Splunk Performance

Observations and Recommendations

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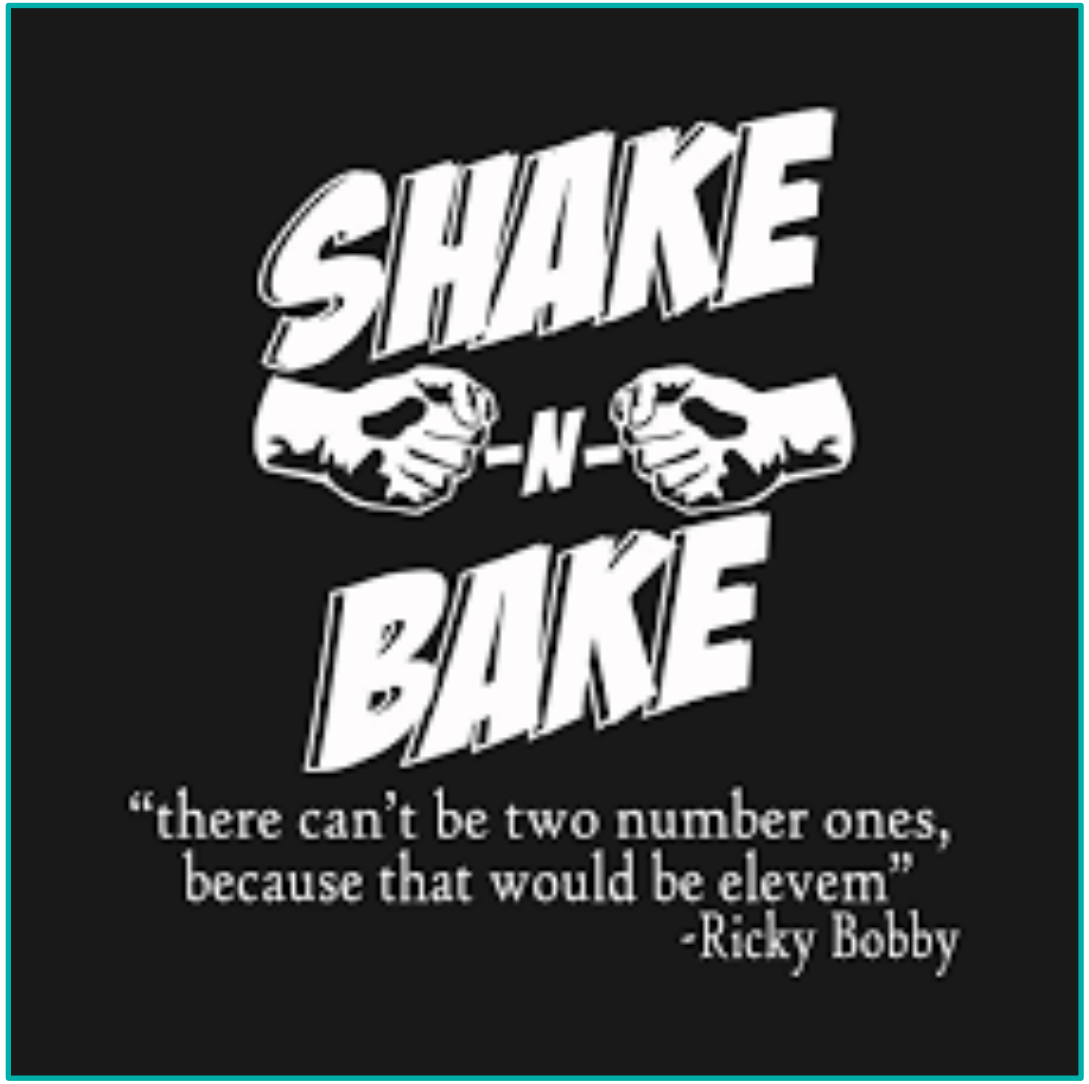
Agenda

- Performance Overview
  - Race Car Analogy
  - Observation Sources
- Indexing
  - Overview
  - Tests
  - Interpretations
- Searching
  - Search Type Review
  - With and Without Indexing Load
  - Analysis

Splunk is a racecar

- New vs Used
- Courses vary
  - So do search and alerting use cases
  - Straight line fast isn't always the goal
- We can tune the car for the course (data set)
- We can tune the car for the driver (searcher)



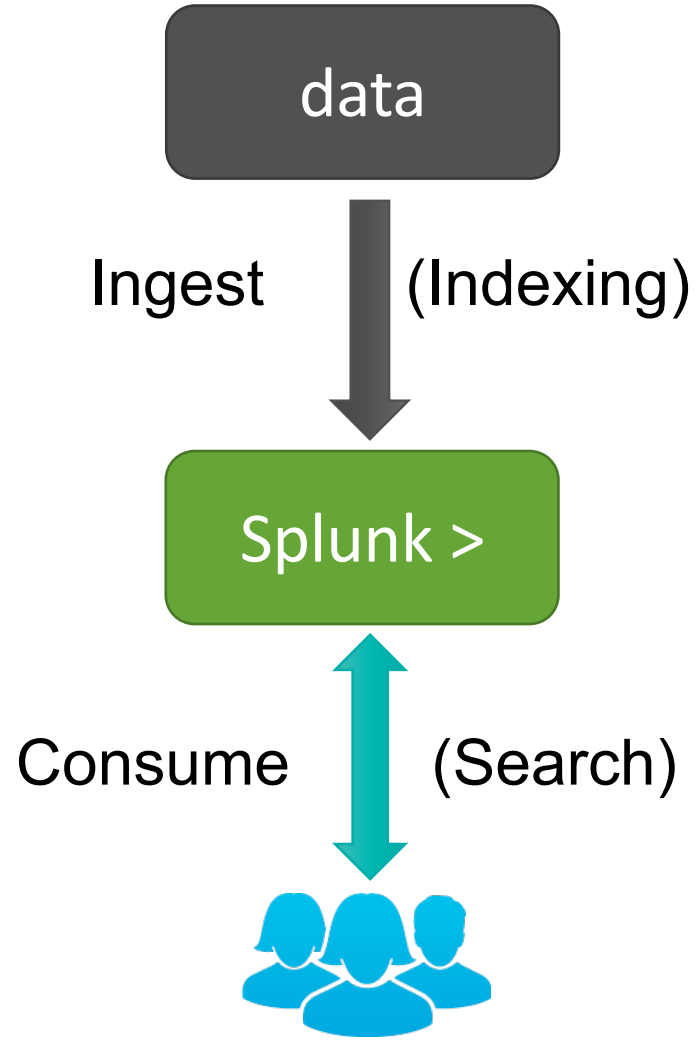
Observation Sources

Pros & Cons for Test Tracks vs Road Courses

- Lab Testing Caveats
  - Pros
    - Dedicated & Isolated Equipment
    - Arbitrary Data Sets
    - Known configurations
    - Repeatability
  - Cons
    - Arbitrary Data Sets
- Real World
  - Pros
    - Improved data mix
    - IRL
  - Cons
    - Prescribed configurations may stray
    - Reduced automation may introduce gremlins

