Administration & Operations

Planning / Testing

AEROSPIKE

Objectives

At the end of this module, you will be able to:

- Have a basic sense of capacity planning.
- Load test data into an Aerospike database using the Aerospike Java Benchmark tool.
- Run benchmark tests.

Capacity Planning

Capacity Planning

For a exact, detailed planning guide, go to:

http://www.aerospike.com/docs/operations/plan/capacity/

For a quick estimate (no secondary indexes) you will need the following:

- number of records
- replication factor
- size of records
- number of bins
- average set size
- type of storage (RAM or flash/SSD)

Capacity Planning – Quick Estimate

Area	How stored	Formula	Note
Primary Index	RAM	n * r * 64	The amount of RAM needed for the primary index is fixed at 64 bytes.
Data storage	RAM	n * r * (2 + (17 * b) + v)	Every objects needs 2 bytes for overhead, 17 bytes per bin, and the actual data
Data storage	Flash/SSD	n * r * p Where p is (64 + (9 + s) + (28 * b) +5 + v) -> round up to nearest 128 bytes	Every object needs to store the index (64 bytes), set overhead (9 +s bytes) , general overhead (28 bytes), type info (5 bytes), and the actual data. Because Aerospike stores data in 128 byte blocks, you must round up to the nearest 128 byte amount.

- n = number of records
- r = replication factor
- v = average size of records
- b = number of bins
- s = average set size

Benchmarks

Benchmarking

Goal: **Saturate the cluster**

- Start with single server – BEWARE: “writes” values are not representative
- Change **1 thing** at a time
  - Move toward production configuration
- Are you **bottlenecked** on the
  - Client
  - Network

Note:

- Don’t expect high performance with **VMs**. You must be very careful when testing in a public cloud such as Amazon.
- Don’t expect realistic number with client and server on the **same host**.

The Java Benchmark Tool

- Multi-platform
- Portable
- Easy to use
- Total throughput easily seen from database nodes

- Poor performance with objects larger than 4 KB
- Run multiple instances on multiple servers to get to high throughput

Java Benchmark Syntax

```
> ./run_benchmarks [options]
```

Flag	Description
`-b, --bins <arg>`	The number of bins (like columns) of data.
`-g, --throughput <arg>`	The target total throughput. This will include all operations.
`-h, --host <arg>`	A seed node (any node in the cluster). The tool will learn about the other nodes from this one.
`-p, --port <arg>`	The port on the Aerospike node to connect to (default 3000)
`-k, --keys <arg>`	This is the number of keys/records to use. If you select a number too small, you will get write contention. Too large and you may run out of memory.
`-s, --set <arg>`	The set where the data will be loaded.
`-latency <arg>`	Produce a table of latencies as measured from the client. This can be compared with the latencies on the server to see where any bottleneck may lie. Recommended value “-latency 7,1”
`-n, --namespace <arg>`	The namespace to test against. This is similar to a “database” in a relational database.
`-o, --objectSpec <arg>`	The type of object to use: “I” is an integer, “S:<size>” is the size of the object. Is is recommended to start with small objects to remove the network
`-w, --workload <arg>`	Type of workload: `I` - Insert only. test stops when the final record is loaded (based on –k above) `RU,<percent>` - The read percentage. “90” means a 90% read rate.
`-z, --threads <arg>`	The number of threads used by the benchmark. For bare metal, 64 is a good value. For VMs, you should use 4-8 threads/core.

The Java Benchmark Tool

The Aerospike benchmark tool can be found within the full Aerospike Java Client.

Untar, go to the appropriate directory and compile it:

```
cd /home/aerotraining/packages/aerospike
tar xvf aerospike-client-java.tgz
cd aerospike-client-java-*/benchmarks
mvn package
```

Loading Test Data

Loading Data Example

Prior to running any tests, you should load data into the database.

```
./run_benchmarks    -h 127.0.0.1 \    # Local DB server
                    -p 3000 \         # Local port
                    -n test \         # Namespace “test”
                    -k 100000 \       # Load 100,000 records
                    -s testset \      # Use the set "testset"
                    -latency "7,1" \ # Show latency numbers
                    -o S:100 \        # Use 100 byte string
                    -w I \            # Insert only
                    -z 8              # Use 8 threads
```

➢
```
./run_benchmarks -h 127.0.0.1 -p 3000 -n test -s testset -k 100000 -latency "7,1" -S 1 -o S:100 -w I -z 8
```

When the script has loaded all the data, it will exit.

