Indexer Clustering – Internals & Performance

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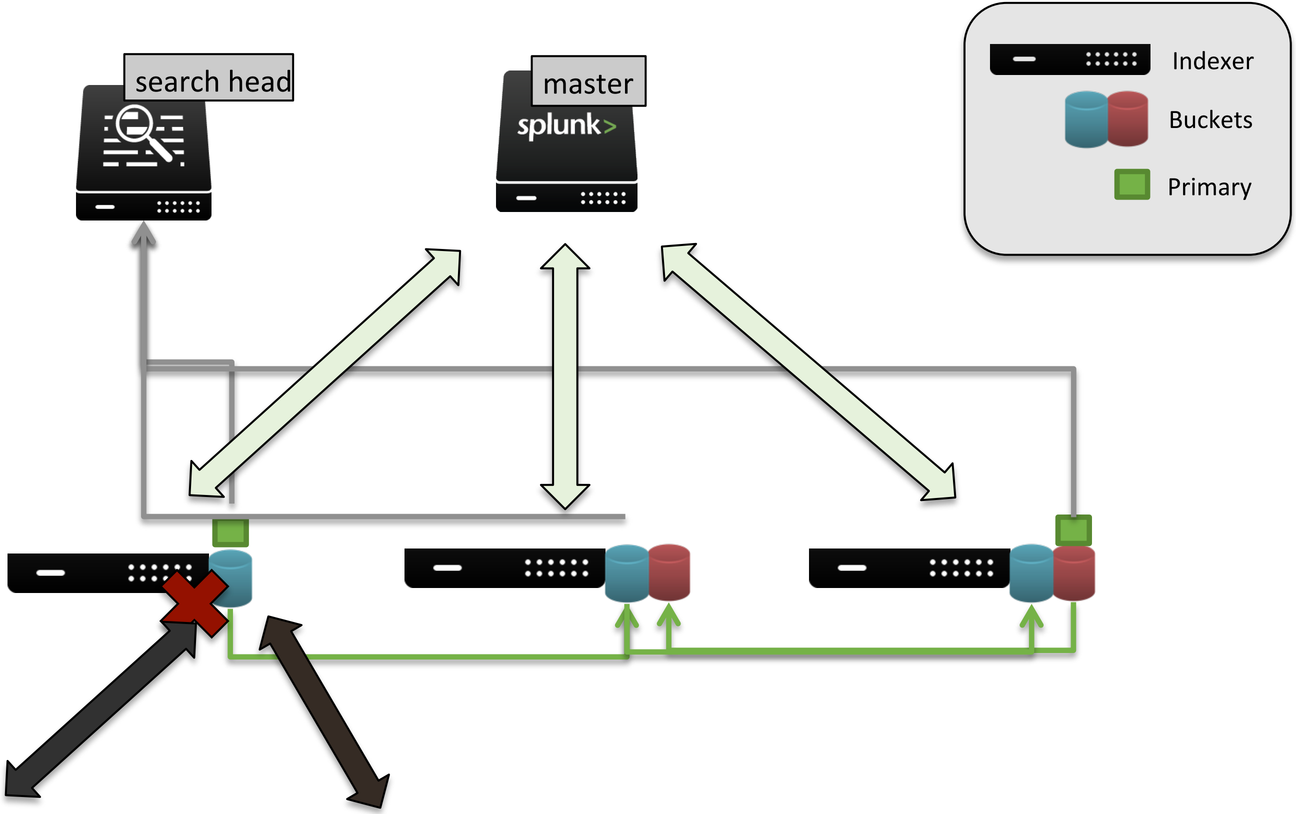
Indexer Clustering Overview

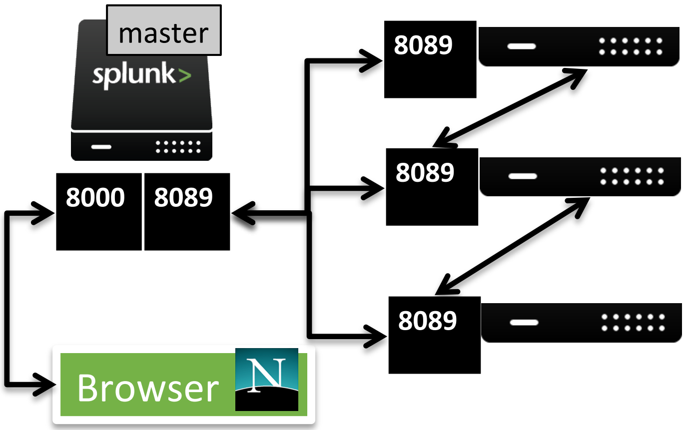
Cluster!



Communication Through Endpoints

The cluster master and peers communicate amongst themselves through the clustering endpoints on the management ports. Some examples:

- Peers->Master:
  - /services/cluster/master/peers
    - Add Peer to cluster
    - Heartbeat to master
  - /services/cluster/master/buckets
    - Alert master there is a new bucket
    - Alert master a bucket changes (hot -> warm, warm -> frozen)
- Master->Peers
  - /services/cluster/slave/buckets
    - Change primaries
    - Become searchable / unsearchable



What’s My Cluster Doing?

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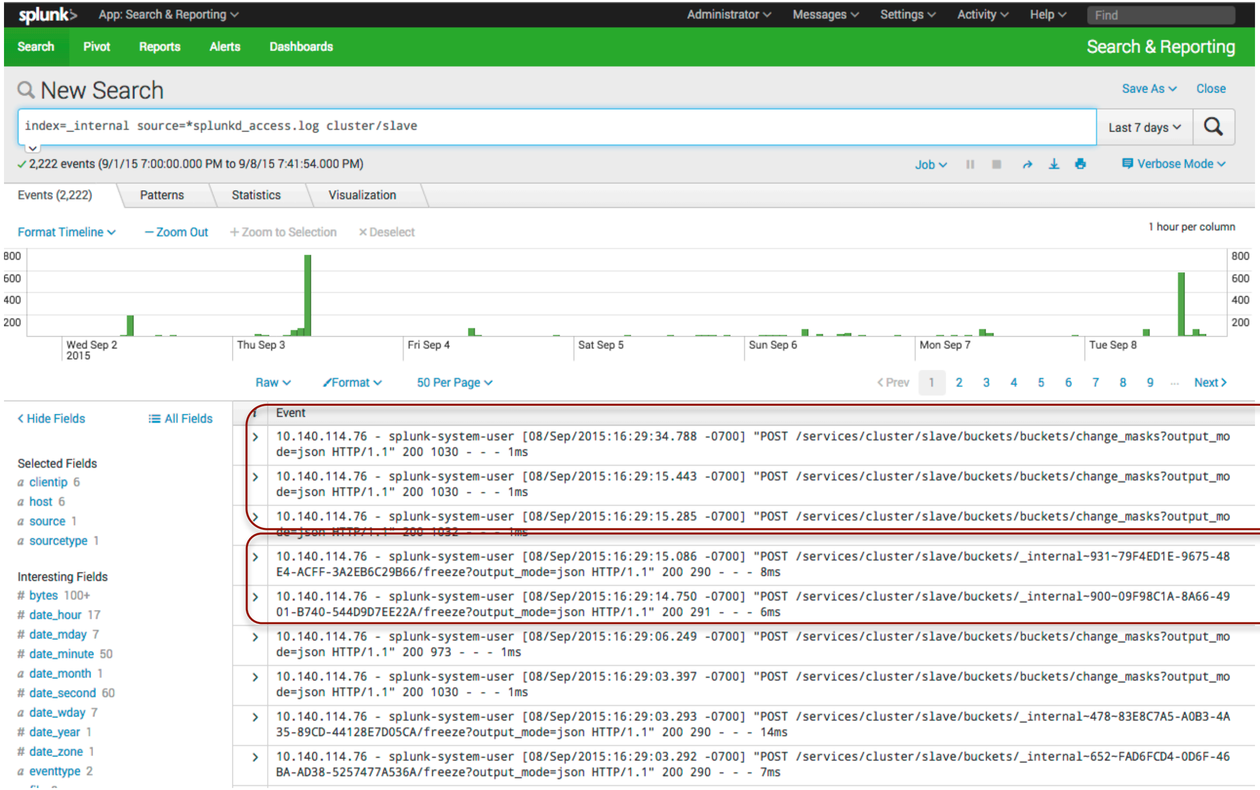
Endpoints Are Logged!



