Sizing Splunk SmartStore - Spend Less and Get More out of Splunk

Make your infra $$ work harder for you

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Bharath Aleti

Director Product Management |
Splunk Inc.

Jon Rust

Splunk Architect | ADP

Jane Joki

Offering Manager | IBM Cloud Object Storage

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Agenda

1. Why SmartStore
2. SmartStore Overview
3. Sizing, Performance & TCO Savings
4. Customer story - ADP
5. Storage Partner - IBM COS

Splunk SmartStore ?

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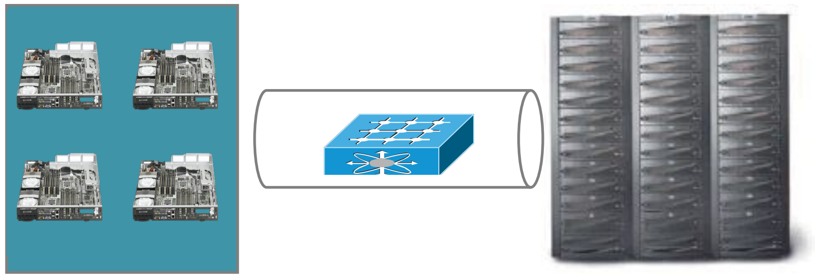
Data Technology Transitions

Trending with data growth and business needs

1990s

Gigabyte-Terabyte Era
Bring Data to Compute
Databases and File-systems

Data Ponds

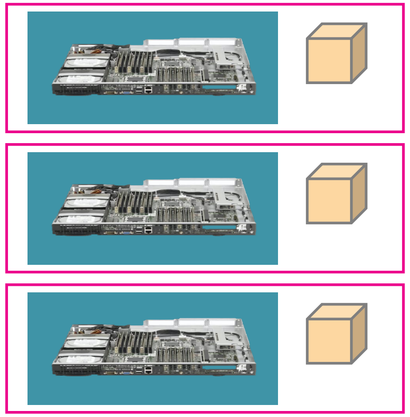


Scale-up
Ship data to compute

2005+

Terabyte-Petabyte Era
Bring Compute to Data
Hadoop, Splunk, DistFS

Data Lakes



Scale-out
Compute and Storage Co-location

2018+

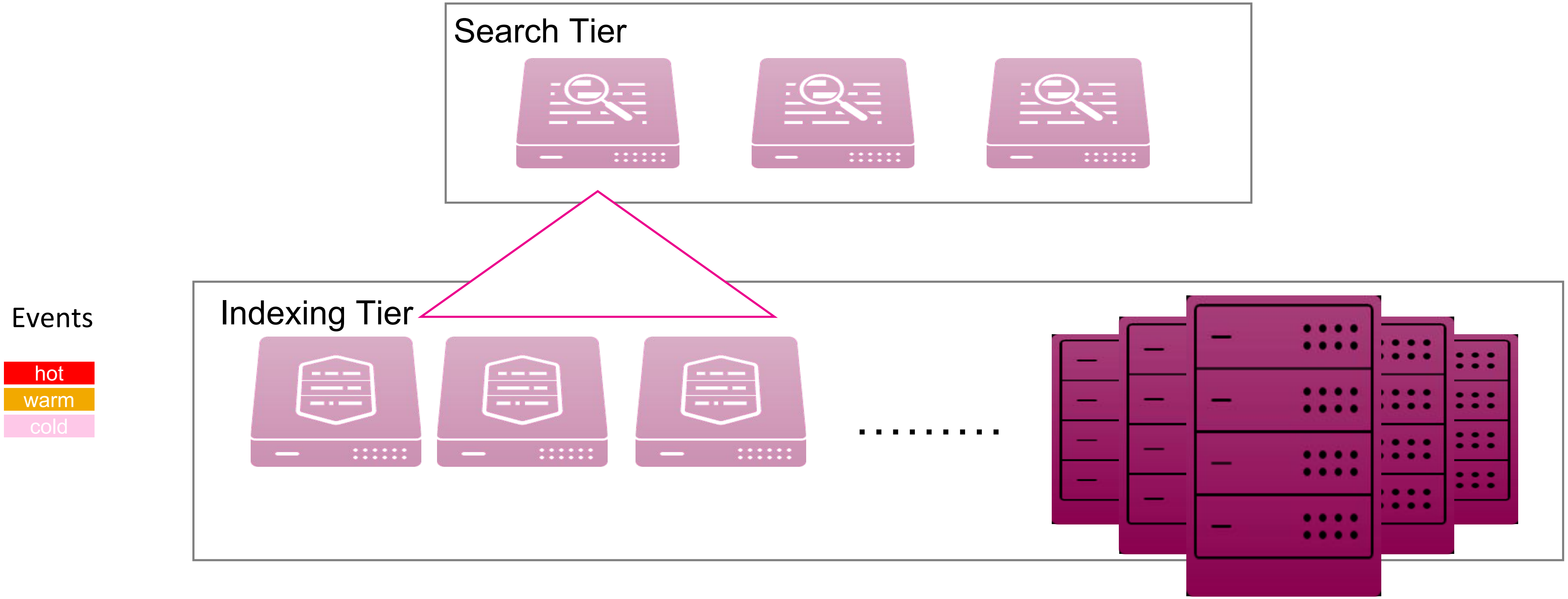
Exabyte-Zetabyte Era

Data Oceans

Will the same scale-out colocation model work ?

