Harnessing 6.3 Performance and Scalability

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Splunk

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About Us

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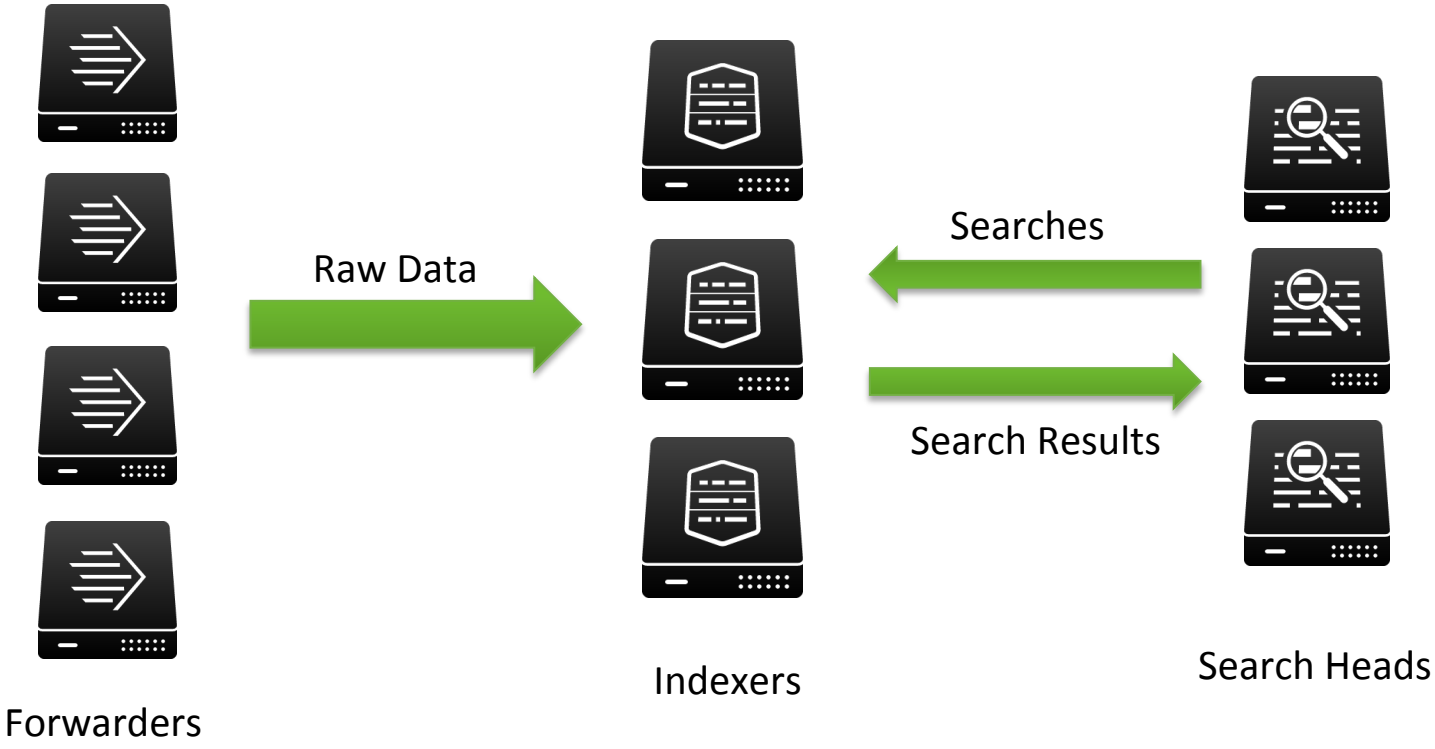
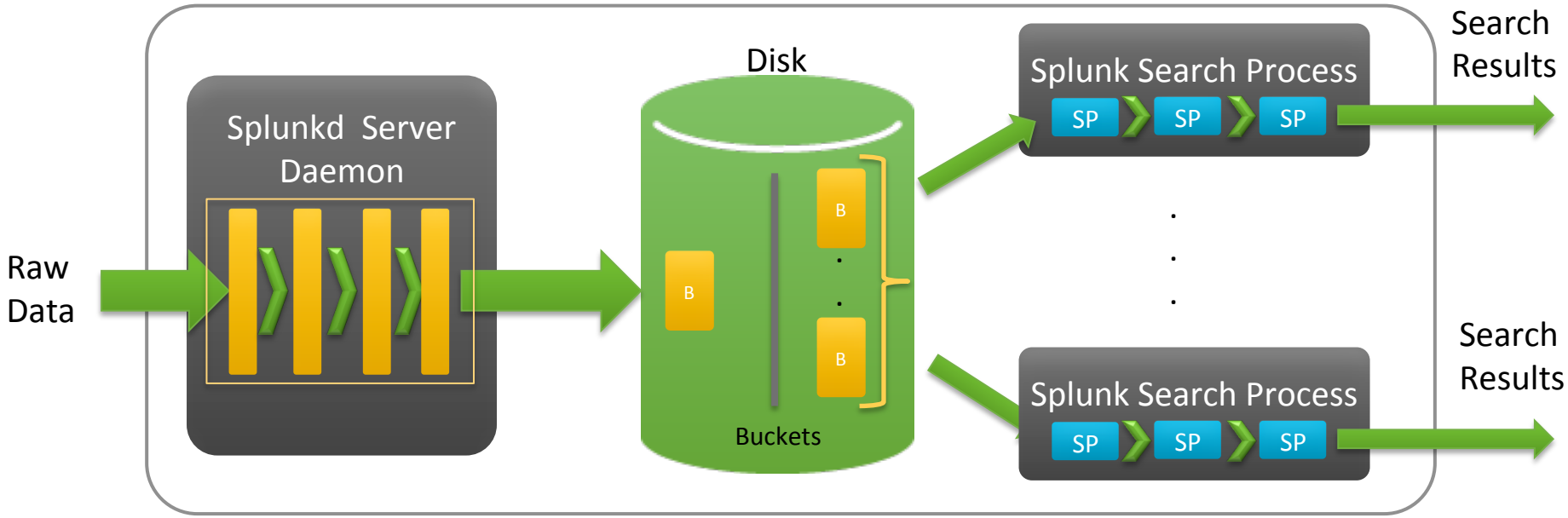
3 Tier Architecture

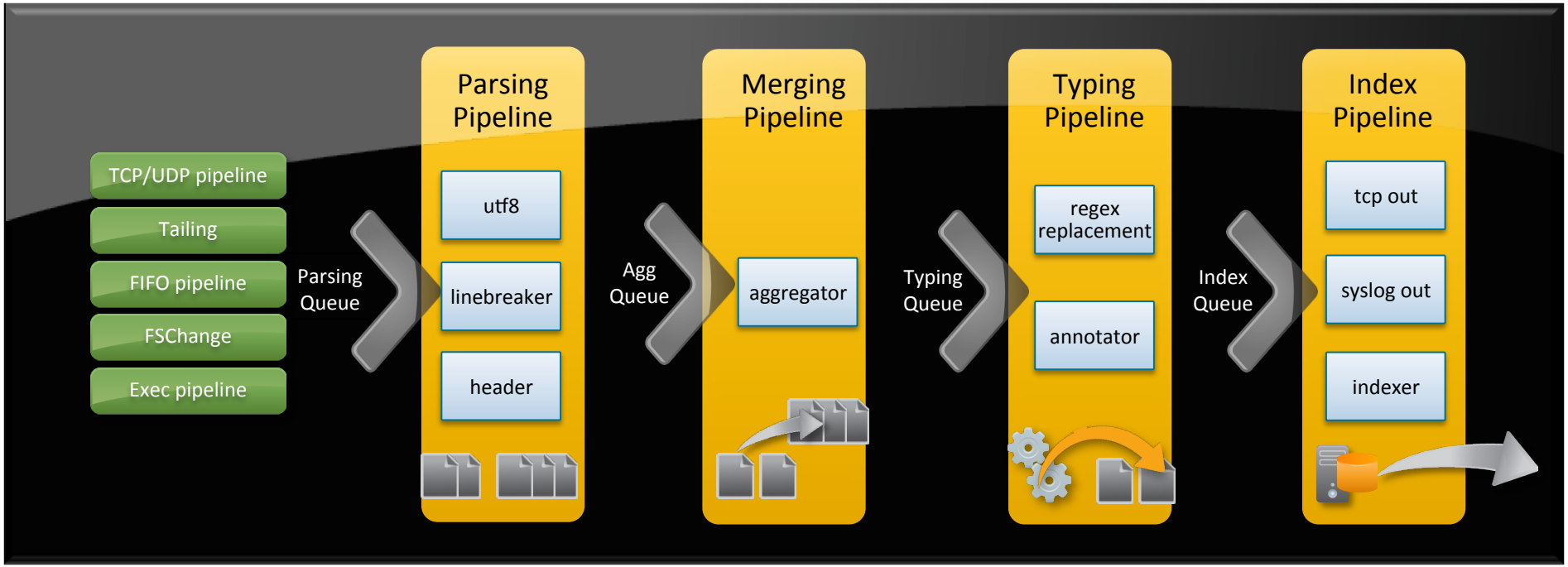


Insight into the Indexer



Traditional Indexer Hosts

Splunkd Server Daemon / Pipelineset



Ingestion Pipeline Set

Indexer Core Utilization

- Rule of Thumb:

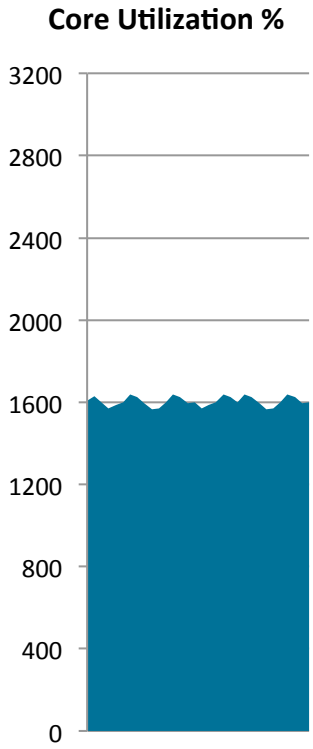
Process	Cores (approx.)
Splunkd Server Daemon	4 to 6 cores
Splunk Search Process	1 core / search process

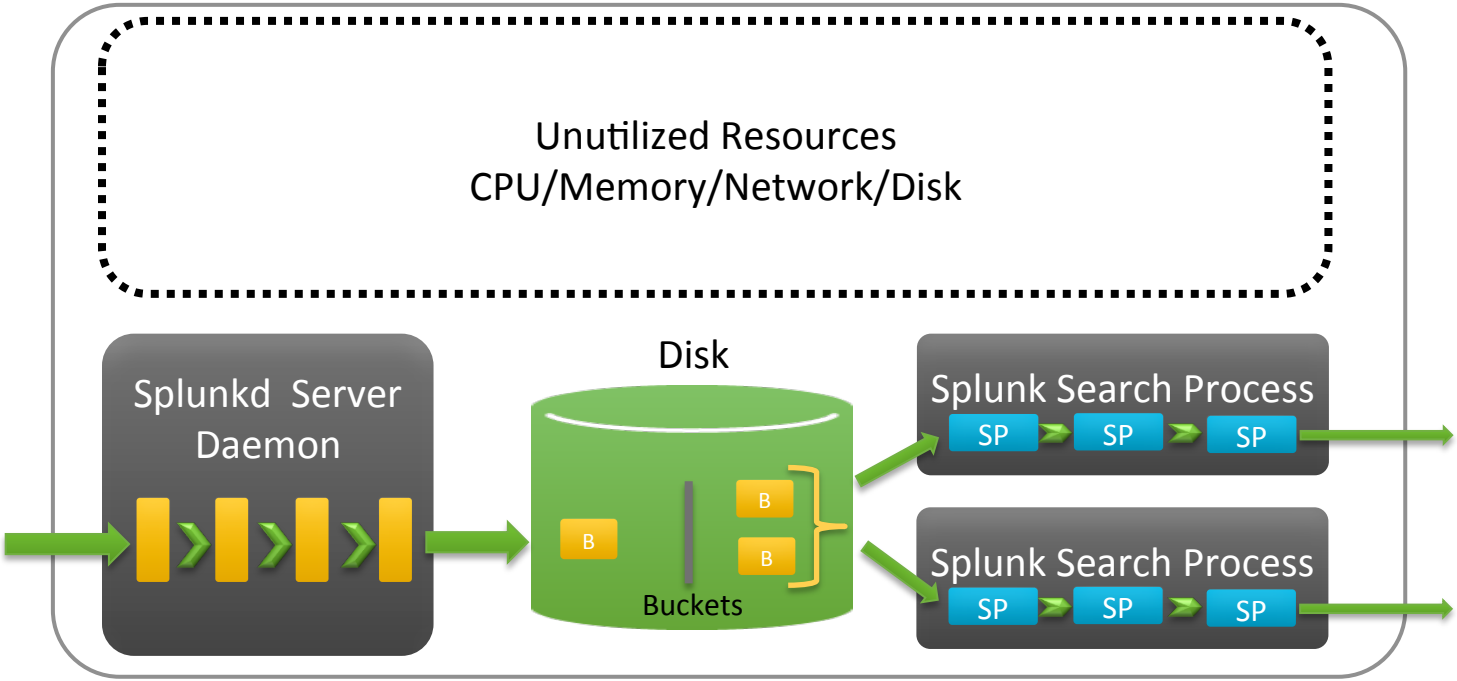
- Example core utilization of a Indexer Host:
  - 4 To 6 cores for Splunkd Server daemon
  - 10 X 1 Cores for Splunk Search Processes
  - Total cores used: 14 to 16 cores

Today's Commodity Hardware

- Dell PowerEdge R820
- Intel(R) Xeon(R) CPU E5-4620 0 @ 2.20GHz - 32 cores
- 8 x 146Gb SAS 15k disks
- 128GB RAM

Under-Utilized Indexer





Performance Enhancements in 6.3

- Multiple Pipeline Sets
  - Parallel ingesting pipeline sets
  - Improves resource utilization of the host machine
- Search Improvements
  - Faster batch searches using parallel search pipelines

Multiple Ingestion Pipeline Sets

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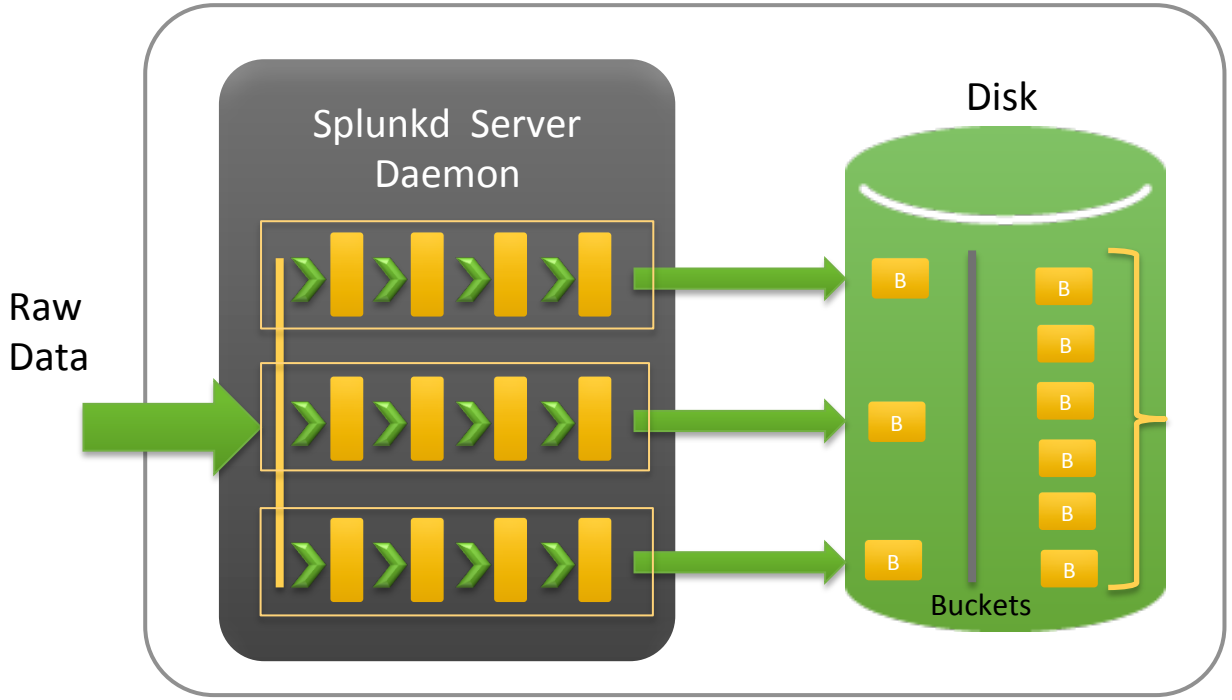
Splunkd with Multiple Ingestion Pipeline Sets