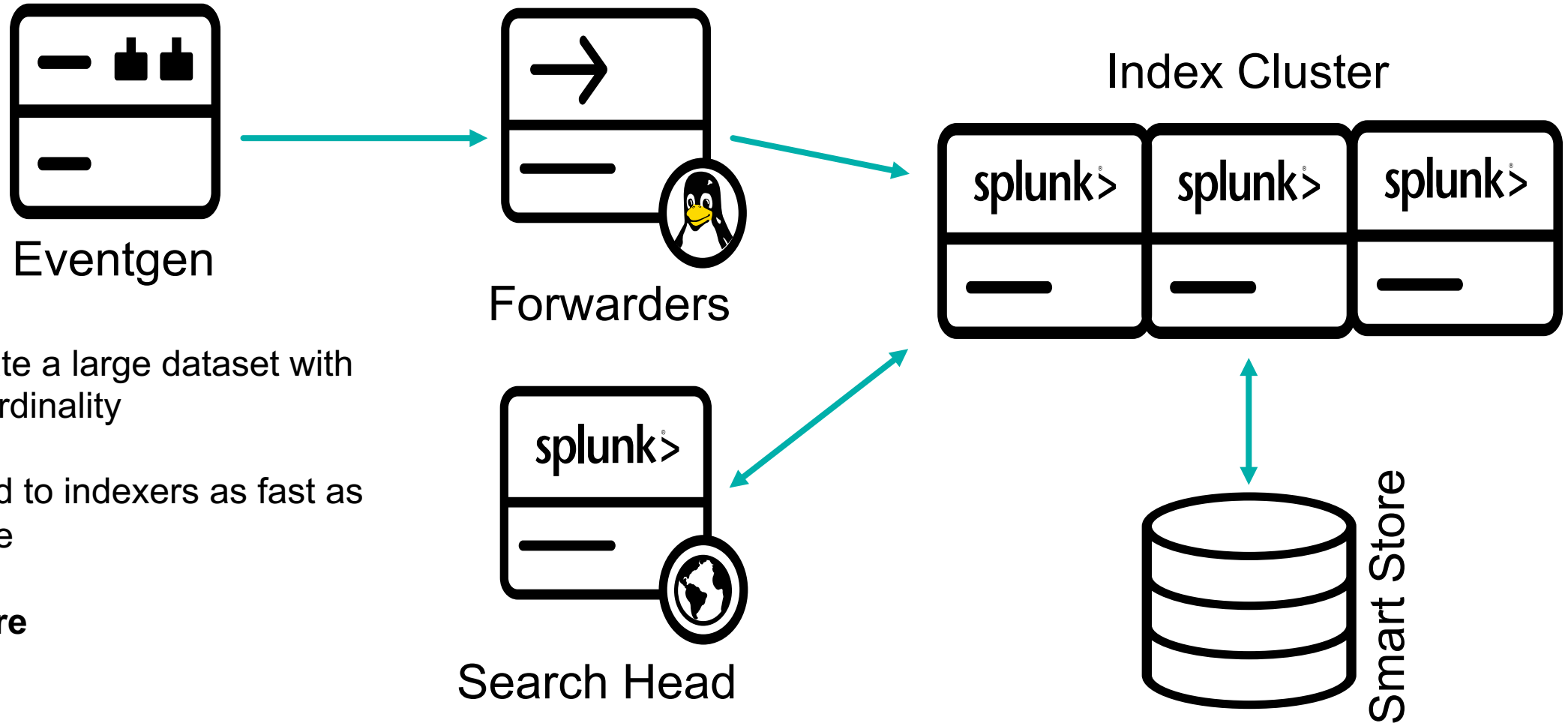
General Testing Methodology

- Understand data flows
  - Splunk operations pipelines
- Instrument
  - Capture metrics for relevant operations
- Run tests
- Draw conclusions
  - Chart and table metrics, looks for emerging patterns
- Make recommendations



Lab Setup

Using Eventgen in Stand Alone mode

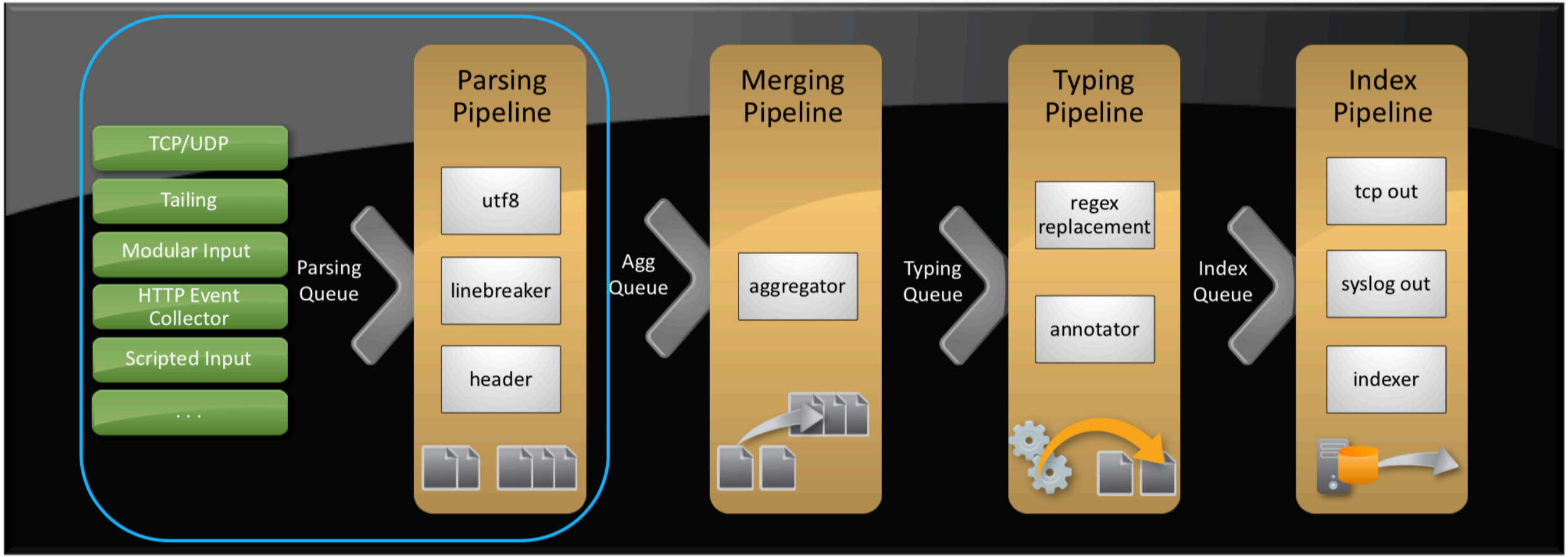


1. Generate a large dataset with high cardinality
2. Forward to indexers as fast as possible
3. **Measure**

Indexing

Pipelines, queues, and tests

Pipelining



LINE_BREAKER
TRUNCATE

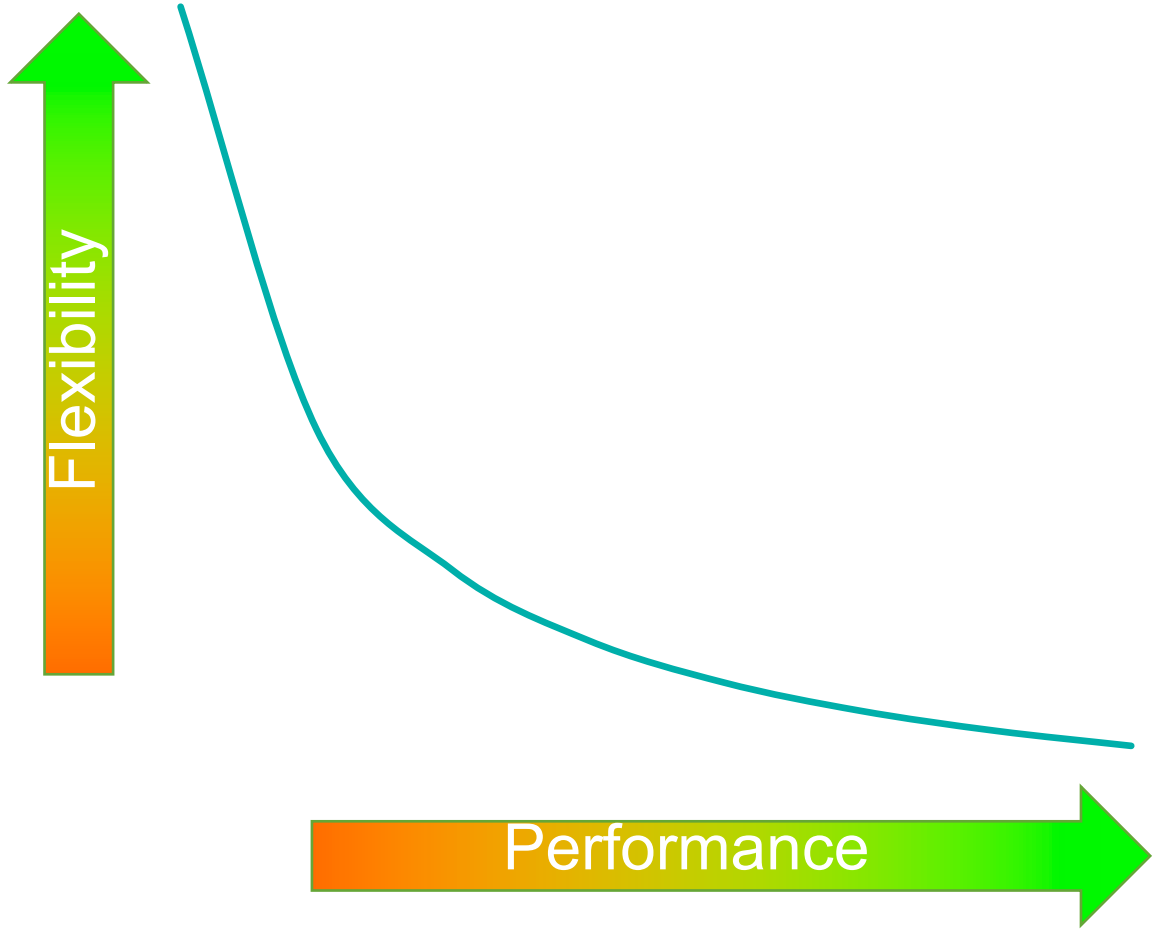
SHOULD_LINEMERGE
BREAK_ONLY_BEFORE
MUST_BREAK_AFTER
TIME_*

TRANSFORMS-xxx
SEDCMD
ANNOTATE_PUNCT

Index-time processing

Event Breaking	LINE_BREAKER <where to break the stream> SHOULD_LINEMERGE <enable/disable merging>
Timestamp Extraction	MAX_TIMESTAMP_LOOKAHEAD <# chars in to look for ts> TIME_PREFIX <pattern before ts> TIME_FORMAT <strptime format string to extract ts>
Typing	ANNOTATE_PUNCT <enable/disable punct:: extraction>