Bucket primary changes!

Buckets being frozen!

Metrics.log

```
> 09-08-2015 22:59:15.184 -0700 INFO  Metrics - group=subtask_seconds, name=cmmaster_service, to_fix_streaming=0.000, to_fix_data_safety=0.016, to_fix_gen=0.000, to_fix_rep_factor=0.036, to_fix_search_factor=0.032, to_fix_sync=0.000, service=0.085
> 09-08-2015 22:59:15.184 -0700 INFO  Metrics - group=subtask_seconds, name=cmmaster_endpoints, clustermastergeneration_edit=0.018000, clustermasterinfo_list=0.018000, clustermasterpeers_edit=0.185000
> 09-08-2015 22:59:15.184 -0700 INFO  Metrics - group=subtask_counts, name=cmmaster_service, to_fix_streaming=0, to_fix_data_safety=97, to_fix_gen=0, to_fix_rep_factor=235, to_fix_search_factor=235, to_fix_sync=0, to_fix_added=0, to_fix_removed=0, to_fix_total=235, count=15
> 09-08-2015 22:59:15.184 -0700 INFO  Metrics - group=subtask_counts, name=cmmaster_endpoints, clustermastergeneration_edit=18, clustermasterinfo_list=18, clustermasterpeers_edit=185
> 09-08-2015 22:59:15.184 -0700 INFO  Metrics - group=executor, name=cmmaster_executor, jobs_added=0, jobs_finished=0, current_size=0, smallest_size=0, largest_size=0, max_size=0
> 09-08-2015 22:59:15.184 -0700 INFO  Metrics - group=cmmaster_servicejobs, serviced=0.000000, current_size=0.000000
> 09-08-2015 22:58:44.184 -0700 INFO  Metrics - group=subtask_seconds, name=cmmaster_service, to_fix_streaming=0.000, to_fix_data_safety=0.016, to_fix_gen=0.000, to_fix_rep_factor=0.036, to_fix_search_factor=0.031, to_fix_sync=0.000, service=0.084
> 09-08-2015 22:58:44.184 -0700 INFO  Metrics - group=subtask_seconds, name=cmmaster_endpoints, clustermastergeneration_edit=0.019000, clustermasterinfo_list=0.019000, clustermasterpeers_edit=0.181000
> 09-08-2015 22:58:44.184 -0700 INFO  Metrics - group=subtask_counts, name=cmmaster_service, to_fix_streaming=0, to_fix_data_safety=97, to_fix_gen=0, to_fix_rep_factor=235, to_fix_search_factor=235, to_fix_sync=0, to_fix_added=0, to_fix_removed=0, to_fix_total=235, count=16
> 09-08-2015 22:58:44.184 -0700 INFO  Metrics - group=subtask_counts, name=cmmaster_endpoints, clustermastergeneration_edit=19, clustermasterinfo_list=19, clustermasterpeers_edit=181
```

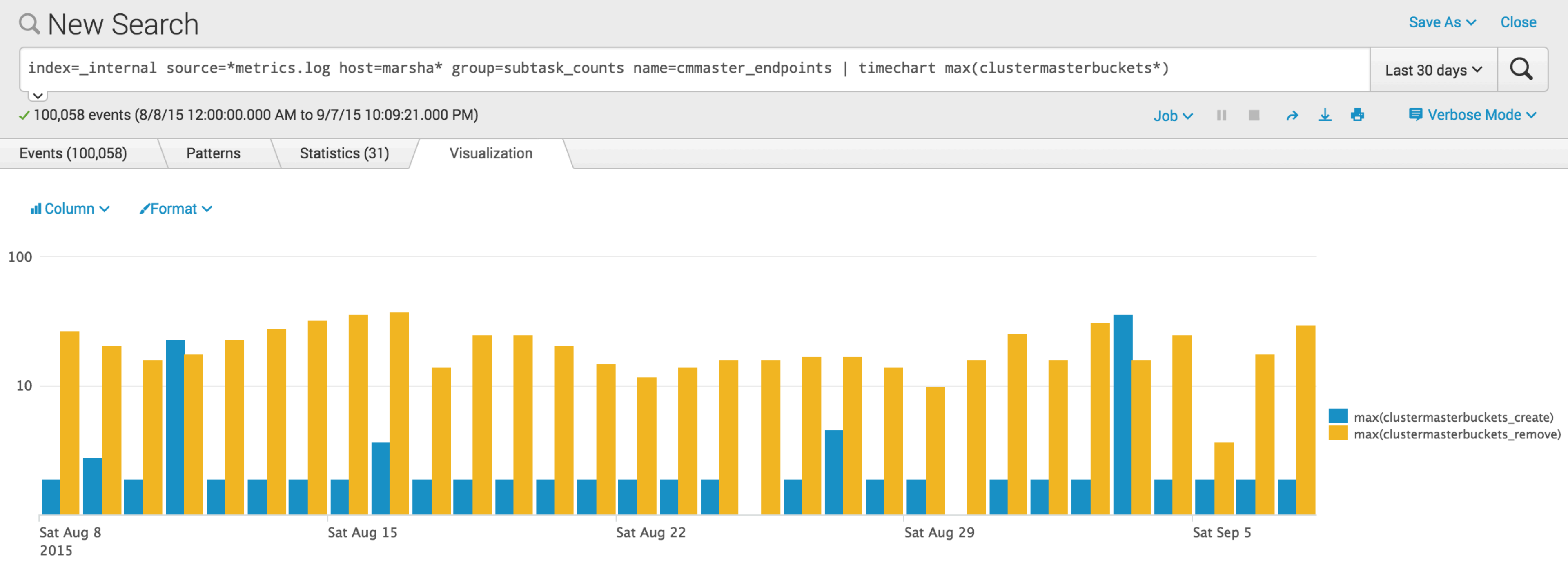
- Cluster master/slave activity can be found under cmmaster* or cmslave* groupings/names
- Metrics about cluster endpoints
  - How many times each endpoint was hit
  - How long we spent in those endpoints
- Metrics about jobs (rep fixup jobs, searchable fixup jobs, freeze jobs, etc)
  - How many jobs remain?
- How many # of buckets do we still need to fix?