Indexer with 3 Pipeline Sets

Configuring Multiple Ingestion Pipeline Sets

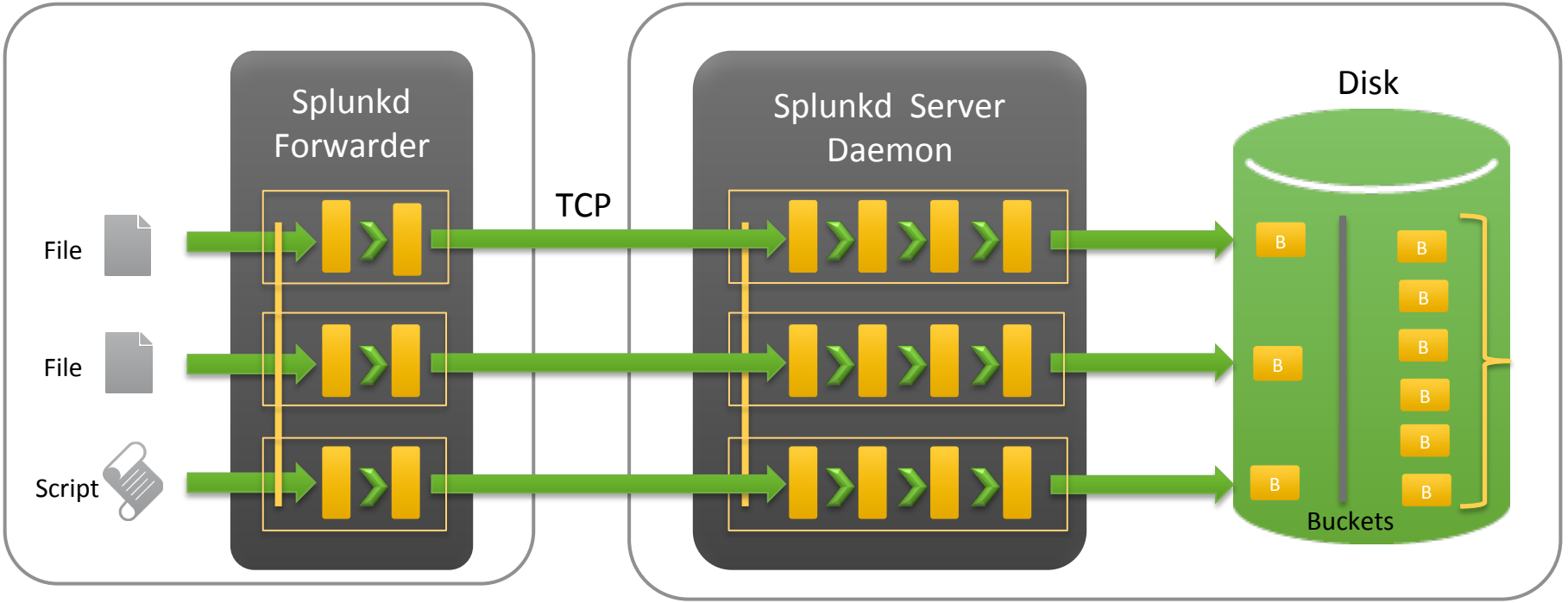
- $SPLUNK_HOME/etc/system/local/server.conf

```
[general]
parallelIngestionPipelines = 3
```

Multiple Ingestion Pipeline Sets – Details

- Each Pipeline Set has its own set of Queues, Pipelines and Processors
  - Exceptions are Input Pipelines which are usually singleton
- No state is shared across Pipeline Sets
- Data from a unique source is handled by only one Pipeline Set at a time

Multiple Ingestion Pipeline Sets over Network



Forwarder with 3 Pipeline Sets

Indexer with 3 Pipeline Sets

Multiple Ingestion Pipeline Sets – Monitor Input

- Each Pipelineset has its own set of TailReader, BatchReader and Archive Processor
- Enables parallel reading of files and archives on Forwarders
- Each file/archive is assigned to one pipeline set

Multiple Ingestion Pipeline Sets - Forwarding

- Forwarder:
  - One tcp output processor per pipeline set
  - Multiple tcp connections from the forwarder to different indexers at the same time
  - Load balancing rules applied to each pipeline set independently
- Indexer:
  - Every incoming tcp forwarder connection is bound to one pipeline set on the Indexer

Multiple Ingestion Pipeline Sets - Indexing

- Every pipeline set will independently write new data to indexes
- Data is written in parallel to better utilize resources
- Buckets produced by different pipeline sets could have overlapping time ranges

Search : Parallelization Efforts Performance Improvements

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Search Parallelization: Performance Improvement

Splunk Searches are faster in 6.3.

- Parallelizing the Search Pipeline
- Improving the Search Scheduler
- The Summary Building is parallelized and faster.

Search Pipeline

Batch Search

Reading Order

Reading Order

Option1:…B3 B5 B1 B2 B1 B6

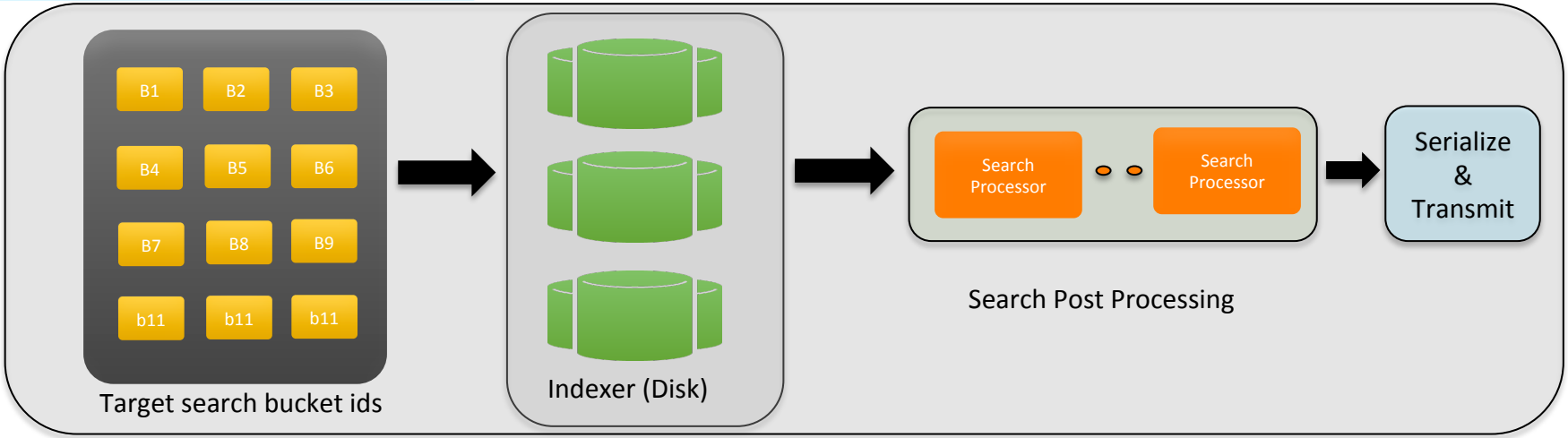
Option2:…B6 B5 B4 B3 B2 B1

Option 3…B6 B5 B4 B7 B4 B9

- Cursored Search: Time ordered data retrieval
- Batch Search: Bucket ordered data retrieval

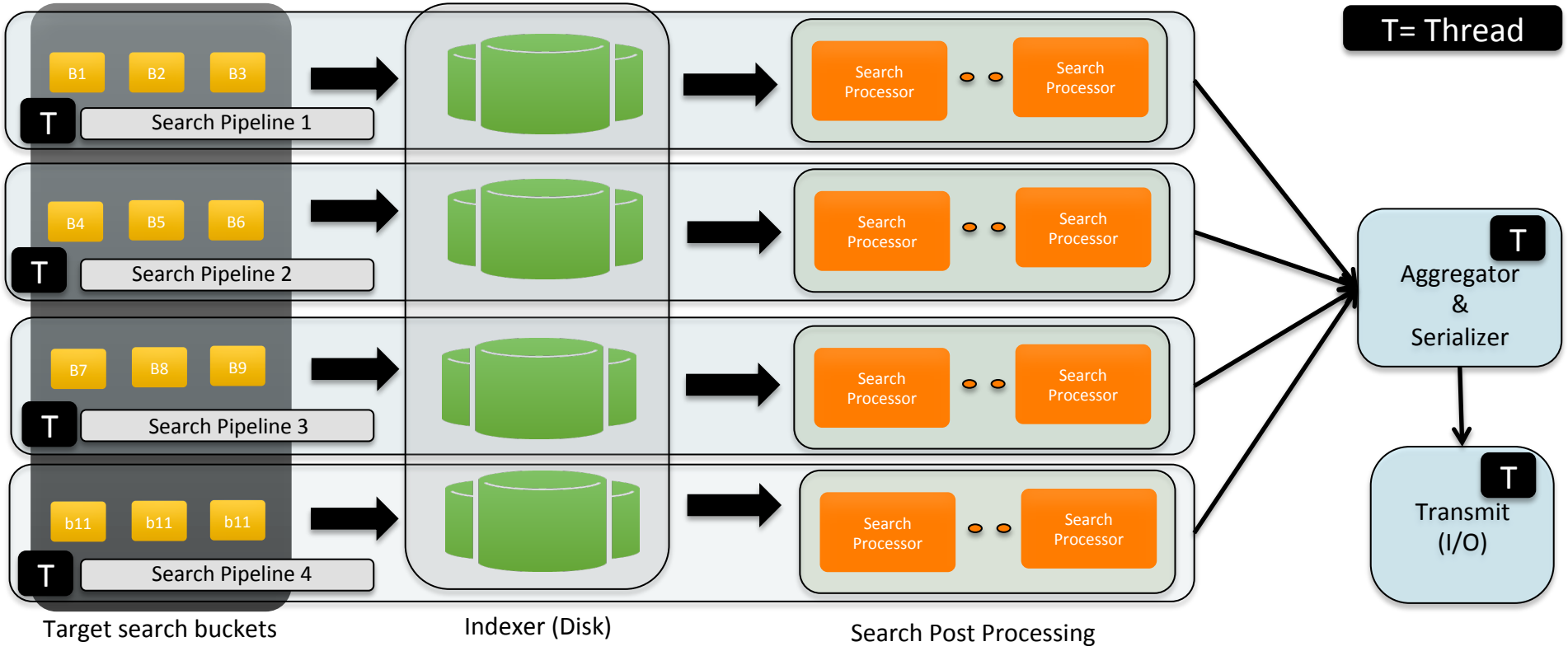
Iterates over buckets, creates a cursor and hence needs to time ordering is not tracked

Facilitates parallel processing of buckets independently across multiple pipeline



Search Pipeline at the Peer

Batch Search: Pipeline Parallelization



Batch Search: Pipeline Parallelization

- Under-utilized indexers provide us opportunity to execute multiple search pipelines
- Batch Search time-unordered data access mode is ideal for multiple search pipelines
- No state is shared i.e. no dependency exists across Search Pipelines.
- Peer/Indexer side optimizations
- Takeaway :
  - Under utilized indexers are candidates for search pipeline parallelization.
  - Do NOT enable if indexers are loaded

Configuring the Batch Search in Parallel mode

- How to enable?