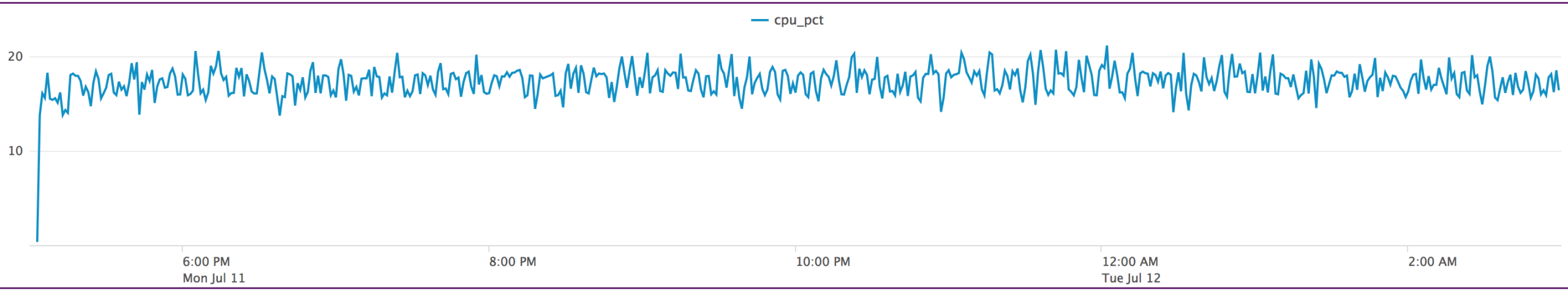
“We are our choices”
-Jean-Paul Sartre

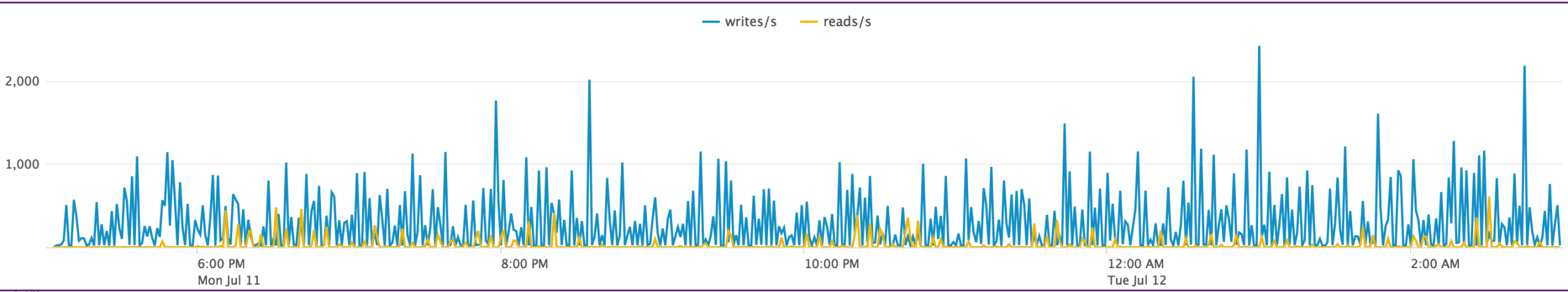


- All pre-indexing pipelines are expensive at default settings.
  - Price of flexibility
- If you’re looking for performance, minimize generality

  - LINE_BREAKER
  - SHOULD_LINEMERGE
  - MAX_TIMESTAMP_LOOKAHEAD
  - TIME_PREFIX
  - TIME_FORMAT

Indexing: CPU and IO





Indexing Test Findings

- CPU Utilization
  - ~17.6% in this case, 4-5 Real CPU Cores
- IO Utilization
  - Characterized by both reads and writes but not as demanding as search. Note the splunk-optimize process.
- Ingestion Rate
  - 30MB/s
  - “Speed of Light” – no search load present on the server

Index Pipeline Parallelization

- Splunk 6.3+ introduced multiple independent pipelines sets
  - i.e. same as if each set was running on its own indexer
- If machine is under-utilized (CPU and I/O), you can configure the indexer to run 2 such sets.
- Achieve roughly double the indexing throughput capacity.
- Try not to set over 2
- Be mindful of associated resource consumption

Indexing Test Conclusions

- Distribute as much as you can
  - Splunk scales horizontally
  - Enable more pipelines but be aware of compute tradeoff
- Tune event breaking and timestamping attributes in props.conf whenever possible
- Faster disk (ex. SSDs) will not generally improve indexing throughput by meaningful amount
- Faster (not more) CPUs would have improved indexing throughput
  - multiple pipelines would need more CPUs
- Smart Store behaves relatively the same for INDEXING
  - We'll see graphs and charts to back this up later, Yay!!

Search

Types & Tests

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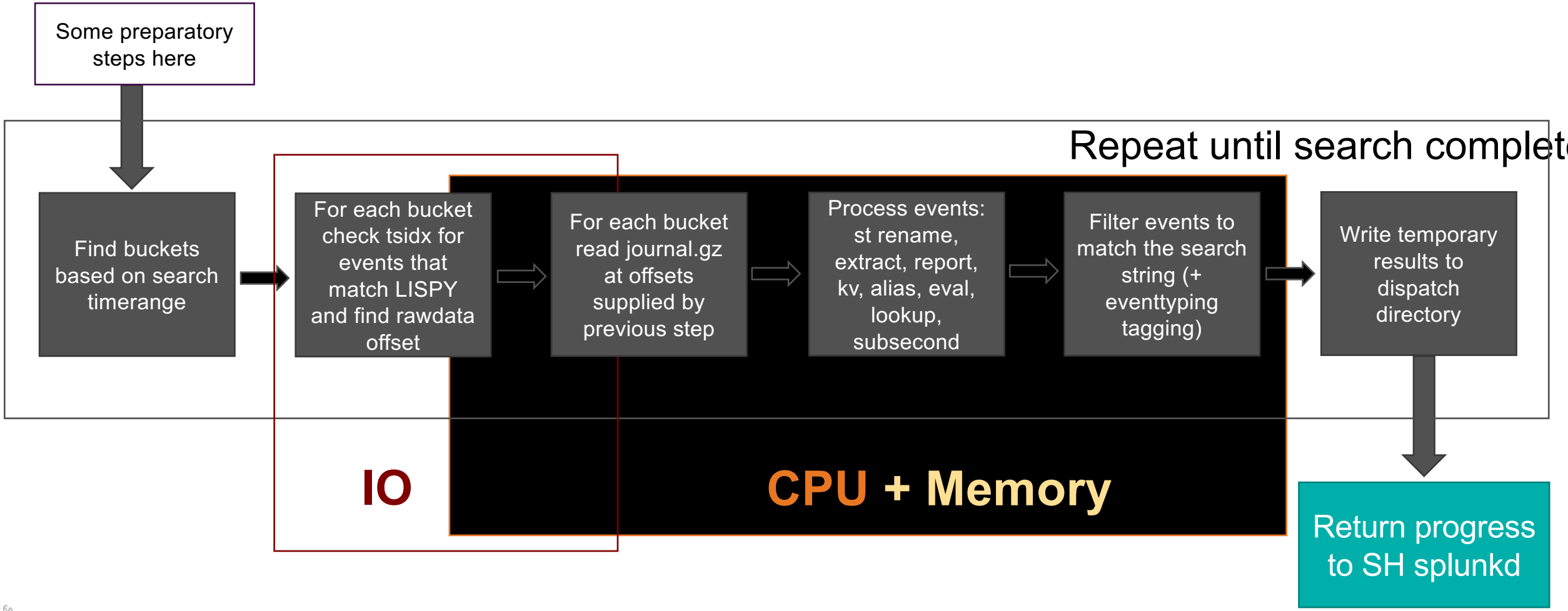
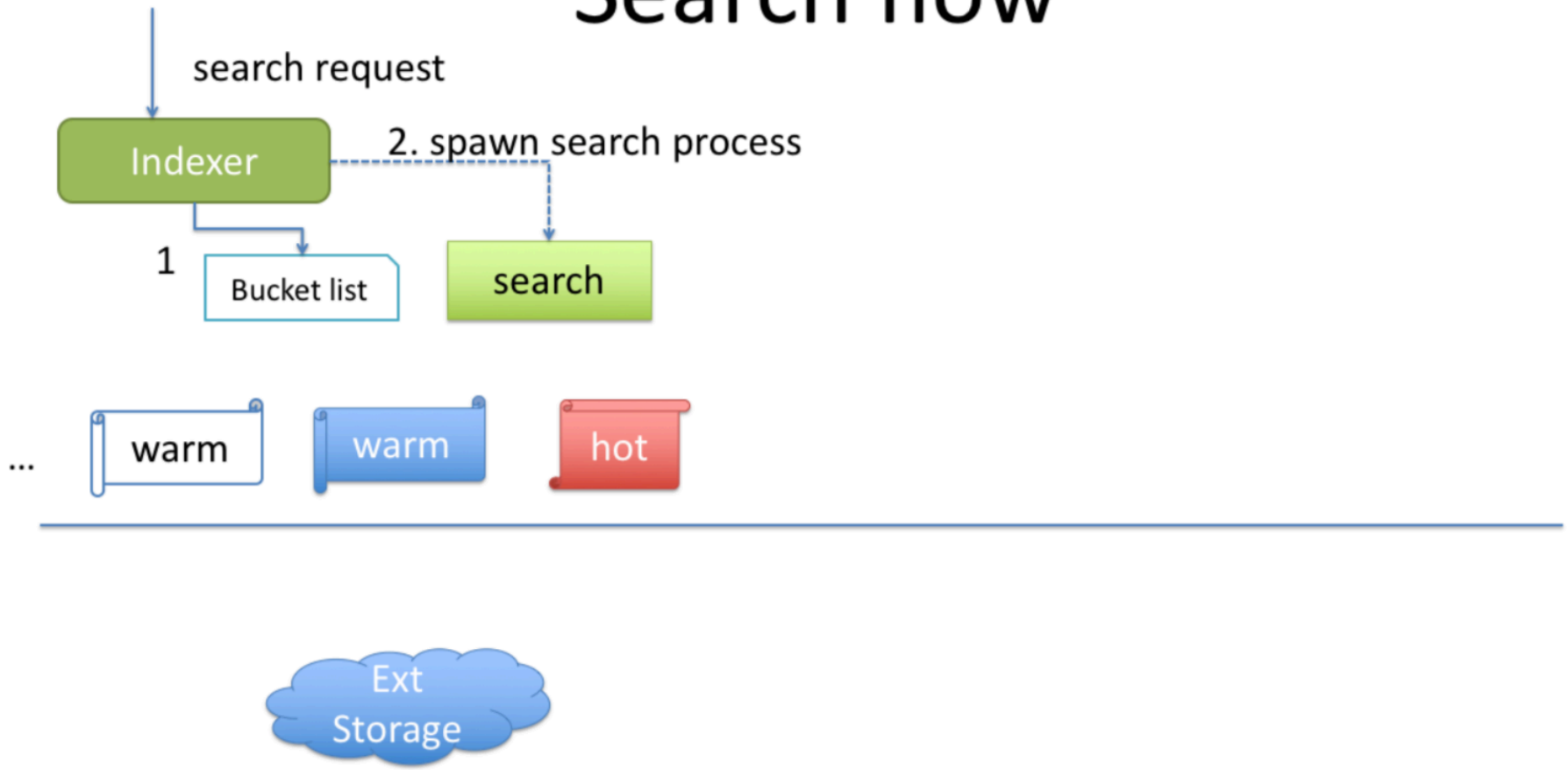
Search Types