Clustering Logs/Activity

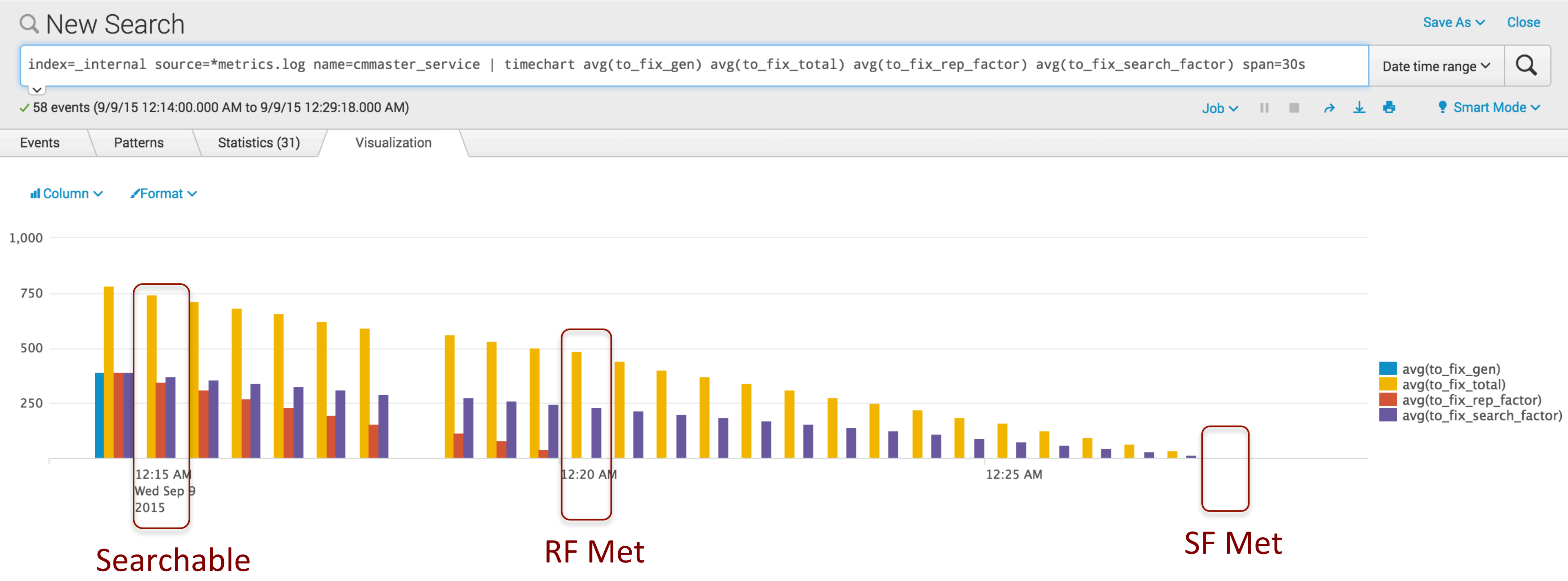
splunkd_access.log	metrics.log

• Each individual endpoint access
  • (master-side) services/cluster/master/…
  • (indexer-side) services/cluster/slave/…
• How long we've spend at the endpoint (ms)
  • Higher times indicate the CM/Indexer is swamped with work (>50ms? >100ms?)
• The response (200 = success, non 200 = failure)
	Metric information with regards to Clustering Activity, recorded every 30 seconds.
	
	• name=cmmaster_endpoints
	  • group=subtask_count total number of accesses
	  • group=subtask_seconds time Splunk spent responding to these endpoints
	• name=cmmaster_executor
	  • "Jobs" the CM has scheduled, finished, and current size of jobs to complete
	    • Jobs are responsible for hitting the endpoints and performing the action (move-primary, freeze, etc)
	• group=jobs, name=cmmaster
	  • Actual counts of the jobs and their jobnames
	
	Indexers have their own corresponding jobs (cmslave)

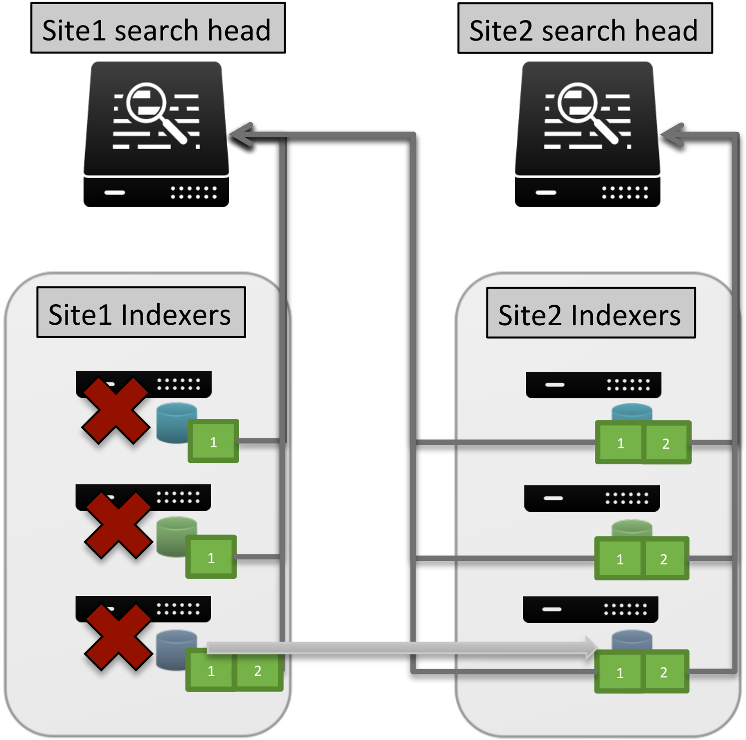
Cluster Activity



Cluster Activity

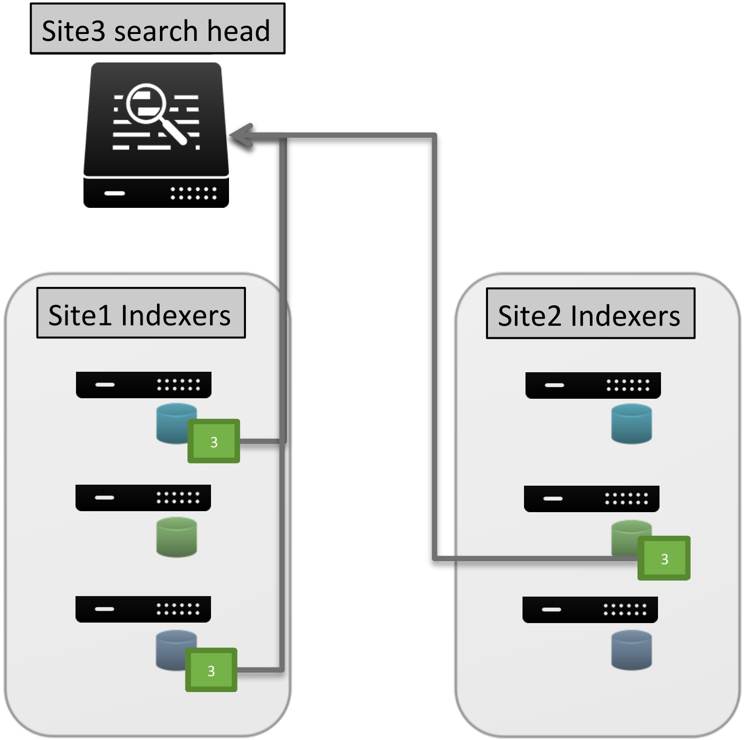


Multisite Search Affinity



- When a searchable copy becomes available on a site, splunk will move the primary for that site to its local copy
- Buckets on a site will return events to a searchhead with the same site.
- If a peer goes down, the master will move the primaries that peer had to another copy
- If the entire site goes down, the other site(s) will become primaries

Multisite ~~Search Affinity~~



- Splunk 6.3 – site0
  - Primaries behave just like non-multisite, without any regards to site!
- Pre 6.3
  - Workaround!
  - Add another site to available_sites
  - Set SH (no indexers) to new site
  - Make sure to call “splunk set indexing-ready” on every CM restart
  - (wont work if your excess ‘total’ sites is greater than the # of non-specified sites… ie origin:1 total:3 in our illustration will not work, because then the CM will try to put the 2 non-origin copies into a site each, and there are no indexers in site3!)