?

Growing data volumes requires $$$ infra spend

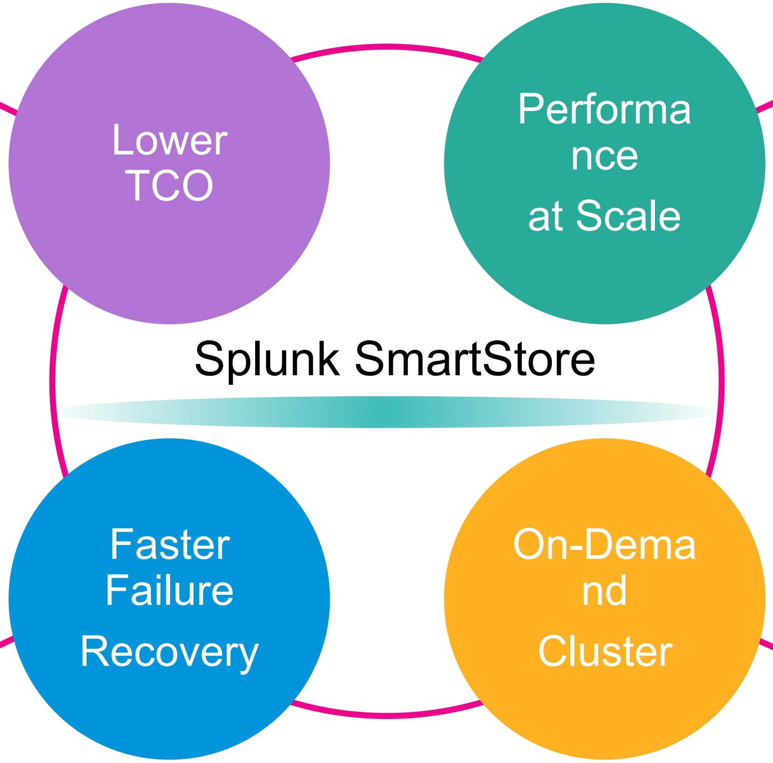


Adding new indexers in response to data growth is expensive => High cost
Searches typically run over only on a partial subset of data => Inefficient utilization
Distributed scale out architecture => No longer a good fit for growing data volumes

Splunk SmartStore

Achieve massive scale with lower TCO

- Decoupled compute and storage
- Scale storage for longer retention & indexers on performance demand
- Reduced indexer footprint for warm/cold data



- Brings in data closer to compute on-demand
- Application and data aware cache
- Cache data based on age, priority and access patterns

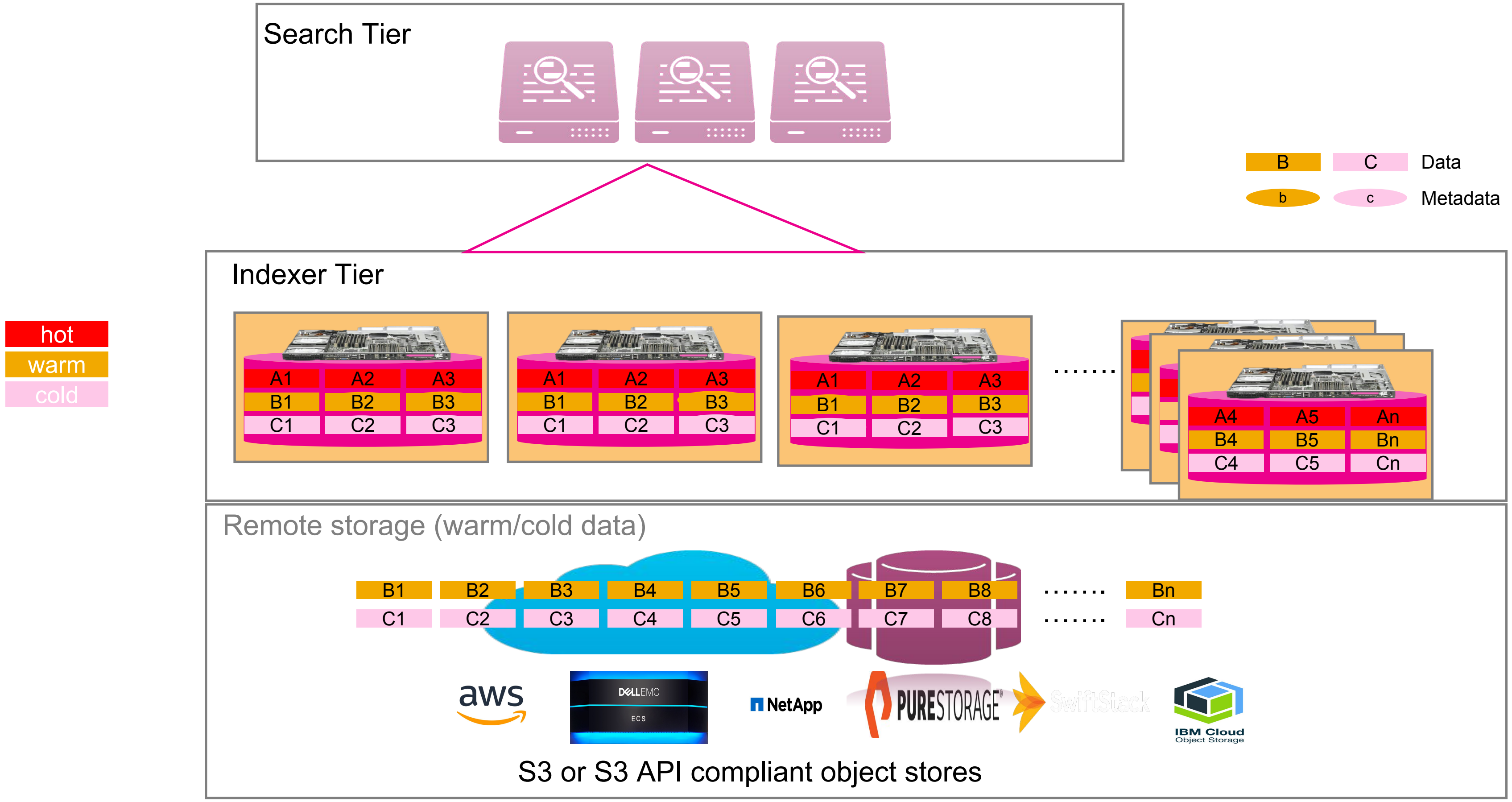
- Faster indexer recovery
- Faster data rebalance