- Dense
  - Characterized predominantly by returning many events per bucket
  - index=web | stats count by clientip
- Sparse
  - Characterized predominantly by returning some events per bucket
  - index=web some_term | stats count by clientip
- Rare
  - Characterized predominantly by returning only a few events per index
  - index=web url=onedomain* | stats count by clientip

Search pipeline boundedness



S2
Search flow



Searching

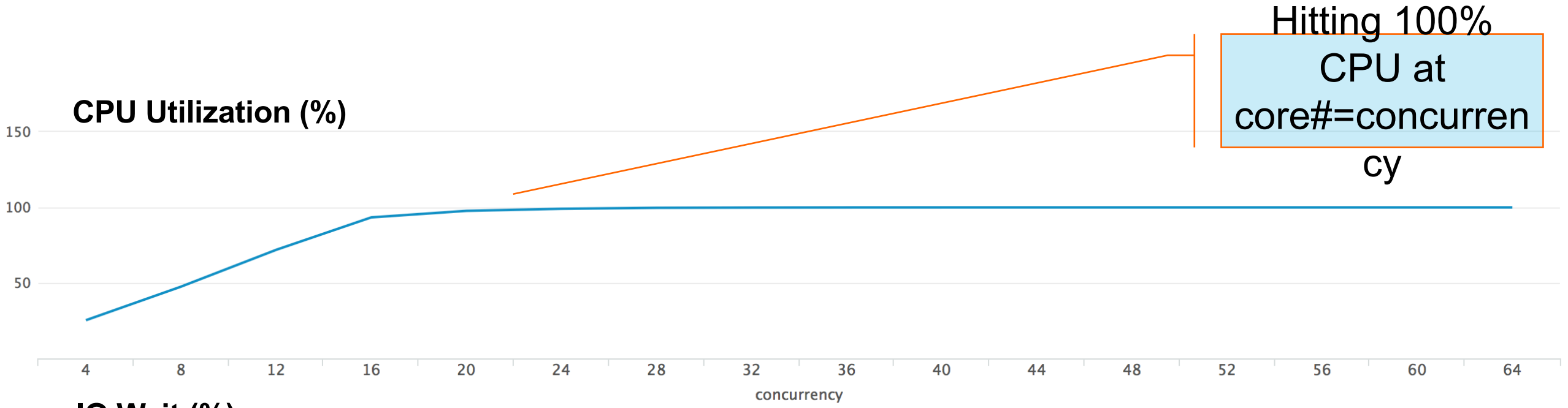
CPU or IO?

- Real-life search workloads are complex and varied
  - Difficult to encapsulate every organization's needs into one neat profile
- We can still generate arbitrary workloads covering a wide range of resource utilization and profile them
  - Actual profile will fall somewhere in between.

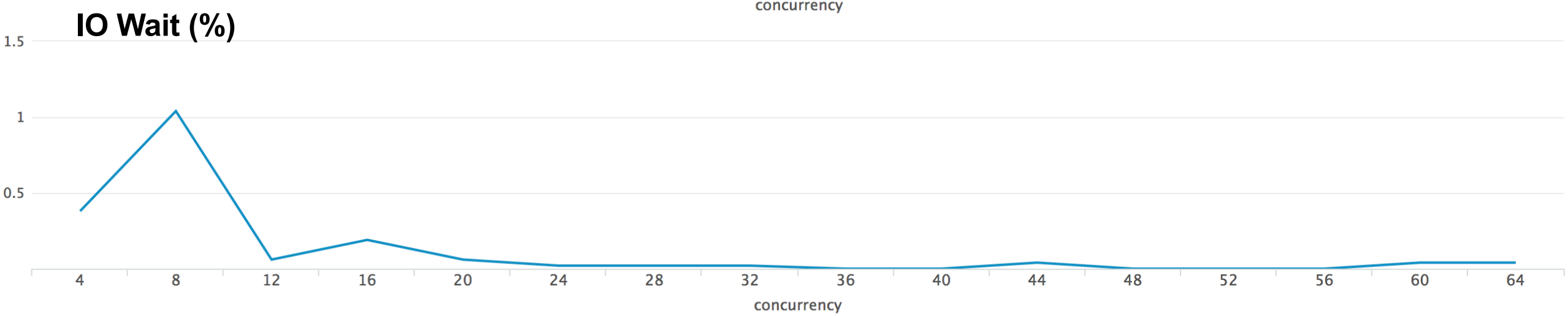
Okay, let's test some searches

- Use our already indexed data
  - It contains many unique terms with predictable term density
- Search under several term densities and concurrencies
  - Term density: 1/100, 1/1M, 1/100M
  - Search Concurrency: 4 – 60
  - Searches:
    - Rare: over all 1TB dataset
    - Dense: over a preselected time range
- Repeat all of the above while under an indexing workload
- Measure