Buckets

More Buckets More Problems

splunk> Apps Administrator 30 Messages Settings Activity Help

Indexer Clustering: Master Node

Edit More Info Documentation

✓ **All Data is Searchable** | ⚠ **Search Factor is Not Met** | ⚠ **Replication Factor is Not Met**

150 searchable **0** not searchable
Peers

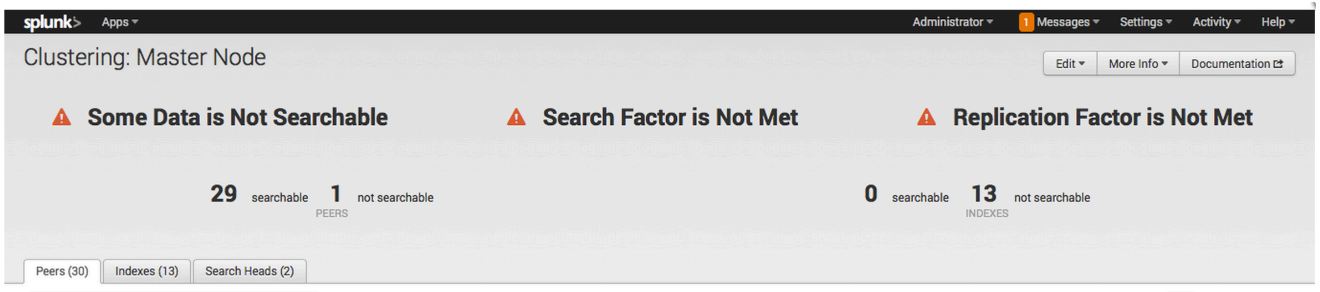
32 searchable **0** not searchable
Indexes

Peers (150) | Indexes (32) | Search Heads (1)

filter | 100 per page | Bucket Status

Index Name	Fully Searchable	Searchable Data Copies	Replicated Data Copies	Buckets	Cumulative Raw Data Size
index10	✓ Yes	2	3	34680	65.56 GB
index17	✓ Yes	2	3	34519	66.54 GB
index01	✓ Yes	2	3	33968	65.09 GB
index16	✓ Yes	2	3	33948	64.70 GB
index20	✓ Yes	2	3	33876	66.09 GB
index03	✓ Yes	2	3	33767	63.43 GB
index15	✓ Yes	2	3	33640	66.33 GB
index25	✓ Yes	2	3	33564	60.89 GB
index07	✓ Yes	2	3	33554	70.02 GB
index13	✓ Yes	2	3	33545	64.44 GB
index18	✓ Yes	2	3	33522	63.62 GB
index11	✓ Yes	2	3	33396	64.23 GB
index12	✓ Yes	2	3	33369	65.71 GB
index08	✓ Yes	2	3	33253	62.88 GB
index29	✓ Yes	2	3	33194	63.73 GB
index02	✓ Yes	2	3	33054	64.54 GB
index19	✓ Yes	2	3	33042	63.57 GB
index04	✓ Yes	2	3	32961	61.66 GB
index28	✓ Yes	2	3	32792	60.72 GB
index30	✓ Yes	2	3	32722	62.15 GB
index26	✓ Yes	2	3	32717	61.21 GB
index05	✓ Yes	2	3	32697	64.35 GB
index24	✓ Yes	2	3	32637	62.12 GB
index14	✓ Yes	2	3	32615	64.45 GB
index21	✓ Yes	2	3	32443	62.57 GB
index09	✓ Yes	2	3	32339	62.48 GB
index23	✓ Yes	2	3	31975	60.81 GB
index22	✓ Yes	2	3	31789	61.27 GB
index06	✓ Yes	2	3	31711	62.87 GB
index27	✓ Yes	2	3	31490	57.84 GB

More Buckets More Problems

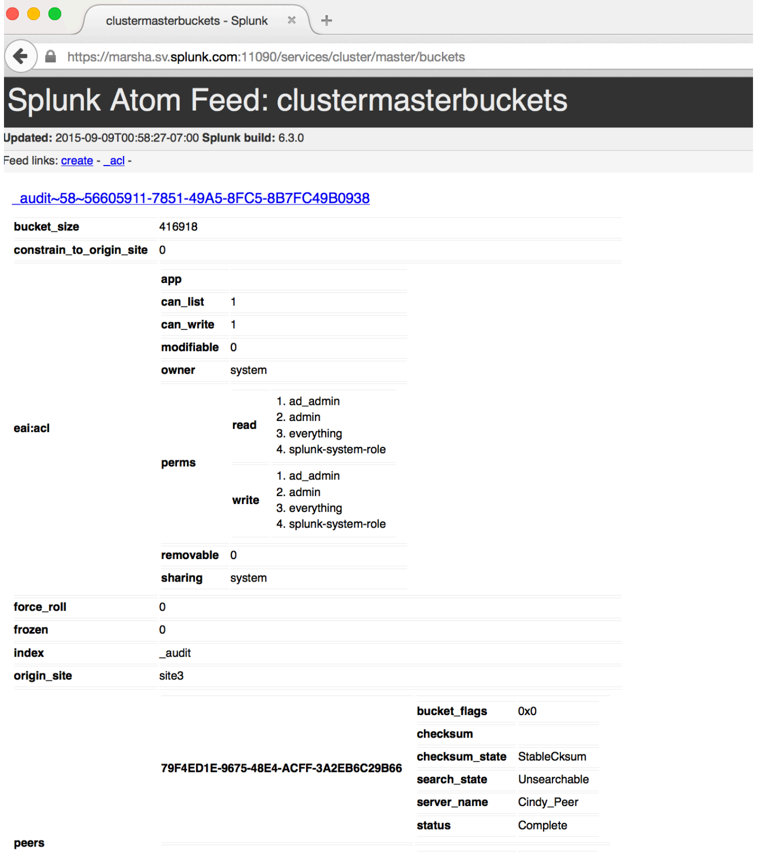


- More buckets (and more peers) means the CM has to do more work
  - Iterates through each bucket, checking whether it needs to queue up any fixup jobs
    - Replication Jobs (to meet RF)
    - Search Jobs (to meet SF)
    - Primary Jobs (all buckets need to have a primary copy per site)
    - Other jobs (freezing, checksum, rolling, etc)
- As the number of buckets grows, CM responsiveness goes down