  $SPLUNK_HOME/etc/system/local/limits.conf

```
[search]
batch_search_max_pipeline  = 2
```

- What to expect?

  Search performance in terms of retrieving search results improved.

  Increase in number of threads

Search Scheduler Improvements

- Scheduler improvements in Splunk Enterprise 6.3:
  - Priority Scoring
  - Schedule Windows
- Performance improvements over previous schedulers
  - Lower Lag
  - Fewer skipped searches

Search Scheduler Improvements
Priority Score

Problem in 6.2:

Simple single-term priority scoring could result in saved search lag, skipping, and starvation (under CPU constraint).

Solution in 6.3:

Better multi-term priority scoring mitigates problems and improves performance by 25%.

score(j) = next_runtime(j)
+ average_runtime(j) × priority_runtime_factor
– skipped_count(j) × period(j) × priority_skipped_factor
+ schedule_window_adjustment(j)

Search Scheduler Improvements

Problem in 6.2

Scheduler can not distinguish between searches that (A) *really should* run at a specific time (just like cron) from those that (B) don't have to. This can cause lag or skipping.

Solution in 6.3:

Give a *schedule window* to searches that don't have to run at specific times.

Example:

For a given search, it's OK if it starts running sometime between midnight and 6am, but you don't really care when specifically.

- A search with a window helps *other* searches.
- Search windows *should not* be used for searches that run every minute.
- Search windows *must* be less than a search's period

Configuring Search Scheduler

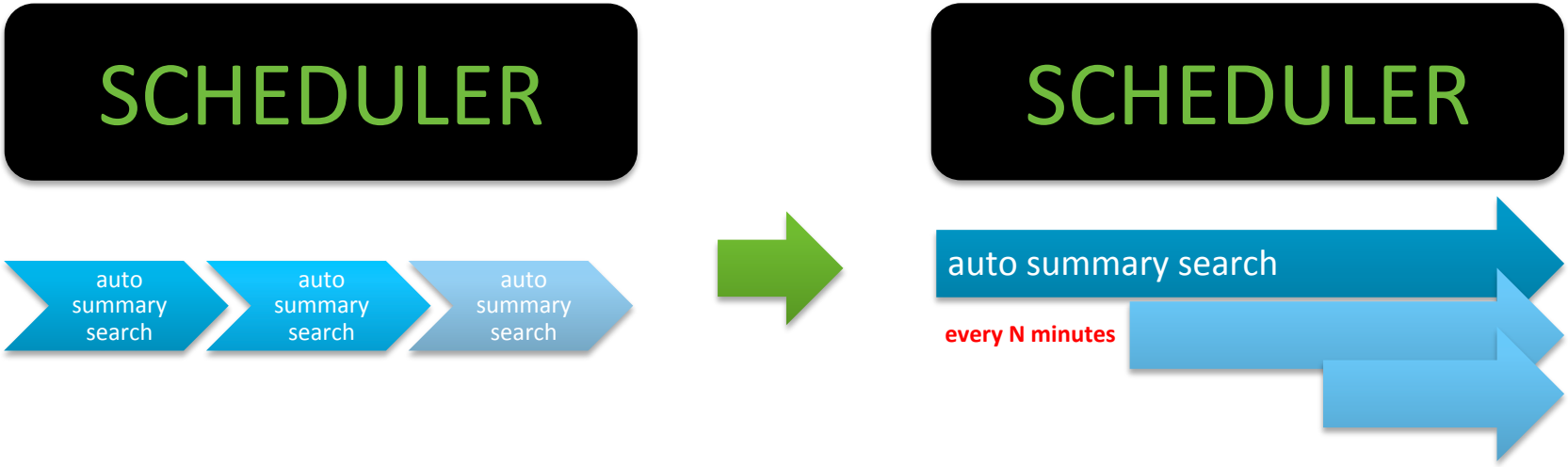
$SPLUNK_HOME/etc/system/local/limits.conf

```
[scheduler]
max_searches_perc = 50

# Allow value to be 75 anytime on weekends.
max_searches_perc.1 = 75
max_searches_perc.1.when = * * * * 0,6

# Allow value to be 90 between midnight and 5am.
max_searches_perc.2 = 90
max_searches_perc.2.when = * 0-5 * * *
```

Search: Parallel Summarization

- Sequential nature of building summary data for data model and saved reports is slow
- Summary Building process has been parallelized in 6.3

Summary Building Parallelization



Sequential Summary Building

Parallelized Summary Building

Configuring Summary Building for Parallelization

- $SPLUNK_HOME/etc/system/local/savedsearches.conf

```
[default]
auto_summarize.max_concurrent = 2
```

- $SPLUNK_HOME/etc/system/local/datamodels.conf

```
[default]
acceleration.max_concurrent = 2
```

6.3 Performance

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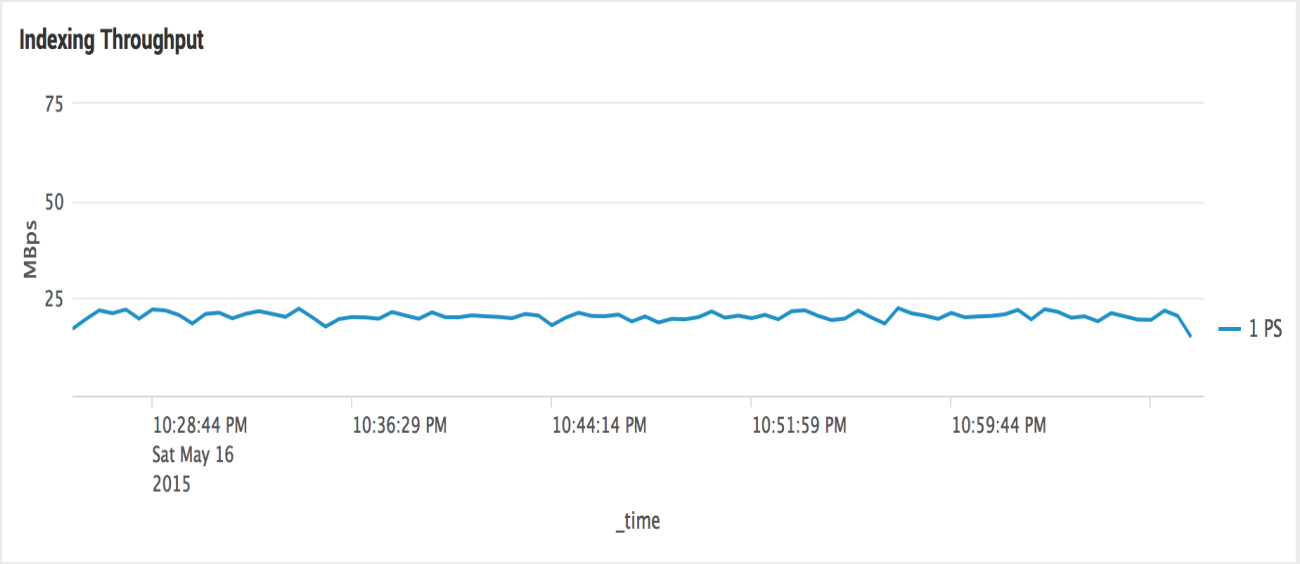
6.2 vs. 6.3 Performance Tests

- System Info
  - Dell PowerEdge R820
  - Intel(R) Xeon CPU E5-4620 @ 2.20 GHz
  - 32 cores w/o Hyper-Threading
  - 128 GB RAM
  - 8 x 146GB SAS 15k RPM disks in RAID-10
  - 1 Gb Ethernet NIC
  - CentOS 6
- No other load on the box