- Add/remove indexers on-demand
- Setup/teardown cluster on-demand

SmartStore Overview

SmartStore

Decoupled Compute and Storage

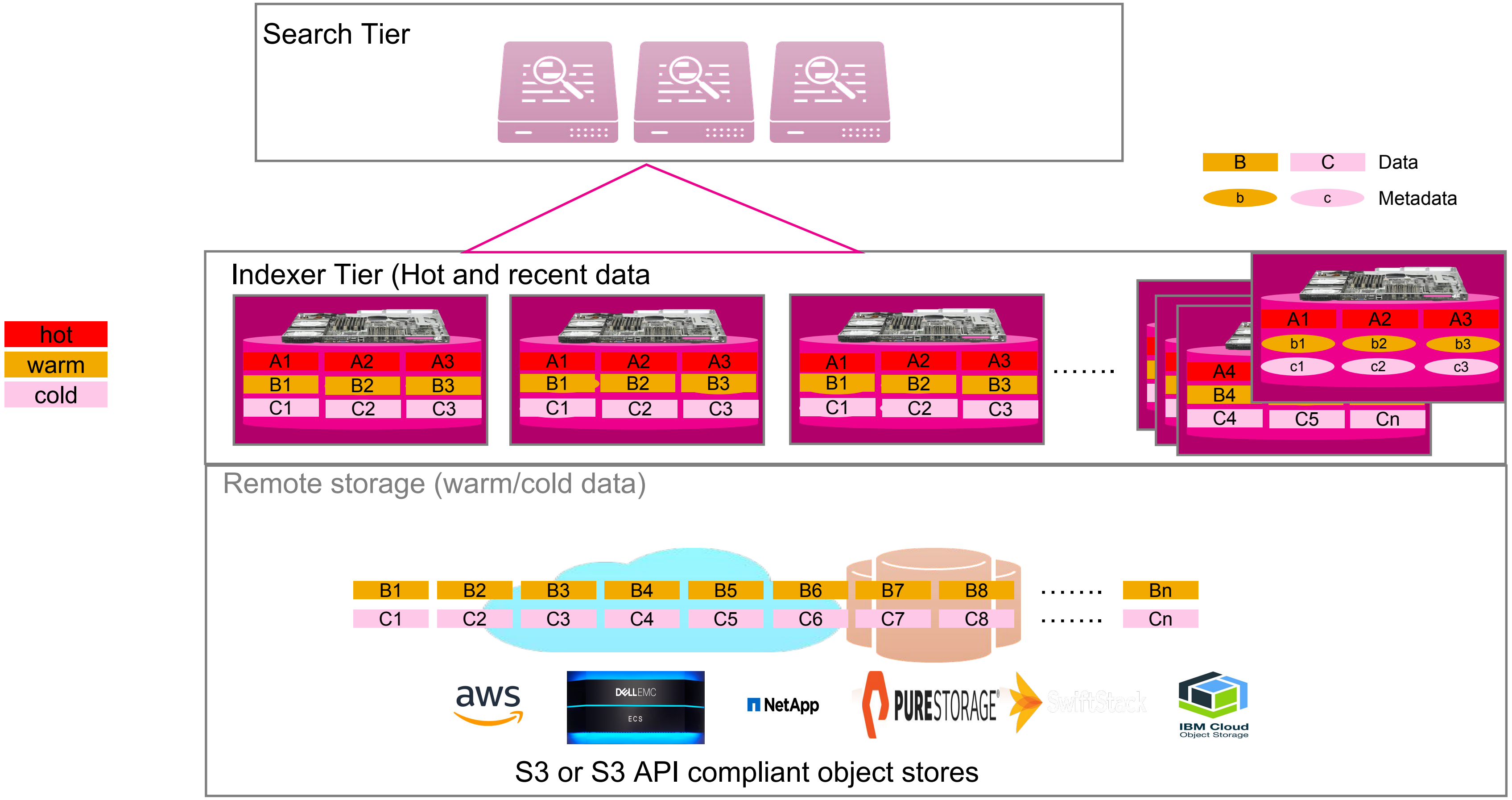


- Decoupled storage and compute
- Warm/cold data in remote storage
- Hot and recently access data on indexers

- Longer data retention by independently scaling storage
- Scale out compute based on performance demands