More Buckets More Settings

server.conf	
service_interval (CM)	Specifies how often the CM should look through the buckets, scheduling jobs as necessary. Default = 1. • Adjust to 1 sec for every 50k buckets.
heartbeat_period (Indexer)	Specifies how often the Indexers contact the CM. Defaults to every 1 second. • For lots of peers (>50) or lots of buckets (>100k), we can increase this value to 5-30
heartbeat_timeout (CM)	Specifies how long before an Indexer is considered 'Down' when no heartbeats comes in • Multiple of heartbeat_period, anywhere from 20x – 60x
cxn_timeout (CM+Indexer) rcv_timeout (CM+Indexer) send_timeout (CM+Indexer)	Specifies how long before an intra-cluster connection will terminate. Default = 60 • If a cluster indexer times out, it will re-add itself to the CM, which itself is a busy operation (it needs to resync the state of all its buckets), which can lead to negative feedback loops… • These can be bumped up for busier clusters (300s)
indexes.conf	
rotatePeriodInSecs (Indexer)	Specifies how often to check through all the buckets – rolling them from hot->warm->cold as necessary. Default = 60 • 10min=600

Inspecting Buckets



clustermasterbuckets - Splunk

https://marsha.sv.splunk.com:11090/services/cluster/master/buckets

Splunk Atom Feed: clustermasterbuckets

Updated: 2015-09-09T00:58:27-07:00 **Splunk build:** 6.3.0

Feed links: create - _acl -

_audit~58~56605911-7851-49A5-8FC5-8B7FC49B0938

bucket_size 416918

constrain_to_origin_site 0

eai:acl
- **app**
- **can_list** 1
- **can_write** 1
- **modifiable** 0
- **owner** system
- **perms**
  - **read**
    1. ad_admin
    2. admin
    3. everything
    4. splunk-system-role
  - **write**
    1. ad_admin
    2. admin
    3. everything
    4. splunk-system-role
- **removable** 0
- **sharing** system

force_roll 0

frozen 0

index _audit

origin_site site3

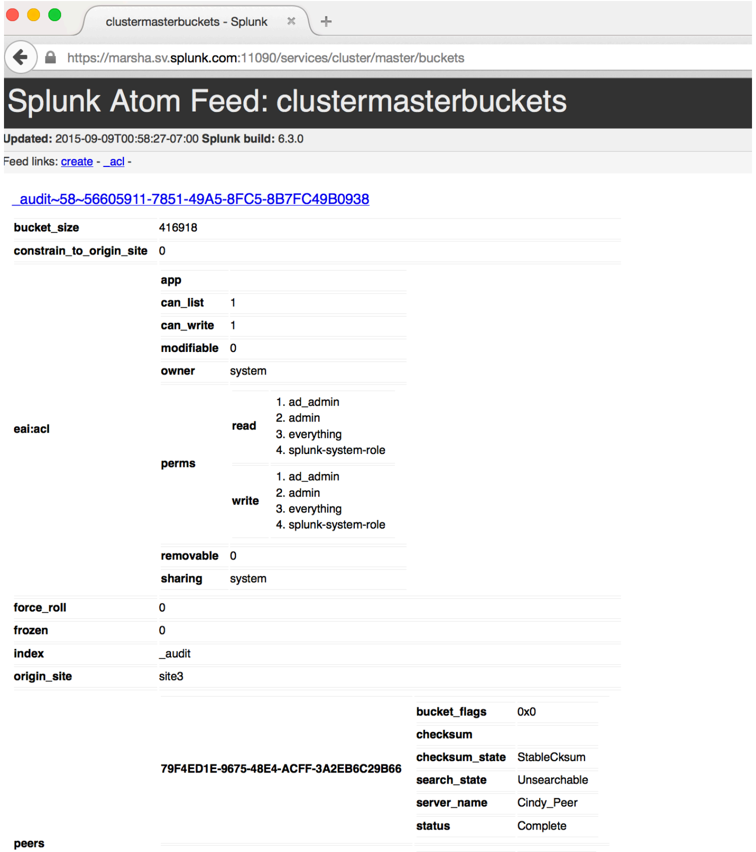
peers
- **79F4ED1E-9675-48E4-ACFF-3A2EB6C29B66**
  - **bucket_flags** 0x0
  - **checksum**
  - **checksum_state** StableCksum
  - **search_state** Unsearchable
  - **server_name** Cindy_Peer
  - **status** Complete

services/cluster/master/buckets

- Which peers does the bucket exist on?
- Which peers is the bucket primary?
- Is the bucket searchable/unsearchable/ pending-searchable?

peers	09F98C1A-8A66-4901-B740-544D9D7EE22A	bucket_flags	0x4
		checksum	
		checksum_state	StableCksum
		search_state	Searchable
		server_name	Bobby_Peer
		status	Complete
	83E8C7A5-A0B3-4A35-89CD-44128E7D05CA	bucket_flags	0x3
		checksum	
		checksum_state	StableCksum
		search_state	Searchable
		server_name	Marsha_Peer
		status	Complete
	FAD6FCD4-0D6F-46BA-AD38-5257477A536A	bucket_flags	0x0
		checksum	
		checksum_state	StableCksum
		search_state	Searchable
		server_name	Jan_Peer
		status	Complete
primaries_by_site	site0	83E8C7A5-A0B3-4A35-89CD-44128E7D05CA	
	site1	83E8C7A5-A0B3-4A35-89CD-44128E7D05CA	
	site2	09F98C1A-8A66-4901-B740-544D9D7EE22A	
rep_count_by_site	site1	2	
	site2	1	
search_count_by_site	site1	2	
	site2	1	

Inspecting Buckets



There's so many buckets! How do I find one that I care about? Why would I care?

Filters! services/cluster/master/buckets?filter=

- Which buckets do not have primaries?
  - buckets?filter=has_primary=false
- Which buckets do not meet my RF=3?
  - buckets?filter=replication_count<3
- Which buckets are frozen?
  - buckets?filter=frozen=true
- Standalone?
  - buckets?filter=standalone=true
- Standalone and frozen?
  - buckets?filter=standalone=true&filter=frozen=true
  - (don't think this is a thing)
- Don't meet RF=3 and index=main?
  - buckets?filter=replication_count>3&filter=index=main