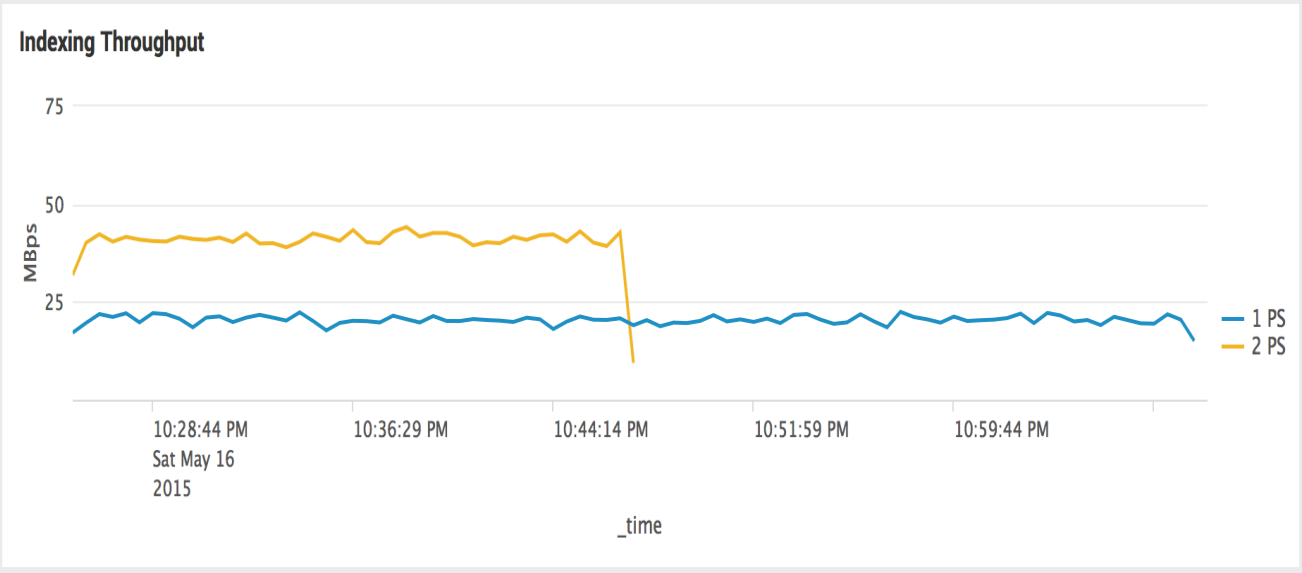
Indexing Tests



Pipelines	Average Throughput (MB/s)
1	20.02
2	
3	
4	

- Index a 50 GB generic syslog dataset. No search loads.
- Time to Index – 41.23 minutes
- Single Pipeline on 6.2 or 6.3 will have similar performance

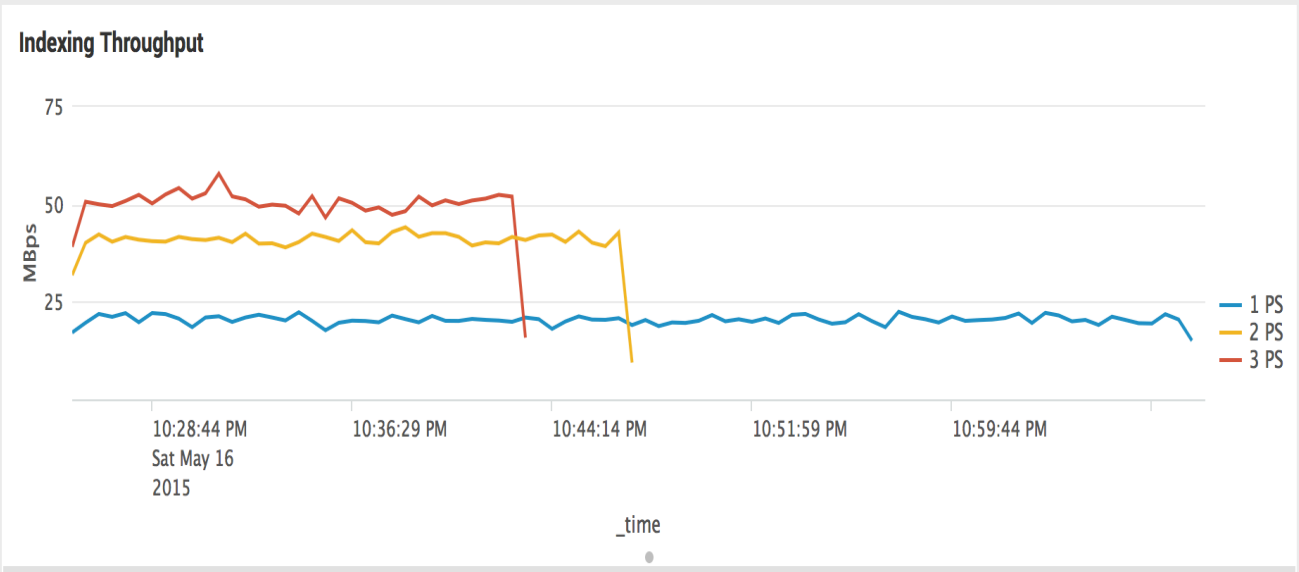
Indexing Tests



Pipelines	Average Throughput (MB/s)
1	20.02
2	40.04
3	
4	

- Time to Index 50 GB – 20.81 minutes
- 98.2 % Increase in Average Indexing Throughput
- On an average Splunk utilized 2x CPU cores , 1.3x Memory and 2x Disk IOPS

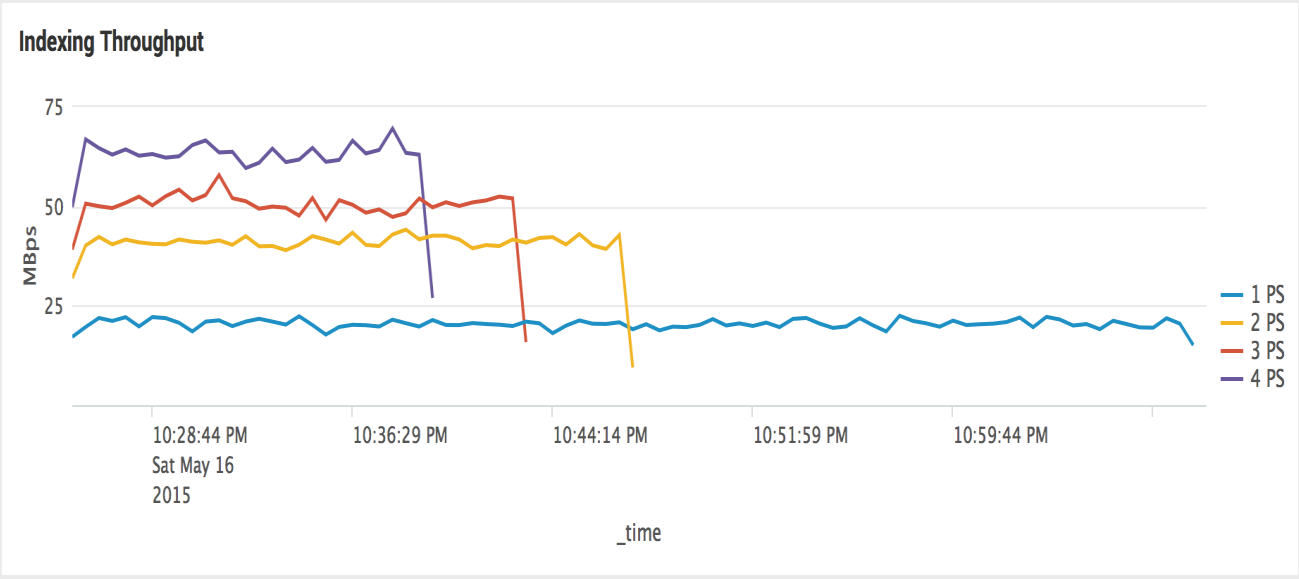
Indexing Tests



Pipelines	Average Throughput (MB/s)
1	20.02
2	40.04
3	50.91
4	

- Time to Index 50 GB – 16.63 minutes
- 152 % Increase in Average Indexing Throughput
- On an average Splunk utilized 3x CPU cores, 1.6x Memory and 2.5x Disk IOPS

