated with NewSQL and NoSQL databases and that’s why we chose it. You can use these benchmark results as a baseline to get an apples-to-apples performance comparison between NuoDB and your existing database solution.

The NuoDB benchmark tests presented in this paper are based on a transactional workload of 95% reads and 5% updates, a configuration similar to other vendor benchmark setups and consistent with 5% to 10% write operations reported by the likes of Facebook. In our benchmark tests we reached a peak of 1,093,969 transactions per second (TPS). The average read latency (i.e. the time required to execute a query) was under 2 milliseconds and the average update latency was under 46 milliseconds. NuoDB’s elastic scalability was evaluated by growing the database from 1 to 24 server hosts in increments. As demonstrated by our benchmark results, capacity is near linear, growing...
incrementally at an average rate of approximately 45,000 TPS for each new host added to the database.

The read and update latencies, in microseconds, for our tests are shown in Figure 3. Even with multiple instances of the benchmark client application competing for the same database records, the response time remains consistently low. The modest slowdown in update latency is the expected consequence of increased update contention among client processes, each of which is performing updates across the entire database.

The NuoDB YCSB tests were run using a pure SQL schema and standard API calls, while maintaining ACID transactions and durability guarantees to ensure that the database can handle the most rigorous of app requirements. As the demand on the database increased, NuoDB dynamically balanced the load and storage infrastructure without interrupting services.

### How It Was Done

Tests were run using the current released version of NuoDB with no custom modifications. The benchmark use case is the open source YCSB benchmark “Workload B”. Workload B performs a series of queries and updates against a single database table with records about one kilobyte in size. We used the default operation mix, which does 5% updates and 95% queries. We tested elastic scalability of NuoDB the same way a real Web app would: as load demand increased, we added a web app server and simultaneously increased database capacity by adding a Transaction Engine (TE). A single Storage Manager (SM) provided persistence for all the TEs, with a single-spindle commodity disk for storage. Transaction communication among the TEs and SMs used MVCC “read committed” mode, which guarantees consistent read and isolated updates across the entire database.

### YCSB Modifications

YCSB was designed to model a monolithic application, rather than a distributed network of web applications that is the focus of this benchmark. To support a distributed model the following enhancements were submitted to the YCSB project:

- A clientID parameter that helps us assign the simulated app server role to the YCSB client,
- A plugin to randomly generate query keys in the semi-clustered manner typical of app servers,
- A plugin to route trend statistics to our monitoring tool, so we could track aggregate performance in the web app.

These changes are not specific to NuoDB and will allow developers to benchmark the scale-out demands of web applications on any SQL or NoSQL database using YCSB.

### What It Means For Your Business

For any DBMS solution there is always the possibility of squeezing higher performance numbers out by running on bigger, faster, more expensive hardware. In order to make a more realistic comparison, it is common to assess the cost per TPS for the benchmark. In simple terms, this is computed by dividing the total dollar cost by the Transactions Per Second (TPS) achieved.
Figure 4 outlines the hardware configuration and cost associated to this benchmark.

System cost was limited to hardware only, evaluated for a three-year time frame and assuming hardware was 100% amortized over that period.

**Deployment Scenario**

To add some perspective, take for example a requirement to support a peak load of 150,000 TPS excluding weekends and there was virtually no activity outside one hour per day.

That gives you 3 years X 250 days X 3600 seconds X 150,000 TPS equal to 405,000,000,000 transactions executed during that time.

This workload would cost you $8,550 in hardware over a three year period.

This means that for $1 you are getting 47,368,421 transactions.

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**Summary**

The key benefits of NuoDB to your business consist of an extremely low cost of transactional throughput, elastic cloud distribution and higher application resilience resulting from transactional and durability guarantees.

In this benchmark report, we have demonstrated that:

- NuoDB is a distributed database capable of running across many machines in the cloud, on premises or in a hybrid configuration.
- NuoDB exceeded 1 million transactions per second on 24 host machines with the configuration outlined in Figure 4.
- NuoDB scales elastically without the need to shard or partition your data.

Users can download and install NuoDB with about 6-clicks and if you are interested in running your own benchmark visit www.nuodb.com/ycsb and download the performance kit.

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**Hardware Details**

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Figure 4: Hardware costs for the 1M TPS NuoDB YCSB performance test.