Troubleshooting Cassandra

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Slides: http://goo.gl/SdAzOJ

Troubleshooting Philosophy

Troubleshooting Process

1 | **_Determine which nodes have problems_**

2 | **_Examine bottlenecks_**

3 | **_Find and understand errors_**

4 | **_Ask what changed_**

5 | **_Determine root cause_**

**6** | **_Take corrective action_**

What changed?

- **Did it work before?**

- **Does it work in another environment?**

- **What's different?**
  - Settings
  - Application Code
  - Read/Write Load
  - Data Volume
  - Hardware
  - Network

- **Did you upgrade?**
  - Cassandra
  - Kernel
  - JVM
  - Driver

- **What metrics changed?**
  - OpsCenter
  - Graphite, etc.

- **Change one thing at a time!**
- **Use configuration management**

Tools of the Trade

OpsCenter Metrics
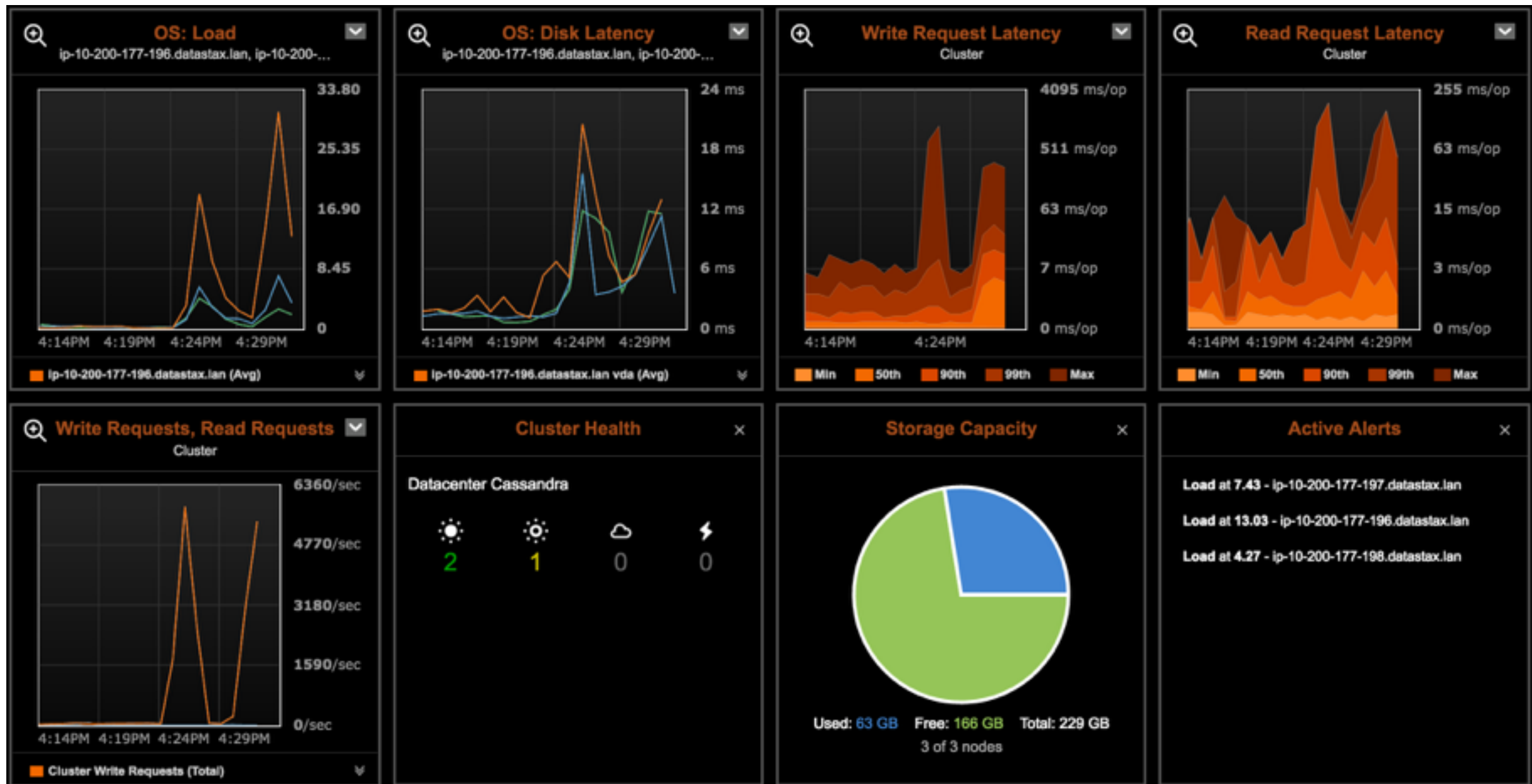
Now with Graphite Integration! (since 6.0)

OpsCenter Diagnostic Tarball

- **Logs**
  - system.log
  - debug.log
  - Spark logs
  - OpsCenter logs

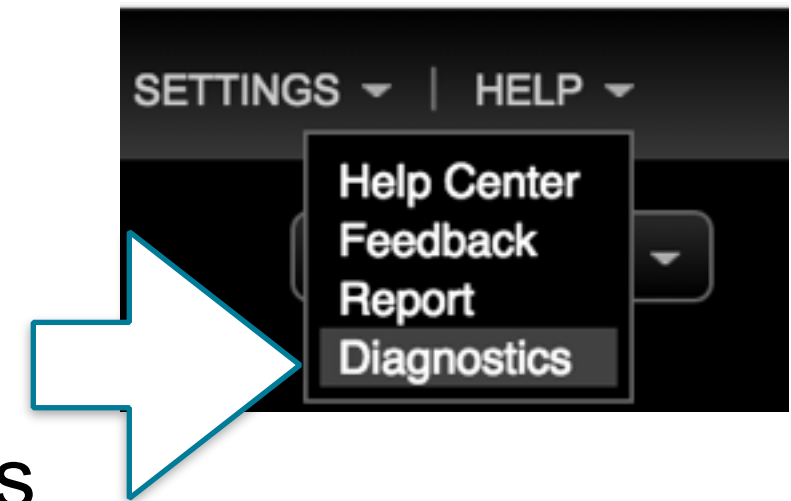- **Configuration**
  - cassandra.yaml
  - cassandra-env.sh
  - dse.yaml
  - OpsCenter conf/yaml files

- **Schema**

- **Nodetool**
  - status
  - tablestats
  - tpstats
  - describecluster
  - netstats
  - etc…

- **OS metrics**

SETTINGS ▾ | HELP ▾

Help Center
Feedback
Report
Diagnostics

Cassandra Logs

DATASTAX

Default Location

/var/log/cassandra/system.log - INFO and higher
/var/log/cassandra/debug.log - all enabled messages

Since 3.0 many system.log messages are now in debug.log!

Configuration File

/etc/dse/cassandra/logback.xml

Basic Format

Level	Thread Type & ID	Date & Time	Source File	Line No.
INFO	[CompactionExecutor:155]	2015-02-13 02:18:40,986	CompactionTask.java	:287
WARN	[GossipTasks:1]	2015-02-17 19:47:37,331	Gossiper.java	:648
ERROR	[AntiEntropySessions:1]	2015-02-17 20:32:11,959	CassandraDaemon.java	:199
DEBUG	[OptionalTasks:1]	2015-02-20 11:29:14,056	ColumnFamilyStore.java	:298

Configuring Logging Levels

```
$ nodetool getlogginglevels                        # show current levels

Logger Name                                                Log Level
ROOT                                                            INFO
DroppedAuditEventLogger                                         INFO
SLF4JAuditWriter                                                INFO
com.cryptsoft                                                    OFF
com.datastax.bdp.search.solr.metrics.MetricsWriteEventListener     DEBUG
com.thinkaurelius.thrift                                       ERROR
org.apache.cassandra                                          DEBUG
org.apache.lucene.index                                        INFO
org.apache.solr.core.CassandraSolrConfig                       WARN
org.apache.solr.core.RequestHandlers                           WARN
org.apache.solr.core.SolrCore                                  WARN
org.apache.solr.handler.component                              WARN
org.apache.solr.search.SolrIndexSearcher                       WARN
org.apache.solr.update                                         WARN
```

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com.thinkaurelius.thrift                                   ERROR
org.apache.cassandra                                       DEBUG
org.apache.lucene.index                                     INFO
org.apache.solr.core.CassandraSolrConfig                    WARN
org.apache.solr.core.RequestHandlers                        WARN
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org.apache.solr.search.SolrIndexSearcher                    WARN
org.apache.solr.update                                      WARN
```

 # all of cassandra
$ nodetool setlogginglevel org.apache.cassandra TRACE

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org.apache.solr.core.RequestHandlers                          WARN
org.apache.solr.core.SolrCore                                 WARN
org.apache.solr.handler.component                             WARN
org.apache.solr.search.SolrIndexSearcher                      WARN
org.apache.solr.update                                        WARN

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# entire package
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```

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com.thinkaurelius.thrift                                        ERROR
org.apache.cassandra                                           DEBUG
org.apache.lucene.index                                        INFO
org.apache.solr.core.CassandraSolrConfig                       WARN
org.apache.solr.core.RequestHandlers                           WARN
org.apache.solr.core.SolrCore                                  WARN
org.apache.solr.handler.component                              WARN
org.apache.solr.search.SolrIndexSearcher                       WARN
org.apache.solr.update                                         WARN

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# specific class
$ nodetool setlogginglevel org.apache.cassandra.service.GCInspector TRACE
```

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org.apache.cassandra                                        DEBUG
org.apache.lucene.index                                     INFO
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org.apache.solr.core.RequestHandlers                        WARN
org.apache.solr.core.SolrCore                               WARN
org.apache.solr.handler.component                           WARN
org.apache.solr.search.SolrIndexSearcher                    WARN
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# specific class
$ nodetool setlogginglevel org.apache.cassandra.service.GCInspector TRACE

# reset to defaults
$ nodetool setlogginglevel
```

DATASTAX

Overall status

Up or down?

```
$ nodetool status

Datacenter: Cassandra
======================
Status=Up/Down
|/ State=Normal/Leaving/Joining/Moving
--  Address          Load          Tokens         Owns       Host ID                                    Rack
UN  10.200.177.196   3.45 GB       1              ?          108af27a-43d8-4814-b617-f8f93ba2bb0e  rack1
UN  10.200.177.197   3.45 GB       1              ?          432bc964-3cd3-4784-9ab7-d7a4a9e063b6  rack1
UN  10.200.177.198   3.45 GB       1              ?          3c467f89-7cce-485f-bb16-dd782c9a84ec  rack1

Note: Non-system keyspaces don't have the same replication settings, effective ownership information
meaningless
```

Lots of nodes? Use grep...

```
$ nodetool status | grep DN

DN  10.200.177.197   3.45 GB       1              ?          432bc964-3cd3-4784-9ab7-d7a4a9e063b6  rack1
```

Company Confidential

OpsCenter Ring View

OpsCenter Alerts
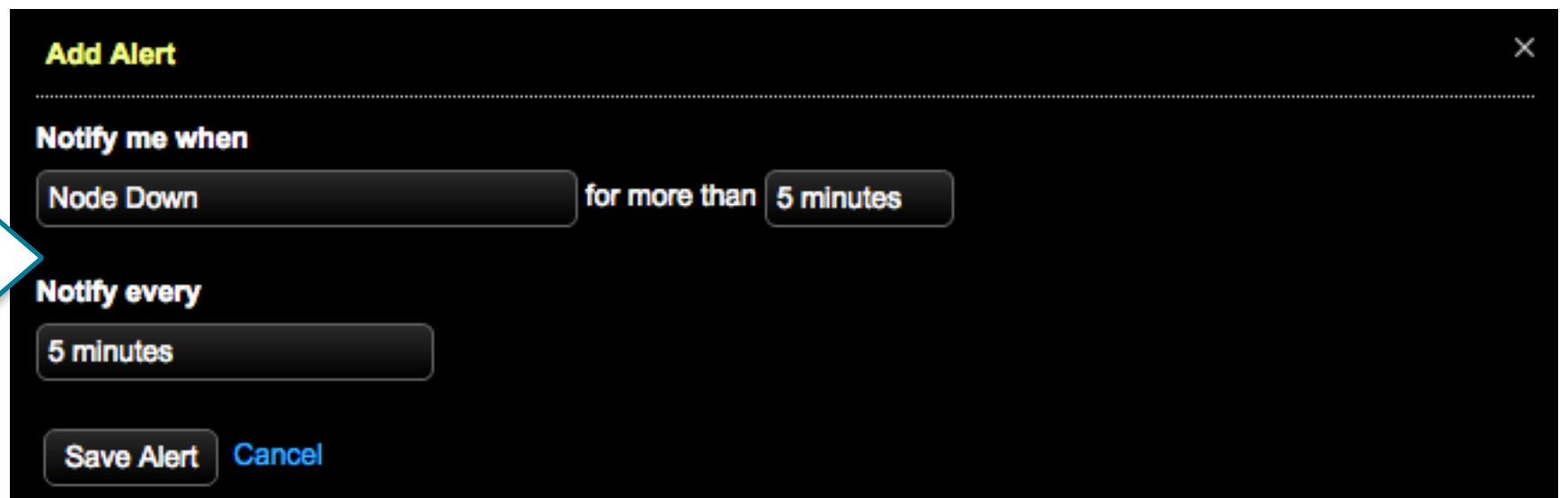
Alert on:
- Nodes Down
- Metrics Exceeding Limit
- Data Balance Issues
- more…

Send Alerts to:
- Email
- HTTP API
- SNMP
- Ex: Hipchat, Slack, Pagerduty

Alerts > Manage Alerts > Add Alert

Add Alert

Notify me when

Node Down   for more than   5 minutes

Notify every

5 minutes

Save Alert   Cancel

Reads and Writes
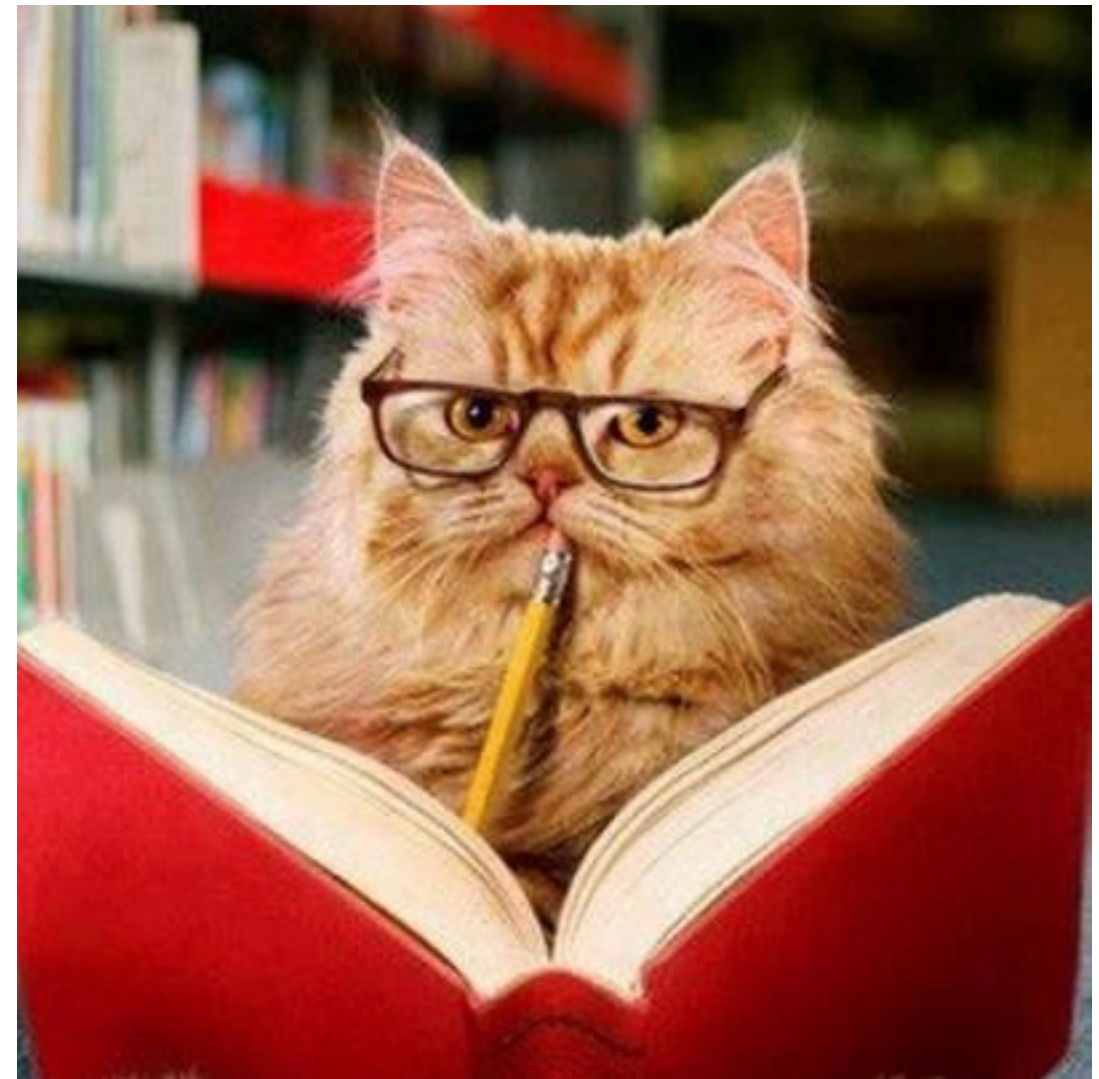
Latency

Coordinator Latency

```
$ nodetool proxyhistograms
proxy histograms
```

Percentile	Read Latency (micros)	Write Latency (micros)	Range Latency (micros)
50%	1358.10	654.95	1131.75
75%	1955.67	1358.10	2346.80
95%	5839.59	4055.27	4866.32
98%	10090.81	7007.51	8409.01
99%	12108.97	10090.81	8409.01
Min	51.01	29.52	545.79
Max	1155149.91	4966933.18	14530.76

Common Causes

- Large batches
- Table scans
- Secondary indexes
- IN clause
- Consistency levels
- Network latency
- Cross-DC traffic
- Garbage collection
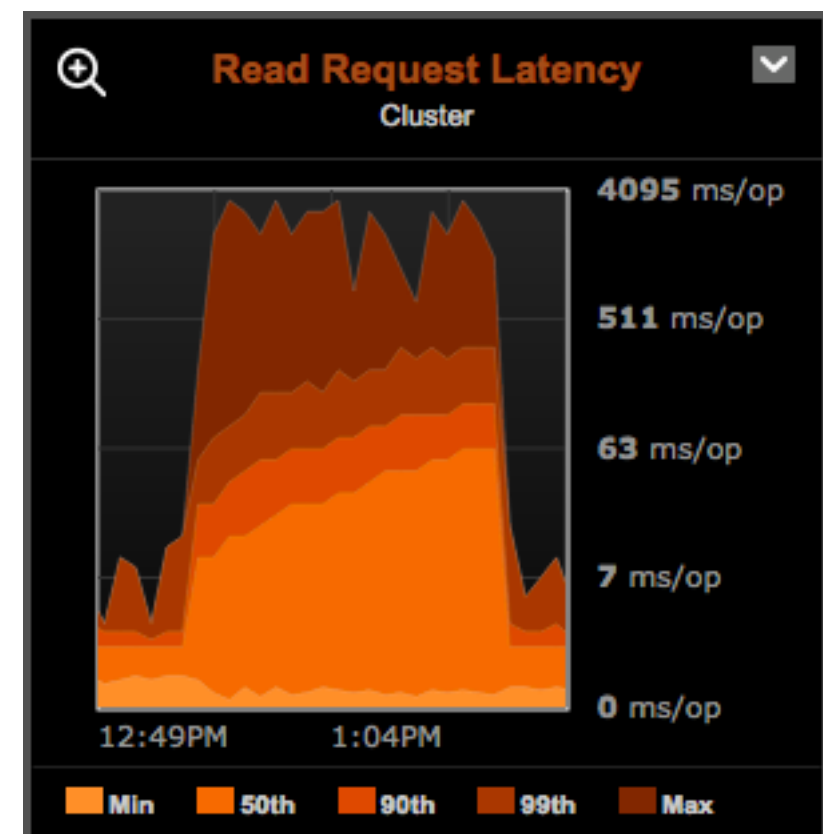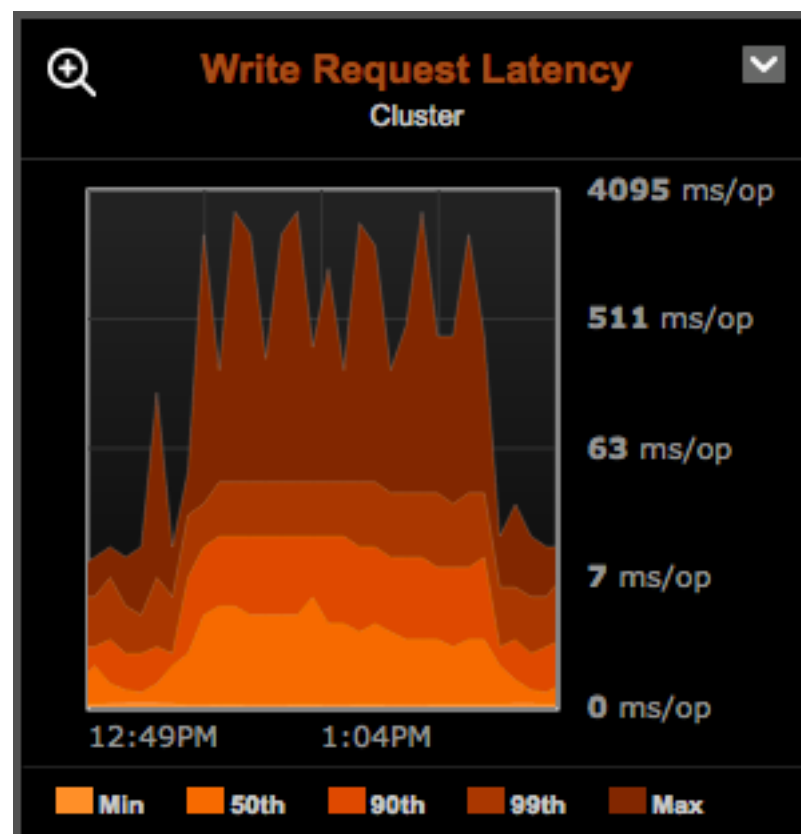
Local Latency