- Lower TCO with S3 & S3 API compliant object stores

SmartStore

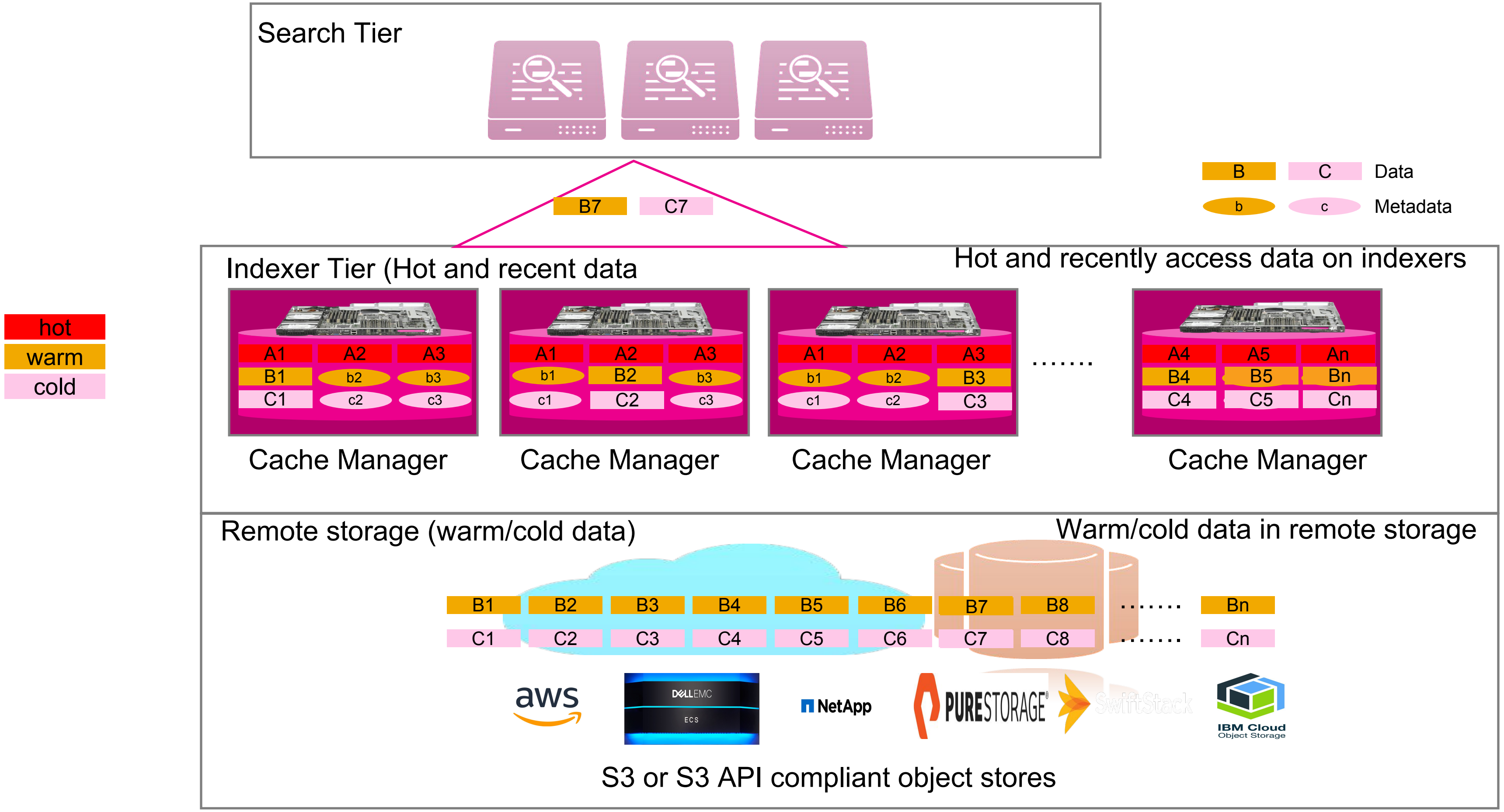
Reduced Indexer Footprint & Faster Node Recovery



- 1 Full copy + RF-1 Metadata copies of warm/cold on indexers
- Fewer indexers required with only one full copy of warm/cold
- Faster node recovery & data rebalance with metadata copy