Loading Data Example Output

```
$./run_benchmarks -h 127.0.0.1 -p 3000 -n test -s testset -k 100000 -latency "7,1" -S 1 -o
S:100 -w I -z 8
```

```
Benchmark: 127.0.0.1:3000, namespace: test, set: testset, threads: 8, workload: INITIALIZE
keys: 100000, start key: 1, key length: 10, bins: 1, throughput: unlimited, debug: false
write policy: timeout: 0, maxRetries: 2, sleepBetweenRetries: 500
bin type 1: string[100]
2014-08-27 22:12:52.091 INFO Thread 1 Add node BB9ED14150B0022 127.0.0.1:3000
2014-08-27 22:12:52.137 write(count=0 tps=0 timeouts=0 errors=0)
      <=1ms >1ms >2ms >4ms >8ms >16ms >32ms
write    0%   0%   0%   0%   0%    0%    0%
2014-08-27 22:12:53.141 write(count=2432 tps=2432 timeouts=0 errors=0)
      <=1ms >1ms >2ms >4ms >8ms >16ms >32ms
write   90%  10%   9%   8%   7%    5%    1%
2014-08-27 22:12:54.170 write(count=6492 tps=4060 timeouts=0 errors=0)
      <=1ms >1ms >2ms >4ms >8ms >16ms >32ms
write   92%   8%   7%   6%   5%    3%    1%
2014-08-27 22:12:55.194 write(count=12705 tps=6213 timeouts=0 errors=0)
...
```

While this is running, check on the AMC.

Latency measurement

Latency parameter determines how latencies are displayed.

Format:

- “-latency N,E[,us]”
- N is the number of buckets
- E is the number of powers of 2 between each bucket
- us to get microsecond resolution on timings (Default is ms)

Buckets show percent transaction greater than that number (except 1st one)

-latency “7,1”

<=1ms	>1ms	>2ms	>4ms	>8ms	>16ms	>32ms	>64ms	>128ms	...
58%	42%	27%	15%	3%	1%	0%	0%	0%	

-latency “5,2”

<=1ms	>1ms	>2ms	>4ms	>8ms	>16ms	>32ms	>64ms	>128ms	...
58%	42%	27%	15%	3%	1%	0%	0%	0%	

Running Benchmarks

Running Balanced Workload

The first test to run is on a balanced workload. This will test database operations that are **50% reads 50% writes** (and updates).

```
./run_benchmarks     -h 127.0.0.1 \    # Local DB server
                     -p 3000 \         # Local port
                     -n test \         # Namespace “test”
                     -k 100000 \       # Load 100,000 records
                     -s testset \      # Use the set "testset"
                     -latency "7,1" \ # Show latency numbers
                     -o S:100 \        # Use 100 byte string
                     -w RU,50 \        # Read at 50%
                     -z 8              # Use 8 threads
```

This script will continue running until it is stopped.