```
$ nodetool tablehistograms keyspace1 standard1
keyspace1/standard1 histograms
```

Percentile	SSTables	Write Latency (micros)	Read Latency (micros)	Partition Size (bytes)	Cell Count
50%	4.00	24.60	1629.72	14237	5
75%	4.00	35.43	3379.39	17084	5
95%	5.00	61.21	7007.51	20501	5
98%	6.00	152.32	12108.97	20501	5
99%	6.00	454.83	14530.76	20501	5
Min	1.00	4.77	182.79	536	5
Max	8.00	4139110.98	1155149.91	24601	5

Common Causes

- I/O bottlenecks
- Lots of sstables
- Garbage collection
- Insufficent threads
- Insufficient cache
- Bloom filter false positive
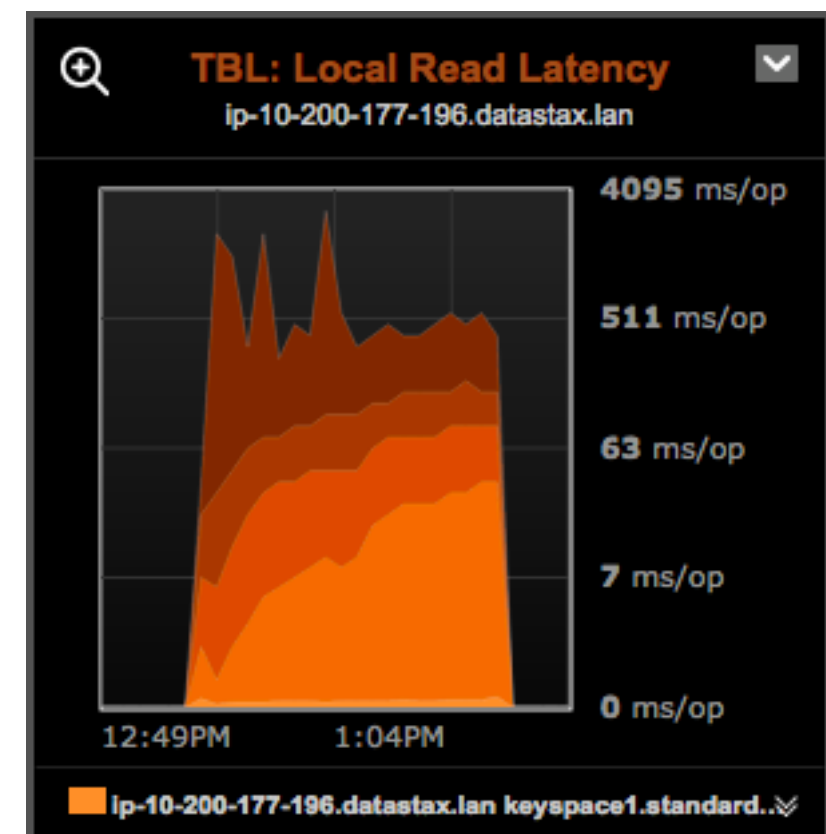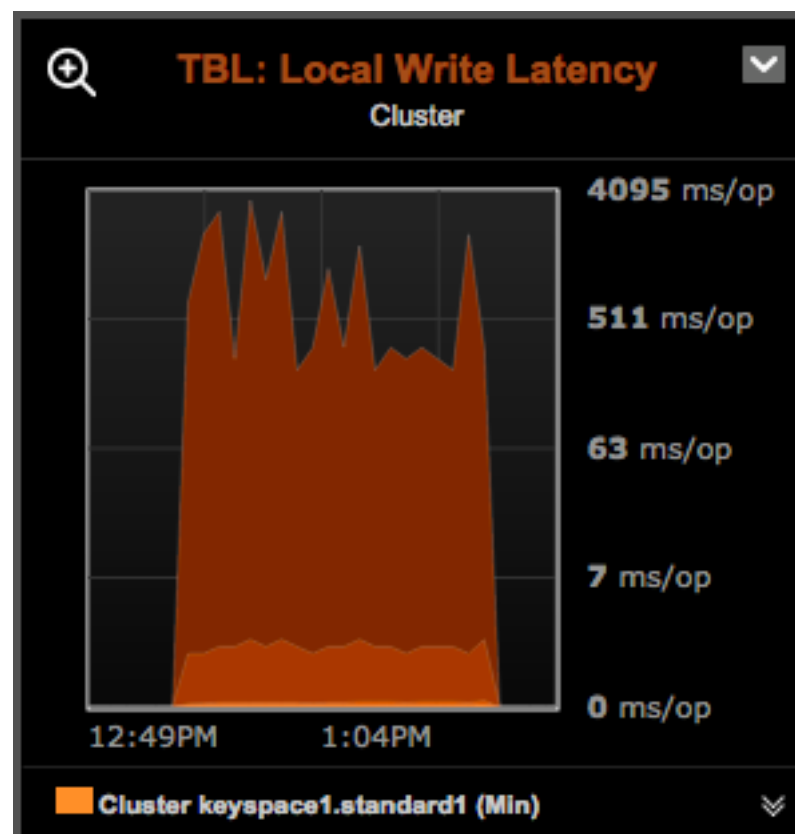
Read/Write Volume

```
$ nodetool tablestats keyspace1
Keyspace: keyspace1
        Read Count: 71035
        Read Latency: 2.6125789258816075 ms.
        Write Count: 2604424
        Write Latency: 0.07452477393273357 ms.
        Pending Flushes: 0
            Table: standard1
            SSTable count: 10
            Space used (live): 17634915179
            Space used (total): 17634915179
            Space used by snapshots (total): 0
            Off heap memory used (total): 4471240
            SSTable Compression Ratio: 0.0
            Number of keys (estimate): 835234
            Memtable cell count: 8958
            Memtable data size: 51012431
            Memtable off heap memory used: 0
            Memtable switch count: 120
            Local read count: 71035
            Local read latency: NaN ms
            Local write count: 2604424
            Local write latency: 0.196 ms
            Pending flushes: 0
            Bloom filter false positives: 0
            Bloom filter false ratio: 0.00000
            Bloom filter space used: 3931968
            Bloom filter off heap memory used: 3931888
            Index summary off heap memory used: 539352
            Compression metadata off heap memory used: 0
            Compacted partition minimum bytes: 1917
            Compacted partition maximum bytes: 9887
            Compacted partition mean bytes: 6143
            Average live cells per slice (last five minutes): NaN
            Maximum live cells per slice (last five minutes): 0
            Average tombstones per slice (last five minutes): NaN
            Maximum tombstones per slice (last five minutes): 0
```
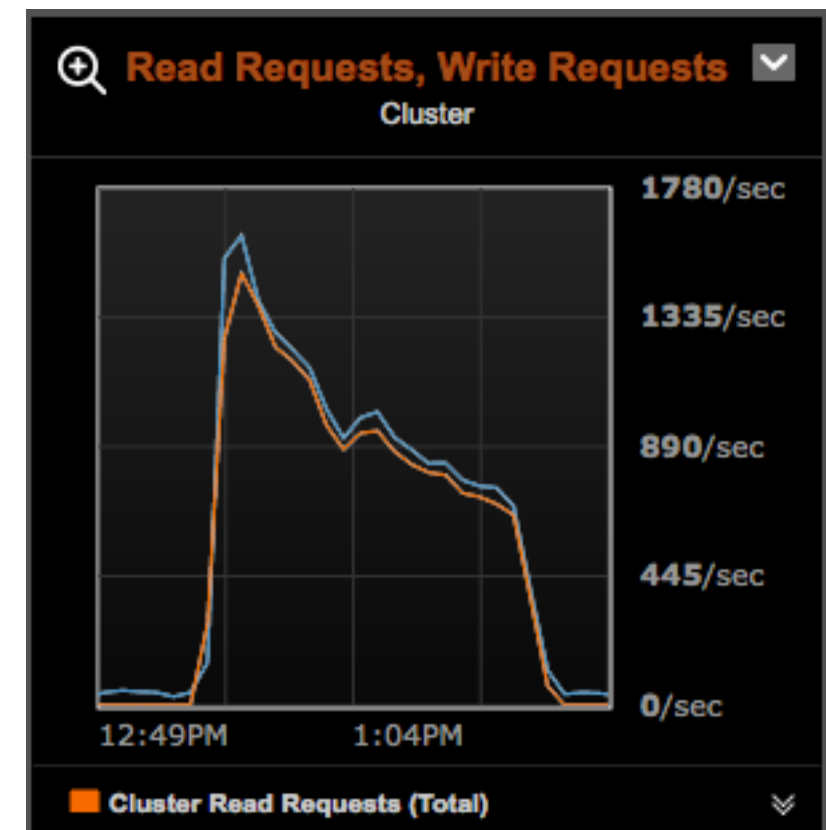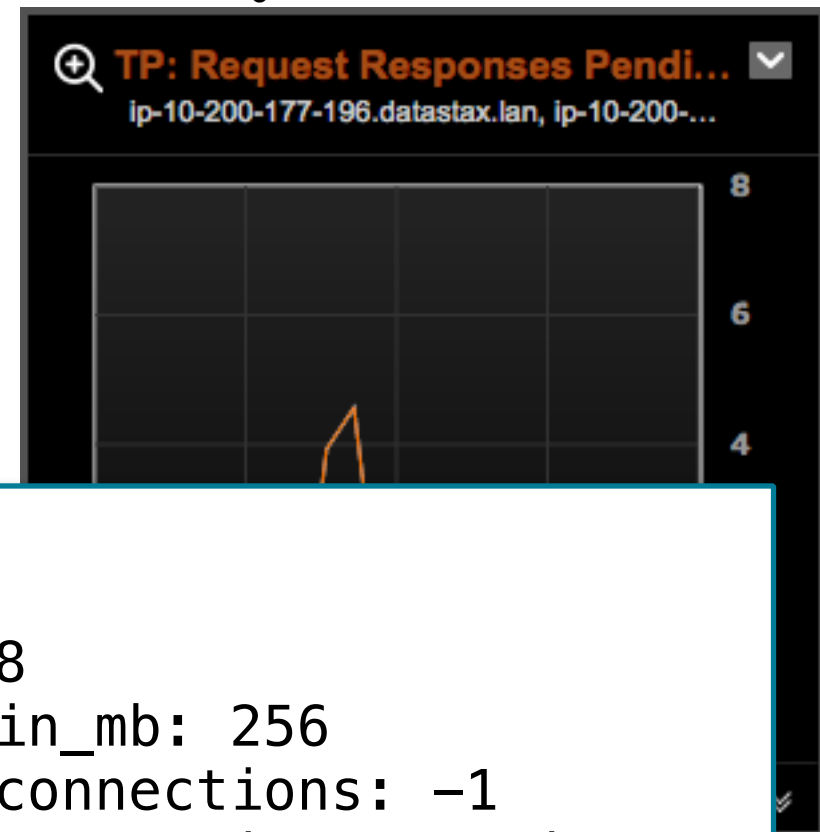
Thread Pools and Timeouts

Native Transport Requests

```
$ nodetool tpstats
Pool Name                     Active     Pending     Completed   Blocked   All time blocked
MutationStage                      0          34       1273902         0                  0
ViewMutationStage                  0           0             0         0                  0
ReadStage                          0           0        561050         0                  0
RequestResponseStage               0           0        894363         0                  0
ReadRepairStage                    0           0         26007         0                  0
CounterMutationStage               0           0             0         0                  0
MiscStage                          0           0             0         0                  0
CompactionExecutor                 1           1          4699         0                  0
MemtableReclaimMemory              0           0            77         0                  0
PendingRangeCalculator             0           0             3         0                  0
GossipStage                        0           0         21833         0                  0
SecondaryIndexManagement           0           0             0         0                  0
HintsDispatcher                    0           0            87         0                  0
MigrationStage                     0           0             0         0                  0
MemtablePostFlush                  1           1            99         0                  0
ValidationExecutor                 0           0             0         0                  0
Sampler                            0           0             0         0                  0
MemtableFlushWriter                1           1            77         0                  0
InternalResponseStage              0           0         38112         0                  0
AntiEntropyStage                   0           0             0         0                  0
CacheCleanupExecutor               0           0             0         0                  0
Native-Transport-Requests         33           0       1186750         0                  0

Message type             Dropped
READ                        3227
RANGE_SLICE                    0
_TRACE                         0
HINT                           0
MUTATION
COUNTER_MUTATION
BATCH_STORE
BATCH_REMOVE
REQUEST_RESPONSE
PAGED_RANGE
READ_REPAIR
```


TP: Request Responses Pendi...
ip-10-200-177-196.datastax.lan, ip-10-200-...

```
# cassandra.yaml settings

native_transport_max_threads: 128
native_transport_max_frame_size_in_mb: 256
native_transport_max_concurrent_connections: -1
native_transport_max_concurrent_connections_per_ip: -1
```
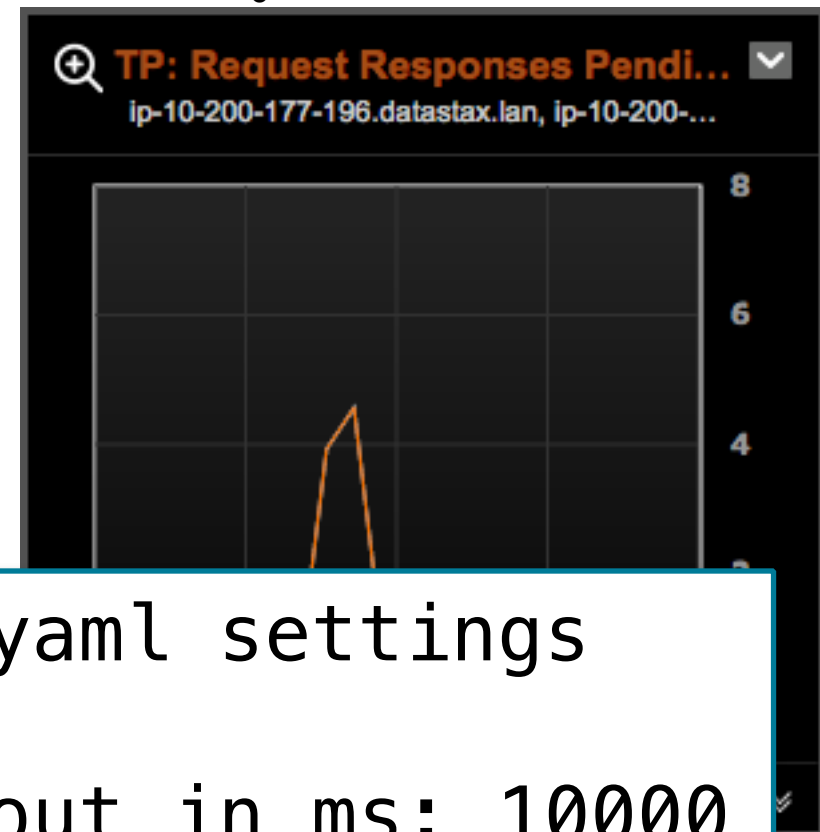
Request Response Threads

```
$ nodetool tpstats
Pool Name                        Active    Pending    Completed    Blocked    All time blocked
MutationStage                         0         34      1273902          0                    0
ViewMutationStage                     0          0            0          0                    0
ReadStage                             0          0       561050          0                    0
RequestResponseStage                  0          0       894363          0                    0
ReadRepairStage                       0          0        26007          0                    0
CounterMutationStage                  0          0            0          0                    0
MiscStage                             0          0            0          0                    0
CompactionExecutor                    1          1         4699          0                    0
MemtableReclaimMemory                 0          0           77          0                    0
PendingRangeCalculator                0          0            3          0                    0
GossipStage                           0          0        21833          0                    0
SecondaryIndexManagement              0          0            0          0                    0
HintsDispatcher                       0          0           87          0                    0
MigrationStage                        0          0            0          0                    0
MemtablePostFlush                     1          1           99          0                    0
ValidationExecutor                    0          0            0          0                    0
Sampler                               0          0            0          0                    0
MemtableFlushWriter                   1          1           77          0                    0
InternalResponseStage                 0          0        38112          0                    0
AntiEntropyStage                      0          0            0          0                    0
CacheCleanupExecutor                  0          0            0          0                    0
Native-Transport-Requests            33          0      1186750          0

Message type            Dropped
READ                       3227
RANGE_SLICE                   0
_TRACE                        0
HINT                          0
MUTATION                    144
COUNTER_MUTATION              0
BATCH_STORE                   0
BATCH_REMOVE                  0
REQUEST_RESPONSE             10
PAGED_RANGE                   0
READ_REPAIR                   0
```


TP: Request Responses Pendi...
ip-10-200-177-196.datastax.lan, ip-10-200-...
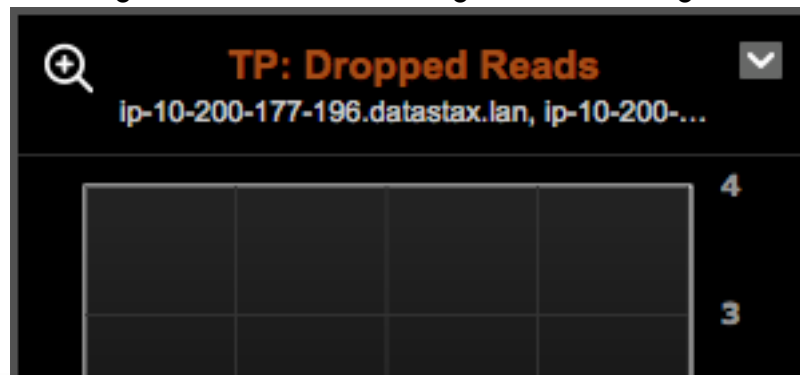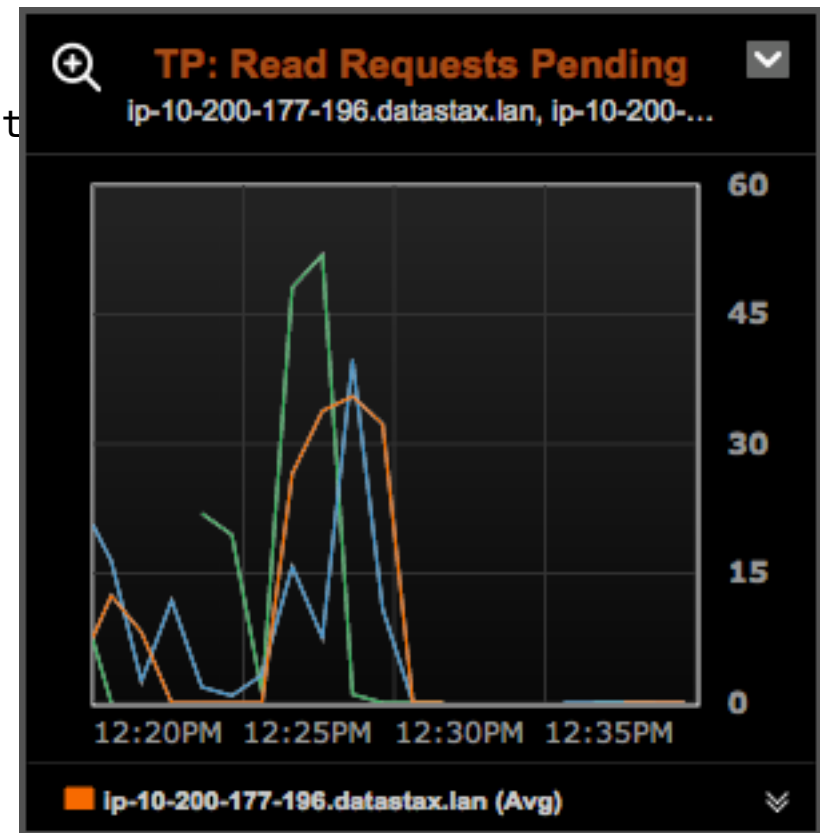
```
# cassandra.yaml settings

request_timeout_in_ms: 10000
```

Read Threads

```
$ nodetool tpstats
Pool Name                        Active     Pending        Completed     Blocked    All t
MutationStage                         0           0          1214289           0
ViewMutationStage                     0           0                0           0
ReadStage                            32          49           508565           0
RequestResponseStage                  0           0           812868           0
ReadRepairStage                       0           0            22916           0
CounterMutationStage                  0           0                0           0
MiscStage                             0           0                0           0
CompactionExecutor                    0           0             4766           0
MemtableReclaimMemory                 0           0               77           0
PendingRangeCalculator                0           0                3           0
GossipStage                           0           0            20991           0
SecondaryIndexManagement              0           0                0           0
HintsDispatcher                       0           0               87           0
MigrationStage                        0           0                0           0
MemtablePostFlush                     0           0               99           0
ValidationExecutor                    0           0                0           0
Sampler                               0           0                0           0
MemtableFlushWriter                   0
InternalResponseStage                 0
AntiEntropyStage                      0
CacheCleanupExecutor                  0
Native-Transport-Requests            24

Message type                     Dropped
READ                                8802
RANGE_SLICE                            0
_TRACE                                 0
HINT                                   3
MUTATION                             348
COUNTER_MUTATION                       0
BATCH_STORE                            0
BATCH_REMOVE                           0
REQUEST_RESPONSE                       0
PAGED_RANGE                            0
READ_REPAIR                            0
```


TP: Read Requests Pending — ip-10-200-177-196.datastax.lan, ip-10-200-...

TP: Dropped Reads — ip-10-200-177-196.datastax.lan, ip-10-200-...

TP: Read Requests Active — ip-10-200-177-196.datastax.lan, ip-10-200-...