Dense Searches



Hitting 100% CPU at core#=concurrency



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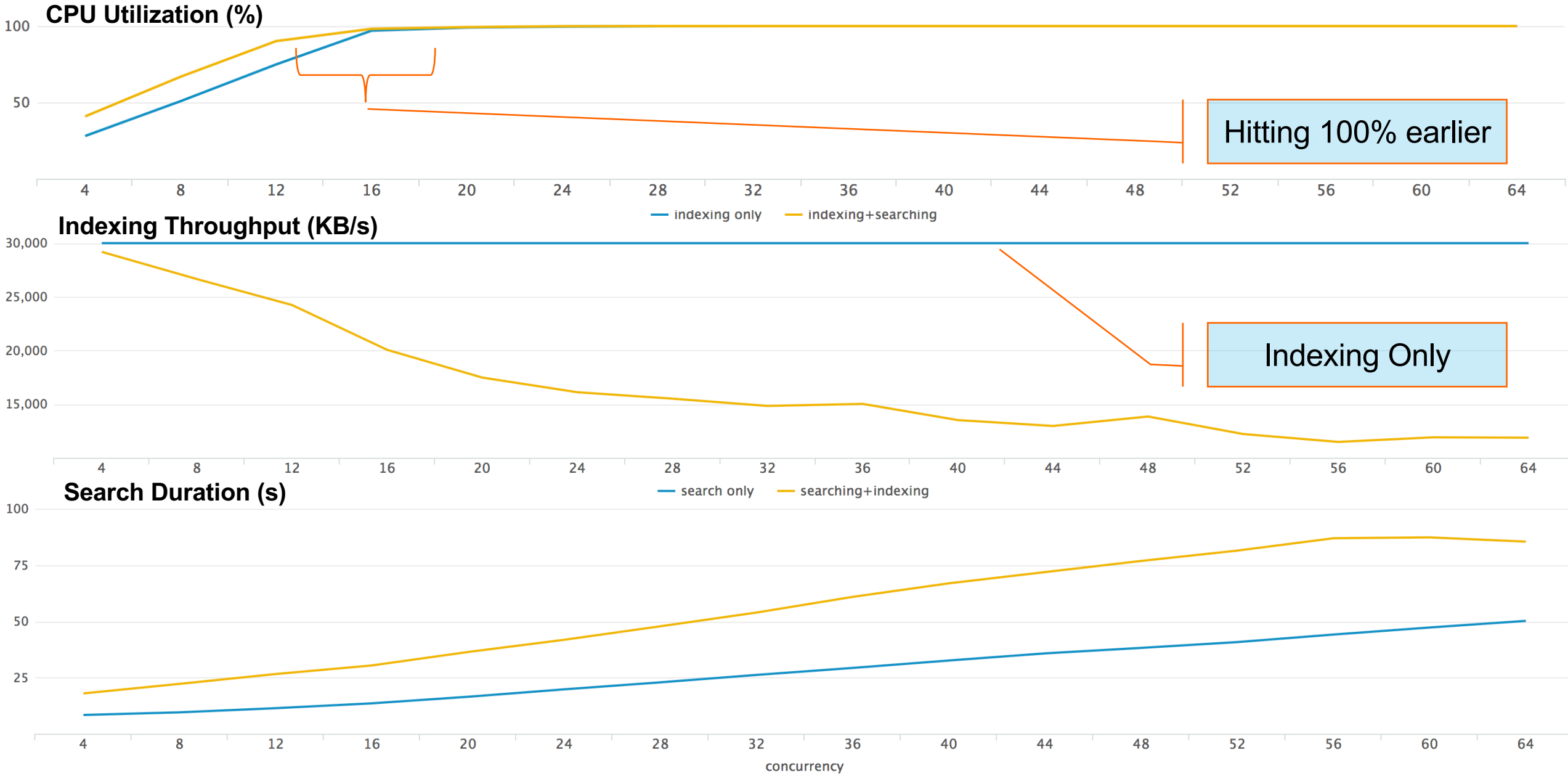
Indexing with Dense Searches



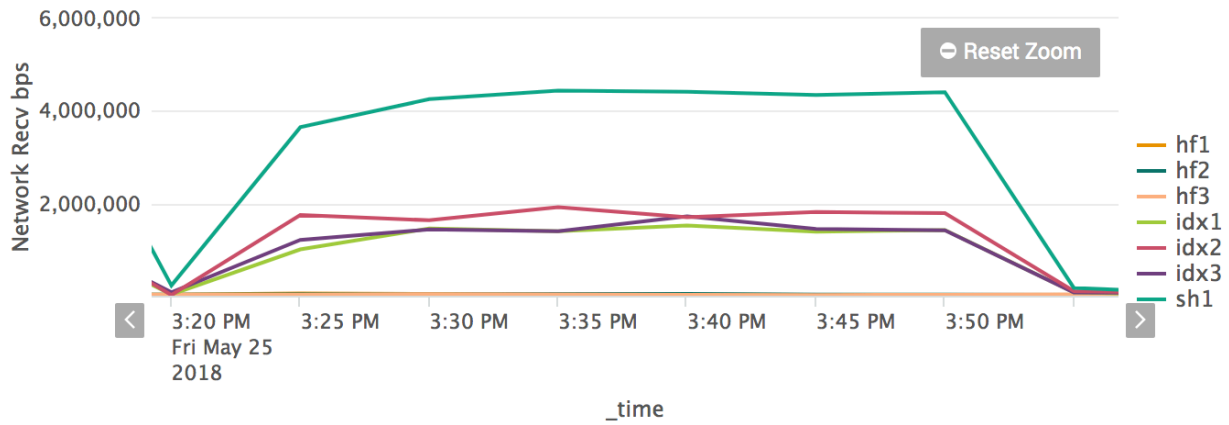
Dense Searches Summary

- Dense workloads are CPU bound
- Dense workload completion times and indexing throughput both negatively affected while running simultaneously
- Faster disk wont necessarily help as much here
  - Majority of time in dense searches is spent in CPU decompressing rawdata + other SPL processing
- Faster and more CPUs would have improved overall performance