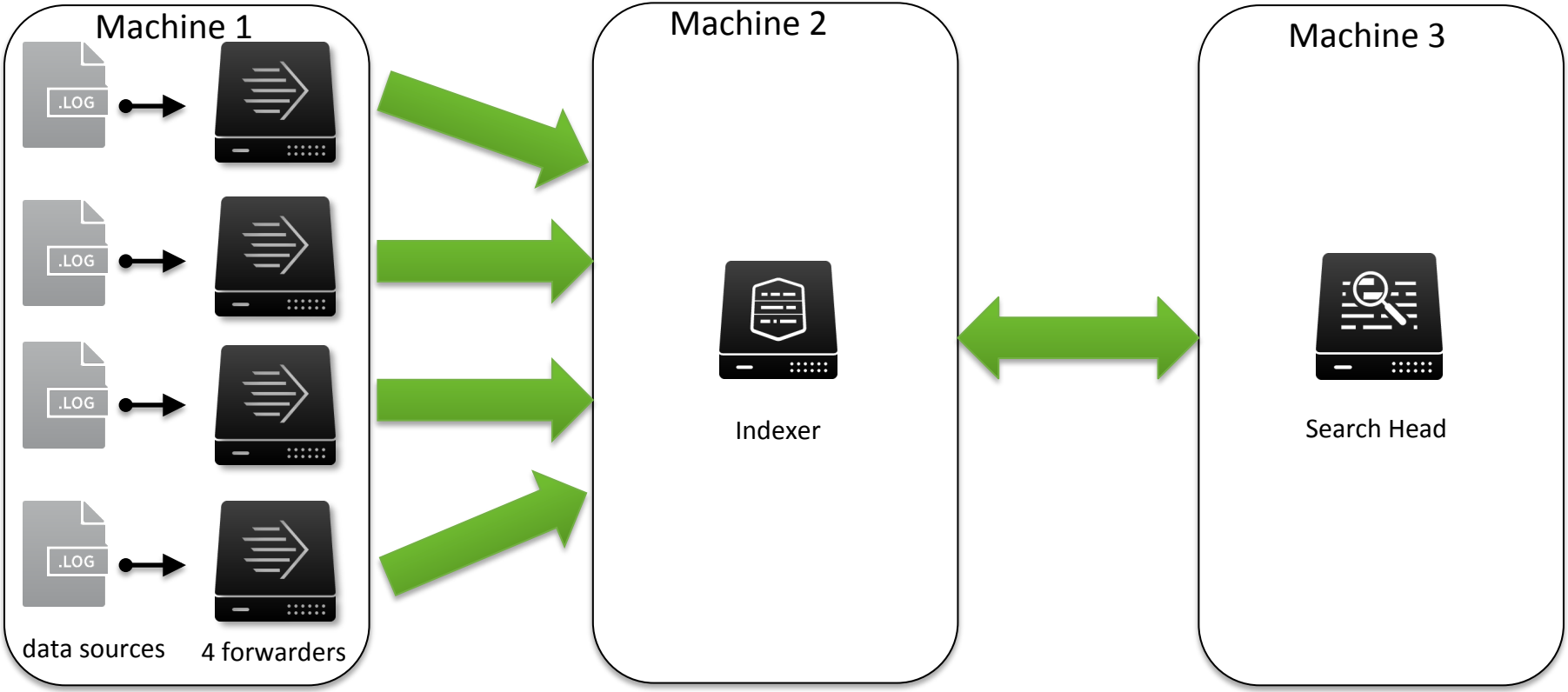
Indexing Tests



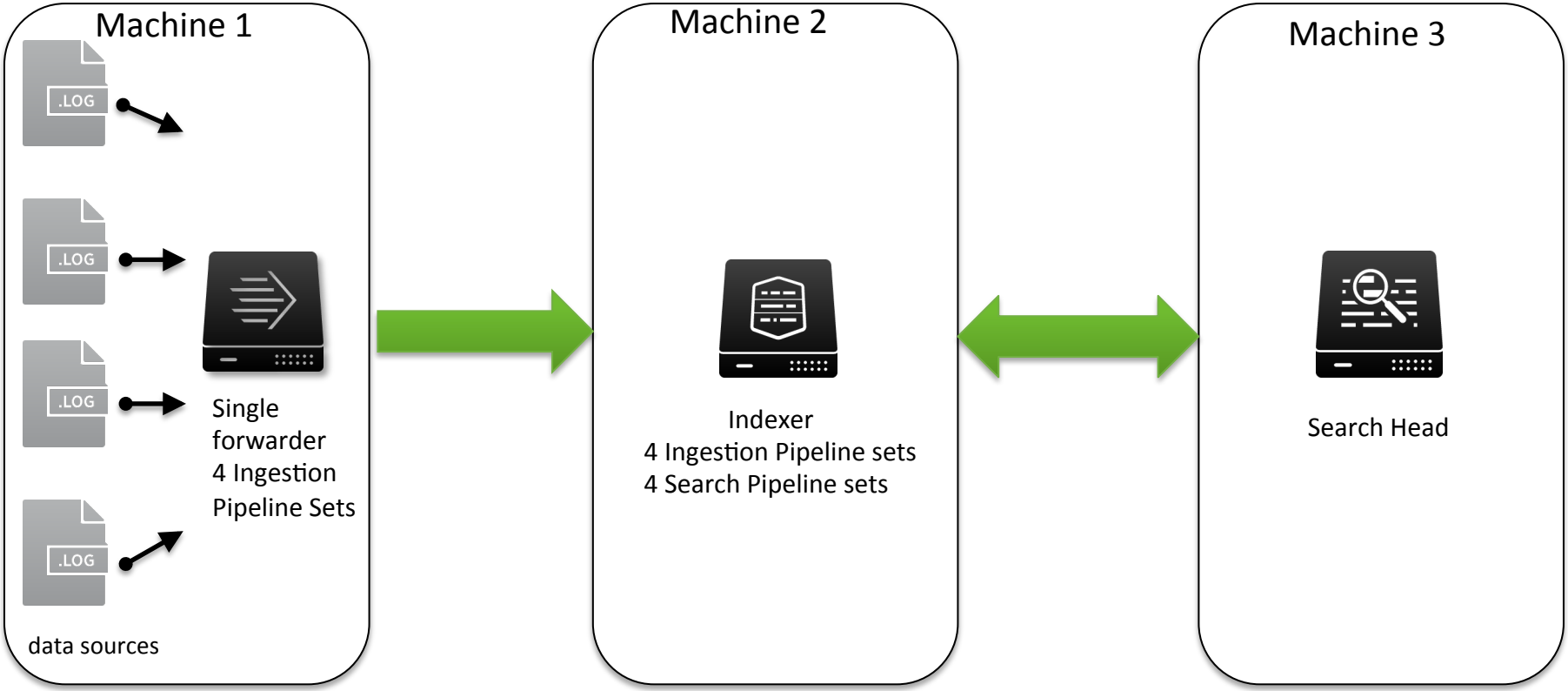
Pipelines	Average Throughput (MB/s)
1	20.02
2	40.04
3	50.91
4	62.07

- Time to Index 50 GB – 13.42 minutes
- 207% Increase in Average Indexing Throughput
- On an average Splunk utilized 4x CPU cores, 2.25x Memory and 3x Disk IOPS

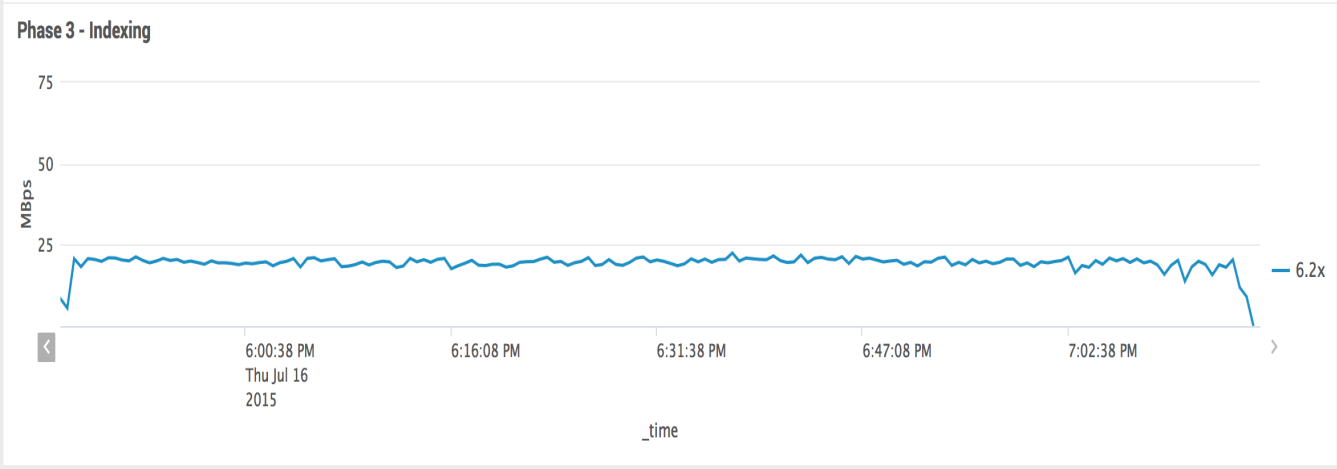
6.2 Setup


Machine 1
.LOG
.LOG
.LOG
.LOG
data sources
4 forwarders
Machine 2
Indexer
Machine 3
Search Head

6.3 Setup


Machine 1
.LOG
.LOG
.LOG
.LOG
Single forwarder
4 Ingestion Pipeline Sets
data sources
Machine 2
Indexer
4 Ingestion Pipeline sets
4 Search Pipeline sets
Machine 3
Search Head