```
# cassandra.yaml settings

concurrent_reads: 32
read_request_timeout_in_ms: 5000
range_request_timeout_in_ms: 10000
```
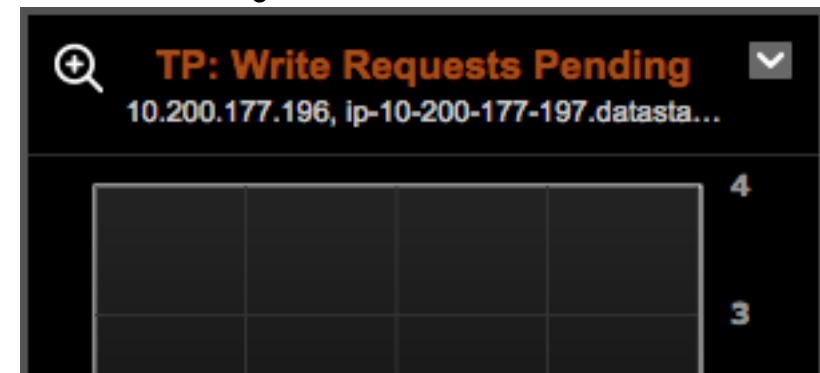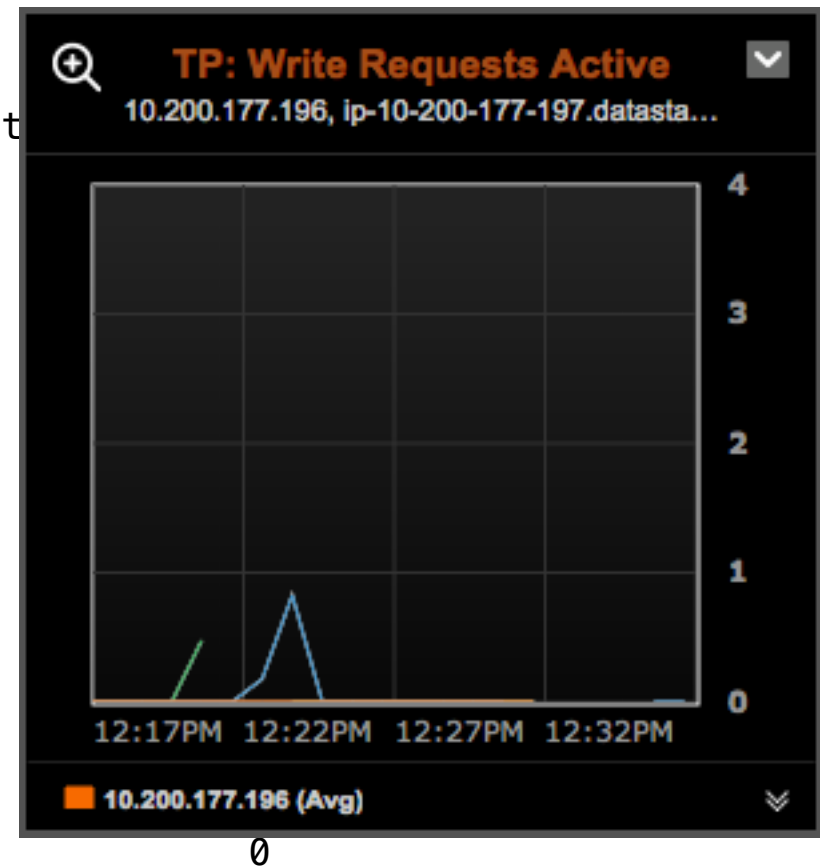
Write Threads

```
$ nodetool tpstats
Pool Name                        Active    Pending       Completed    Blocked    All t
MutationStage                         0         34         1273902          0
ViewMutationStage                     0          0               0          0
ReadStage                             0          0          561050          0
RequestResponseStage                  0          0          894363          0
ReadRepairStage                       0          0           26007          0
CounterMutationStage                  0          0               0          0
MiscStage                             0          0               0          0
CompactionExecutor                    1          1            4699          0
MemtableReclaimMemory                 0          0              77          0
PendingRangeCalculator                0          0               3          0
GossipStage                           0          0           21833          0
SecondaryIndexManagement              0          0               0          0
HintsDispatcher                       0          0              87          0
MigrationStage                        0          0               0          0
MemtablePostFlush                     1          1              99          0
ValidationExecutor                    0          0               0          0
Sampler                               0          0               0          0
MemtableFlushWriter                   1
InternalResponseStage                 0
AntiEntropyStage                      0
CacheCleanupExecutor                  0
Native-Transport-Requests            33

Message type          Dropped
READ                     3227
RANGE_SLICE                 0
_TRACE
HINT
MUTATION
COUNTER_MUTATION
BATCH_STORE
BATCH_REMOVE
REQUEST_RESPONSE
PAGED_RANGE
READ_REPAIR
```


TP: Write Requests Active
10.200.177.196, ip-10-200-177-197.datasta...
10.200.177.196 (Avg)
12:17PM 12:22PM 12:27PM 12:32PM

TP: Dropped Mutations
10.200.177.196, ip-10-200-177-197.datasta...

TP: Write Requests Pending
10.200.177.196, ip-10-200-177-197.datasta...

```
# cassandra.yaml settings

concurrent_writes: 32
write_request_timeout_in_ms: 2000
counter_write_request_timeout_in_ms: 100
```

SSTables

SSTable Count

```
$ nodetool tablestats keyspace1
Keyspace: keyspace1
        Read Count: 408439
        Read Latency: 48.24464316825768 ms.
        Write Count: 437331
        Write Latency: 0.1109122129462581 ms.
        Pending Flushes: 0
            Table: standard1
            SSTable count: 20
            Space used (live): 37002901216
            Space used (total): 37002901216
            Space used by snapshots (total): 0
            Off heap memory used (total): 9595368
            SSTable Compression Ratio: 1.0038997780827315
            Number of keys (estimate): 1009214
            Memtable cell count: 12226
            Memtable data size: 146845620
            Memtable off heap memory used: 0
            Memtable switch count: 18
            Local read count: 408687
            Local read latency: 52.956 ms
            Local write count: 437471
            Local write latency: 0.120 ms
            Pending flushes: 0
            Bloom filter false positives: 130
            Bloom filter false ratio: 0.00007
            Bloom filter space used: 3666792
            Bloom filter off heap memory used: 4134856
            Index summary off heap memory used: 546304
            Compression metadata off heap memory used: 4914208
            Compacted partition minimum bytes: 447
            Compacted partition maximum bytes: 24601
            Compacted partition mean bytes: 13783
            Average live cells per slice (last five minutes): 1.0
            Maximum live cells per slice (last five minutes): 1
            Average tombstones per slice (last five minutes): 1.0
            Maximum tombstones per slice (last five minutes): 1
```

Common Causes
- Compaction behind
- Compactions failing
- Flushing too often
- Disk full

TBL: SSTable Count
ip-10-200-177-196.datastax.lan, ip-10-200-...

ip-10-200-177-196.datastax.lan keyspace1.standard...
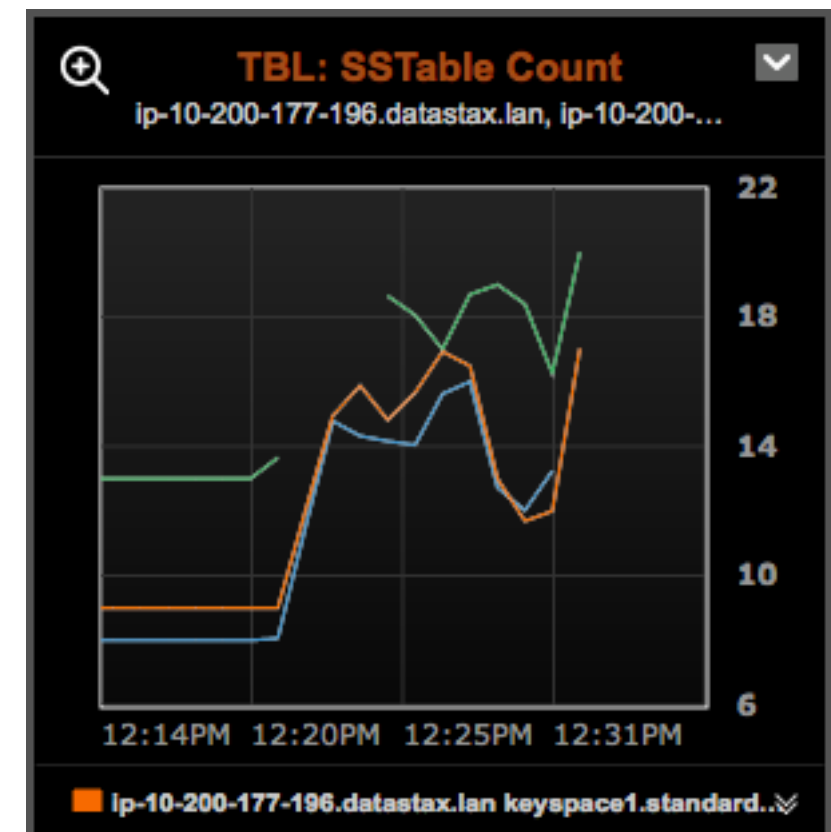
SSTables Per Read

```
$ nodetool tablehistograms keyspace1 standard1
keyspace1/standard1 histograms
Percentile  SSTables    Write Latency    Read Latency    Partition Size      Cell Count
                           (micros)         (micros)          (bytes)
50%            3.00          35.43         30130.99           14237                  5
75%            4.00          42.51         74975.55           17084                  5
95%            6.00          88.15        129557.75           20501                  5
98%            7.00         182.79        155469.30           20501                  5
99%            7.00         454.83        186563.16           20501                  5
Min            1.00           5.72            61.22             447                  5
Max           20.00     2395318.86       2874382.63           24601                  5
```
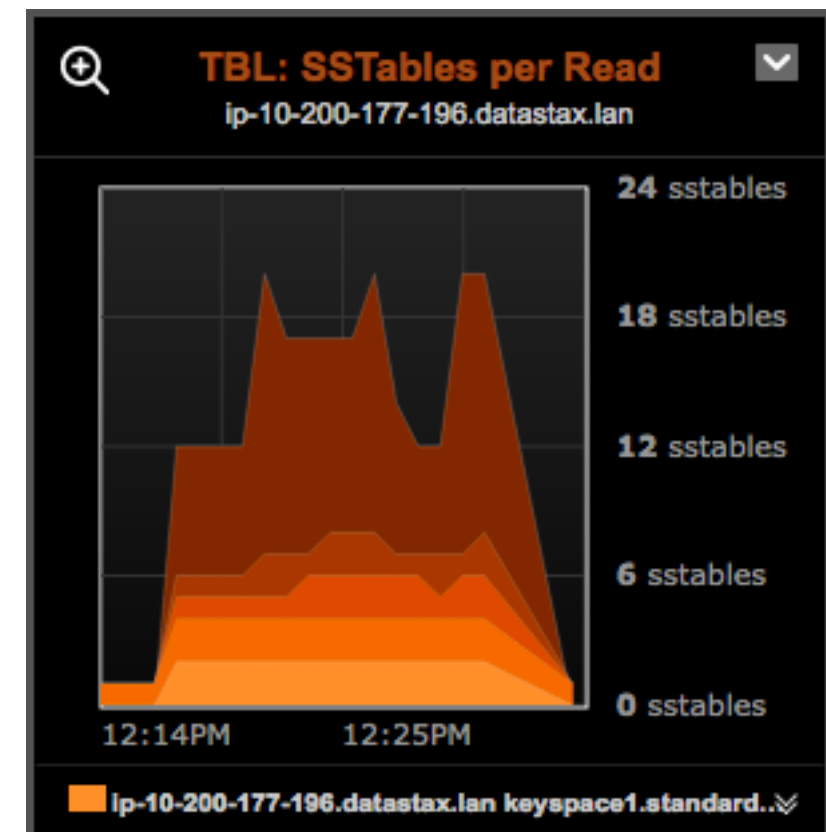
Tombstones

Tombstone Warnings

WARN [SharedPool-Worker-2] 2016-08-21 17:25:00,381 SliceQueryFilter.java:319 - Read **493 live** and **1479 tombstone** cells in **foo.bar** for key: **315847b3-67c4-11e6-9797-1db751d46fa1** (see **tombstone_warn_threshold**). 5000 columns were requested, slices=[-]

ERROR [SharedPool-Worker-3] 2016-08-23 01:12:32,504 SliceQueryFilter.java:284 - Scanned over **100000** tombstones in **foo.bar**; query aborted (see tombstone_failure_threshold)

Mitigation

- Avoid implementing queues
- Avoid massive deletes; truncate instead
- Don't insert nulls (be careful with prepared statements)
- Decrease gc_grace_seconds if you can

```
# configure gc_grace_seconds in CQL
alter table with gc_grace_seconds = 0; # use with caution!

# thresholds configurable in cassandra.yaml
tombstone_warn_threshold: 1000
tombstone_failure_threshold: 100000
```

System Resources

CPU + Disk Utilization = Load Average

```
top – 19:47:11 up 4 days,  5:12,  1 user,  load average: 0.12, 0.71, 2.58
Tasks: 108 total,   2 running, 106 sleeping,   0 stopped,   0 zombie
%Cpu(s):  3.6 us,  1.7 sy,  0.0 ni, 94.6 id,  0.0 wa,  0.          s        0 st
KiB Mem:  16434208 total,  8966924 used,  7467284 free,    78
KiB Swap:        0 total,        0 used,        0 free.  2478732 cached Mem
```

```
  PID USER       PR  NI    VIRT     RES    SHR S  %CPU %MEM     TIME+ COMMAND
 9421 cassand+   20   0 19.490g 4.613g  36832 S  23.0 29.4  39:08.01 java
14749 cassand+   20   0 3752964 376148  15116 S  11.3  2.3  18:58.59 java
14494 opscent+   20   0 5051000 895292  20360 S   1.7  5.4  10:24.98 java
14641 automat+   20   0   23632    1568   1108 R   0.3  0.0   0:00.09 top
    1 root       20   0   33620    2888   1476 S   0.0  0.0   0:01.82 init
    2 root       20   0       0       0      0 S   0.0  0.0   0:00.22 kthreadd
    3 root       20   0       0       0      0 S   0.0  0.0   0:01.55 ksoftirqd/0
    5 root        0 -20       0       0      0 S   0.0  0.0
```

1   5   15

Historic 1 min avg

CPU

Total CPU Utilization

```
top — 19:47:11 up 4 days,  5:12,  1 user,  load average: 0.12, 0.71, 2.58
Tasks: 108 total,   2 running, 106 sleeping,   0 stopped,   0 zombie
%Cpu(s):  3.6 us,  1.7 sy,  0.0 ni, 94.6 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
KiB Mem:  16434208 total,  8966924 used,  7467284 free,    98784 buffers
KiB Swap:        0 total,        0 used,        0 free.  2478732 cached Mem

  PID USER      PR  NI    VIRT    RES    SHR S  %CPU %MEM     TIME+ COMMAND
 9421 cassand+  20   0 19.490g 4.613g  36832 S  23.0 29.4  39:08.01 java
14749 cassand+  20   0 3752964 376148  15116 S  11.3  2.3  18:58.59 java
14494 opscent+  20   0 5051000 895292  20360 S   1.7  5.4  10:24.98 java
14641 automat+  20   0   23632   1568   1108 R   0.3  0.0   0:00.09 top
    1 root      20   0   33620   2888   1476 S   0.0  0.0   0:01.82 init
    2 root      20   0       0      0      0 S   0.0  0.0   0:00.22 kthreadd
    3 root      20   0       0      0      0 S   0.0  0.0   0:01.55 ksoftirqd/0
    5 root       0 -20       0      0      0 S   0.0  0.0   0:0
```

Company Confidential

Is it Cassandra?

```
top — 19:47:11 up 4 days,  5:12,  1 user,  load average: 0.12, 0.71, 2.58
Tasks: 108 total,   2 running, 106 sleeping,   0 stopped,   0 zombie
%Cpu(s):  3.6 us,  1.7 sy,  0.0 ni, 94.6 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
KiB Mem:  16434208 total,  8966924 used,  7467284 free,    98784 buffers
KiB Swap:        0 total,        0 used,        0 free.  2478732 cached Mem

  PID USER       PR  NI    VIRT    RES    SHR S  %CPU %MEM     TIME+ COMMAND
 9421 cassand+   20   0 19.490g 4.613g  36832 S  23.0 29.4  39:08.01 java
14749 cassand+   20   0 3752964 376148  15116 S  11.3  2.3  18:58.59 java
14494 opscent+   20   0 5051000 895292  20360 S   1.7  5.4  10:24.98 java
14641 automat+   20   0   23632   1568   1108 R   0.3  0.0   0:00.09 top
    1 root       20   0   33620   2888   1476 S   0.0  0.0   0:01.82 init
    2 root       20   0       0      0      0 S   0.0  0.0   0:00.22 kthreadd
    3 root       20   0       0      0      0 S   0.0  0.0   0:01.55 ksoftirqd/0
    5 root        0 -20       0      0      0 S   0.0  0.0   0:00.00 kworker/0:0H
```

Per-Thread Utilization

```
$ java –jar sjk–plus–0.4.2.jar ttop –p 22226 –o CPU –n 20
2016–08–17T18:54:00.188+0000 Process summary
  process cpu=320.99%
  application cpu=303.13% (user=174.83% sys=128.30%)
  other: cpu=17.86%
  heap allocation rate 218mb/s
[000224] user= 6.39% sys= 4.00%          e-Incoming–/10.200.177.196
[000293] user= 7.89% sys= 5.05%          e-Incoming–/10.200.177.198
[000305] user= 6.79% sys= 3.17% alloc=    14mb/s – CompactionExecutor:4
[000157] user= 6.19% sys= 4.00% alloc= 6727kb/s – SharedPool–Worker–5
[000153] user= 7.49% sys= 3.51% alloc= 6596kb/s – SharedPool–Worker–2
[000152] user= 7.49% sys= 3.41% alloc= 6436kb/s – SharedPool–Worker–1
[000155] user= 6.39% sys= 3.80% alloc= 6153kb/s – SharedPool–Worker–4
[000154] user= 6.89% sys= 3.29% alloc= 6054kb/s – SharedPool–Worker–3
[000156] user= 6.39% sys= 3.68% alloc= 6030kb/s – SharedPool–Worker–6
[000168] user= 5.89% sys= 3.33% alloc= 5947kb/s – SharedPool–Worker–8
[000181] user= 5.49% sys= 3.28% alloc= 5343kb/s – SharedPool–Worker–9
[000169] user= 6.39% sys= 2.86% alloc= 5202kb/s – SharedPool–Worker–7
[000179] user= 4.80% sys= 2.29% alloc= 4969kb/s – SharedPool–Worker–12
[000158] user= 5.29% sys= 2.43% alloc= 4830kb/s – SharedPool–Worker–11
[000159] user= 4.60% sys= 2.06% alloc= 4734kb/s – SharedPool–Worker–13
[000178] user= 3.80% sys= 2.30% alloc= 4304kb/s – SharedPool–Worker–14
[000180] user= 4.90% sys= 2.45% alloc= 4294kb/s – SharedPool–Worker–10
[000160] user= 3.90% sys= 1.55% alloc= 4160kb/s – SharedPool–Worker–15
[000177] user= 3.30% sys= 1.29% alloc= 3268kb/s – SharedPool–Worker–16
[000247] user= 2.40% sys= 3.48% alloc= 3253kb/s – epollEventLoopGroup–6–2
```

Per-thread utilization

Per-Thread Utilization