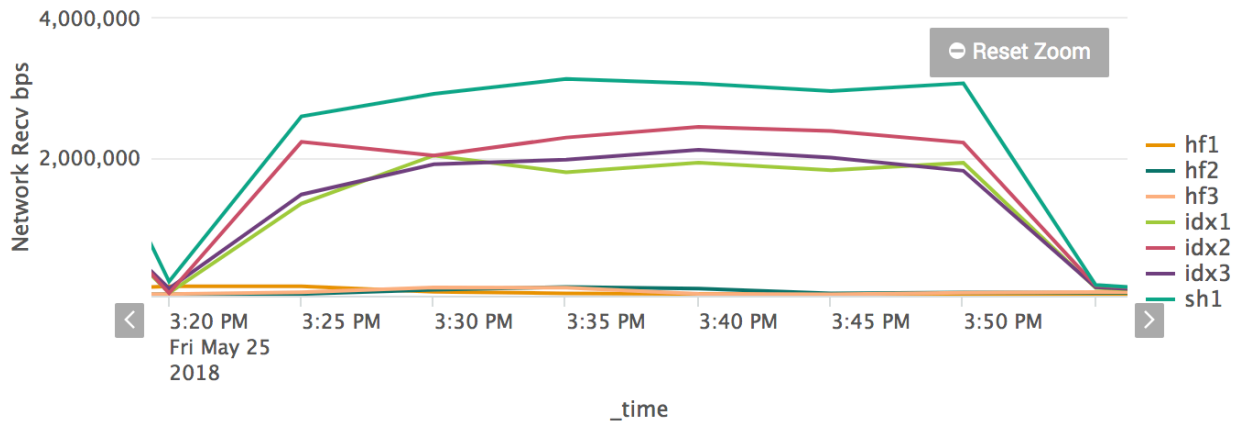
Mixed Load Searching & Indexing

Smart Storage top, Traditional Storage, bottom

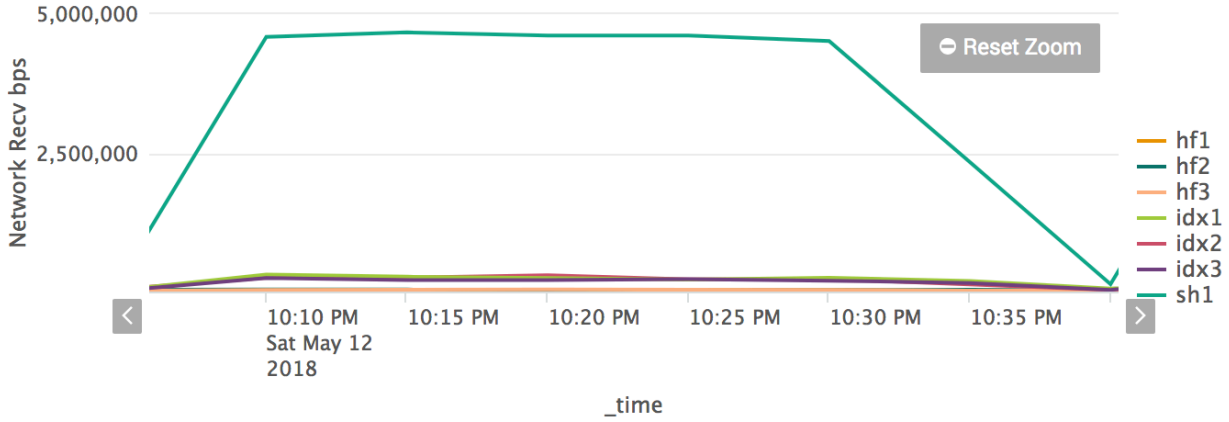
Network Recv bps



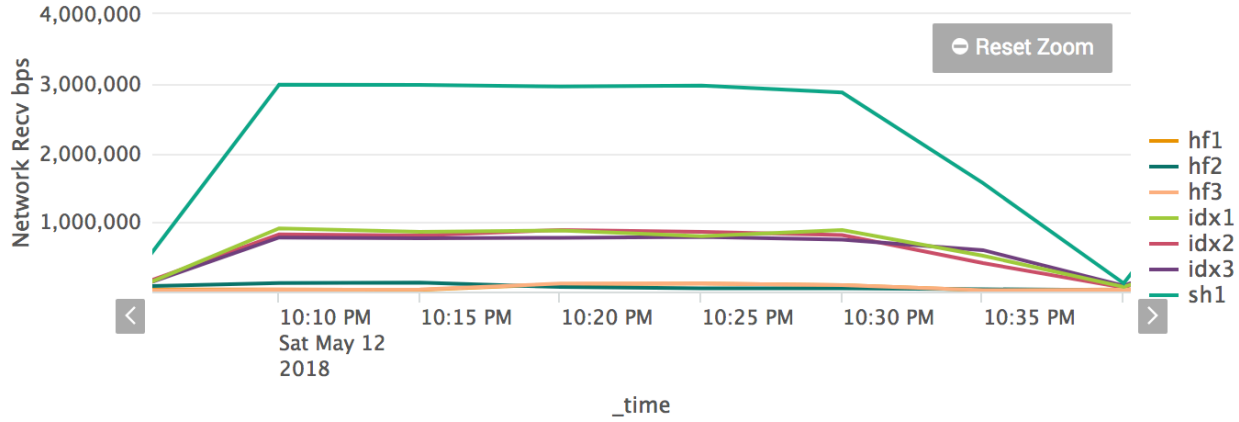
Network Sent bps



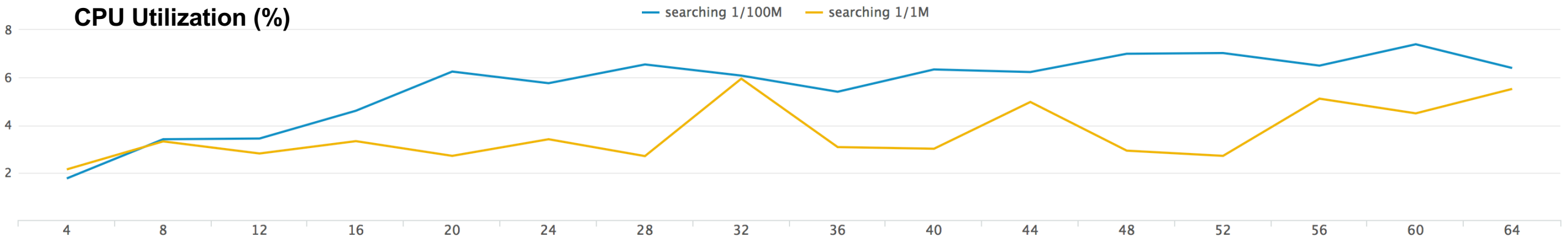
Network Recv bps

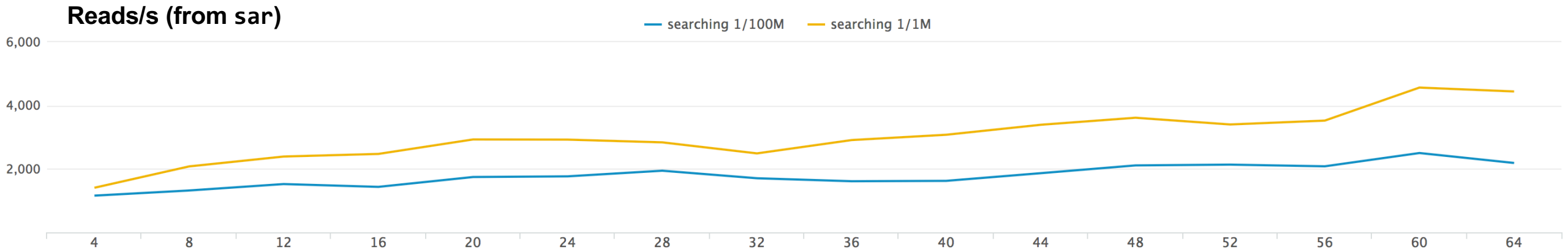


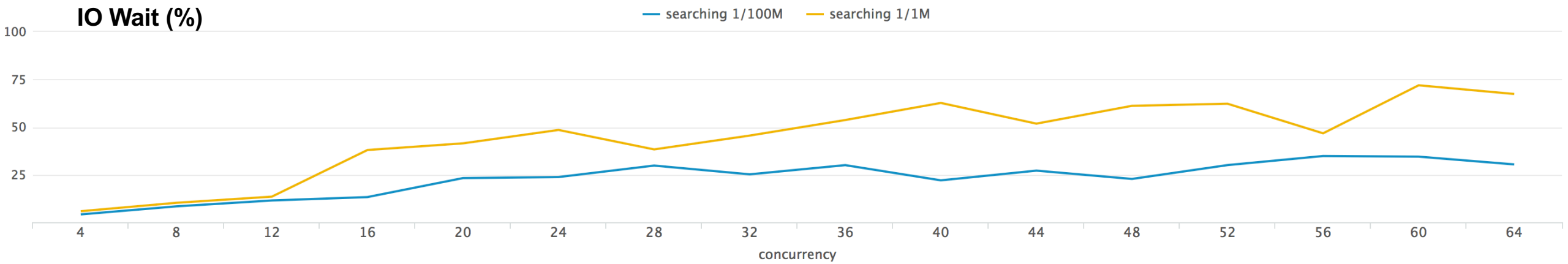
Network Sent bps



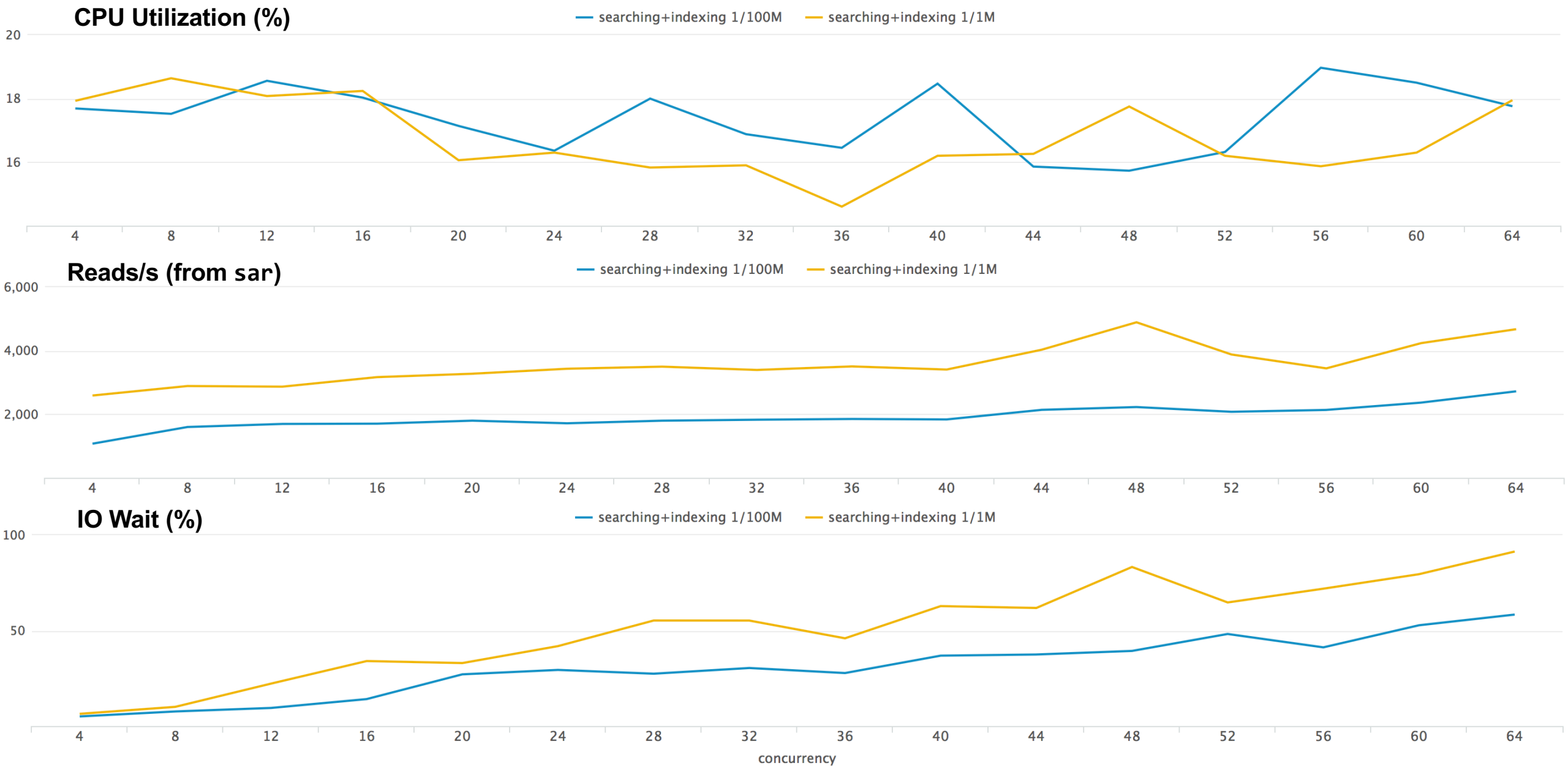
Rare Searches



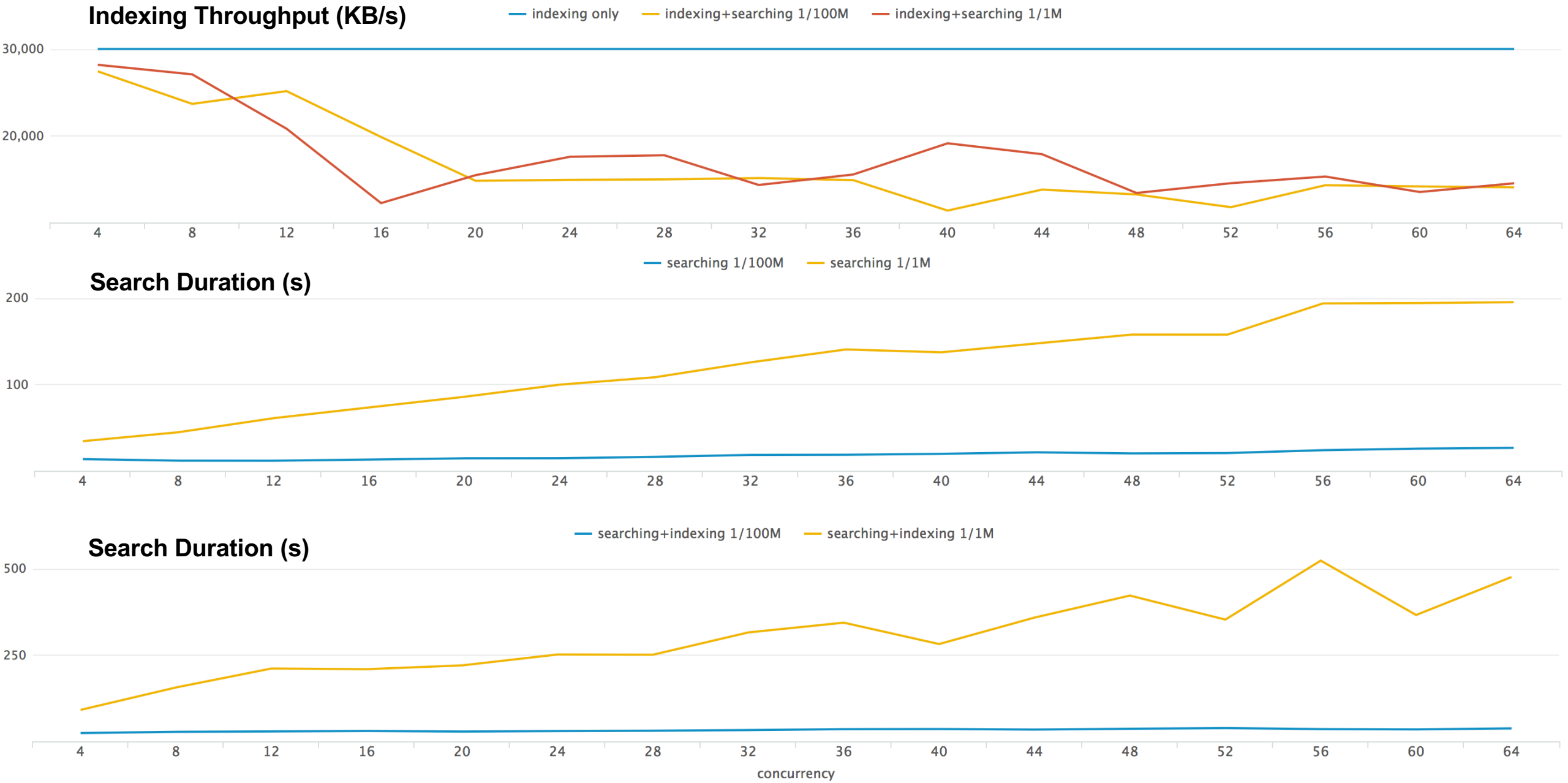




Indexing with Rare Searches

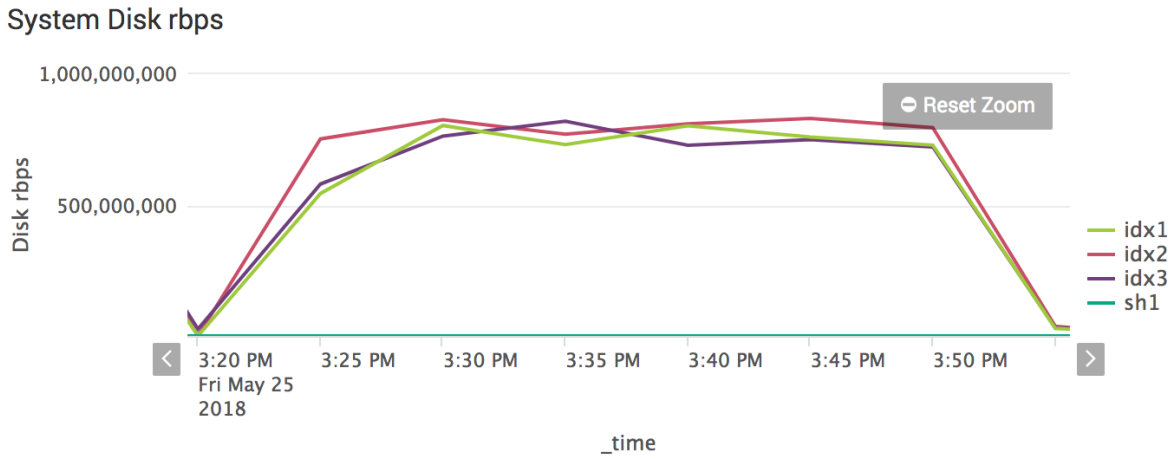


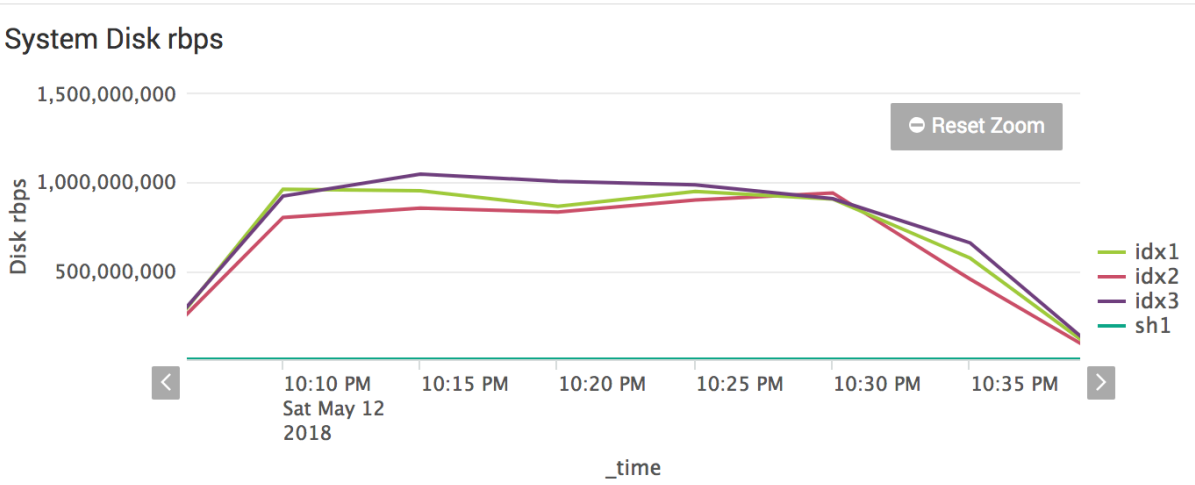
Indexing & Searching Rare

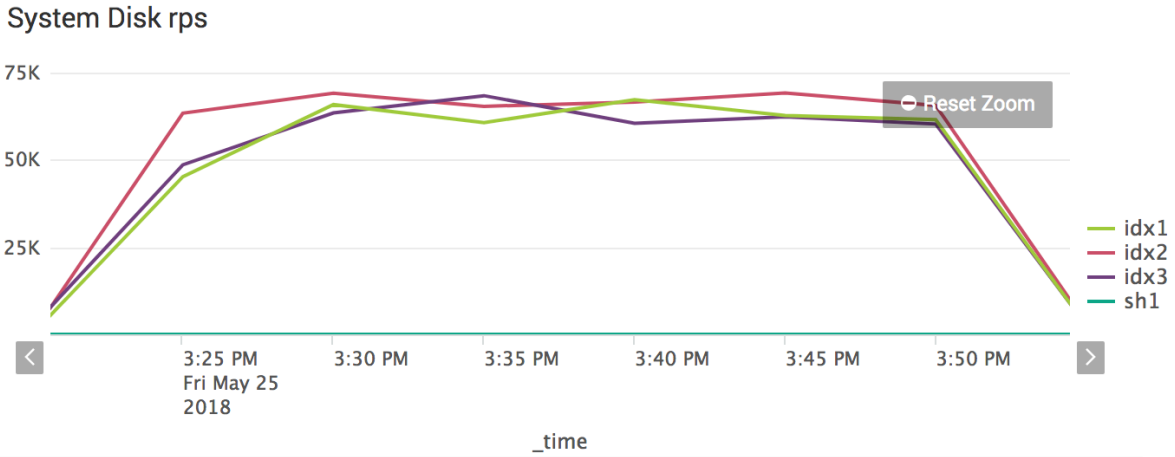


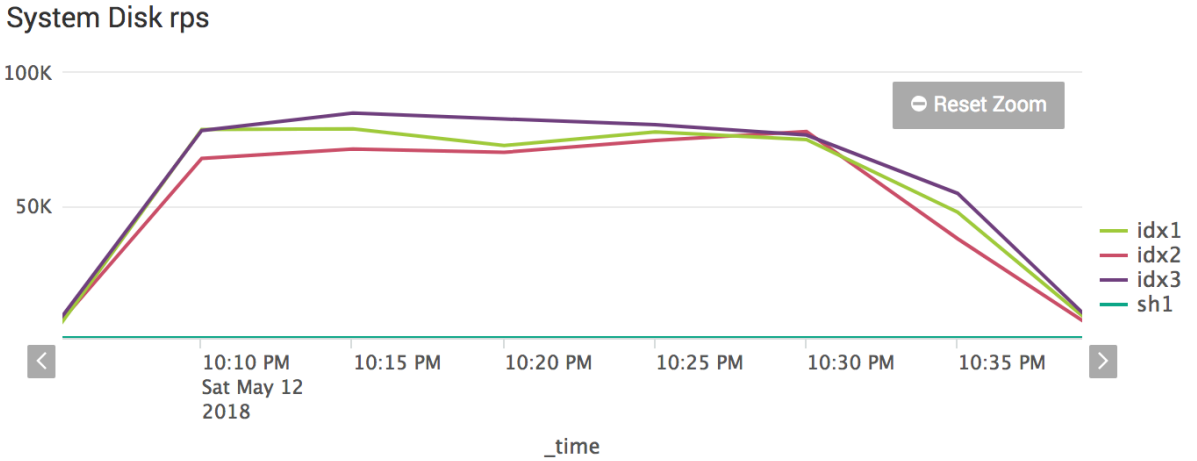
Rare Searches

Smart Store (left) vs Traditional Storage (right)









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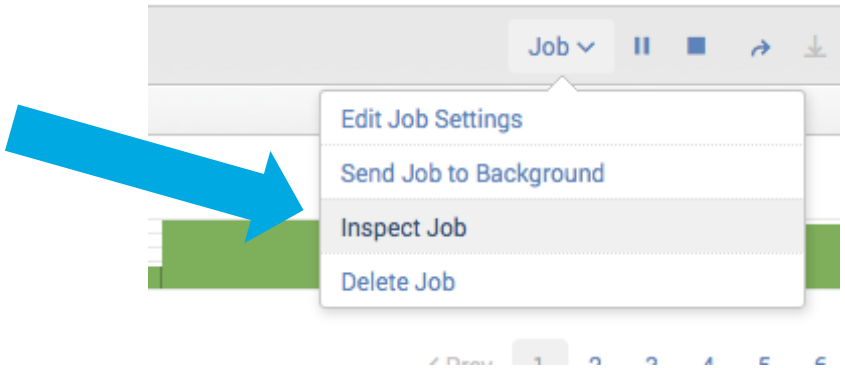
Rare Searches Summary

- Rare workloads (investigative, ad-hoc) are IO bound
- Rare workload completion times and indexing throughput both negatively affected while running simultaneously
- 1/100M searches have a lesser impact on IO than 1/1M.
- When indexing is on, in 1/1M case search duration increases substantially more vs. 1/100M. Search and indexing are both contenting for IO.
- In case of 1/100M, bloomfilters help improve search performance