Burst in Indexing Load + Searches

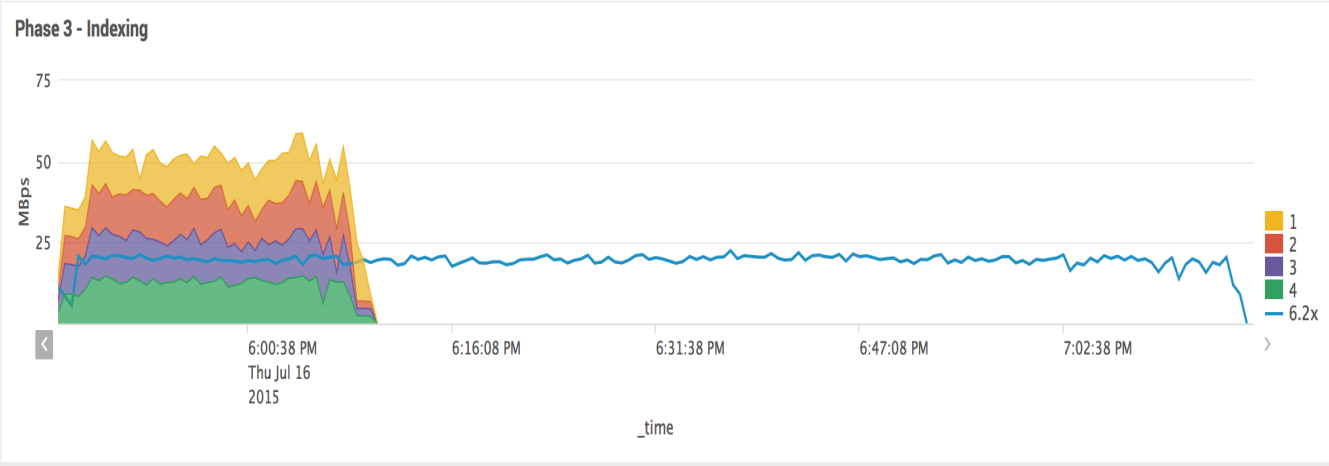


Version	Average Throughput (MB/s)
6.2	20.0
6.3	

Splunk 6.2

- Data forwarded @ 9 MB/s + Monitor 50GB dataset
- 89.8 Minutes to Index this 50 GB dataset
- Number of Ingestion Pipelines - 1
- Number of Concurrent Searches – 4

Burst in Indexing Load + Searches



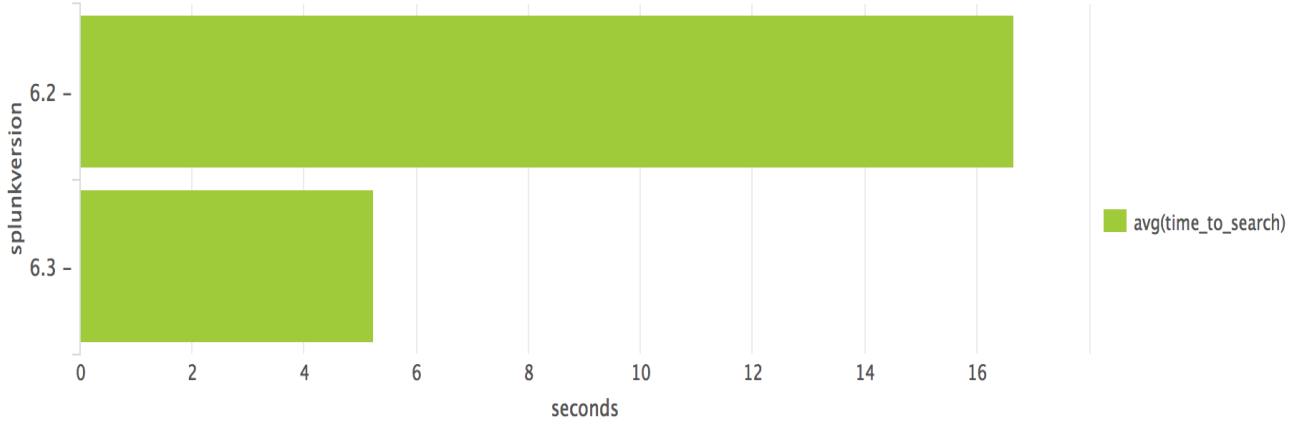
Version	Average Throughput (MB/s)
6.2	20.0
6.3	48.5

Splunk 6.3

- Data forwarded @ 9 MB/s + Monitor 50GB dataset
- 23.4 Minutes to Index this 50 GB dataset
- 142% Increase in Average Indexing Throughout
- Number of Ingestion Pipelines - 4
- Number of Concurrent Searches – 4

Batch Mode Sparse Search

index=test_static every1k | stats count

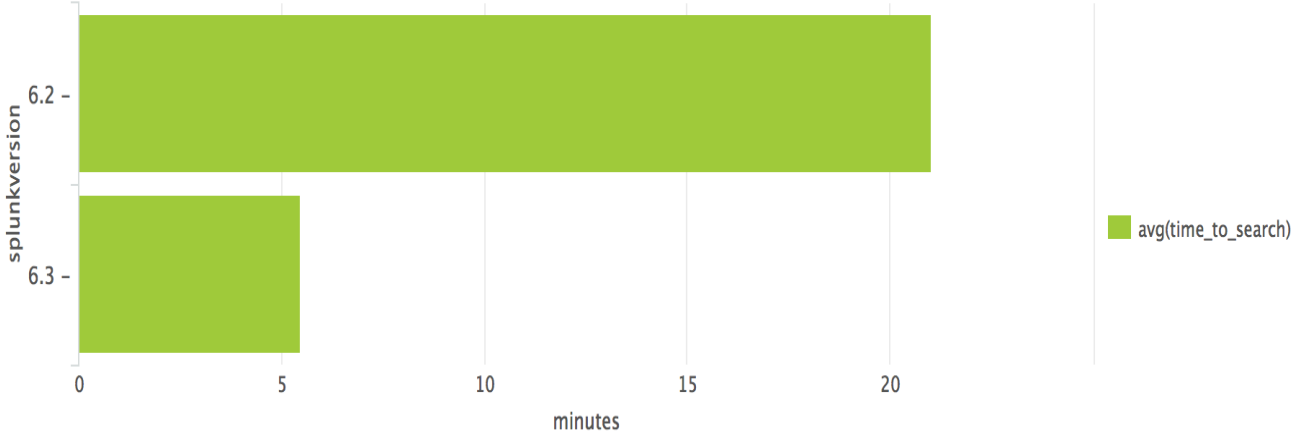


Version	Average Search Time (seconds)
6.2	16.67 s
6.3	5.24 s

- Sparse Search – Characterized predominately by returning some events per bucket
- Splunk 6.2 – 1 Search Pipelines
- Splunk 6.3 – 4 Search Pipelines
- Search is 3.18x faster in 6.3

Batch Mode Dense Search

index=test_static every1 | stats count



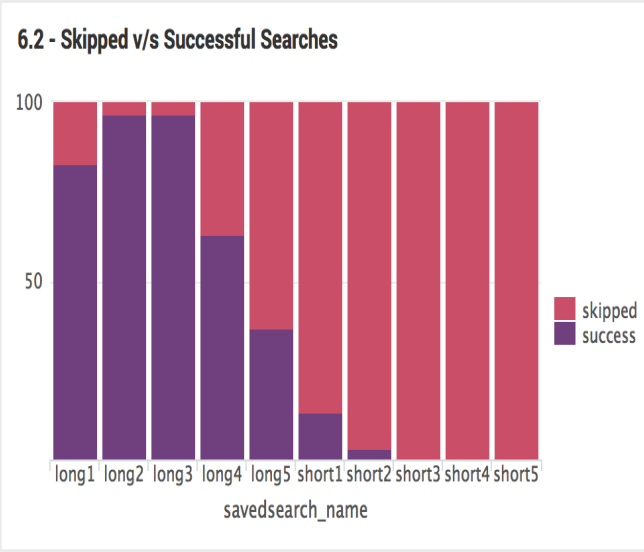
Version	Average Search Time (minutes)
6.2	21.0 m
6.3	5.46 m

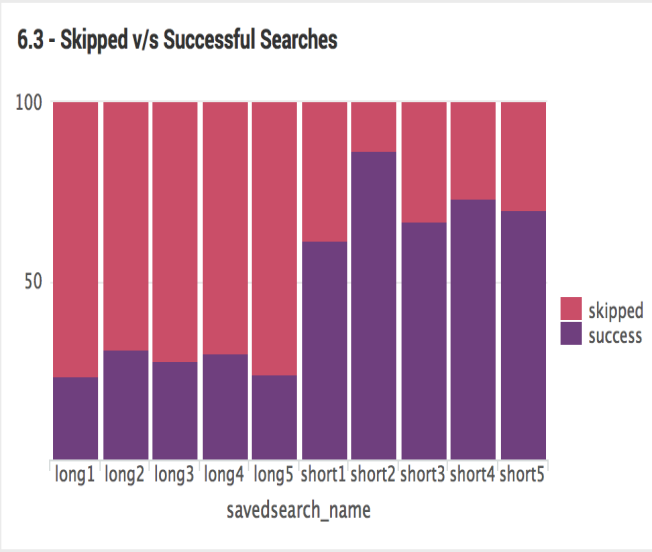
- Dense Search – Characterized predominately by returning many events per bucket
- Splunk 6.2 – 1 Search Pipelines
- Splunk 6.3 – 4 Search Pipelines
- Search is 3.85x faster in 6.3

Scheduled Searches Setup

- 10 Searches are scheduled to run every minute
- 5 Longer running searches (~40s)
- 5 Shorter running searches (~15s)
- Test configured to run only 3 scheduled concurrently