```
$ java -jar sjk-plus-0.4.2.jar ttop -p 22226 -o CPU -n 20
2016-08-17T18:54:00.188+0000 Process summary
  process cpu=320.99%
  application cpu=303.13% (user=174.83% sys=128.30%)
  other: cpu=17.86%
  heap allocation rate 21
[000224] user= 6.39% sys=                              MessagingService-Incoming-/10.200.177.196
[000293] user= 7.89% sys=            Thread Name    - MessagingService-Incoming-/10.200.177.198
[000305] user= 6.79% sys= 3.17% alloc=     14mb/s - CompactionExecutor:4
[000157] user= 6.19% sys= 4.00% alloc= 6727kb/s - SharedPool-Worker-5
[000153] user= 7.49% sys= 3.51% alloc= 6596kb/s - SharedPool-Worker-2
[000152] user= 7.49% sys= 3.41% alloc= 6436kb/s - SharedPool-Worker-1
[000155] user= 6.39% sys= 3.80% alloc= 6153kb/s - SharedPool-Worker-4
[000154] user= 6.89% sys= 3.29% alloc= 6054kb/s - SharedPool-Worker-3
[000156] user= 6.39% sys= 3.68% alloc= 6030kb/s - SharedPool-Worker-6
[000168] user= 5.89% sys= 3.33% alloc= 5947kb/s - SharedPool-Worker-8
[000181] user= 5.49% sys= 3.28% alloc= 5343kb/s - SharedPool-Worker-9
[000169] user= 6.39% sys= 2.86% alloc= 5202kb/s - SharedPool-Worker-7
[000179] user= 4.80% sys= 2.29% alloc= 4969kb/s - SharedPool-Worker-12
[000158] user= 5.29% sys= 2.43% alloc= 4830kb/s - SharedPool-Worker-11
[000159] user= 4.60% sys= 2.06% alloc= 4734kb/s - SharedPool-Worker-13
[000178] user= 3.80% sys= 2.30% alloc= 4304kb/s - SharedPool-Worker-14
[000180] user= 4.90% sys= 2.45% alloc= 4294kb/s - SharedPool-Worker-10
[000160] user= 3.90% sys= 1.55% alloc= 4160kb/s - SharedPool-Worker-15
[000177] user= 3.30% sys= 1.29% alloc= 3268kb/s - SharedPool-Worker-16
[000247] user= 2.40% sys= 3.48% alloc= 3253kb/s - epollEventLoopGroup-6-2
```
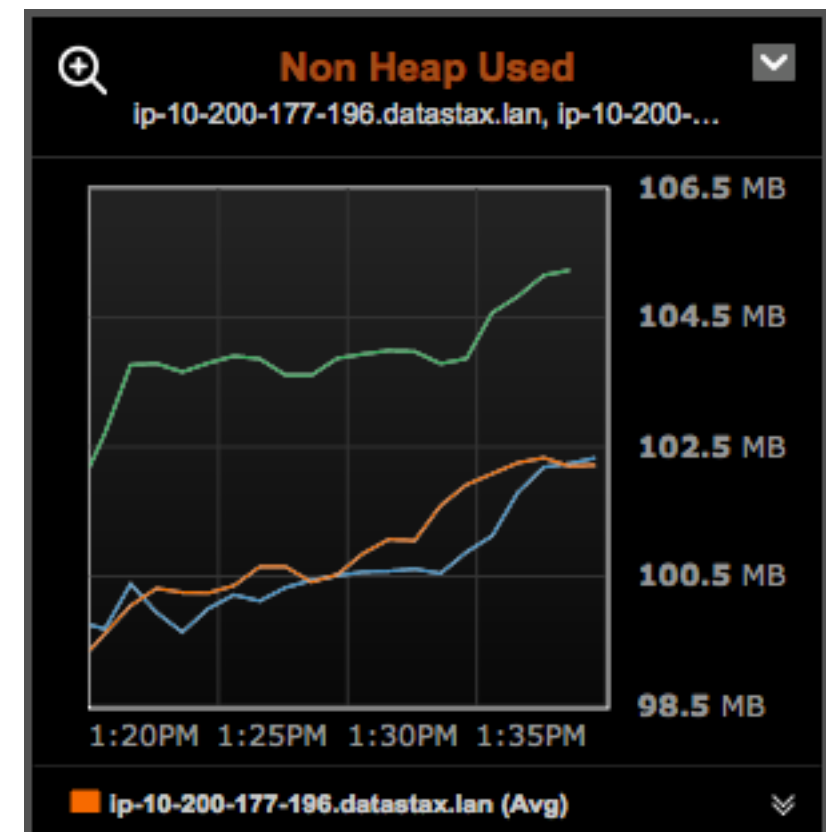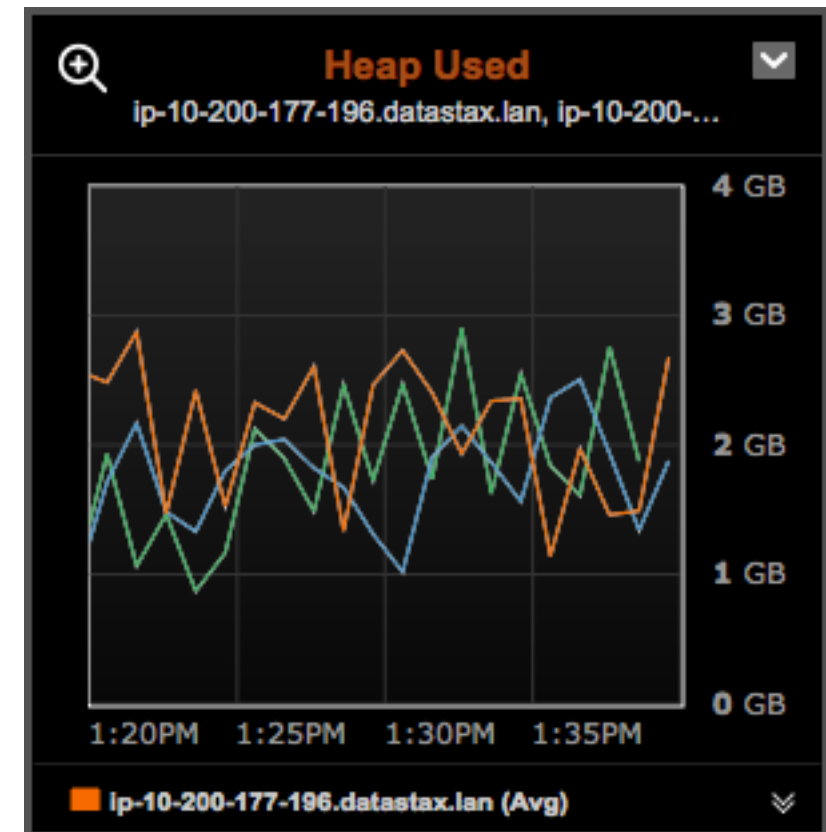
JVM Utilization

```
$ java -jar sjk-plus-0.4.2.jar ttop -p 22226 -o CPU -n 20
2016-08-17T18:54:00.188+0000 Process summary
  process cpu=320.99%
  application cpu=303              28.30%)
  other: cpu=17.86%
  heap allocation rat
[000224] user= 6.39% sys= 4.00% alloc=   29mb/s - MessagingService-Incoming-/10.200.177.196
[000293] user= 7.89% sys= 5.05% alloc=   29mb/s - MessagingService-Incoming-/10.200.177.198
[000305] user= 6.79% sys= 3.17% alloc=   14mb/s - CompactionExecutor:4
[000157] user= 6.19% sys= 4.00% alloc= 6727kb/s - SharedPool-Worker-5
[000153] user= 7.49% sys= 3.51% alloc= 6596kb/s - SharedPool-Worker-2
[000152] user= 7.49% sys= 3.41% alloc= 6436kb/s - SharedPool-Worker-1
[000155] user= 6.39% sys= 3.80% alloc= 6153kb/s - SharedPool-Worker-4
[000154] user= 6.89% sys= 3.29% alloc= 6054kb/s - SharedPool-Worker-3
[000156] user= 6.39% sys= 3.68% alloc= 6030kb/s - SharedPool-Worker-6
[000168] user= 5.89% sys= 3.33% alloc= 5947kb/s - SharedPool-Worker-8
[000181] user= 5.49% sys= 3.28% alloc= 5343kb/s - SharedPool-Worker-9
[000169] user= 6.39% sys= 2.86% alloc= 5202kb/s - SharedPool-Worker-7
[000179] user= 4.80% sys= 2.29% alloc= 4969kb/s - SharedPool-Worker-12
[000158] user= 5.29% sys= 2.43% alloc= 4830kb/s - SharedPool-Worker-11
[000159] user= 4.60% sys= 2.06% alloc= 4734kb/s - SharedPool-Worker-13
[000178] user= 3.80% sys= 2.30% alloc= 4304kb/s - SharedPool-Worker-14
[000180] user= 4.90% sys= 2.45% alloc= 4294kb/s - SharedPool-Worker-10
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[000177] user= 3.30% sys= 1.29% alloc= 3268kb/s - SharedPool-Worker-16
[000247] user= 2.40% sys= 3.48% alloc= 3253kb/s - epollEventLoopGroup-6-2
```

JVM (GC, etc.)

DATASTAX

Memory

Heap/Off-Heap Usage

```
$ nodetool info

ID                         : 432bc964-3cd3-4784-9ab7-d7a4a9e063b6
Gossip active              : true
Thrift active              : true
Native Transport active: true
Load                       : 13.41 GB
Generation No              : 1471459228
Uptime (seconds)           : 97288
Heap Memory (MB)           : 1065.20 / 4012.00
Off Heap Memory (MB)       : 3.49
Data Center                : Cassandra
Rack                       : rack1
Exceptions                 : 0
Key Cache                  : entries 9002, size 760.92 KB,
capacity 100 MB, 19723 hits, 29234 requests, 0.675 recent hit
rate, 14400 save period in seconds
Row Cache                  : entries 0, size 0 bytes, capacity 0
bytes, 0 hits, 0 requests, NaN recent hit rate, 0 save period
in seconds
Counter Cache              : entries 0, size 0 bytes, capacity 50
MB, 0 hits, 0 requests, NaN recent hit rate, 7200 save period
in seconds
Token                      : -3074457345618258603
```


Heap Used
ip-10-200-177-196.datastax.lan, ip-10-200-...

ip-10-200-177-196.datastax.lan (Avg)

Non Heap Used
ip-10-200-177-196.datastax.lan, ip-10-200-...

ip-10-200-177-196.datastax.lan (Avg)

Caches

Cassandra Caches
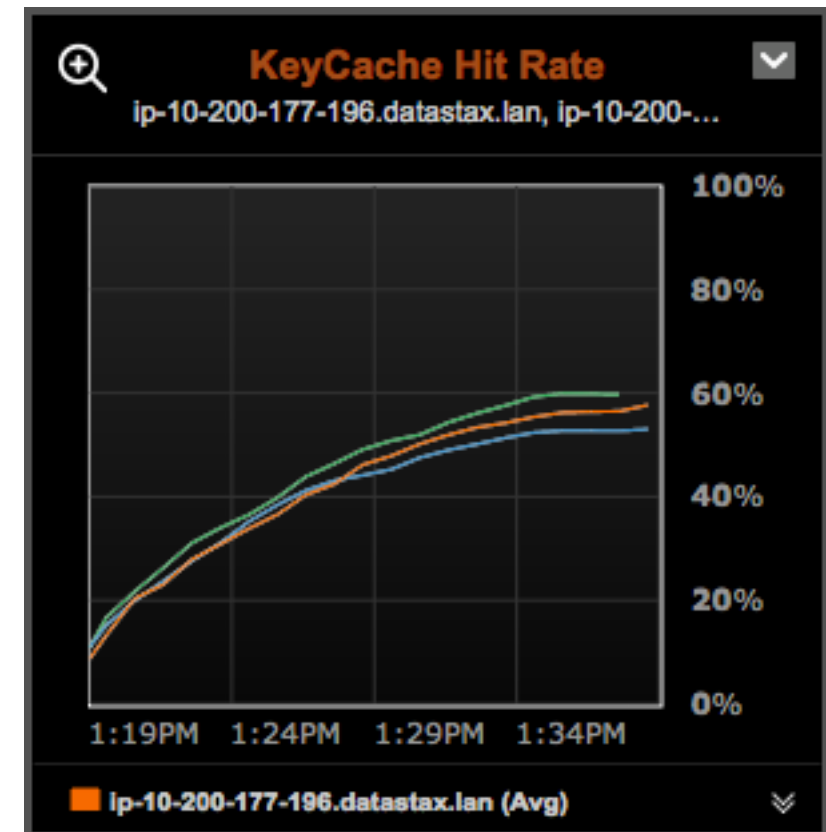
```
$ nodetool info

ID                        : 6817e9ca-e79d-4fed-946e-7318bcfd5343
Gossip active             : true
Thrift active             : true
Native Transport active: true
Load                      : 22.68 MB
Generation No             : 1426523950
Uptime (seconds)          : 1557
Heap Memory (MB)          : 270.85 / 1842.00
Off Heap Memory (MB)      : 0.11
Data Center               : us-east
Rack                      : 1b
Exceptions                : 0
Key Cache                 : entries 156962, size 12.83 MB, capacity 100 MB, 649 hits, 713 requests,
                            0.910 recent hit rate, 14400 save period in seconds
Row Cache                 : entries 0, size 0 bytes, capacity 0 bytes, 0 hits, 0 requests,
                            NaN recent hit rate, 0 save period in seconds
Counter Cache             : entries 0, size 0 bytes, capacity 50 MB, 0 hits, 0 requests,
                            NaN recent hit rate, 7200 save period in seconds
Token                     : 80372383360720788
```

Cache Size vs Capacity

```
$ nodetool info

ID                        : 6817e9ca-e79d-4fed-946e-7318bcfd5343
Gossip active             : true
Thrift active             : true
Native Transport active   : true
Load                      : 22.68 MB
Generation No             : 1426523950
Uptime (seconds)          : 1557
Heap Memory (MB)          : 270.85 / 1842.00
Off Heap Memory (MB)      : 0.11
Data Center               : us-east
Rack                      : 1b
Exceptions                : 0
Key Cache                 : entries 156962, size 12.83 MB, capacity 100 MB, 649 hits, 713 requests,
                            0.910 recent hit rate, 14400 save period in seconds
Row Cache                 : entries 0, size 0 bytes, capacity 0 bytes, 0 hits, 0 requests,
                            NaN recent hit rate, 0 save period in seconds
Counter Cache             : entries 0, size 0 bytes, capacity 50 MB, 0 hits, 0 requests,
                            NaN recent hit rate, 7200 save period in seconds
Token                     : 8037238360720788
```

In Use   Available

Cache Hit Rate

$ nodetool info

```
ID                   : 6817e9ca-e79d-4fed-946e-7318bcfd5343
Gossip active        : true
Thrift active        : true
Native Transport active: true
Load                 : 22.68 MB
Generation No        : 1426523950
Uptime (seconds)     : 1557
Heap Memory (MB)     : 270.85 / 1842.00
Off Heap Memory (MB) : 0.11
Data Center
Rack
Exceptions
Key Cache            : entries 156962, size 12.83 MB, capacity 100 MB, 649 hits, 713 requests,
                       0.910 recent hit rate, 14400 save period in seconds
Row Cache            : entries 0, size 0 bytes, capacity 0 bytes, 0 hits, 0 requests,
                       NaN recent hit rate, 0 save period in seconds
Counter Cache        : entries 0, size 0 bytes, capacity 50 MB, 0 hits, 0 requests,
                       NaN recent hit rate, 7200 save period in seconds
Token                : 80372383360720788
```

Hit Rate

KeyCache Hit Rate
ip-10-200-177-196.datastax.lan, ip-10-200-...

ip-10-200-177-196.datastax.lan (Avg)

cassandra.yaml Cache Settings

```
$ nodetool info

ID                      : 6817e9ca-e79d-4fed-946e-7318bcfd5343
Gossip active           : true
Thrift active           : true
Native Transport active: true
Load                    : 22.68 MB
Generation No           : 1426523950
Uptime (seconds)        : 1557
Heap Memory (MB)        : 270.85 / 1842.00
Off Heap Memory (MB)    : 0.11
Data Center             : us-east
Rack                    : 1b
Exceptions              : 0
Key Cache               : entries 156962, size 12.83 MB, capacity 100 MB, 649 hits, 713 requests,
                          0.910 recent hit rate, 14400 save period in seconds
Row Cache               : entries 0, size 0 bytes, capacity 0 bytes, 0 hits, 0 requests,
                          NaN recent hit rate, 0 save period in seconds
Counter Cache           : entries 0, size 0 bytes, capacity 50 MB, 0 hits, 0 requests,
                          NaN recent hit rate, 7200 save period in seconds
Token                   : 80372383360720788

# cassandra.yaml settings
key_cache_size_in_mb: 100
row_cache_size_in_mb: 0
counter_cache_size_in_mb: 50

# cql per-table configuration
alter table foo with caching = {'keys': 'ALL', 'rows_per_partition': 'NONE'};
```

CQL Cache Settings

```
$ nodetool info

ID                     : 6817e9ca-e79d-4fed-946e-7318bcfd5343
Gossip active          : true
Thrift active          : true
Native Transport active: true
Load                   : 22.68 MB
Generation No          : 1426523950
Uptime (seconds)       : 1557
Heap Memory (MB)       : 270.85 / 1842.00
Off Heap Memory (MB)   : 0.11
Data Center            : us-east
Rack                   : 1b
Exceptions             : 0
Key Cache              : entries 156962, size 12.83 MB, capacity 100 MB, 649 hits, 713 requests,
                         0.910 recent hit rate, 14400 save period in seconds
Row Cache              : entries 0, size 0 bytes, capacity 0 bytes, 0 hits, 0 requests,
                         NaN recent hit rate, 0 save period in seconds
Counter Cache          : entries 0, size 0 bytes, capacity 50 MB, 0 hits, 0 requests,
                         NaN recent hit rate, 7200 save period in seconds
Token                  : 80372383360720788

# cassandra.yaml settings
key_cache_size_in_mb: 100
row_cache_size_in_mb: 0
counter_cache_size_in_mb: 50

# cql per-table configuration
alter table foo with caching = {'keys': 'ALL', 'rows_per_partition': 'NONE'};
```

Linux Page Cache

```
$ free –h
                total          used          free        shared       buffers        cached
Mem:              15G          6.3G          9.4G          416K          101M          1.4G
–/+ buffers/cache:            4.8G           10G
Swap:              0B            0B            0B
```

Don't forget about me!
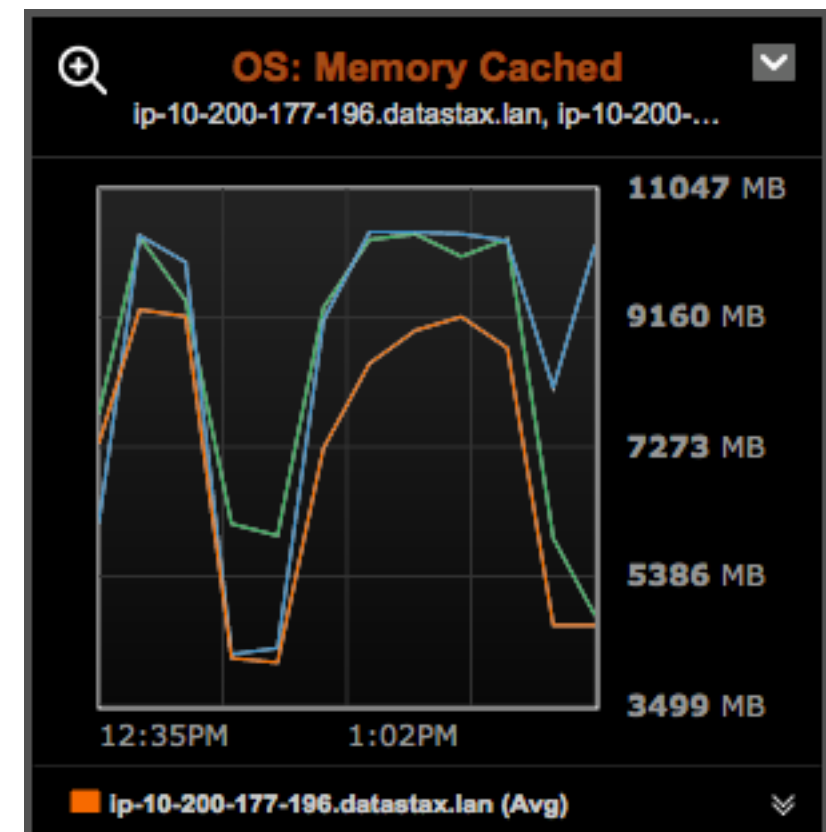
Large Data Structures

Bloom Filters