  - Bloomfilters are special data structures that indicate with 100% certainty that a term does not exist in a bucket (indicating to the search process to skip that bucket).
- Faster disks would have definitely helped here
- More CPUs would not have improved performance by much

Is my search CPU or IO bound?



- Guideline in absence of full instrumentation
- **command.search.rawdata**
  ~ CPU Bound
  - Also: .kv, .typer, .calcfields,
- **command.search.index**
  ~ IO Bound

Search job inspector

This search has completed and has returned **1** result by scanning **4,159,473** events in **20.706** seconds.

The following messages were returned by the search subsystem:

DEBUG: **Disabling timeline and fields picker for reporting search due to adhoc_search_level=smart**
DEBUG: **base lispy: [AND index::_internal]**
DEBUG: **search context: user="admin", app="aws_app", bs-pathname="/opt/splunk61/etc"**

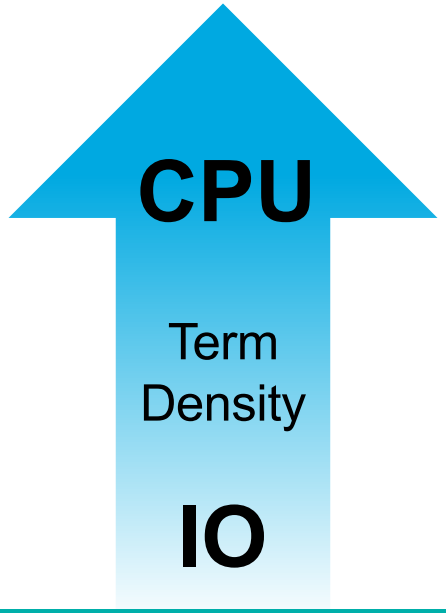
(SID: 1410010633.156)

Execution costs

Duration (seconds)		Component	Invocations	Input count	Output count
	0.344	command.addinfo	344	4,159,473	4,159,473
	0.343	command.fields	344	4,159,473	4,159,473
	7.133	command.prestats	344	4,159,473	343
	13.247	command.search	344	-	4,159,473
	10.254	command.search.rawdata			
	0.363	command.search.kv	343	-	-
	0.344	command.search.tags	344	4,159,473	4,159,473
	0.344	command.search.typer	344	4,159,473	4,159,473