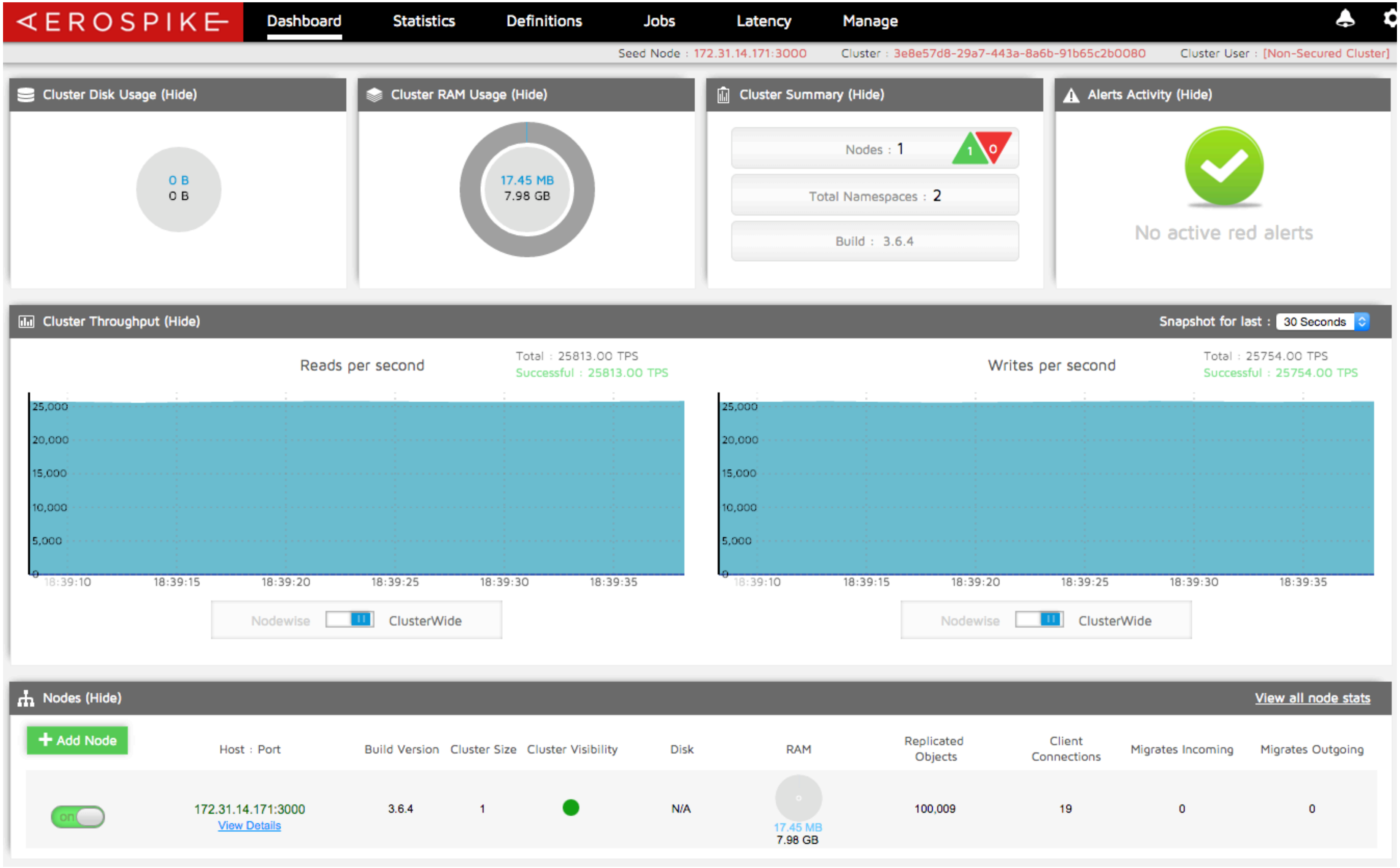
Running Balanced Load Example Output

```
$./run_benchmarks -h 127.0.0.1 -p 3000 -n test -s testset -k 100000 -latency "7,1" -o S:100 -w
RU,50 -z 8
```

```
Benchmark: 127.0.0.1:3000, namespace: test, set: testset, threads: 8, workload: READ_UPDATE
read: 50% (all bins: 100%, single bin: 0%), write: 50% (all bins: 100%, single bin: 0%)
keys: 100000, start key: 0, key length: 10, bins: 1, throughput: unlimited, debug: false
read policy: timeout: 0, maxRetries: 2, sleepBetweenRetries: 500, reportNotFound: false
write policy: timeout: 0, maxRetries: 2, sleepBetweenRetries: 500
bin type 1: string[100]
2014-08-27 22:14:56.269 INFO Thread 1 Add node BB9ED14150B0022 127.0.0.1:3000
2014-08-27 22:14:56.329 write(tps=2 timeouts=0 errors=0) read(tps=0 timeouts=0 errors=0)
total(tps=2 timeouts=0 errors=0)
      <=1ms >1ms >2ms >4ms >8ms >16ms >32ms
write   89%  11%  11%  11%  11%    5%    2%
read    86%  14%  13%  13%  13%    9%    2%
2014-08-27 22:14:57.577 write(tps=1458 timeouts=0 errors=0) read(tps=1402 timeouts=0 errors=0)
total(tps=2860 timeouts=0 errors=0)
      <=1ms >1ms >2ms >4ms >8ms >16ms >32ms
write   86%  14%  13%  12%  11%    6%    1%
read    89%  11%  10%   9%   8%    5%    2%
2014-08-27 22:14:58.585 write(tps=1994 timeouts=0 errors=0) read(tps=1934 timeouts=0 errors=0)
total(tps=3928 timeouts=0 errors=0)
      <=1ms >1ms >2ms >4ms >8ms >16ms >32ms
write   93%   7%   7%   6%   5%    3%    1%
read    94%   6%   5%   5%   4%    2%    1%
...
```

While this is running, check on the AMC.