```
$ nodetool tablestats keyspace1
Keyspace: keyspace1
        Read Count: 4433559
        Read Latency: 0.16309469277390917 ms.
        Write Count: 15528537
        Write Latency: 0.03023585988815302 ms.
        Pending Flushes: 0
            Table: standard1
            SSTable count: 5
            Space used (live): 3464993787
            Space used (total): 3464993787
            Space used by snapshots (total): 0
            Off heap memory used (total): 19517188
            SSTable Compression Ratio: 0.0
            Number of keys (estimate): 10196252
            Memtable cell count: 123604
            Memtable data size: 34015680
            Memtable off heap memory used: 0
            Memtable switch count: 38
            Local read count: 4433559
            Local read latency: 0.179 ms
            Local write count: 15528537
            Local write latency: 0.034 ms
            Pending flushes: 0
            Bloom filter false positives: 2
            Bloom filter false ratio: 0.00000
            Bloom filter space used: 17159136
            Bloom filter off heap memory used: 17159096
            Index summary off heap memory used: 2358092
            Compression metadata off heap memory used: 0
            Compacted partition minimum bytes: 180
            Compacted partition maximum bytes: 258
            Compacted partition mean bytes: 258
            Average live cells per slice (last five minutes): 1.0
            Maximum live cells per slice (last five minutes): 1
            Average tombstones per slice (last five minutes): 1.0
            Maximum tombstones per slice (last five minutes): 1
```
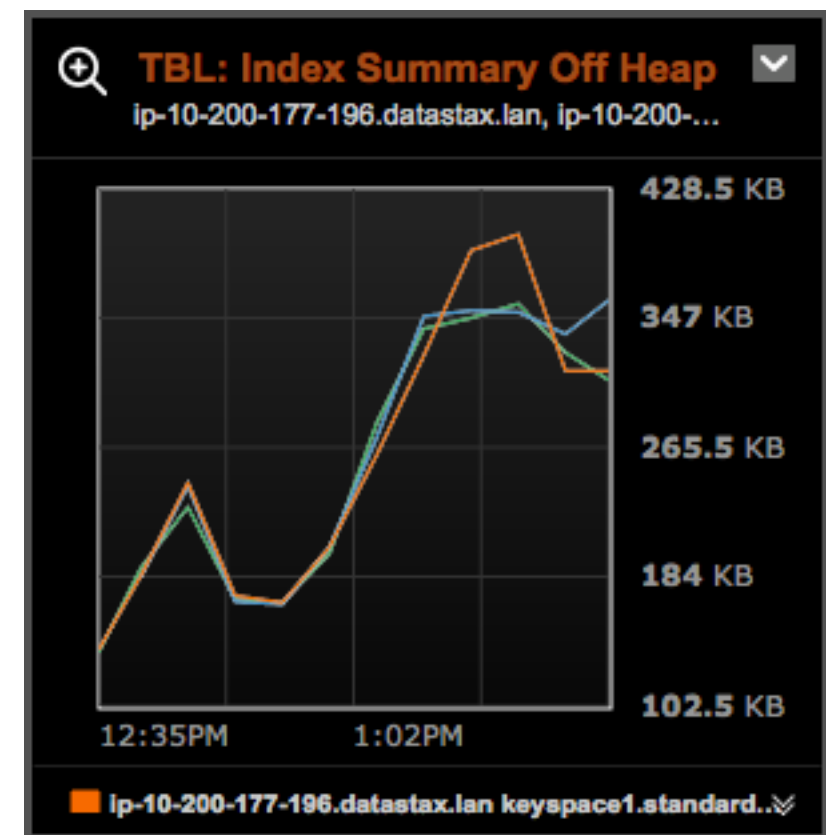
 # CQL configuration
alter table foo with bloom_filter_fp_chance = 0.01;
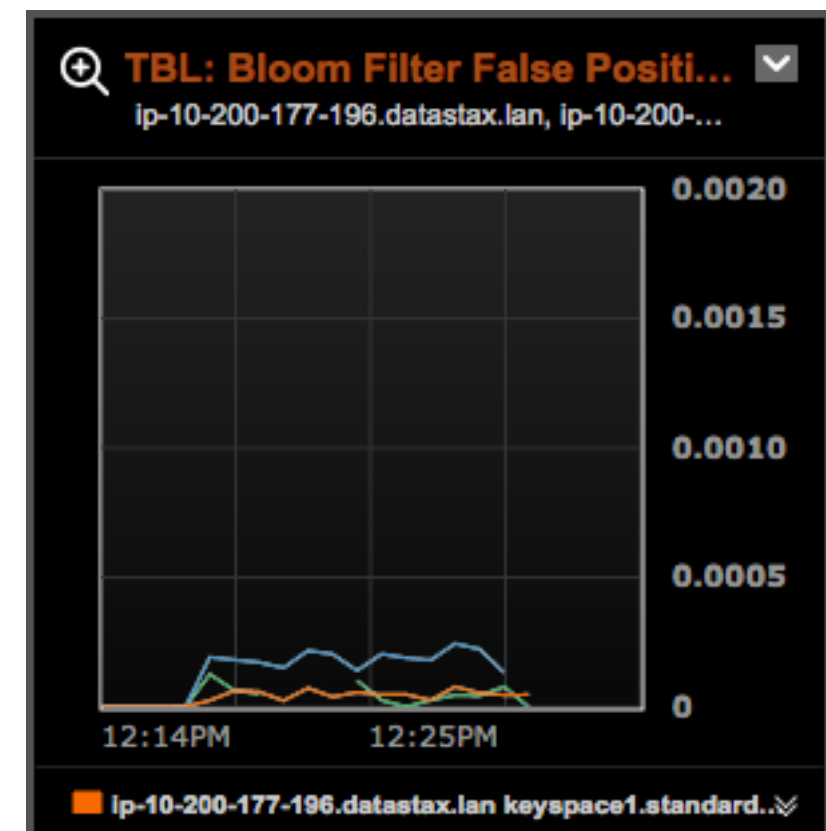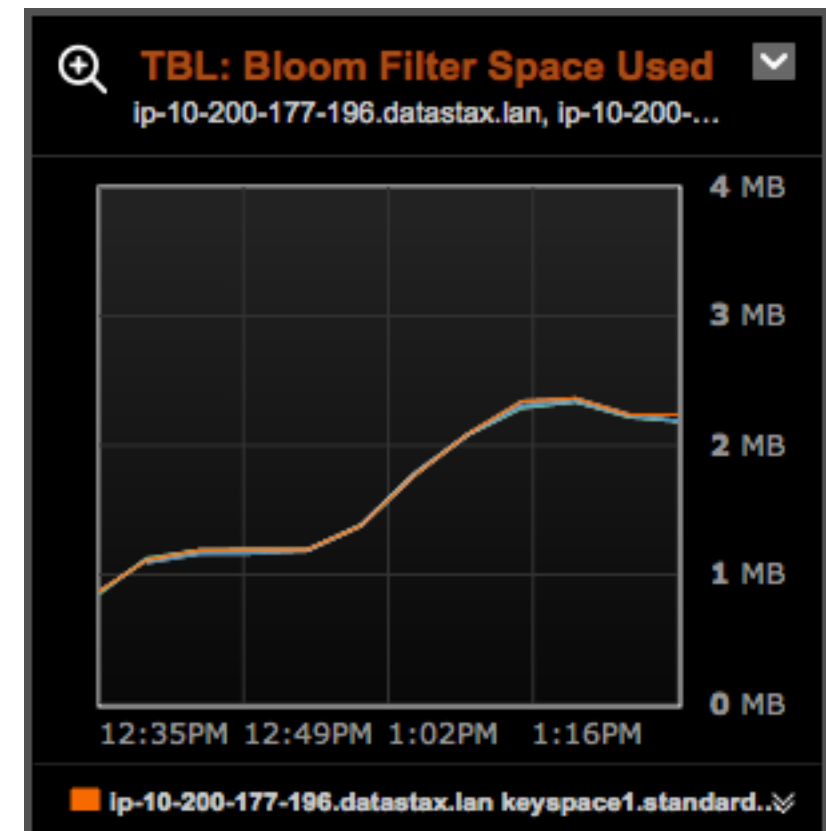
Index Summaries

`$ nodetool tablestats keyspace1`
```
Keyspace: keyspace1
        Read Count: 4433559
        Read Latency: 0.16309469277390917 ms.
        Write Count: 15528537
        Write Latency: 0.03023585988815302 ms.
        Pending Flushes: 0
            Table: standard1
            SSTable count: 5
            Space used (live): 3464993787
            Space used (total): 3464993787
            Space used by snapshots (total): 0
            Off heap memory used (total): 19517188
            SSTable Compression Ratio: 0.0
            Number of keys (estimate): 10196252
            Memtable cell count: 123604
            Memtable data size: 34015680
            Memtable off heap memory used: 0
            Memtable switch count: 38
            Local read count: 4433559
            Local read latency: 0.179 ms
            Local write count: 15528537
            Local write latency: 0.034 ms
            Pending flushes: 0
            Bloom filter false positives: 2
            Bloom filter false ratio: 0.00000
            Bloom filter space used: 17159136
            Bloom filter off heap memory used: 17159096
            Index summary off heap memory used: 2358092
            Compression metadata off heap memory used: 0
            Compacted partition minimum bytes: 180
            Compacted partition maximum bytes: 258
            Compacted partition mean bytes: 258
            Average live cells per slice (last five minutes): 1.0
            Maximum live cells per slice (last five minutes): 1
            Average tombstones per slice (last five minutes): 1.0
            Maximum tombstones per slice (last five minutes): 1
```
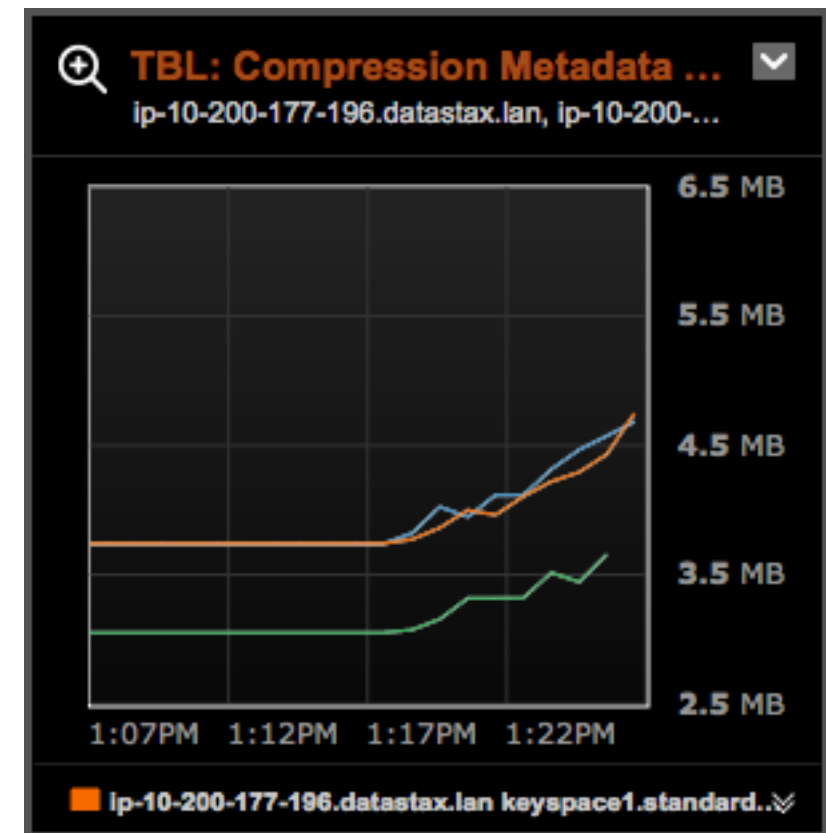

TBL: Index Summary Off Heap
ip-10-200-177-196.datastax.lan, ip-10-200-...

ip-10-200-177-196.datastax.lan keyspace1.standard..

```
# cassandra.yaml settings
index_summary_capacity_in_mb: 400
index_summary_resize_interval_in_minutes: 60
```

Compression Metadata

```
$ nodetool tablestats keyspace1
Keyspace: keyspace1
        Read Count: 408439
        Read Latency: 48.24464316825768 ms.
        Write Count: 437331
        Write Latency: 0.1109122129462581 ms.
        Pending Flushes: 0
            Table: standard1
            SSTable count: 20
            Space used (live): 37002901216
            Space used (total): 37002901216
            Space used by snapshots (total): 0
            Off heap memory used (total): 9595368
            SSTable Compression Ratio: 1.0038997780827315
            Number of keys (estimate): 1009214
            Memtable cell count: 12226
            Memtable data size: 146845620
            Memtable off heap memory used: 0
            Memtable switch count: 18
            Local read count: 408687
            Local read latency: 52.956 ms
            Local write count: 437471
            Local write latency: 0.120 ms
            Pending flushes: 0
            Bloom filter false positives: 130
            Bloom filter false ratio: 0.00007
            Bloom filter space used: 3666792
            Bloom filter off heap memory used: 4134856
            Index summary off heap memory used: 546304
            Compression metadata off heap memory used: 4914208
            Compacted partition minimum bytes: 447
            Compacted partition maximum bytes: 24601
            Compacted partition mean bytes: 13783
            Average live cells per slice (last five minutes): 1.0
            Maximum live cells per slice (last five minutes): 1
            Average tombstones per slice (last five minutes): 1.0
            Maximum tombstones per slice (last five minutes): 1
```


TBL: Compression Metadata ...
ip-10-200-177-196.datastax.lan, ip-10-200-...

ip-10-200-177-196.datastax.lan keyspace1.standard..

```
# CQL configuration
alter table foo with compression = {'sstable_compression': ''};
```

Disk

I/O Utilization

```
$ iostat –xd 5
Linux 3.13.0–92–generic (ip–10–200–177–196.datastax.lan)          08/18/2016          _x86_64_          (4 CPU)

Device:          rrqm/s    wrqm/s    r/s      w/s      rkB/s      wkB/s avgrq–sz avgqu–sz    await r_await w_await  svctm  %util
vda              0.00      1.95      7.94     5.33     691.72  2027.59   409.76     0.10     7.56    1.58   16.46   0.75   0.99

Device:          rrqm/s    wrqm/s    r/s      w/s      rkB/s      wkB/s avgrq–sz avgqu–sz    await r_await w_await  svctm  %util
vda              0.00     28.00      0.00    79.40       0.00 31832.80   801.83     0.97    12.21    0.00   12.21   0.80   6.32

Device:          rrqm/s    wrqm/s    r/s      w/s      rkB/s      wkB/s avgrq–sz avgqu–sz    await r_await w_await  svctm  %util
vda              0.00     63.80      0.00   208.60       0.00 86608.80   830.38     3.77    18.06    0.00   18.06   1.55  32.40
```

% Utilization

OS: Disk Utilization
ip-10-200-177-196.datastax.lan, ip-10-200-...

ip-10-200-177-196.datastax.lan vda (Avg)

I/O Utilization

```
$ iostat -xd 5
Linux 3.13.0-92-generic (ip-10-200-177-196.datastax.lan)        08/18/2016        _x86_64_            (4 CPU)

Device:          rrqm/s    wrqm/s      r/s      w/s     rkB/s      wkB/s avgrq-sz avgqu-sz   await r_await w_await  svctm  %util
vda                0.00      1.95     7.94     5.33    691.72    2027.59   409.76     0.10    7.56    1.58   16.46   0.75   0.99

Device:          rrqm/s    wrqm/s      r/s      w/s     rkB/s      wkB/s avgrq-sz avgqu-sz   await r_await w_await  svctm  %util
vda                0.00     28.00     0.00    79.40      0.00  31832.80   801.83     0.97   12.21    0.00   12.21   0.80   6.32

Device:          rrqm/s    wrqm/s      r/s      w/s     rkB/s      wkB/s avgrq-sz avgqu-sz   await r_await w_await  svctm  %util
vda                0.00     63.80     0.00   208.60      0.00  86608.80   830.38     3.77   18.06    0.00   18.06   1.55  32.40
```

Queue Size

OS: Disk Queue Size
ip-10-200-177-196.datastax.lan, ip-10-200-...

40 requests
30 requests
20 requests
10 requests
0 requests

2:02PM   2:32PM

ip-10-200-177-196.datastax.lan vda (Avg)

I/O Utilization

```
$ iostat -xd 5
Linux 3.13.0-92-generic (ip-10-200-177-196.datastax.lan)          08/18/2016          _x86_64_          (4 CPU)

Device:         rrqm/s   wrqm/s     r/s     w/s    rkB/s     wkB/s avgrq-sz avgqu-sz   await r_await w_await  svctm  %util
vda               0.00     1.95    7.94    5.33   691.72   2027.59   409.76     0.10    7.56    1.58   16.46   0.75   0.99

Device:         rrqm/s   wrqm/s     r/s     w/s    rkB/s     wkB/s avgrq-sz avgqu-sz   await r_await w_await  svctm  %util
vda               0.00    28.00    0.00   79.40     0.00  31832.80   801.83     0.97   12.21    0.00   12.21   0.80   6.32

Device:         rrqm/s   wrqm/s     r/s     w/s    rkB/s     wkB/s avgrq-sz avgqu-sz   await r_await w_await  svctm  %util
vda               0.00    63.80    0.00  208.60     0.00  86608.80   830.38     3.77   18.06    0.00   18.06   1.55  32.40
```

Average Wait
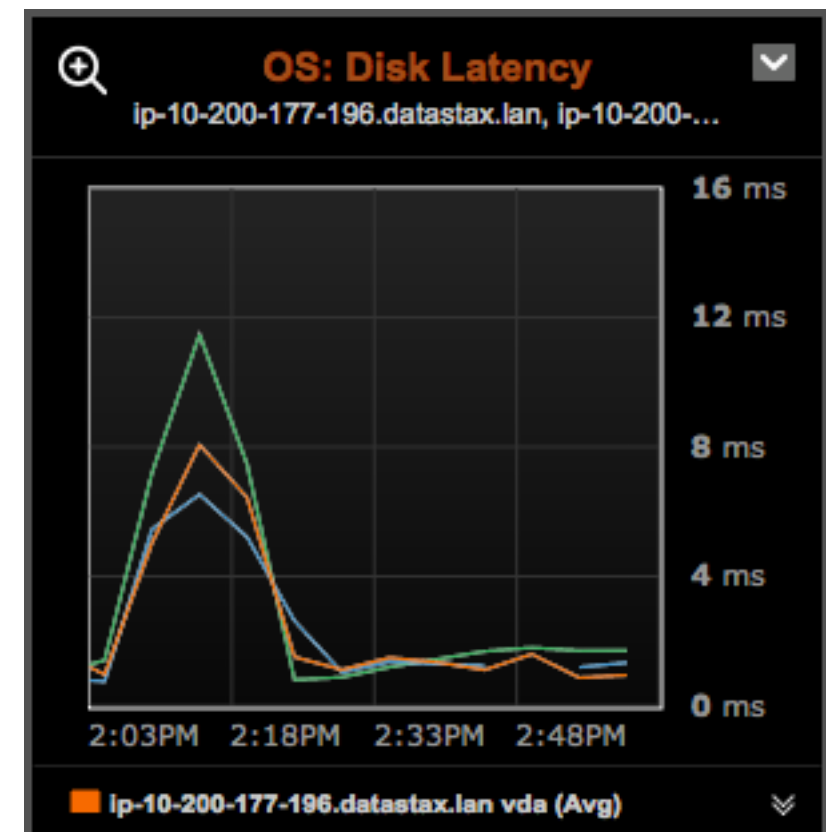
Space Used per Node

$ nodetool status

```
Datacenter: Cassandra
======================
Status=Up/Down
|/ State=Normal/Leaving/Joining/Moving
--  Address          Load          Tokens          Owns        Host ID                                    Rack
UN  10.200.177.196   36.02 GB      256             ?           fbb34d33-5f93-4f24-84e0-bd9cc42b1860       rack1
UN  10.200.177.197   35.73 GB      256             ?           0373dd12-25ef-4d97-a1c1-a4014dbd6eaa       rack1
UN  10.200.177.198   29.85 GB      256             ?           a9d22c58-2554-40c4-b4b1-37c7e96d00b4       rack1
```
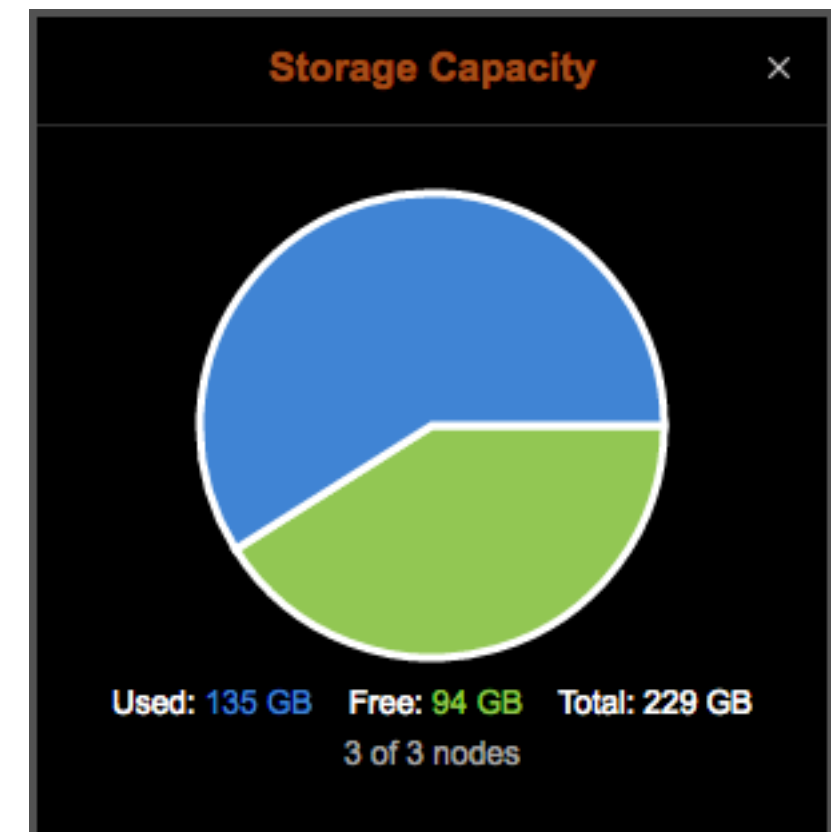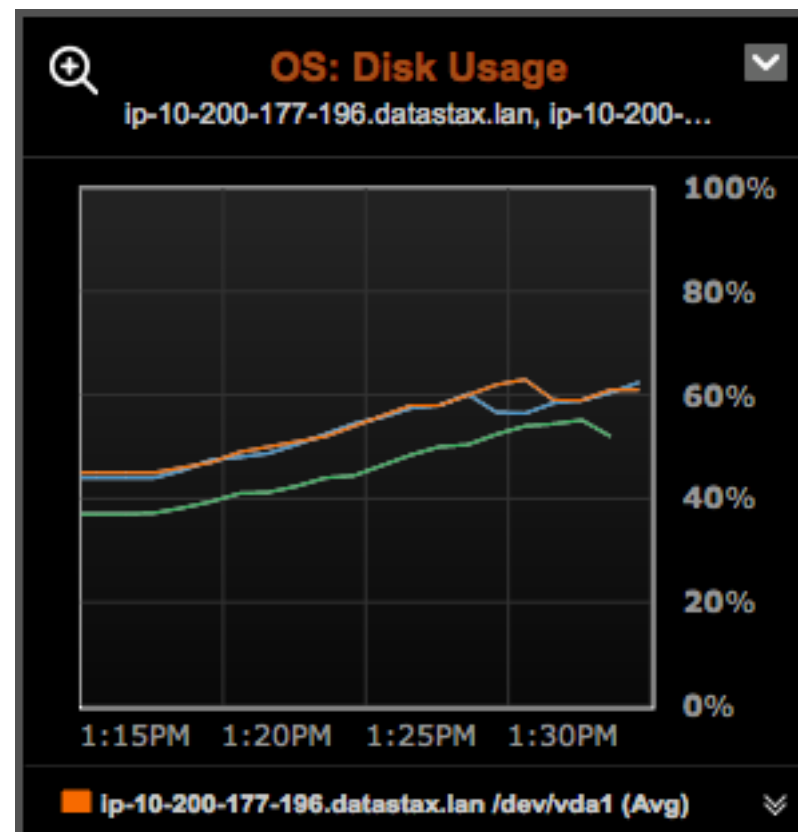
Space Used Per Table