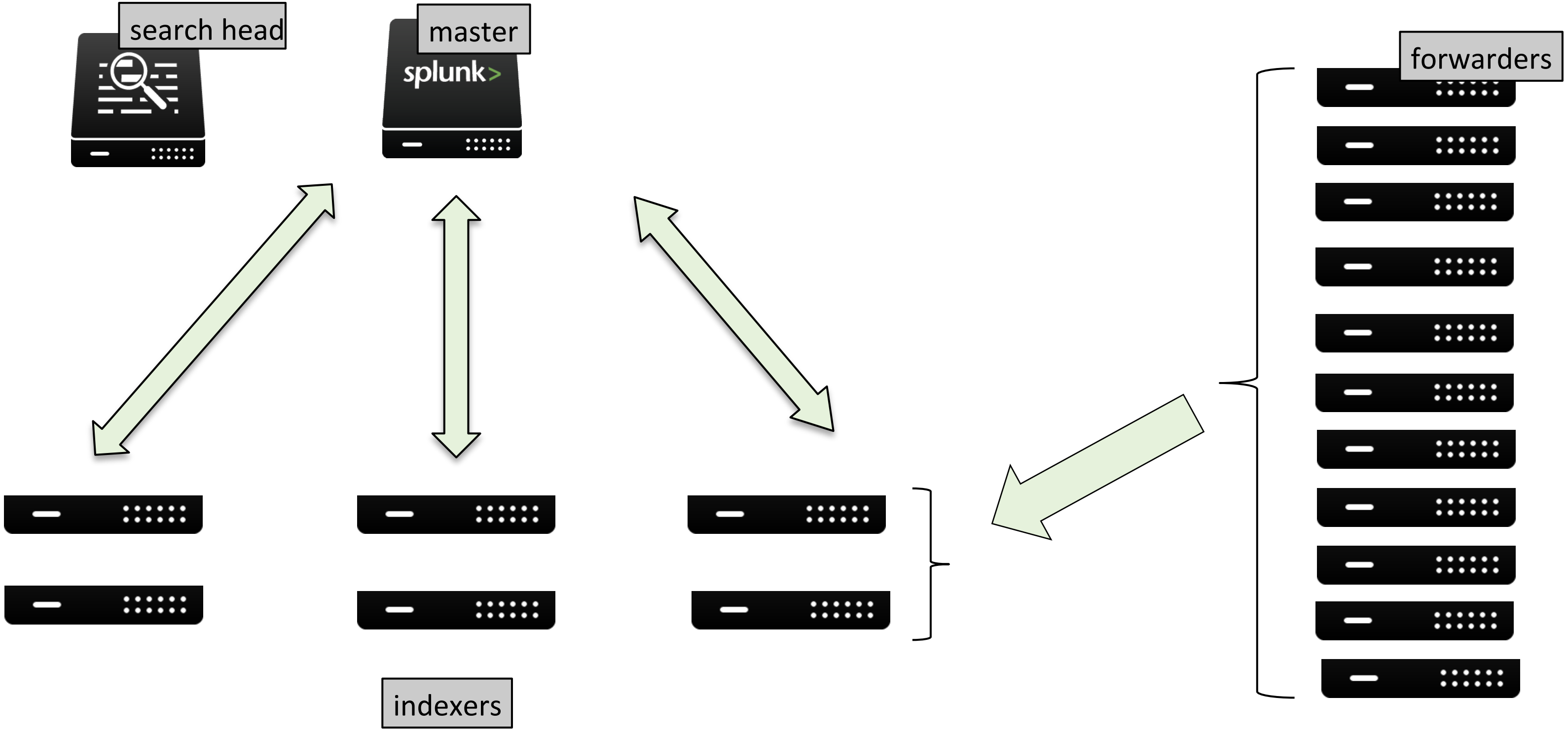
Modifying Buckets

Endpoints!

- Freeze a bucket:
  - curl -k -u admin:changeme https://{indexer}:{mgmt}/services/data/indexes/{INDEX}/freeze-buckets -d bucket_ids=46_11115C7A-E2F0-4225-A740-4ED6BD2D9CE5 -X POST
- Remove a copy of a bucket:
  - curl -k -u admin:changeme "https://{master}:{mgmt}/services/cluster/master/buckets/main~1490~D4A07A5D-3C3C-4D36-BD70-D610B432466F/remove_from_peer" -d peer={PEER_GUID}
- Remove all copies of a bucket:
  - curl -k -u admin:changeme "https://{master}:{mgmt}/services/cluster/master/buckets/main~1490~D4A07A5D-3C3C-4D36-BD70-D610B432466F/remove_all" -d peer={PEER_GUID

Performance Testing

Clustering Performance Tests



Scale Testing

Cluster Variable	Tested up to
Indexers	1000
Indexes	1000
Unique buckets	1.5 million
Forwarders	100000

1000 Node Performance Test

Amazon EC2

- 1 hs1.8xlarge master
- 1 c1.xlarge searchhead
- 1000 c1.xlarge indexers
- 10000 forwarders
  - 100 m1.small (10 forwarders / box)

Replication factor: origin:2, total:3
Search factor: origin:1, total:2
Data ingestion rate: 2 MB/s per indexer

Ingested 1 million unique buckets
11 TB of syslog data

Machine type	vCPUz	Memory (GB)	Instance Store (GB)
hs1.8xlarge	16	117	24 x 2000
c1.xlarge	8	7	4 x 420
m1.small	1	1.7	1 x 160

Large Cluster Configurations

Master

Server.conf

```
[sslConfig]
allowSslCompression = false


[clustering]
heartbeat_timeout = 600
service_interval = 10
```

Indexer

Server.conf

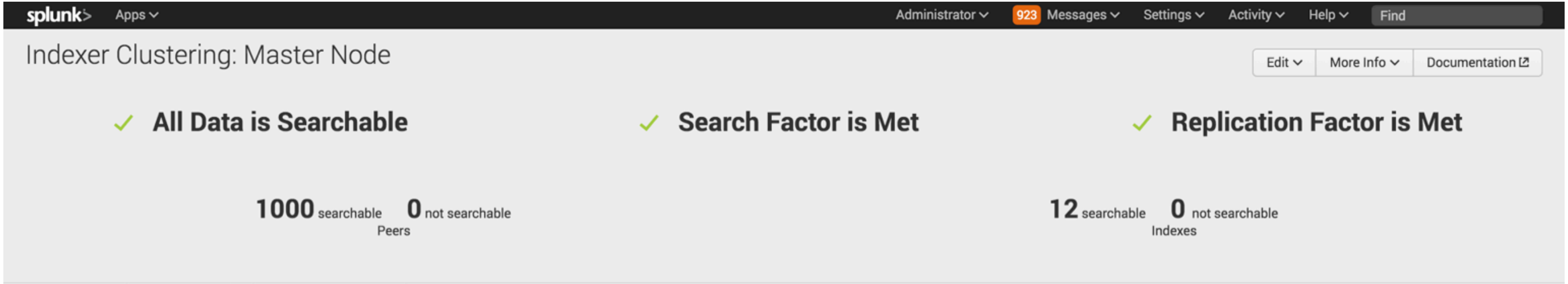
```
[general]
useHTTPClientCompression =
true


[clustering]
heartbeat_period = 10
cxn_timeout = 1200
send_timeout = 1200
rcv_timeout = 1200
```

Test Case: Peer Failure

1. Take down a peer
   ./splunk stop –f
2. Wait for:
   – Searchable
   – Replication factor met
   – Search factor met

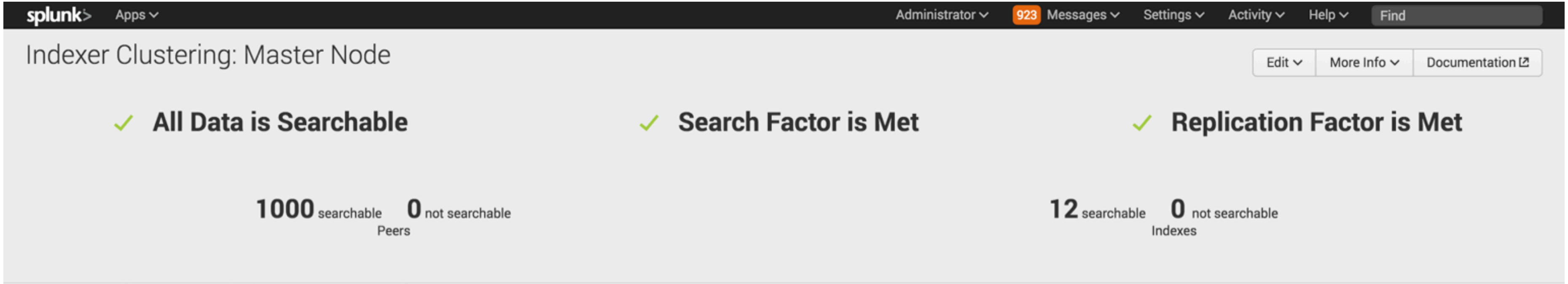
Splunk Release	Number of buckets	Time to be searchable	Time to meet rf/sf
6.3	30000	160 s	85 s
6.4	51000	36 s	47 s
6.5	935000	2 s	32 s