SmartStore

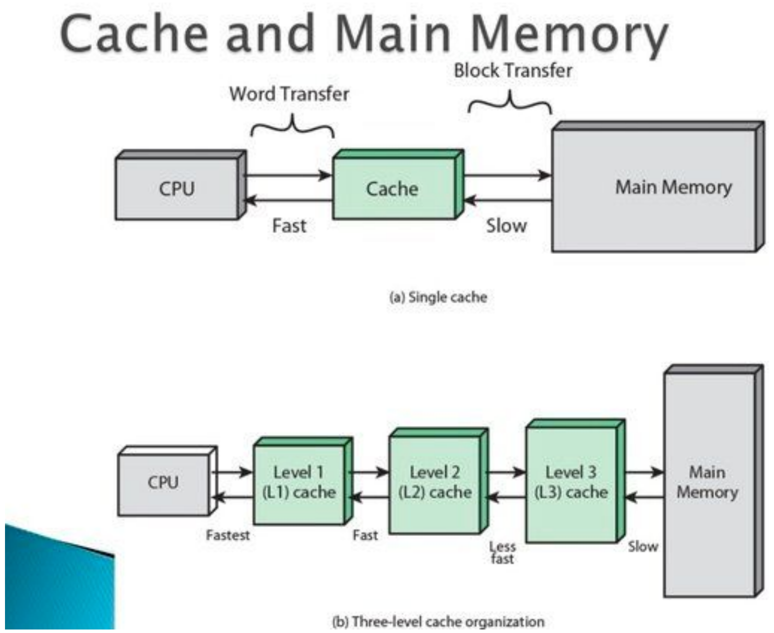
Application & data aware cache brings in data on-demand

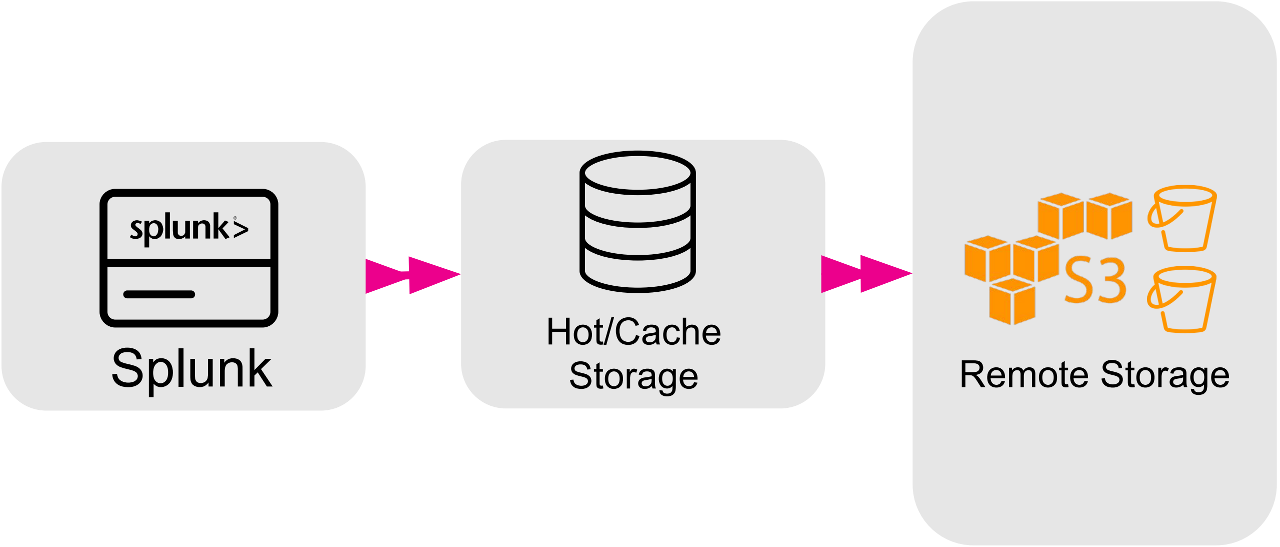


- Fills up indexer storage cache until available capacity
- When cache is full, buckets are evicted based on LRU, data age and priority
- Loads active dataset on indexers