```
$ nodetool tablestats keyspace1
Keyspace: keyspace1
        Read Count: 4433559
        Read Latency: 0.16309469277390917 ms.
        Write Count: 15528537
        Write Latency: 0.03023585988815302 ms.
        Pending Flushes: 0
            Table: standard1
            SSTable count: 5
            Space used (live): 3464993787
            Space used (total): 3464993787
            Space used by snapshots (total): 0
            Off heap memory used (total): 19517188
            SSTable Compression Ratio: 0.0
            Number of keys (estimate): 10196252
            Memtable cell count: 123604
            Memtable data size: 34015680
            Memtable off heap memory used: 0
            Memtable switch count: 38
            Local read count: 4433559
            Local read latency: 0.179 ms
            Local write count: 15528537
            Local write latency: 0.034 ms
            Pending flushes: 0
            Bloom filter false positives: 2
            Bloom filter false ratio: 0.00000
            Bloom filter space used: 17159136
            Bloom filter off heap memory used: 17159096
            Index summary off heap memory used: 2358092
            Compression metadata off heap memory used: 0
            Compacted partition minimum bytes: 180
            Compacted partition maximum bytes: 258
            Compacted partition mean bytes: 258
            Average live cells per slice (last five minutes): 1.0
            Maximum live cells per slice (last five minutes): 1
            Average tombstones per slice (last five minutes): 1.0
            Maximum tombstones per slice (last five minutes): 1
```

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Uneven Data Distribution

Disk Usage Per Node

```
$ nodetool status
Datacenter: Cassandra
=======================
Status=Up/Down
|/ State=Normal/Leaving/Joining/Moving
--  Address           Load        Tokens        Owns      Host ID                                Rack
UN  10.200.177.196    31.85 GB    256           ?         fbb34d33-5f93-4f24-84e0-bd9cc42b1860   rack1
UN  10.200.177.197    13.63 GB    256           ?         0373dd12-25ef-4d97-a1c1-a4014dbd6eaa   rack1
UN  10.200.177.198    32.95 GB    256           ?         a9d22c58-2554-40c4-b4b1-37c7e96d00b4   rack1
```

Note   It have the same replication settings, effective ownership information
mean:

> **Very Uneven!**

Data Size

Total Size	Avg. Node	Standard Deviation
78 GB	26 GB	+/- 11 GB
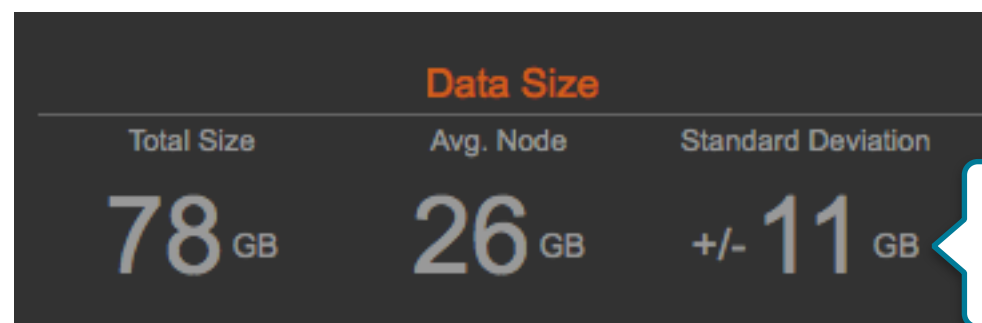
> **Standard deviation**

Ownership Percentage

```
$ nodetool status keyspace1
Datacenter: Cassandra
======================
Status=Up/Down
|/ State=Normal/Leaving/Joining/Moving
--  Address          Load       Tokens  Owns (effective)   Host ID                                Rack
UN  10.200.177.196   32.71 GB   256     67.1%              fbb34d33-5f93-4f24-84e0-bd9cc42b1860   rack1
UN  10.200.177.197   31.82 GB   256     69.1%              0373dd12-25ef-4d97-a1c1-a4014dbd6eaa   rack1
UN  10.200.177.198   32.95 GB   256     63.8%              a9d22c58-2554-40c4-b4b1-37c7e96d00b4   rack1
```

> Must specify keyspace

> - Should be roughly equal
> - May vary with vnodes up to 10%
> - Adds up to 100% times RF

Unbalanced Racks

```
$ nodetool status

Datacenter: Cassandra
=====================
Status=Up/Down
|/ State=Normal/Leaving/Joining/Moving
--  Address          Load        Tokens          Owns      Host ID                                   Rack
UN  10.200.177.196   3.45 GB     256             ?         108af27a-43d8-4814-b617-f8f93ba2bb0e      rack1
UN  10.200.177.197   3.45 GB     256             ?         432bc964-3cd3-4784-9ab7-d7a4a9e063b6      rack2
UN  10.200.177.198   3.45 GB     256             ?         3c467f89-7cce-485f-bb16-dd782c9a84ec      rack2

Note: Non-system keyspaces don't have the same replication settings, effective ownership
information is meaningless
```

Ensure same # in each rack

```
# recommended snitch in cassandra.yaml
endpoint_snitch: GossipingPropertyFileSnitch

# cassandra-rackdc.properties setting
dc=Cassandra
dc_suffix=Cassandra
rack=rack1
```

Inconsistent Token Count

```
$ nodetool status

Datacenter: Cassandra
=====================
Status=Up/Down
|/ State=Normal/Leaving/Joining/Moving
--  Address          Load       Tokens        Owns       Host ID                                 Rack
UN  10.200.177.196   3.45 GB    256           ?          108af27a-43d8-4814-b617-f8f93ba2bb0e    rack1
UN  10.200.177.197   3.45 GB    256           ?          432bc964-3cd3-4784-9ab7-d7a4a9e063b6    rack2
UN  10.200.177.198   3.45 GB    128           ?          3c467f89-7cce-485f-bb16-dd782c9a84ec    rack2

Note: Non-sys                            ngs, effective ownership information
meaningless
```

Must be the same within a DC

```
# cassandra.yaml setting
num_tokens: 256
```

Uneven Token Distribution*

$ nodetool ring

* If not using vnodes

```
Datacenter: Cassandra
==========
Address          Rack        Status State    Load        Owns        Token
                                                                      3074457345618258602
10.200.177.196   rack1       Up     Normal   13.41 GB    ?           −9223372036854775808
10.200.177.197   rack1       Up     Normal   4.41 GB     ?           −3074457345618258603
10.200.177.198   rack1       Up     Normal   4.4 GB      ?           3074457345618258602
```

> ## Must be evenly spaced

```
# to generate evenly spaced tokens
$ token−generator 3 5

# cassandra.yaml setting – make sure it's set*
initial_token: −9223372036854775808

# to change after the node is bootstrapped
$ nodetool move 3074457345618258602
```

Company Confidential
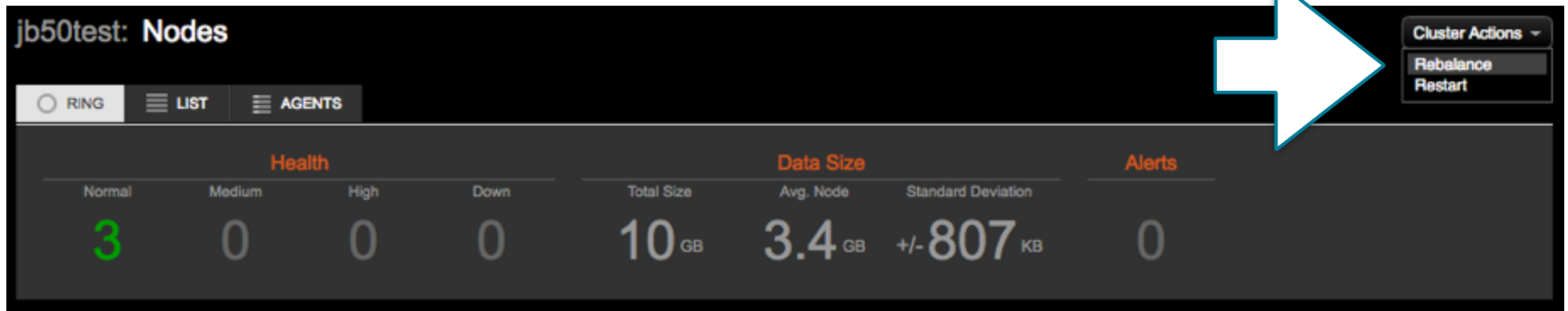
Partition Size and Cell Count

```
$ nodetool tablehistograms keyspace1 standard1

foo/bar histograms
Percentile   SSTables      Write Latency      Read Latency      Partition Size      Cell Count
                              (micros)          (micros)            (bytes)
50%            3.00           124.00            924.00             29521              149
75%            3.00           215.00           1331.00             61214              310
95%            3.00           642.00           2299.00            219342              924
98%            3.00          1109.00           3311.00            379022             1331
99%            3.00          1331.00           3973.00            454826             1916
Min            0.00            43.00             51.00              1332               11
Max            3.00          2759.00          42510.00           2346799             6866
```

Company Confidential
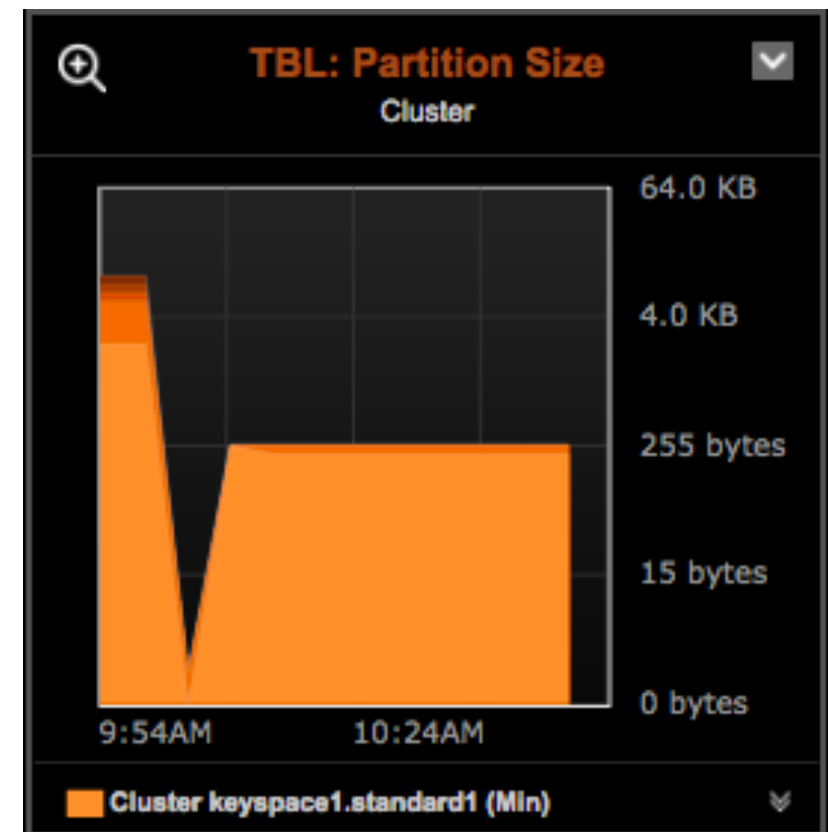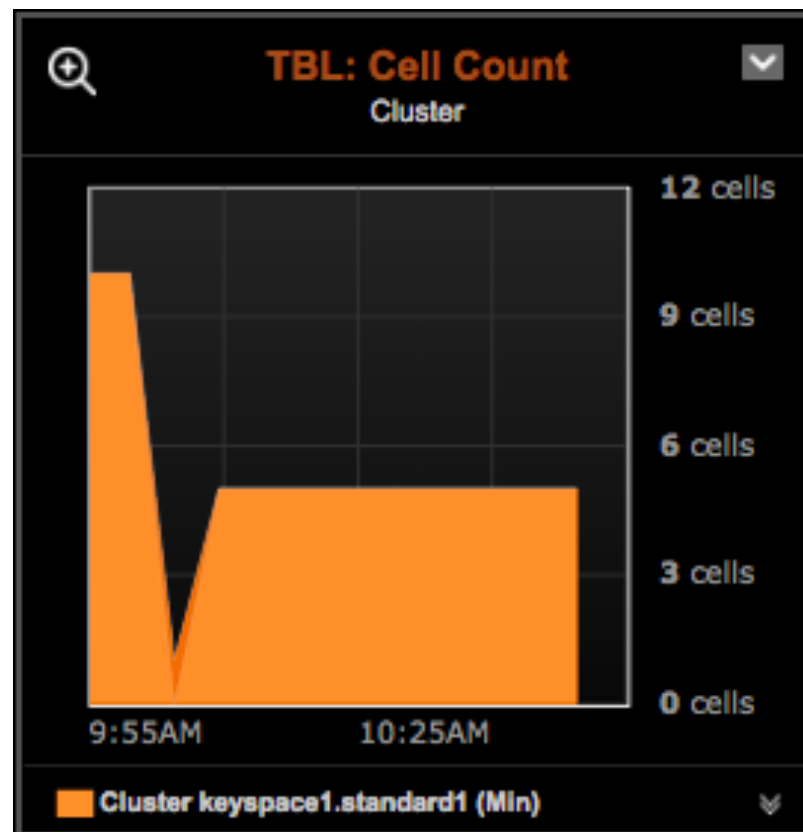
Compactions - large partitions

INFO [CompactionExecutor:633] 2015-09-05 07:34:55,115 CompactionTask.java:141 -
    Compacting [SSTableReader(path='/data/ax/user/ax-user-ka-13684-Data.db'),
    SSTableReader(path='/data/ax/user/ax-user-ka-13674-Data.db'),
    SSTableReader(path='/data/ax/user/ax-user-ka-13670-Data.db'),
    SSTableReader(path='/data/ax/user/ax-user-ka-13687-Data.db'),
    SSTableReader(path='/data/ax/user/ax-user-ka-13680-Data.db'),
    SSTableReader(path='/data/ax/user/ax-user-ka-13685-Data.db')]

WARN [CompactionExecutor:633] 2015-09-05 07:45:25,016 SSTableWriter.java:240 -
    Compacting large partition ax/user:root (2503794228 bytes)

INFO [C   Warning! or:633] 2015-09-05 07:45:25,114 CompactionTask.java:274 -
    Comp   to [/data/ax/user/ax-user-ka-13691,].
    400,997,778 bytes to 276,263,497 (~68% of original) in 629,997ms = 0.418201MB/s.
    21 total partitions merged to 5. Partition merge counts were {3:3, 6:2, }

Compactions - keyspace/table:key

INFO [CompactionExecutor:633] 2015-09-05 07:34:55,115 CompactionTask.java:141 -
    Compacting [SSTableReader(path='/data/ax/user/ax-user-ka-13684-Data.db'),
    SSTableReader(path='/data/ax/user/ax-user-ka-13674-Data.db'),
    SSTableReader(path='/data/ax/user/ax-user-ka-13670-Data.db'),
    SSTableReader(path='/data/ax/user/ax-user-ka-13687-Data.db'),
    SSTableReader(path='/data/ax/user/ax-user-ka-13680-Data.db'),
    SSTableReader(path='/data/ax/user/ax-user-ka-13685-Data.db')]

WARN [CompactionExecutor:633] 2015-09-05 07:45:25,016 SSTableWriter.java:240 -
    Compacting large partition **ax/user:root** (2503794228 bytes)

INFO [CompactionExecuto⌐   ⌐mpactionTask.java:274 -
    Compacted 6 sstables ⌐ keyspace/table:key ⌐
    400,997,778 bytes to 276,263,497 (~68% of original) in 629,997ms = 0.418201MB/s.
    21 total partitions merged to 5. Partition merge counts were {3:3, 6:2, }

Compactions - partition size

INFO [CompactionExecutor:633] 2015-09-05 07:34:55,115 CompactionTask.java:141 -
    Compacting [SSTableReader(path='/data/ax/user/ax-user-ka-13684-Data.db'),
    SSTableReader(path='/data/ax/user/ax-user-ka-13674-Data.db'),
    SSTableReader(path='/data/ax/user/ax-user-ka-13670-Data.db'),
    SSTableReader(path='/data/ax/user/ax-user-ka-13687-Data.db'),
    SSTableReader(path='/data/ax/user/ax-user-ka-13680-Data.db'),
    SSTableReader(path='/data/ax/user/ax-user-ka-13685-Data.db')]

WARN [CompactionExecutor:633] 2015-09-05 07:45:25,016 SSTableWriter.java:240 -
    Compacting large partition ax/user:root (**2503794228 bytes**)

INFO [CompactionExecutor:633] 2015-09   Size   CompactionTask.java:274 -
    Compacted 6 sstables to [/data/ax/use   91,].
    400,997,778 bytes to 276,263,497 (~68% of original) in 629,997ms = 0.418201MB/s.
    21 total partitions merged to 5. Partition merge counts were {3:3, 6:2, }

Compacted Partition Sizes