Scheduled Searches

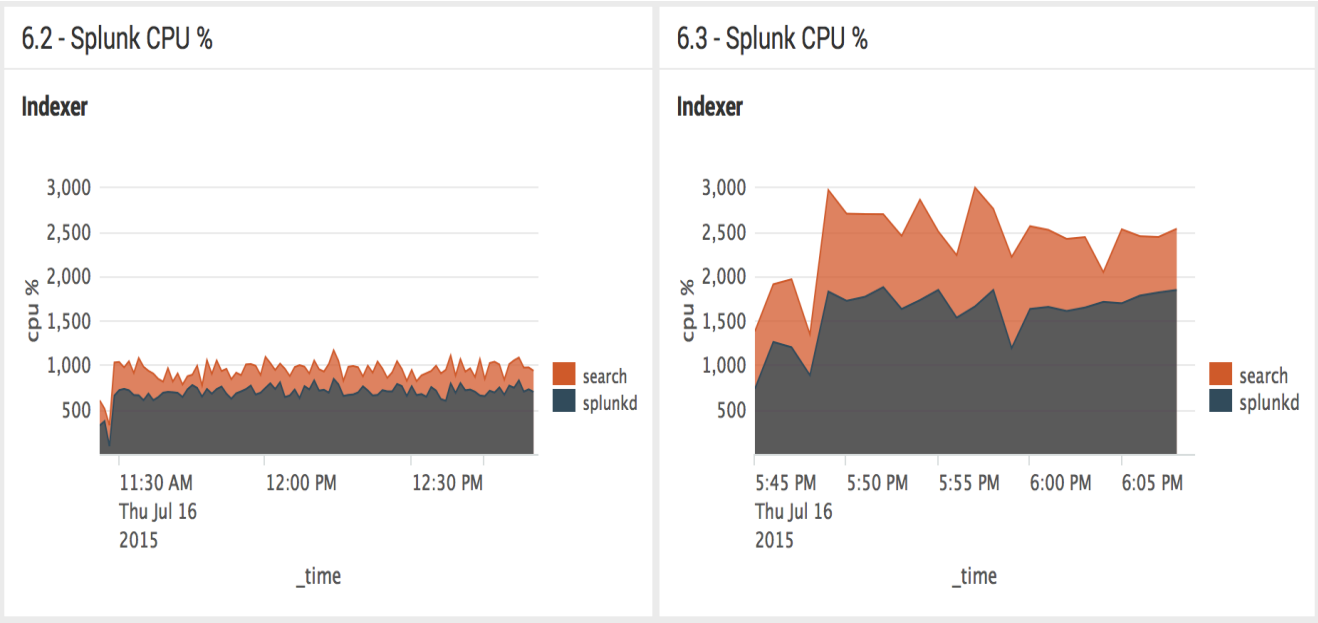




Version	Searches completed
6.2	118
6.3	148

- Skipped vs. Successful Searches – 30 minute window
- 25% Increase in Successful Searches
- This optimization will not utilize additional System Resource

CPU Utilization



Average CPU %

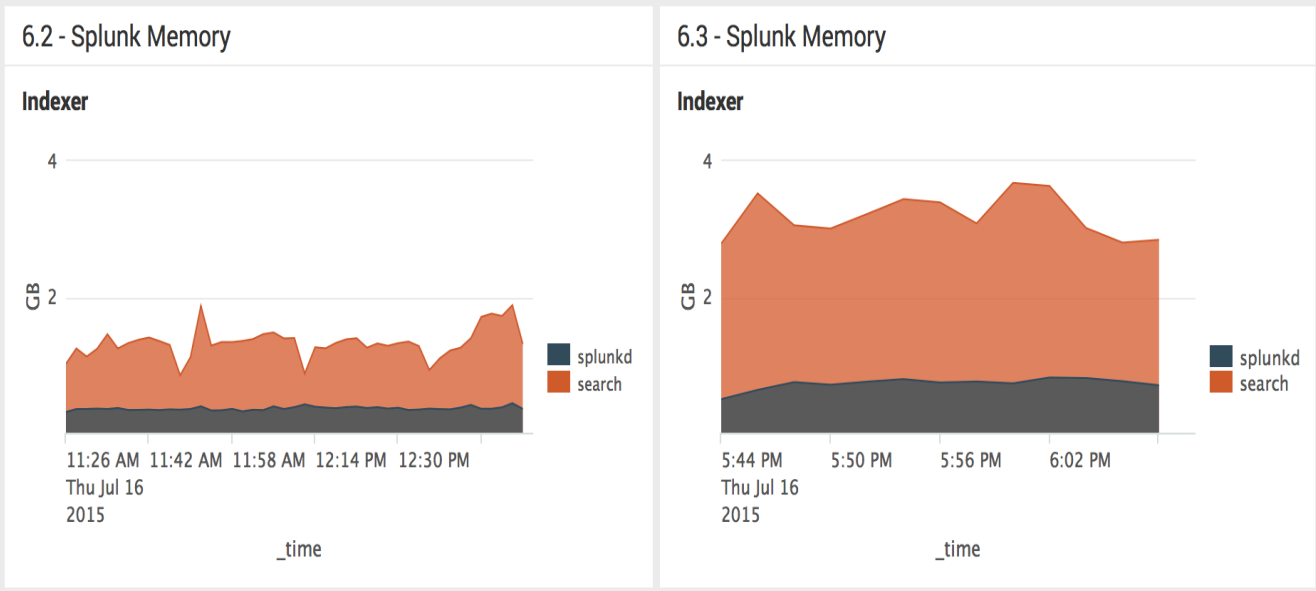
6.2	6.3
882 %	2237 %

Burst in Indexing Load + Searches

Splunk 6.2 – 1 Ingestion Pipeline ; 1 Search Pipeline

Splunk 6.3 – 4 Ingestion Pipelines ; 4 Search Pipelines

Memory Utilization



Average Memory

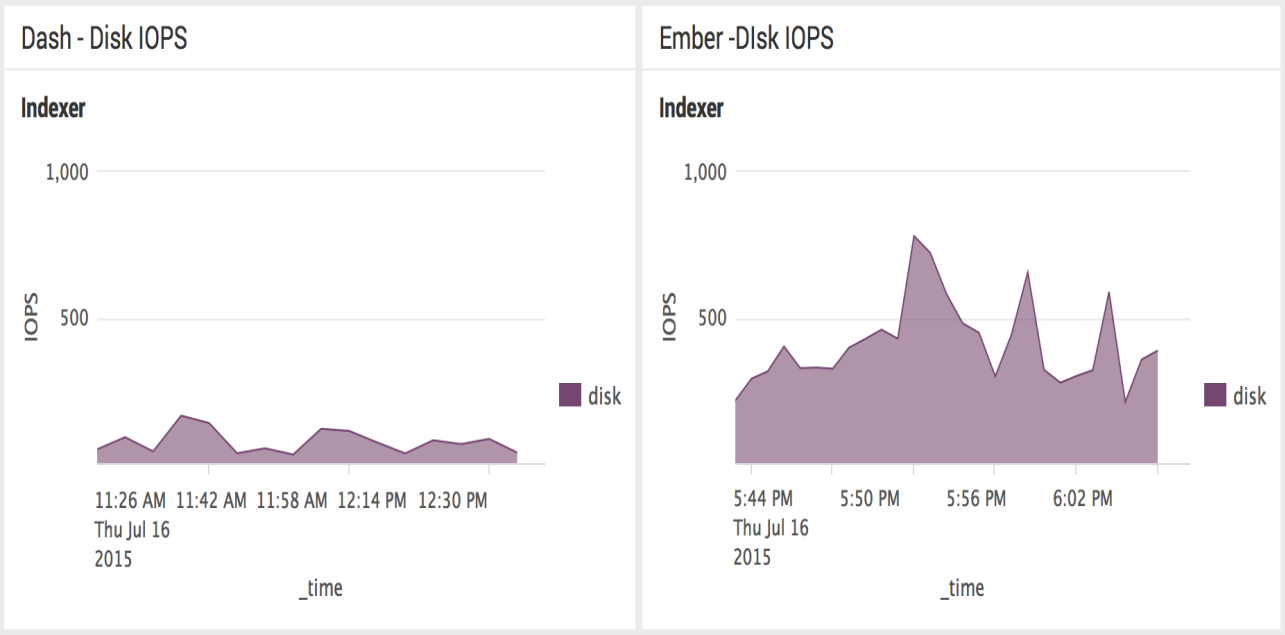
6.2	6.3
1.18 GB	2.69 GB

Burst in Indexing Load + Searches

Splunk 6.2 – 1 Ingestion Pipeline ; 1 Search Pipeline

Splunk 6.3 – 4 Ingestion Pipelines ; 4 Search Pipelines

Disk Utilization



Average Disk IOPS

6.2	6.3
157	483

Burst in Indexing Load + Searches

Splunk 6.2 – 1 Ingestion Pipeline ; 1 Search Pipeline

Splunk 6.3 – 4 Ingestion Pipelines ; 4 Search Pipelines

Final Thoughts

- What is my current workload?
  - Data volume – Daily and Peak
  - Search Volume – Concurrent and total
  - System Resource Usage
- How do I approach these features?
  - System significantly under-utilized ?
  - Search Pipelines
    - Lot of Batch mode Searches ?
  - Parallel Ingestion Pipelines
    - Handling Bursts in Data?
    - Reading large number of files in parallel?
- Splunk scales horizontally

THANK YOU

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