SmartStore Cache Manager

Similar to CPU memory caching

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Hot/Cache Storage

Remote Storage

SmartStore Architectural Advantages

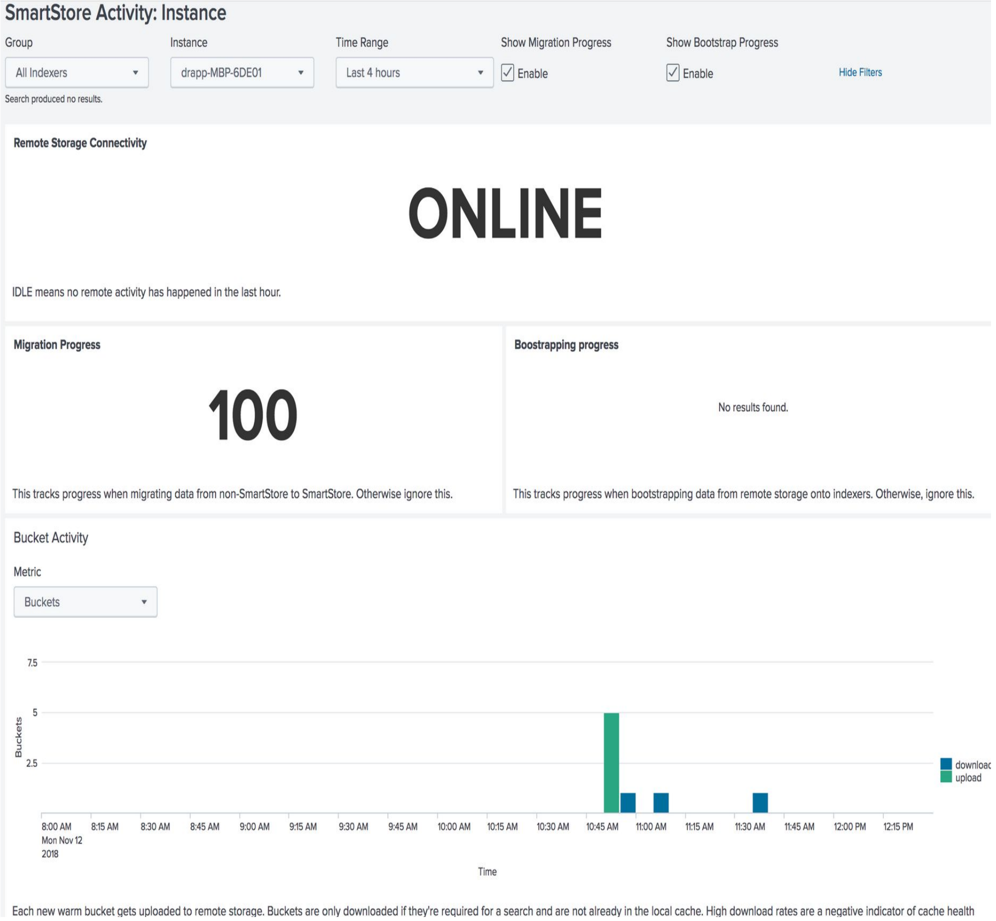
Storage Tier is no longer tied to hardware

- Separation of storage and compute
- Indexer failures is no longer tied to storage failure

Local Storage is now simply a Search-Cache

- No longer need to size local storage to hold long-term retention
- Just need enough local storage for search
  - Majority of searches are typically over last 7 days

Monitoring Console Additions



SmartStore Activity: Instance

Group: All Indexers
Instance: drapp-MBP-6DE01
Time Range: Last 4 hours
Show Migration Progress: ☑ Enable
Show Bootstrap Progress: ☑ Enable

Search produced no results.

Remote Storage Connectivity

ONLINE

IDLE means no remote activity has happened in the last hour.

Migration Progress

100

This tracks progress when migrating data from non-SmartStore to SmartStore. Otherwise ignore this.

Boostrapping progress

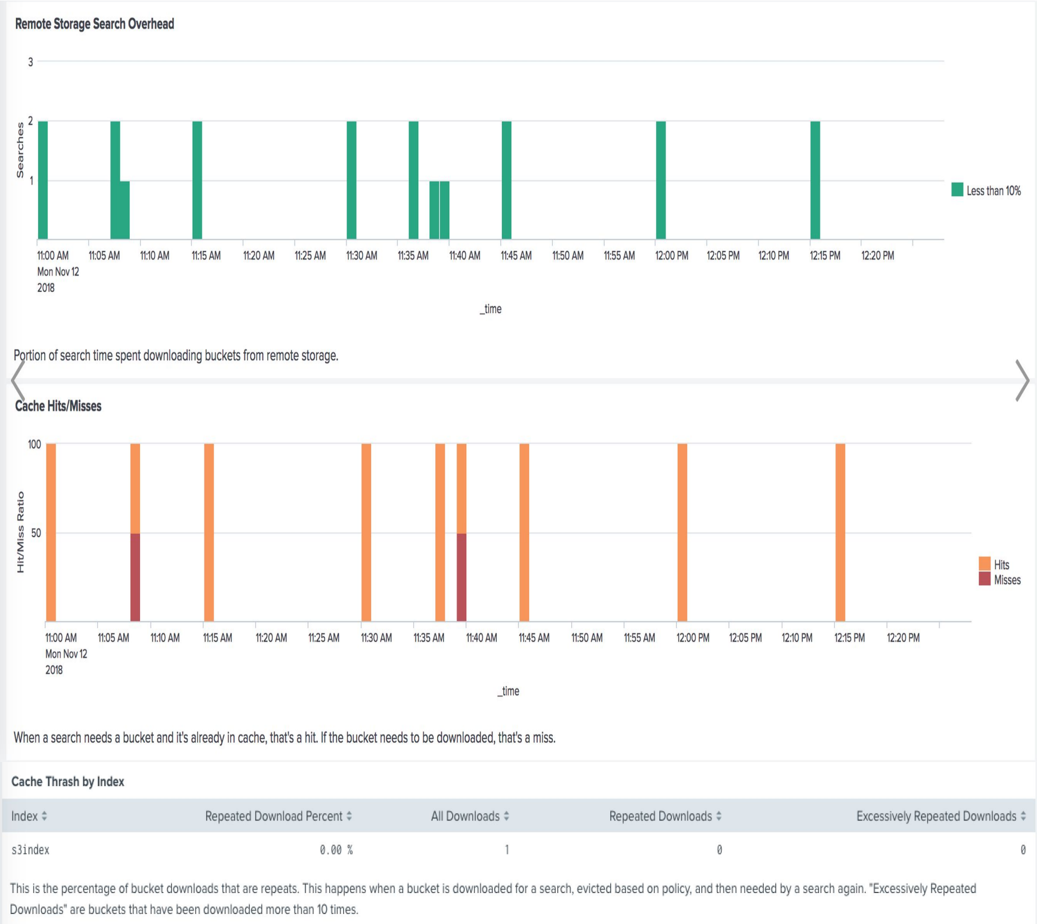
No results found.