```
$ nodetool tablestats keyspace1
Keyspace: keyspace1
        Read Count: 4433559
        Read Latency: 0.16309469277390917 ms.
        Write Count: 15528537
        Write Latency: 0.03023585988815302 ms.
        Pending Flushes: 0
            Table: standard1
            SSTable count: 5
            Space used (live): 3464993787
            Space used (total): 3464993787
            Space used by snapshots (total): 0
            Off heap memory used (total): 19517188
            SSTable Compression Ratio: 0.0
            Number of keys (estimate): 10196252
            Memtable cell count: 123604
            Memtable data size: 34015680
            Memtable off heap memory used: 0
            Memtable switch count: 38
            Local read count: 4433559
            Local read latency: 0.179 ms
            Local write count: 15528537
            Local write latency: 0.034 ms
            Pending flushes: 0
            Bloom filter false positives: 2
            Bloom filter false ratio: 0.00000
            Bloom filter space used: 17159136
            Bloom filter off heap memory used: 17159096
            Index summary off heap memory used: 2358092
            Compression metadata off heap memory used: 0
            Compacted partition minimum bytes: 180
            Compacted partition maximum bytes: 258
            Compacted partition mean bytes: 258
            Average live cells per slice (last five minutes): 1.0
            Maximum live cells per slice (last five minutes): 1
            Average tombstones per slice (last five minutes): 1.0
            Maximum tombstones per slice (last five minutes): 1
```
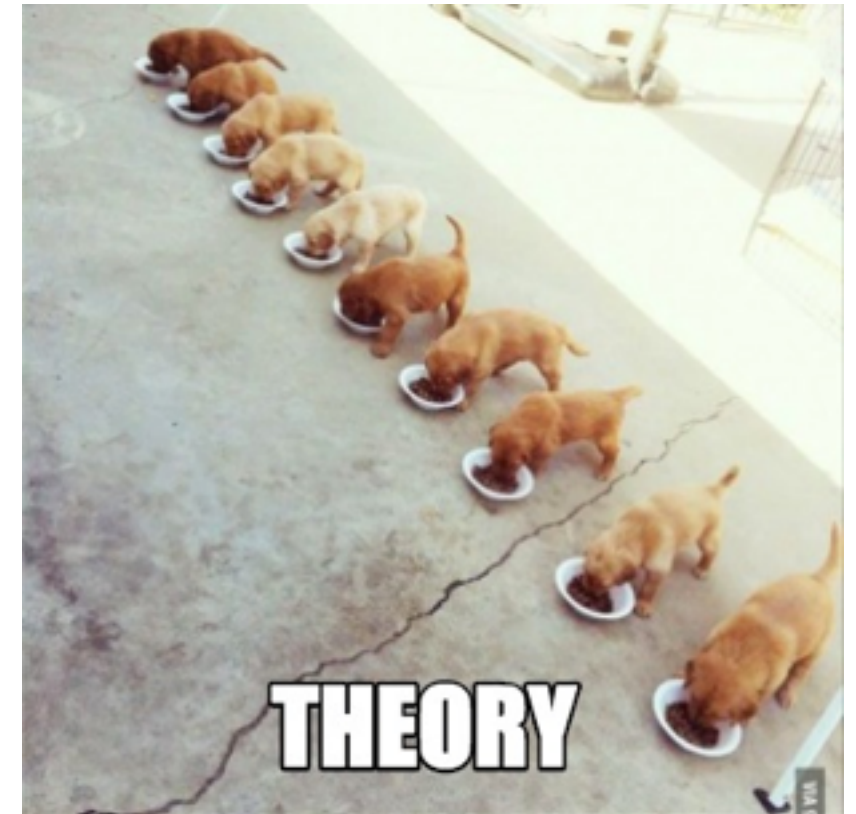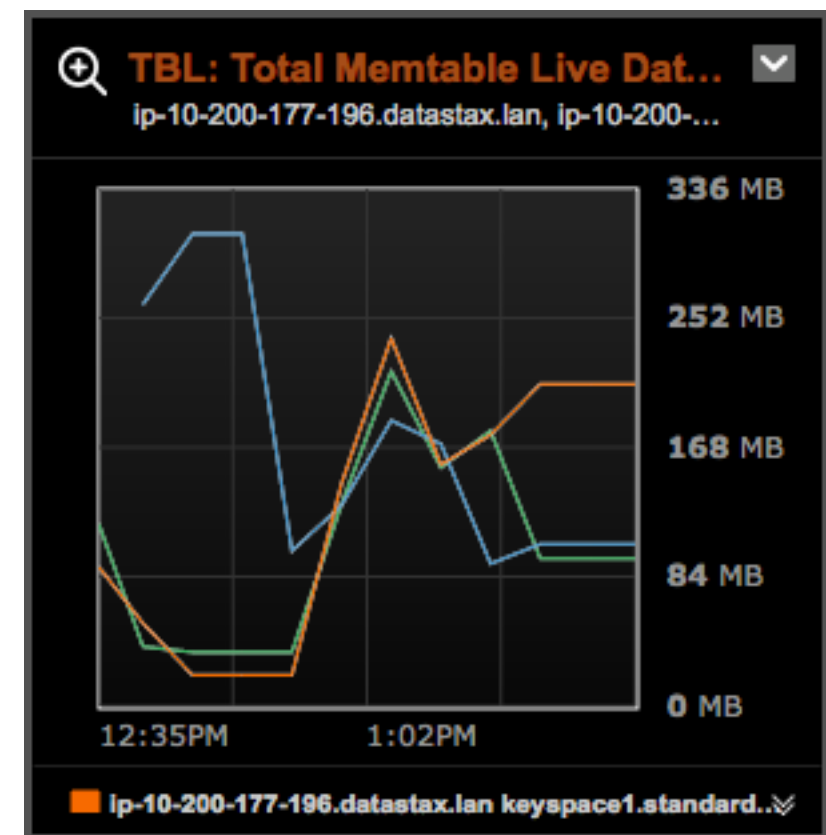
Network

Network Utilization
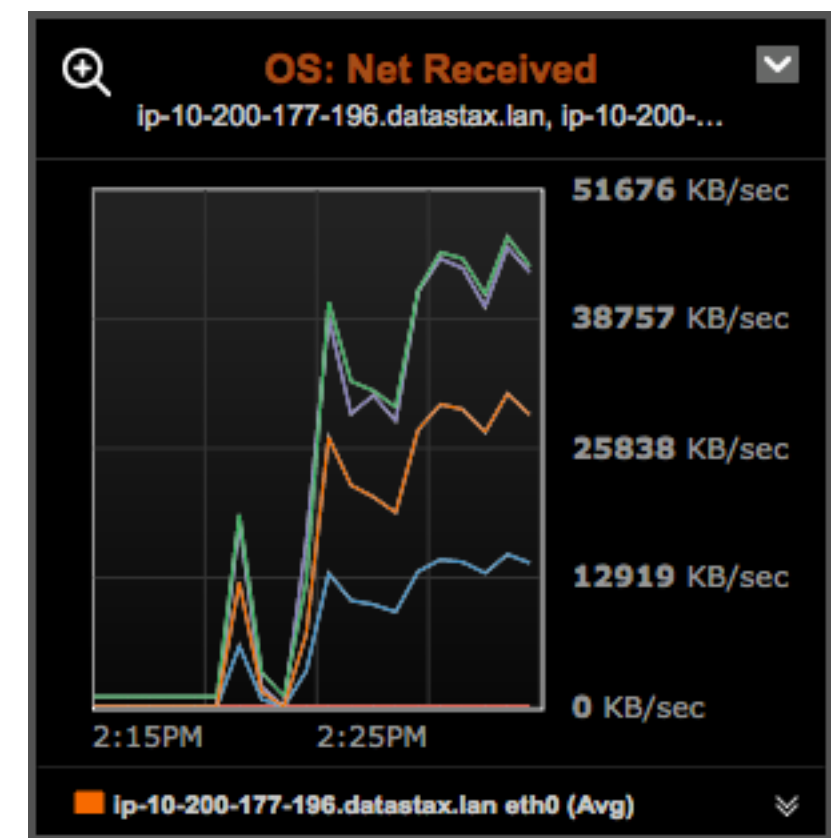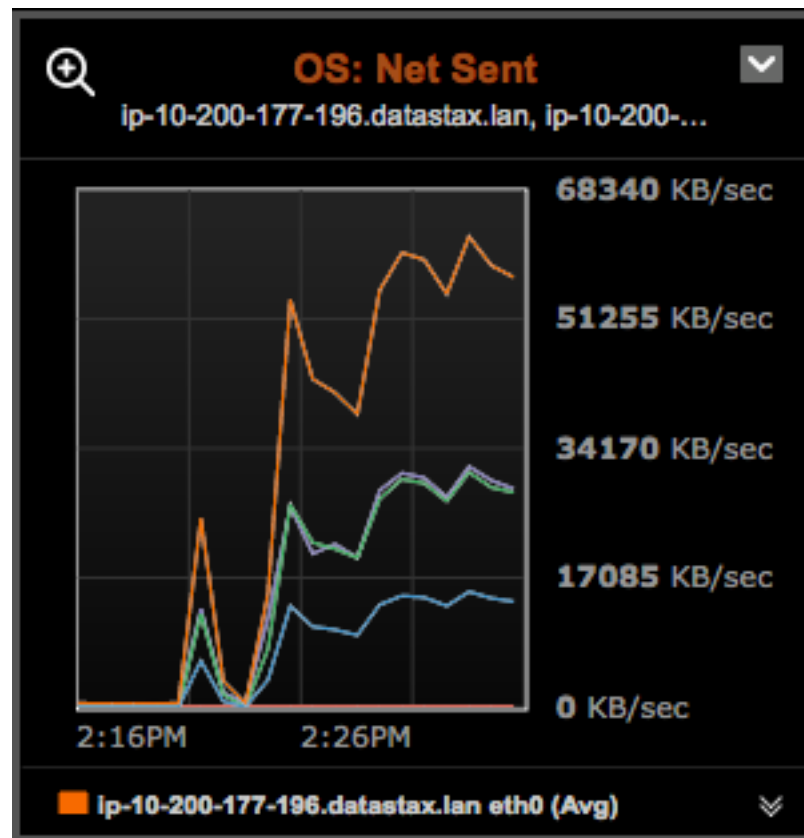
Background Processes

Flushing

Memtable Size

```
$ nodetool tablestats keyspace1
Keyspace: keyspace1
        Read Count: 4433559
        Read Latency: 0.16309469277390917 ms.
        Write Count: 15528537
        Write Latency: 0.03023585988815302 ms.
        Pending Flushes: 0
            Table: standard1
            SSTable count: 5
            Space used (live): 3464993787
            Space used (total): 3464993787
            Space used by snapshots (total): 0
            Off heap memory used (total): 19517188
            SSTable Compression Ratio: 0.0
            Number of keys (estimate): 10196252
            Memtable cell count: 123604
            Memtable data size: 34015680
            Memtable off heap memory used: 0
            Memtable switch count: 38
            Local read count: 4433559
            Local read latency: 0.179 ms
            Local write count: 15528537
            Local write latency: 0.034 ms
            Pending flushes: 0
            Bloom filter false positives: 2
            Bloom filter false ratio: 0.00000
            Bloom filter space used: 17159136
            Bloom filter off heap memory used: 17159096
            Index summary off heap memory used: 2358092
            Compression metadata off heap memory used: 0
            Compacted partition minimum bytes: 180
            Compacted partition maximum bytes: 258
            Compacted partition mean bytes: 258
            Average live cells per slice (last five minutes): 1.0
            Maximum live cells per slice (last five minutes): 1
            Average tombstones per slice (last five minutes): 1.0
            Maximum tombstones per slice (last five minutes): 1
```


TBL: Total Memtable Live Dat...
ip-10-200-177-196.datastax.lan, ip-10-200-...

336 MB
252 MB
168 MB
84 MB
0 MB
12:35PM   1:02PM

ip-10-200-177-196.datastax.lan keyspace1.standard..

```
# cassandra.yaml settings
memtable_heap_space_in_mb: 2048
memtable_offheap_space_in_mb: 2048
memtable_allocation_type: heap_buffers
```

Enqueueing Flushes

Thread

Keyspace

Table

DEBUG [**SlabPoolCleaner**] 2016-08-25 ...771 ColumnFamilyStore.java:1186 -
Flushing largest CFS(Keyspace='**keyspace1**', ColumnFamily='**standard1**') to free up room.
Used total: **0.64**/0.00, live: **0.33**/0.00, flushing: **0.31**/0.00, this: **0.31**/0.31

Total % used

Cleanup threshold

This memtable

DEBUG [SlabPoolCleaner] 2016-08-25 19:16:57,771 ColumnFamilyStore.java:845 -
Enqueuing flush of standard1: **321247911** (31%) on-heap, 0 (0%) off-heap

Size of this memtable

percent of total size to trigger flush
memtable_cleanup_threshold: 0.33

Enqueueing Flushes

Different thread!

DEBUG [**COMMIT-LOG-ALLOCATOR**] 2016-08-26 14:58:28,166 ColumnFamilyStore.java: 845 - Enqueuing flush of standard1: 280740184 (**27%**) on-heap, 0 (0%) off-heap

Less than cleanup threshold

\# total commitlog size in cassandra.yaml
commitlog_total_space_in_mb: 8192

Compaction

Compactions

```
$ nodetool compactionstats

pending tasks: 3
              action type    keyspace        table   completed         total   unit   progress
              Compaction    keyspace1    standard1   508710090    1283148921   bytes    39.65%
              Compaction    keyspace1    standard1    54302737    1275330433   bytes     4.26%
Active compaction remaining time :    0h01m58s
```

Keyspace/table

Pending

Progress

\# configure throughput in cassandra.yaml (0 to unthrottle)
compaction_throughput_mb_per_sec: 16

\# configure throughput temporarily in nodetool
nodetool setcompactionthroughput 16

\# configure number of compactors in cassandra.yaml
concurrent_compactors: 1

\# change compaction strategy in CQL
alter table foo with compaction = {
'class': 'org.apache.cassandra.db.compaction.SizeTieredCompactionStrategy',
'max_threshold': '32', 'min_threshold': '4'}

Compactions in OpsCenter
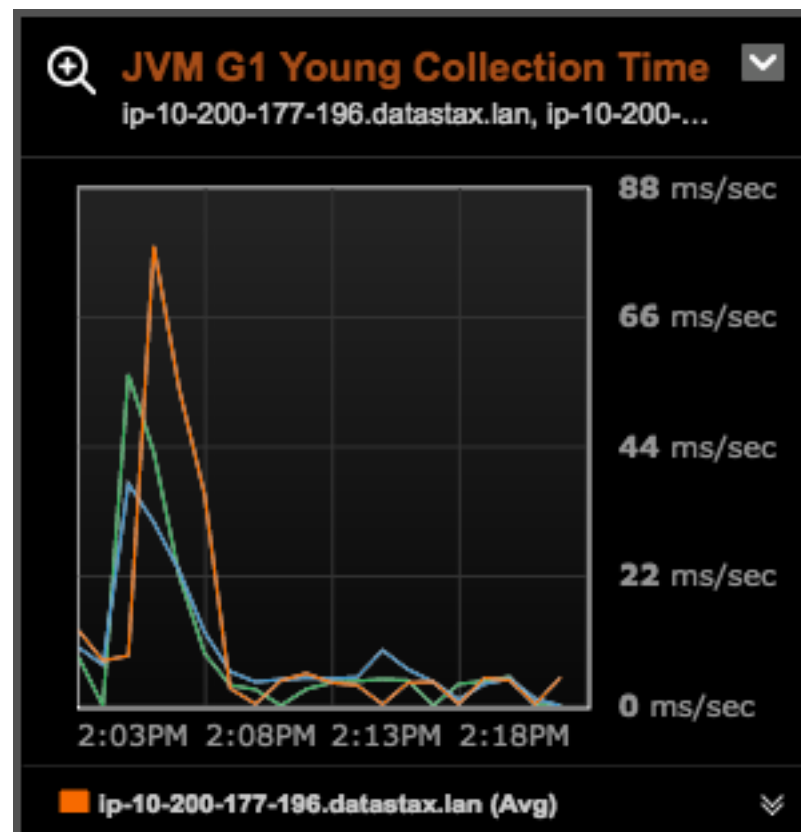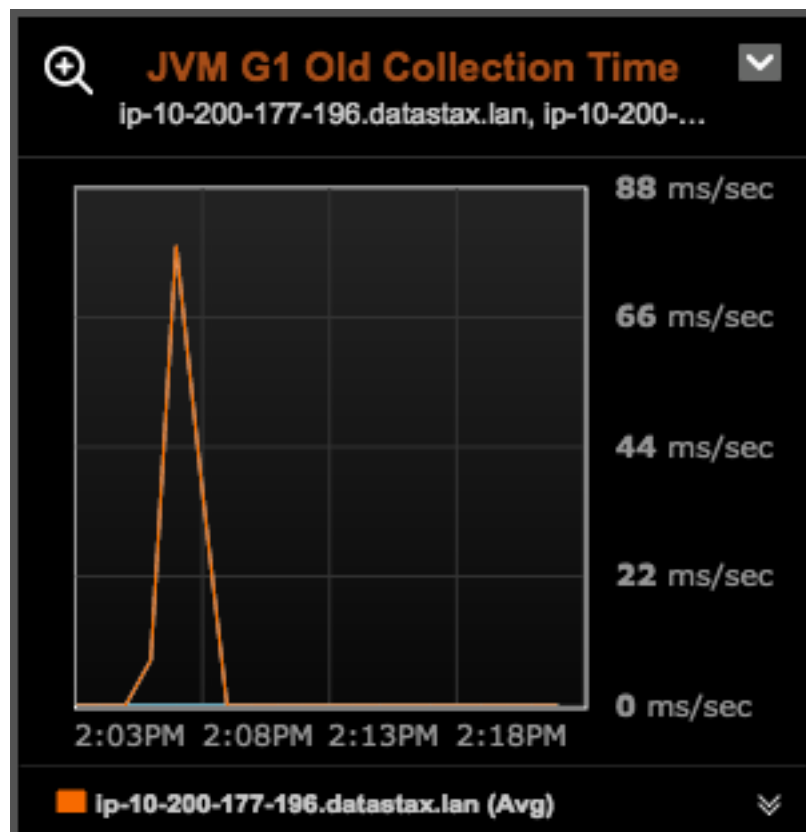
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Garbage Collection

Garbage Collections

INFO [Service Thread] **2016-08-30 18:06:18,444** GCInspector.java:284 - G1 Young Generation GC in **609ms**. G1 Eden Space: 990904320 -> 0; G1 Old Gen: 1693531744 -> 2522955360; G1 Survivor Space: 4194304 -> 9437184;

WARN [Service Thread] **2016-08-30 18:07:32,376** GCInspector.java:282 - G1 Old Generation GC in **1233ms**. G1 Old Gen: 2651134656 -> 1064769688; G1 Survivor Space: 7340032 -> 0;

Heap Allocation Rate

```
$ java -jar sjk-plus-0.4.2.jar ttop -p 22226 -o ALLOC -n 20

2016-08-17T18:54:00.188+0000 Process summary
  process cpu=320.99%
  application cpu=303.13% (user=174.83% sys=128.30%)
  other: cpu=17.86%
  heap allocation rate 218mb/s
[000224] user= 6.39% sys= 4.00% alloc=   29mb/s - MessagingService-Incoming-/10.200.177.196
[000293] user= 7.89% sys= 5.05% alloc=   29mb/s - MessagingService-Incoming-/10.200.177.198
[000305] user= 6.79% sys= 3.17% alloc=   14mb/s - CompactionExecutor:4
[000157] user= 6.19% sys= 4.00% alloc= 6727kb/s - SharedPool-Worker-5
[000153] user= 7.49% sys= 3.51% alloc= 6596kb/s - SharedPool-Worker-2
[000152] user= 7.49% sys= 3.41% alloc= 6436kb/s - SharedPool-Worker-1
[000155] user= 6.39% sys= 3.80% alloc= 6153kb/s - SharedPool-Worker-4
[000154] user= 6.89% sys= 3.29% alloc= 6054kb/s - SharedPool-Worker-3
[000156] user= 6.39% sys= 3.68% alloc= 6030kb/s - SharedPool-Worker-6
[000168] user= 5.89% sys= 3.33% alloc= 5947kb/s - SharedPool-Worker-8
[000181] user= 5.49% sys= 3.28% alloc= 5343kb/s - SharedPool-Worker-9
[000169] user= 6.39% sys= 2.86% alloc= 5202kb/s - SharedPool-Worker-7
[000179] user= 4.80% sys= 2.29% alloc= 4969kb/s - SharedPool-Worker-12
[000158] user= 5.29% sys= 2.43% alloc= 4830kb/s - SharedPool-Worker-11
[000159] user= 4.60% sys= 2.06% alloc= 4734kb/s - SharedPool-Worker-13
[000178] user= 3.80% sys= 2.30% alloc= 4304kb/s - SharedPool-Worker-14
[000180] user= 4.90% sys= 2.45% alloc= 4294kb/s - SharedPool-Worker-10
[000160] user= 3.90% sys= 1.55% alloc= 4160kb/s - SharedPool-Worker-15
[000177] user= 3.30% sys= 1.29% alloc= 3268kb/s - SharedPool-Worker-16
[000247] user= 2.40% sys= 3.48% alloc= 3253kb/s - epollEventLoopGroup-6-2
```

Per-Thread Heap Allocation Rate

```
$ java –jar sjk–plus–0.4.2.jar ttop –p 22226 –o ALLOC –n 20

2016–08–17T18:54:00.188+0000 Process summary
  process cpu=320.99%
  application cpu=303.13% (user=174.83% sys=128.30%)
  other: cpu=17.86%
  heap allocation rate 218mb/s
[000224] user= 6.39% sys= 4.00% alloc=   29mb/s – MessagingService-Incoming–/10.200.177.196
[000293] user= 7.89% sys= 5.05% alloc=   29mb/s – MessagingService-Incoming–/10.200.177.198
[000305] user= 6.79% sys= 3.17% alloc=   14mb/s – CompactionExecutor:4
[000157] user= 6.19% sys= 4.00% alloc= 6727kb/s – SharedPool–Worker–5
[000153] user= 7.49% sys= 3.51% alloc= 6596kb/s – SharedPool–Worker–2
[000152] user= 7.49% sys= 3.41% alloc= 6436kb/s – SharedPool–Worker–1
[000155] user= 6.39% sys= 3.80% alloc= 6153kb/s – SharedPool–Worker–4
[000154] user= 6.89% sys= 3.29% alloc= 6054kb/s – SharedPool–Worker–3
[000156] user= 6.39% sys= 3.68% alloc= 6030kb/s – SharedPool–Worker–6
[000168] user= 5.89% sys= 3.33% alloc= 5947kb/s – SharedPool–Worker–8
[000181] user= 5.49% sys= 3.28% alloc= 5343kb/s – SharedPool–Worker–9
[000169] user= 6.39% sys= 2.86% alloc= 5202kb/s – SharedPool–Worker–7
[000179] user= 4.80% sys= 2.29% alloc= 4969kb/s – SharedPool–Worker–12
[000158] user= 5.29% sys= 2.43% alloc= 4830kb/s – SharedPool–Worker–11
[000159] user= 4.60% sys= 2.06% alloc= 4734kb/s – SharedPool–Worker–13
[000178] user= 3.80% sys= 2.30% alloc= 4304kb/s – SharedPool–Worker–14
[000180] user= 4.90% sys= 2.45% alloc= 4294kb/s – SharedPool–Worker–10
[000160] user= 3.90% sys= 1.55% alloc= 4160kb/s – SharedPool–Worker–15
[000177] user= 3.30% sys= 1.29% alloc= 3268kb/s – SharedPool–Worker–16
[000247] user= 2.40% sys= 3.48% alloc= 3253kb/s – epollEventLoopGroup–6–2
```

Repairs & Streaming

nodetool netstats - repair id

```
Mode: NORMAL
Repair 028763b0-cc1e-11e4-a20c-a1d01a3fbf30
    /54.174.19.98
        Receiving 6 files, 117949006 bytes total
            /var/lib/cassandra/data/Keyspace1/Standard1/Keyspace1-Standard1-tmp-jb-162-Data.db
                851792/17950738 bytes(4%) received from /54.174.19.98
        Sending 2 files, 47709526 bytes total
            /var/lib/cassandra/data/Keyspace1/Standard1/Keyspace1-Standard1-jb-157-Data.db
                3786324/46561942 bytes(8%) sent to /54.174.19.98
Repair 020ed850-cc1e-11e4-a20c-a1d01a3fbf30
    /54.174.245.247
        Receiving 4 files, 93304584 bytes total
            /var/lib/cassandra/data/Keyspace1/Standard1/Keyspace1-Standard1-tmp-jb-161-Data.db
                6094594/46561942 bytes(13%) received from /54.174.245.247
        Sending 2 files, 47709526 bytes total
            /var/lib/cassandra/data/Keyspace1/Standard1/Keyspace1-Standard1-jb-157-Data.db
                34195028/46561942 bytes(73%) sent to /54.174.245.247
Repair 018c88f0-cc1e-11e4-a20c-a1d01a3fbf30
    /54.153.39.203 (using /172.31.10.65)
        Receiving 3 files, 49959102 bytes total
            /var/lib/cassandra/data/Keyspace1/Standard1/Keyspace1-Standard1-tmp-jb-160-Data.db
                9371380/46561942 bytes(20%) received from /54.153.39.203
            /var/lib/cassandra/data/Keyspace1/Standard1/Keyspace1-Standard1-tmp-jb-159-Data.db
                2533414/2533414 bytes(100%) received from /54.153.39.203
        Sending 2 files, 47709526 bytes total
            /var/lib/cassandra/data/Keyspace1/Standard1/Keyspace1-Standard1-jb-158-Data.db
                1147584/1147584 bytes(100%) sent to /54.153.39.203
            /var/lib/cassandra/data/Keyspace1/Standard1/Keyspace1-Standard1-jb-157-Data.db
                46561942/46561942 bytes(100%) sent to /54.153.39.203