	0.343	command.search.calcfields	343	4,159,473	4,159,473
	0.343	command.search.fieldalias	343	4,159,473	4,159,473
	0.343	command.search.lookups	343	4,159,473	4,159,473
	0.11	command.search.summary	344	-	-
	0	command.search.index.usec_1_8	22	-	-
	0	command.search.index.usec_512_4096	84	-	-
	0	command.search.index.usec_64_512	314	-	-
	0	command.search.index.usec_8_64	116	-	-
	0.345	command.stats.execute_input	345	-	-

Top Takeaways

- Indexing
  - Distribute – Splunk scales horizontally
  - Tune event breaking and timestamp extraction
  - Faster CPUs will help with indexing performance
- Searching
  - Distribute – Splunk scales horizontally
  - Dense Search Workloads
    - CPU Bound, better with indexing than rare workloads
    - Faster and more CPUs will help
  - Rare Search Workloads
    - IO Bound, not that great with indexing
    - Bloomfilters help significantly
    - Faster disks will help
- **Performance**
  - Avoid generality, optimize for expected case and add hardware whenever you can



Use case	What Helps?
Trending, reporting over long term etc.	More distribution Faster, more CPUs
Ad-hoc analysis, investigative type	More distribution Faster Disks, SSDs

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Q&A

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Brian Wooden | Partner Integrations

Thank You

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