AMC running benchmark



Seed Node : 172.31.14.171:3000 Cluster : 3e8e57d8-29a7-443a-8a6b-91b65c2b0080 Cluster User : [Non-Secured Cluster]

Cluster Disk Usage (Hide)

0 B
0 B

Cluster RAM Usage (Hide)

17.45 MB
7.98 GB

Cluster Summary (Hide)

Nodes : 1 (1 up, 0 down)

Total Namespaces : 2

Build : 3.6.4

Alerts Activity (Hide)

No active red alerts

Cluster Throughput (Hide)

Snapshot for last : 30 Seconds

Reads per second

Total : 25813.00 TPS
Successful : 25813.00 TPS

Writes per second

Total : 25754.00 TPS
Successful : 25754.00 TPS

Nodes (Hide)

View all node stats

+ Add Node

	Host : Port	Build Version	Cluster Size	Cluster Visibility	Disk	RAM	Replicated Objects	Client Connections	Migrates Incoming	Migrates Outgoing
on	172.31.14.171:3000 View Details	3.6.4	1	●	N/A	17.45 MB 7.98 GB	100,009	19	0	0

Running High-read Workload

You can then run a workload based on high read rates. This will test database operations that are **95% reads 5% writes**

```
./run_benchmarks    -h 127.0.0.1 \    # Local DB server
                    -p 3000 \         # Local port
                    -n test \         # Namespace “test”
                    -k 100000 \       # Load 100,000 records
                    -s testset \      # Use the set "testset"
                    -latency "7,1" \ # Show latency numbers
                    -o S:100 \        # Use 100 byte string
                    -w RU,95 \        # Read at 95%
                    -z 8              # Use 8 threads
```

This script will continue running until it is stopped.