Read Repair Statistics:
Attempted: 39576
Mismatch (Blocking): 0
Mismatch (Background): 746
```

Pool Name	Active	Pending	Completed
Commands	n/a	58	2545817
Responses	n/a	0	2833081

Company Confidential

nodetool netstats - sstable names

```
Mode: NORMAL
Repair 028763b0-cc1e-11e4-a20c-a1d01a3fbf30
    /54.174.19.98
        Receiving 6 files, 117949006 bytes total
            /var/lib/cassandra/data/Keyspace1/Standard1/Keyspace1-Standard1-tmp-jb-162-Data.db
                851792/17950738 bytes(4%) received from /54.174.19.98
        Sending 2 files, 47709526 bytes total
            /var/lib/cassandra/data/Keyspace1/Standard1/Keyspace1-Standard1-jb-157-Data.db
                3786324/46561942 bytes(8%) sent to /54.174.19.98
Repair 020ed850-cc1e-11e4-a20c-a1d01a3fbf30
    /54.174.245.247
        Receiving 4 files, 93304584 bytes total
            /var/lib/cassandra/data/Keyspace1/Standard1/Keyspace1-Standard1-tmp-jb-161-Data.db
                6094594/46561942 bytes(13%) received from /54.174.245.247
        Sending 2 files, 47709526 bytes total
            /var/lib/cassandra/data/Keyspace1/Standard1/Keyspace1-Standard1-jb-157-Data.db
                34195028/46561942 bytes(73%) sent to /54.174.245.247
Repair 018c88f0-cc1e-11e4-a20c-a1d01a3fbf30
    /54.153.39.203 (using /172.31.10.65)
        Receiving 3 files, 49959102 bytes total
            /var/lib/cassandra/data/Keyspace1/Standard1/Keyspace1-Standard1-tmp-jb-160-Data.db
                9371380/46561942 bytes(20%) received from /54.153.39.203
            /var/lib/cassandra/data/Keyspace1/Standard1/Keyspace1-Standard1-tmp-jb-159-Data.db
                2533414/2533414 bytes(100%) received from /54.153.39.203
        Sending 2 files, 47709526 bytes total
            /var/lib/cassandra/data/Keyspace1/Standard1/Keyspace1-Standard1-jb-158-Data.db
                1147584/1147584 bytes(100%) sent to /54.153.39.203
            /var/lib/cassandra/data/Keyspace1/Standard1/Keyspace1-Standard1-jb-157-Data.db
                46561942/46561942 bytes(100%) sent to /54.153.39.203

Read Repair Statistics:
Attempted: 39576
Mismatch (Blocking): 0
Mismatch (Background): 746

Pool Name                       Active    Pending      Completed
Commands                          n/a         58        2545817
Responses                         n/a          0        2833081
```

Company Confidential

nodetool netstats - streaming progress

```
Mode: NORMAL
Repair 028763b0-cc1e-11e4-a20c-a1d01a3fbf30
    /54.174.19.98
        Receiving 6 files, 117949006 bytes total
            /var/lib/cassandra/data/Keyspace1/Standard1/Keyspace1-Standard1-tmp-jb-162-Data.db
                851792/17950738 bytes(4%) received from /54.174.19.98
        Sending 2 files, 47709526 bytes total
            /var/lib/cassandra/data/Keyspace1/Standard1/Keyspace1-Standard1-jb-157-Data.db
                3786324/46561942 bytes(8%) sent to /54.174.19.98
Repair 020ed850-cc1e-11e4-a20c-a1d01a3fbf30
    /54.174.245.247
        Receiving 4 files, 93304584 bytes total
            /var/lib/cassandra/data/Keyspace1/Standard1/Keyspace1-Standard1-tmp-jb-161-Data.db
                6094594/46561942 bytes(13%) received from /54.174.245.247
        Sending 2 files, 47709526 bytes total
            /var/lib/cassandra/data/Keyspace1/Standard1/Keyspace1-Standard1-jb-157-Data.db
                34195028/46561942 bytes(73%) sent to /54.174.245.247
Repair 018c88f0-cc1e-11e4-a20c-a1d01a3fbf30
    /54.153.39.203 (using /172.31.10.65)
        Receiving 3 files, 49959102 bytes total
            /var/lib/cassandra/data/Keyspace1/Standard1/Keyspace1-Standard1-tmp-jb-160-Data.db
                9371380/46561942 bytes(20%) received from /54.153.39.203
            /var/lib/cassandra/data/Keyspace1/Standard1/Keyspace1-Standard1-tmp-jb-159-Data.db
                2533414/2533414 bytes(100%) received from /54.153.39.203
        Sending 2 files, 47709526 bytes total
            /var/lib/cassandra/data/Keyspace1/Standard1/Keyspace1-Standard1-jb-158-Data.db
                1147584/1147584 bytes(100%) sent to /54.153.39.203
            /var/lib/cassandra/data/Keyspace1/Standard1/Keyspace1-Standard1-jb-157-Data.db
                46561942/46561942 bytes(100%) sent to /54.153.39.203

Read Repair Statistics:
Attempted: 39576
Mismatch (Blocking): 0
Mismatch (Background): 746

Pool Name                    Active     Pending      Completed
Commands                       n/a          58        2545817
Responses                      n/a           0        2833081
```

Repairs - unique id

INFO [AntiEntropySessions:1] 2015-03-16 17:24:44,097 RepairSession.java (line 246)
[repair #562f46d0-cc01-11e4-a84d-098a653a7013] new session: will sync /54.174.19.98, /54.153.108.157, /54.153.39.203, /54.174.245.247 on range (3074457345618258602,6148914691236517205] for Keyspace1.[Counter3, Standard1, SuperCounter1, Super1, Counter1]

INFO [RepairJobTask:2] 2015-03-16 17:24:48,102 RepairJob.java (line 161)
[repair #562f46d0-cc01-11e4-a84d-098a653a7013] requesting merkle trees for Standard1 (to [/54.153.108.157, /54.153.39.203, /54.174.245.247, /54.174.19.98])

INFO [AntiEntropyStage:1] 2015-03-16 17:24:52,749 RepairSession.java (line 166)
[repair #562f46d0-cc01-11e4-a84d-098a653a7013] Received merkle tree for Standard1 from /54.174.19.98

INFO [RepairJobTask:4] 2015-03-16 17:24:52,757 Differencer.java (line 67)
[repair #562f46d0-cc01-11e4-a84d-098a653a7013] Endpoints /54.153.39.203 and /54.174.245.247 are consistent for Standard1

INFO [RepairJobTask:6] 2015-03-16 17:24:55,438 Differencer.java (line 74)
[repair #562f46d0-cc01-11e4-a84d-098a653a7013] Endpoints /54.153.108.157 and /54.174.19.98 have 6222 range(s) out of sync for Standard1

INFO [RepairJobTask:6] 2015-03-16 17:24:55,441 StreamingRepairTask.java (line 64)
[streaming task #562f46d0-cc01-11e4-a84d-098a653a7013] Performing streaming repair of 6222 ranges with /54.153.108.157

INFO [StreamReceiveTask:1] 2015-03-16 17:25:01,524 StreamingRepairTask.java (line 92)
[repair #562f46d0-cc01-11e4-a84d-098a653a7013] streaming task succeed, returning response to /54.174.19.98

INFO [AntiEntropyStage:1] 2015-03-16 17:25:01,805 RepairSession.java (line 223)
[repair #562f46d0-cc01-11e4-a84d-098a653a7013] Standard1 is fully synced

INFO [AntiEntropySessions:1] 2015-03-16 17:25:01,806 RepairSession.java (line 284)
[repair #562f46d0-cc01-11e4-a84d-098a653a7013] session completed successfully

Repairs - session started

INFO [AntiEntropySessions:1] 2015-03-16 17:24:44,097 RepairSession.java (line 246)
[repair #562f46d0-cc01-11e4-a84d-098a653a7013] **new session**: will sync /54.174.19.98, /54.153.108.157, /54.153.39.203, /54.174.245.247 on range (3074457345618258602,6148914691236517205] for Keyspace1.[Counter3, Standard1, SuperCounter1, Super1, Counter1]

INFO [RepairJobTask:2] 2015-03-16 17:24:48,102 RepairJob.java (line 161)
[repair #562f46d0-cc01-11e4-a84d-098a653a7013] requesting merkle trees for Standard1 (to [/54.153.108.157, /54.153.39.203, /54.174.245.247, /54.174.19.98])

INFO [AntiEntropyStage:1] 2015-03-16 17:24:52,749 RepairSession.java (line 166)
[repair #562f46d0-cc01-11e4-a84d-098a653a7013] Received merkle tree for Standard1 from /54.174.19.98

INFO [RepairJobTask:4] 2015-03-16 17:24:52,757 Differencer.java (line 67)
[repair #562f46d0-cc01-11e4-a84d-098a653a7013] Endpoints /54.153.39.203 and /54.174.245.247 are consistent for Standard1

INFO [RepairJobTask:6] 2015-03-16 17:24:55,438 Differencer.java (line 74)
[repair #562f46d0-cc01-11e4-a84d-098a653a7013] Endpoints /54.153.108.157 and /54.174.19.98 have 6222 range(s) out of sync for Standard1

INFO [RepairJobTask:6] 2015-03-16 17:24:55,441 StreamingRepairTask.java (line 64)
[streaming task #562f46d0-cc01-11e4-a84d-098a653a7013] Performing streaming repair of 6222 ranges with /54.153.108.157

INFO [StreamReceiveTask:1] 2015-03-16 17:25:01,524 StreamingRepairTask.java (line 92)
[repair #562f46d0-cc01-11e4-a84d-098a653a7013] streaming task succeed, returning response to /54.174.19.98

INFO [AntiEntropyStage:1] 2015-03-16 17:25:01,805 RepairSession.java (line 223)
[repair #562f46d0-cc01-11e4-a84d-098a653a7013] Standard1 is fully synced

INFO [AntiEntropySessions:1] 2015-03-16 17:25:01,806 RepairSession.java (line 284)
[repair #562f46d0-cc01-11e4-a84d-098a653a7013] session completed successfully

Repairs - session complete

INFO [AntiEntropySessions:1] 2015-03-16 17:24:44,097 RepairSession.java (line 246)
[repair #562f46d0-cc01-11e4-a84d-098a653a7013] new session: will sync /54.174.19.98, /54.153.108.157, /54.153.39.203, /54.174.245.247 on range (3074457345618258602,6148914691236517205] for Keyspace1.[Counter3, Standard1, SuperCounter1, Super1, Counter1]

INFO [RepairJobTask:2] 2015-03-16 17:24:48,102 RepairJob.java (line 161)
[repair #562f46d0-cc01-11e4-a84d-098a653a7013] requesting merkle trees for Standard1 (to [/54.153.108.157, /54.153.39.203, /54.174.245.247, /54.174.19.98])

INFO [AntiEntropyStage:1] 2015-03-16 17:24:52,749 RepairSession.java (line 166)
[repair #562f46d0-cc01-11e4-a84d-098a653a7013] Received merkle tree for Standard1 from /54.174.19.98

INFO [RepairJobTask:4] 2015-03-16 17:24:52,757 Differencer.java (line 67)
[repair #562f46d0-cc01-11e4-a84d-098a653a7013] Endpoints /54.153.39.203 and /54.174.245.247 are consistent for Standard1

INFO [RepairJobTask:6] 2015-03-16 17:24:55,438 Differencer.java (line 74)
[repair #562f46d0-cc01-11e4-a84d-098a653a7013] Endpoints /54.153.108.157 and /54.174.19.98 have 6222 range(s) out of sync for Standard1

INFO [RepairJobTask:6] 2015-03-16 17:24:55,441 StreamingRepairTask.java (line 64)
[streaming task #562f46d0-cc01-11e4-a84d-098a653a7013] Performing streaming repair of 6222 ranges with /54.153.108.157

INFO [StreamReceiveTask:1] 2015-03-16 17:25:01,524 StreamingRepairTask.java (line 92)
[repair #562f46d0-cc01-11e4-a84d-098a653a7013] streaming task succeed, returning response to /54.174.19.98

INFO [AntiEntropyStage:1] 2015-03-16 17:25:01,805 RepairSession.java (line 223)
[repair #562f46d0-cc01-11e4-a84d-098a653a7013] Standard1 is fully synced

INFO [AntiEntropySessions:1] 2015-03-16 17:25:01,806 RepairSession.java (line 284)
[repair #562f46d0-cc01-11e4-a84d-098a653a7013] **session completed successfully**

Errors

Exception Count - nodetool info

$ nodetool info

```
ID                      : 108af27a-43d8-4814-b617-f8f93ba2bb0e
Gossip active           : false
Thrift active           : false
Native Transport active: false
Load                    : 49.56 GB
Generation No           : 0
Uptime (seconds)        : 263824
Heap Memory (MB)        : 2698.60 / 4012.00
Off Heap Memory (MB)    : 4.10
Data Center             : Cassandra
Rack                    : rack1
Exceptions              : 5
Key Cache               : entries 12298, size 1.03 MB, capacity 100 MB, 2592495 hits, 7854163 requests
0.330 recent hit rate, 14400 save period in seconds
Row Cache               : entries 0, size 0 bytes, capacity 0 bytes, 0 hits, 0 requests, NaN recent hit
rate, 0 save period in seconds
Counter Cache           : entries 0, size 0 bytes, capacity 50 MB, 0 hits, 0 requests, NaN recent hit
rate, 7200 save period in seconds
Token                   : -9223372036854775808
```

Exceptions

java.io.EOFException
 at java.io.DataInputStream.readFully(DataInputStream.java:197)
 at java.io.DataInputStream.readFully(DataInputStream.java:169)
 at org.apache.cassandra.utils.ByteBufferUtil.read(ByteBufferUtil.java:395)
 at org.apache.cassandra.service.CacheService$KeyCacheSerializer.deserialize
  (CacheService.java:356)
 at org.apache.cassandra.cache.AutoSavingCache.loadSaved(AutoSavingCache.java:119)
 at org.apache.cassandra.db.ColumnFamilyStore.<init>(ColumnFamilyStore.java:261)
 at org.apache.cassandra.db.ColumnFamilyStore.createColumnFamilyStore
  (ColumnFamilyStore.java:415)
 at org.apache.cassandra.db.ColumnFamilyStore.createColumnFamilyStore
  (ColumnFamilyStore.java:386)
 at org.apache.cassandra.db.Keyspace.initCf(Keyspace.java:309)
 at org.apache.cassandra.db.Keyspace.<init>(Keyspace.java:266)
 at org.apache.cassandra.db.Keyspace.open(Keyspace.java:110)
 at org.apache.cassandra.db.Keyspace.open(Keyspace.java:88)
 at org.apache.cassandra.db.SystemKeyspace.checkHealth(SystemKeyspace.java:536)
 at org.apache.cassandra.service.CassandraDaemon.setup(CassandraDaemon.java:246)
 at com.datastax.bdp.server.DseDaemon.setup(DseDaemon.java:376)
 at org.apache.cassandra.service.CassandraDaemon.activate
  (CassandraDaemon.java:480)

Exceptions – stack trace

```
java.io.EOFException
    at java.io.DataInputStream.readFully(DataInputStream.java:197)
    at java.io.DataInputStream.readFully(DataInputStream.java:169)
    at org.apache.cassandra.utils.ByteBufferUtil.read(ByteBufferUtil.java:395)
    at org.apache.cassandra.service.CacheService$KeyCacheSerializer.deserialize
      (CacheService.java:356)
    at org.apache.cassandra.cache.AutoSavingCache.loadSaved(AutoSavingCache.java:119)
    at org.apache.cassandra.db.ColumnFamilyStore.<init>(ColumnFamilyStore.java:261)
    at org.apache.cassandra.db.ColumnFamilyStore.createColumnFamilyStore
      (ColumnFamilyStore.java:415)
    at org.apache.cassandra.db.ColumnFamilyStore.createColumnFamilyStore
      (ColumnFamilyStore.java:386)
    at org.apache.cassandra.db.Keyspace.initCf(Keyspace.java:309)
    at org.apache.cassandra.db.Keyspace.<init>(Keyspace.java:266)
    at org.apache.cassandra.db.Keyspace.open(Keyspace.java:110)
    at org.apache.cassandra.db.Keyspace.open(Keyspace.java:88)
    at org.apache.cassandra.db.SystemKeyspace.checkHealth(SystemKeyspace.java:536)
    at org.apache.cassandra.service.CassandraDaemon.setup(CassandraDaemon.java:246)
    at com.datastax.bdp.server.DseDaemon.setup(DseDaemon.java:376)
    at org.apache.cassandra.service.CassandraDaemon.activate
      (CassandraDaemon.java:480)
```

Exceptions – organization

```
java.io.EOFException
    at java.io.DataInputStream.readFully(DataInputStream.java:197)
    at java.io.DataInputStream.readFully(DataInputStream.java:169)
    at org.apache.cassandra.utils.ByteBufferUtil.read(ByteBufferUtil.java:395)
    at org.apache.cassandra.service.CacheService$KeyCacheSerializer.deserialize
      (CacheService.java:356)
    at org.apache.cassandra.cache.AutoSavingCache.loadSaved(AutoSavingCache.java:119)
    at org.apache.cassandra.db.ColumnFamilyStore.<init>(ColumnFamilyStore.java:261)
    at org.apache.cassandra.db.ColumnFamilyStore.createColumnFamilyStore
      (ColumnFamilyStore.java:415)
    at org.apache.cassandra.db.ColumnFamilyStore.createColumnFamilyStore
      (ColumnFamilyStore.java:386)
    at org.apache.cassandra.db.Keyspace.initCf(Keyspace.java:309)
    at org.apache.cassandra.db.Keyspace.<init>(Keyspace.java:266)
    at org.apache.cassandra.db.Keyspace.open(Keyspace.java:110)
    at org.apache.cassandra.db.Keyspace.open(Keyspace.java:88)
    at org.apache.cassandra.db.SystemKeyspace.checkHealth(SystemKeyspace.java:536)
    at org.apache.cassandra.service.CassandraDaemon.setup(CassandraDaemon.java:246)
    at com.datastax.bdp.server.DseDaemon.setup(DseDaemon.java:376)
    at org.apache.cassandra.service.CassandraDaemon.activate
      (CassandraDaemon.java:480)
```

Exceptions – subsystem

```
java.io.EOFException
    at java.io.DataInputStream.readFully(DataInputStream.java:197)
    at java.io.DataInputStream.readFully(DataInputStream.java:169)
    at org.apache.cassandra.utils.ByteBufferUtil.read(ByteBufferUtil.java:395)
    at org.apache.cassandra.service.CacheService$KeyCacheSerializer.deserialize
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      (CassandraDaemon.java:480)
```

Company Confidential

Exceptions – class

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    at java.io.DataInputStream.readFully(DataInputStream.java:197)
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Exceptions – methods

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    at java.io.DataInputStream.readFully(DataInputStream.java:197)
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```

Exceptions – source files

java.io.EOFException
    at java.io.DataInputStream.readFully(**DataInputStream.java**:197)
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Exceptions – line numbers

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    at java.io.DataInputStream.readFully(DataInputStream.java:**197**)
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Exceptions – nested exceptions

org.apache.thrift.transport.TTransportException: …
    at org.apache.thrift.transport.TIOStreamTransport.read
    at com.datastax.bdp.transport.server.TPreviewableTransport.readUntilEof
    at com.datastax.bdp.transport.server.TPreviewableTransport.preview
    at com.datastax.bdp.transport.server.TNegotiatingServerTransport.open
    at com.datastax.bdp.transport.server.TNegotiatingServerTransport$...
    at com.datastax.bdp.transport.server.TNegotiatingServerTransport$...
    at org.apache.cassandra.thrift.CustomTThreadPoolServer$WorkerProcess.run
    at java.util.concurrent.ThreadPoolExecutor.runWorker
    at java.util.concurrent.ThreadPoolExecutor$Worker.run
    at java.lang.Thread.run
Caused by: java.net.SocketException: Connection reset
    at java.net.SocketInputStream.read
    at java.net.SocketInputStream.read
    at java.io.BufferedInputStream.fill
    at java.io.BufferedInputStream.read1
    at java.io.BufferedInputStream.read
    at org.apache.thrift.transport.TIOStreamTransport.read
    ... 9 more

Exceptions – error message

org.apache.thrift.transport.TTransportException: …
    at org.apache.thrift.transport.TIOStreamTransport.read
    at com.datastax.bdp.transport.server.TPreviewableTransport.readUntilEof
    at com.datastax.bdp.transport.server.TPreviewableTransport.preview
    at com.datastax.bdp.transport.server.TNegotiatingServerTransport.open
    at com.datastax.bdp.transport.server.TNegotiatingServerTransport$...
    at com.datastax.bdp.transport.server.TNegotiatingServerTransport$...
    at org.apache.cassandra.thrift.CustomTThreadPoolServer$WorkerProcess.run
    at java.util.concurrent.ThreadPoolExecutor.runWorker
    at java.util.concurrent.ThreadPoolExecutor$Worker.run
    at java.lang.Thread.run
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    at java.net.SocketInputStream.read
    at java.net.SocketInputStream.read
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    at java.io.BufferedInputStream.read
    at org.apache.thrift.transport.TIOStreamTransport.read
    ... 9 more

Google Tips

Do

- Use exception **and** several package+class+method names
- Use quotation marks around individual elements

- Use "site:" to limit search to relevant web sites
  - **Mailing list**: site:www.mail-archive.com/ user@cassandra.apache.org
  - **JIRA**: site:issues.apache.org/jira/browse/CASSANDRA
  - **StackOverflow**: site:stackoverflow.com cassandra

- Narrow or broaden as necessary

Don't

- Include source file + line number
- Include specific numbers and strings

Exceptions – search terms

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Thanks!