This tracks progress when bootstrapping data from remote storage onto indexers. Otherwise, ignore this.

Bucket Activity

Metric: Buckets

Each new warm bucket gets uploaded to remote storage. Buckets are only downloaded if they're required for a search and are not already in the local cache. High download rates are a negative indicator of cache health



Remote Storage Search Overhead

Portion of search time spent downloading buckets from remote storage.

Cache Hits/Misses

When a search needs a bucket and it's already in cache, that's a hit. If the bucket needs to be downloaded, that's a miss.

Cache Thrash by Index

Index ⇕	Repeated Download Percent ⇕	All Downloads ⇕	Repeated Downloads ⇕	Excessively Repeated Downloads ⇕
s3index	0.00 %	1	0	0

This is the percentage of bucket downloads that are repeats. This happens when a bucket is downloaded for a search, evicted based on policy, and then needed by a search again. "Excessively Repeated Downloads" are buckets that have been downloaded more than 10 times.

SmartStore Architectural Advantages

Scalability & High Availability

- Architectured for massive scale
- High data availability with remote storage tier
- Performance at scale with cached active dataset

TCO Reduction

- Scale compute and storage independently
- Lower TCO with reduced indexer footprint
- Leverage cost benefits of cloud/storage innovations

Simplified Management

- Instant indexer failure recovery
- Faster data rebalance
- Upgrade/replace indexer infrastructure with simple bootstrap from remote store
- New global size based retention policies

SmartStore in Production

- 95% of Splunk Cloud prod stacks running on SmartStore
- Successful adoption at key customer accounts and more in the pipeline
  - ADP, Lawrence Livermore National Labs speaking at Conf ….
  - 100+ on-prem deployments based on Splunk telemetry and support info

- Quotes
  - “SmartStore working like a dream”
  - “Saving many millions per year in AWS storage”
  - “No longer worried about running out of disk space for long term retention”