Test Case: Site Failure

1. Take down 1 site (333 peers)
   ./splunk stop –f
2. Wait for:
   – Searchable

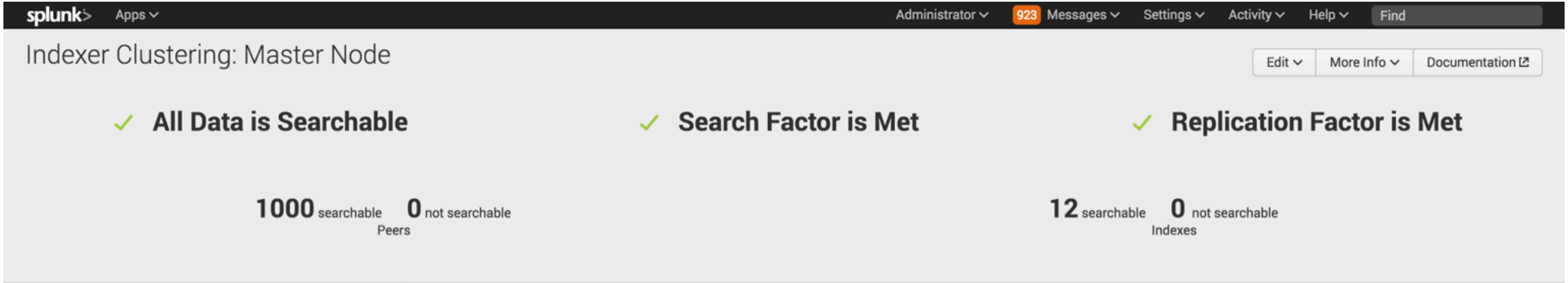
Splunk Release	Number of buckets	Time to be searchable
6.3	30000	791 s
6.4	51000	328 s
6.5	935000	451 s



Test Case: Master Restart

1. Force restart of master
   ./splunk restart -f
2. Wait for:
   – Master to restart
   – Searchable
   – Replication factor met
   – Search factor met

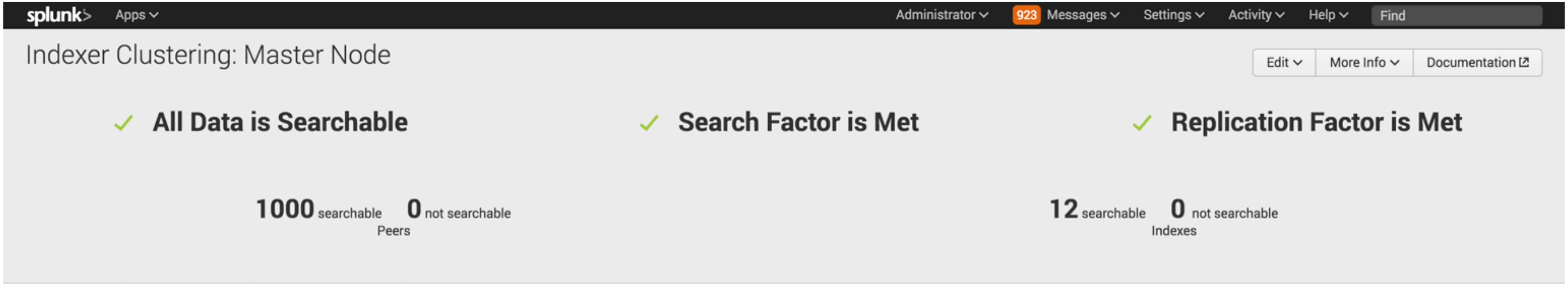
Splunk Release	Number of buckets	Time to be searchable	Time to meet rf/sf
6.3	30,000	361 s	1007 s
6.4	51,000	286 s	488 s
6.5	935,000	720 s	723 s



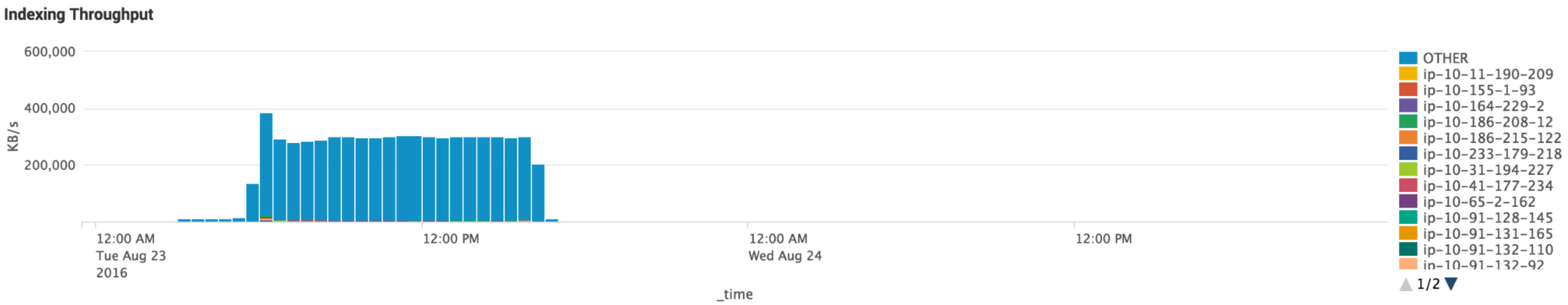
Test Case: Rolling Restart

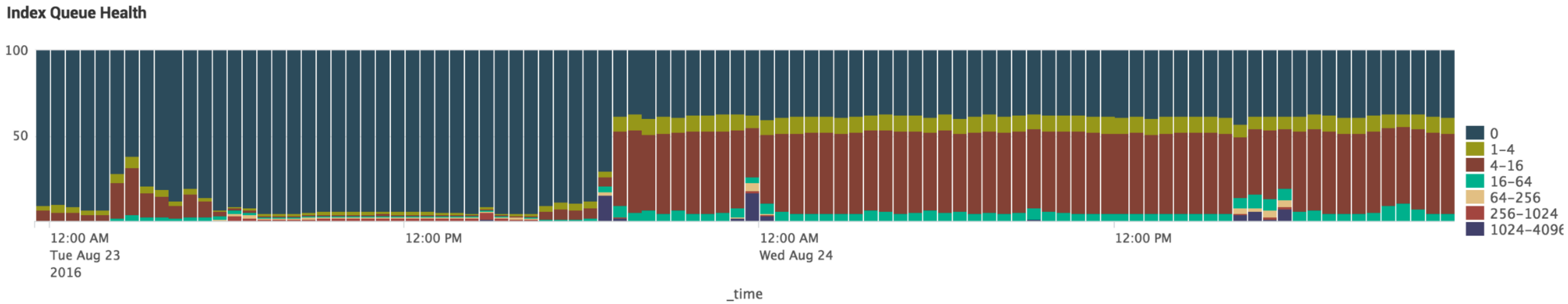
1. Perform rolling restart (on cm)
   ./splunk rolling-restart cluster-peers
2. Wait for:
   - All peers to restart
   - Searchable
   - Replication factor met
   - Search factor met