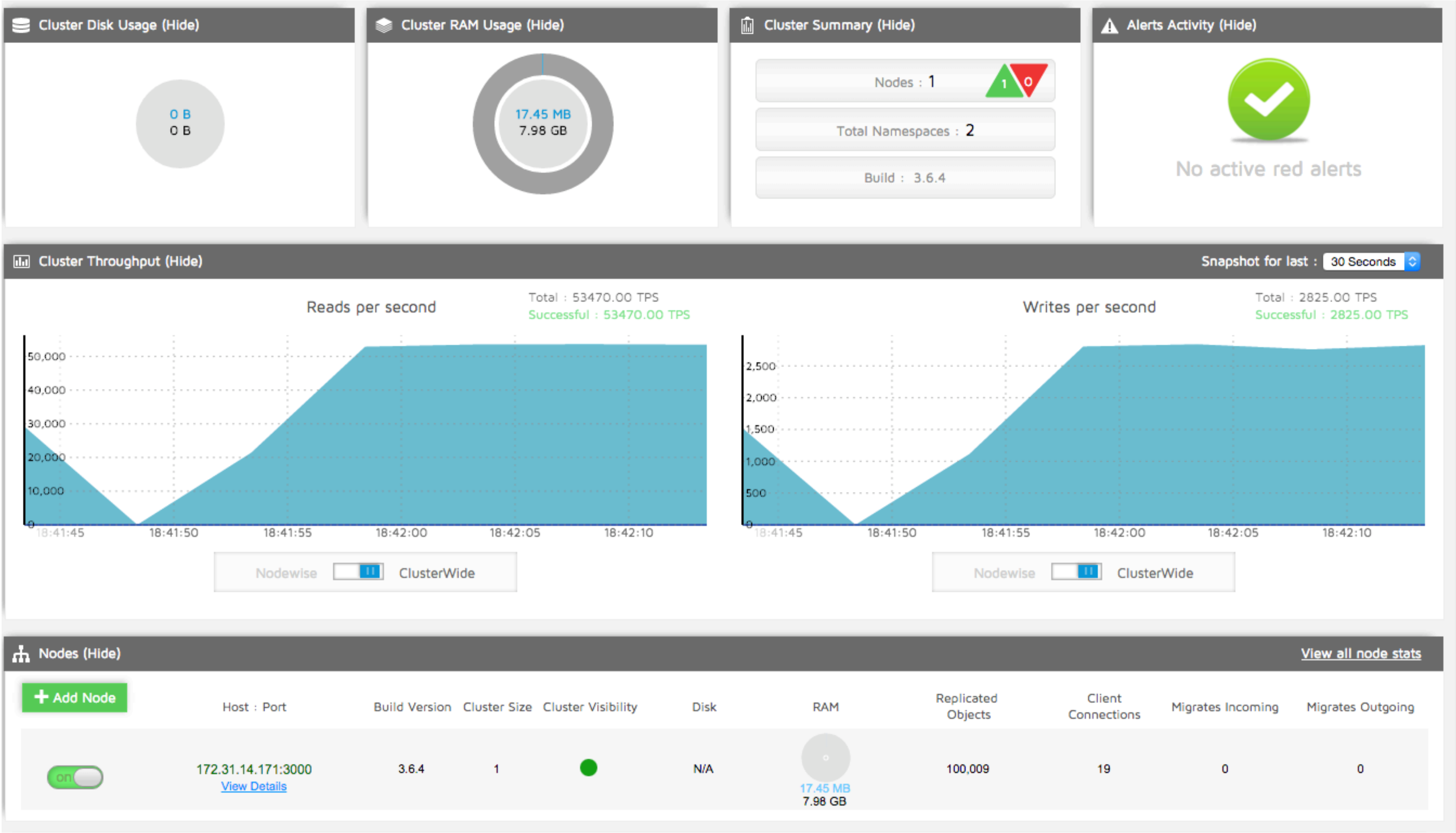
Running High-read workload Example Output

```
$./run_benchmarks -h 127.0.0.1 -p 3000 -n test -s testset -k 100000 -latency "7,1" -o S:100 -w
RU,95 -z 8
```

```
Benchmark: 127.0.0.1:3000, namespace: test, set: <empty>, threads: 8, workload: READ_UPDATE
read: 95% (all bins: 100%, single bin: 0%), write: 5% (all bins: 100%, single bin: 0%)
keys: 100000, start key: 0, key length: 10, bins: 1, throughput: unlimited, debug: false
read policy: timeout: 0, maxRetries: 2, sleepBetweenRetries: 500, reportNotFound: false
write policy: timeout: 0, maxRetries: 2, sleepBetweenRetries: 500
bin type 1: string[100]
2015-05-28 18:58:09.946 INFO Thread 1 Add node BB94FB6A4647106 127.0.0.1:3000
…
2015-05-28 18:58:17.356 write(tps=488 timeouts=0 errors=0) read(tps=8374 timeouts=0 errors=0)
total(tps=8862 timeouts=0 errors=0)
      <=1ms >1ms >2ms >4ms >8ms >16ms >32ms
write   96%   4%   3%   2%   2%    1%    1%
read    97%   3%   3%   2%   2%    1%    1%
2015-05-28 18:58:18.391 write(tps=468 timeouts=0 errors=0) read(tps=9569 timeouts=0 errors=0)
total(tps=10037 timeouts=0 errors=0)
      <=1ms >1ms >2ms >4ms >8ms >16ms >32ms
write   95%   5%   4%   3%   2%    1%    0%
read    97%   3%   2%   2%   2%    1%    0%
...
```

While this is running, check on the AMC.

AMC running benchmark



Cluster Disk Usage: 0 B / 0 B

Cluster RAM Usage: 17.45 MB / 7.98 GB

Nodes : 1 (1, 0)

Total Namespaces : 2

Build : 3.6.4

No active red alerts

Snapshot for last : 30 Seconds

Reads per second
Total : 53470.00 TPS
Successful : 53470.00 TPS

Writes per second
Total : 2825.00 TPS
Successful : 2825.00 TPS

Host : Port	Build Version	Cluster Size	Cluster Visibility	Disk	RAM	Replicated Objects	Client Connections	Migrates Incoming	Migrates Outgoing
172.31.14.171:3000 View Details	3.6.4	1	●	N/A	17.45 MB 7.98 GB	100,009	19	0	0

Summary

What we have covered:

- Have a basic sense of capacity planning.
- Load test data into an Aerospike database using the Aerospike Java Benchmark tool.
- Run benchmark tests.