Splunk Release	Number of buckets	Time to be searchable	Time to meet rf/sf
6.4	51000	746 s	1127 s
6.5	935000	328 s	470 s



Resource Metrics





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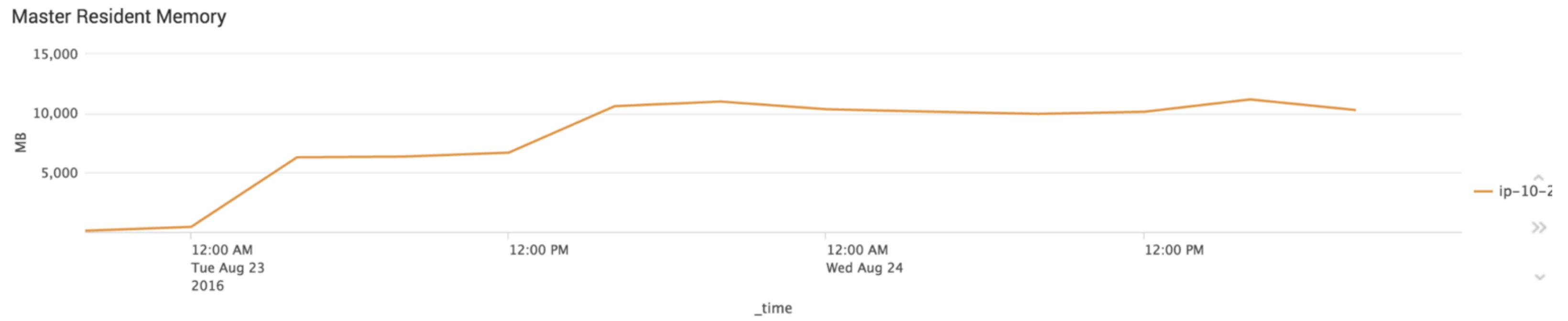
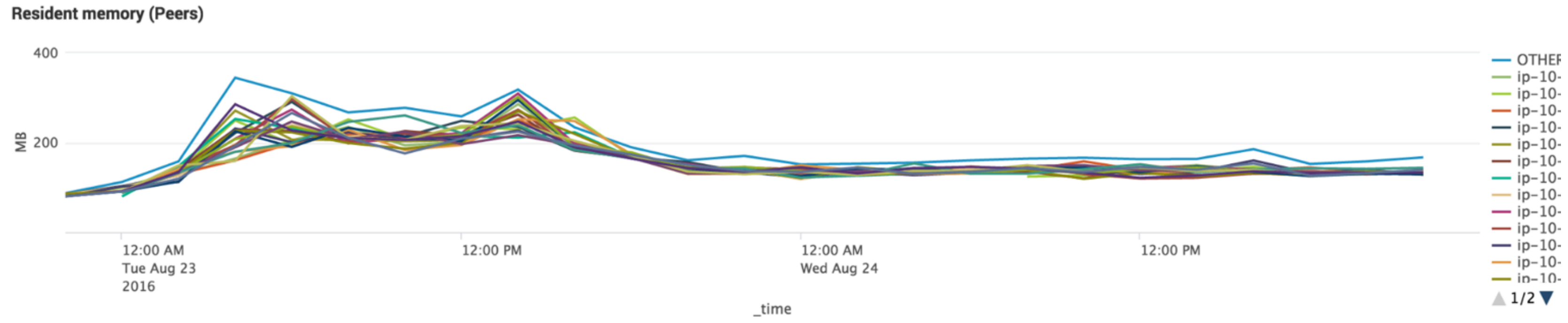
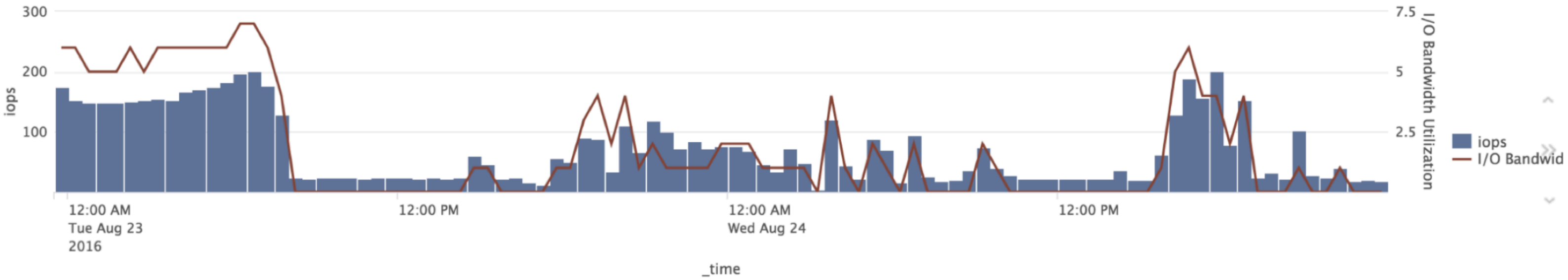


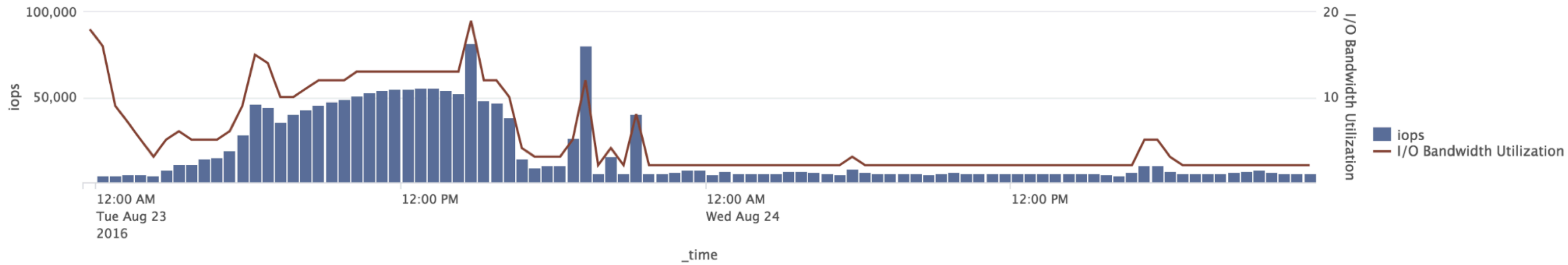


Resource Metrics

Average I/O Usage and Bandwidth Utilization (cm)



Average I/O Usage and Bandwidth Utilization (Peers)



Performance Tests Every Release

- Local in-house 10 indexer lab cluster
- 1000 indexer multi-site cluster
- 500k unique buckets, 150 indexer cluster

Regression tests we run:

- Peer and site failure
- Master restart
- Rolling restart
- Bundle push
- Indexing thruput

And of course, test newest features!

Miscellaneous

Q&A

THANK YOU