Sizing, Performance & TCO

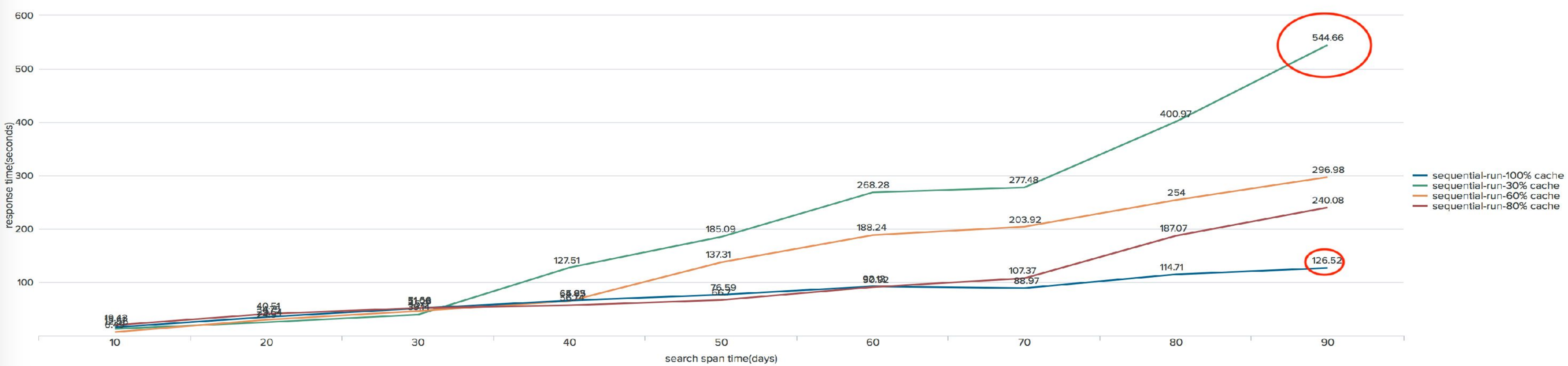
SmartStore Cache Sizing Guidelines

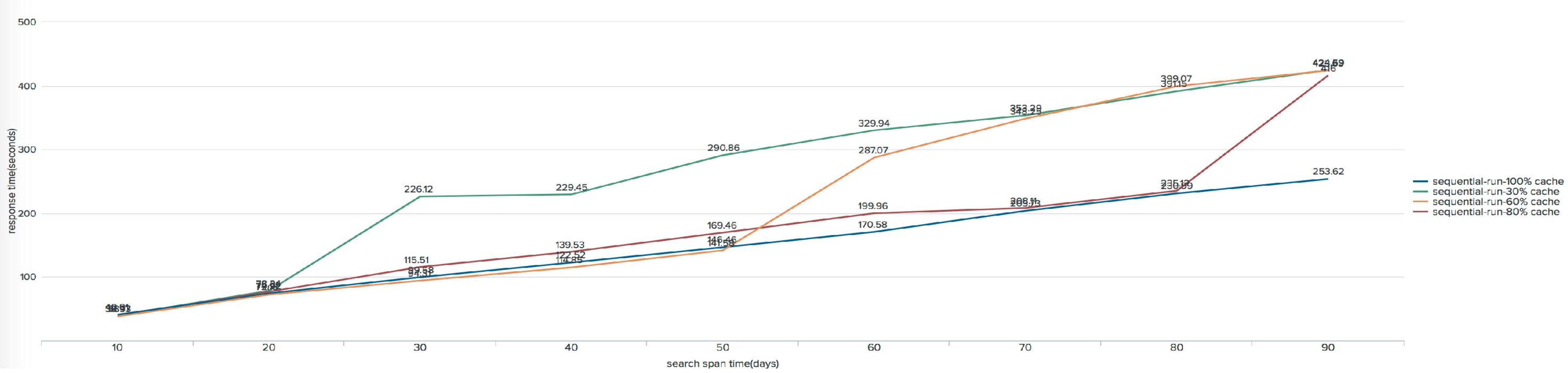
- Daily Ingestion Rate (I)
- Search timespan for majority of your searches
  - Cache Retention (C) = 1 day / 10 days/ 30 days or more
- Available disk space (D) on your indexers (assuming homogenous disk space)
- Replication Factor (R) =2
- Min required cache size: [I*R + (C-1)*I]
- Min required indexers = Min required cache size / D
- Also factor in ingestion throughput requirements (~300GB/day/indexer) to determine the number of indexers

SmartStore Sizing Summary

	1TBDay_7DayCache	1TBDay_10DayCache	1TBDay_30DayCache	10TBday_10DayCache	10TBDay_30DayCache
Ingest/Day (GB)	1,000	1,000	1,000	10,000	10,000
Storage/Indexer (GB)	2,000	2,000	2,000	2,000	2,000
Cache Retention	7	10	30	10	30
Replication Factor	2	2	2	2	2
Min Required Cache (GB)	8000	11000	31000	110000	310000
Min Required #Indexers	4	6	16	55	155

Performance: Cache Miss





Performance: Cache Miss

100% cached: Search time grows linearly along with time range

Cache miss: Sharp spikes when hitting non-cached data

- Impact is lower for dense searches due to data locality and prefetch
- On a cache miss, the search time may increase from 2s to >100s, depending on the search
  - E.g .To fetch a single bucket of 750MB on 1 Gbps network, the latency is 7.5s.
  - Prefetching reduces the overall search response impact by overlapping with CPU/IO operations

Impact of Network Latency

Upload/migration:

- 0ms latency: 500MB/s (1.5s per 750MB bucket)
- 30ms latency: 100MB/s (7.5s per 750MB bucket)
- 100ms latency: 30MB/s (25s per 750MB bucket)

Download/localization:

- 0ms latency: 800MB/s (0.94s per 750MB bucket)
- 30ms latency: 100MB/s (7.5s per 750MB bucket)
- 100ms latency: 30MB/s (25s per 750MB bucket)

- **Total impact is lower with parallel download/upload**
- **By default, Splunk will upload/download 8 operations at a time.**
- **With multi-part upload, this will be 48 operations in parallel**

Object Store Performance Specs

Object Store to per-Splunk-indexer throughput

	Minimum Specs	Performance Specs
Download Throughput	100MB/s or higher	800MB/s or higher
Upload Throughput	30MB/s or higher	500MB/s or higher
Network Connectivity	1Gbps or higher	10Gbps or higher

Scalable/modular network backplane of the Object Store

- Must support network connectivity reqs of all connected indexers
- e.g. for 100 indexers with minimum specs, the backplane must support 100Gbps or higher

Object Store must support at least 1K per second API operations

- (GET/PUT/POST/DELETE) operations to a bucket

SmartStore Cost Savings

Reference only, may vary based on your pricing

Deployment

Ingestion Rate: 1TB/day
Total Retention: 365 days
Replication Factor: 2
Max Search Concurrency: 64

Non-SmartStore Infrastructure Cost

At 1TB/day for 365 days and RF=2, storage capacity req is 365TB
With 12TB per indexer, this would require 31 indexers
At a server cost of $12K/year, this comes to $374K

SmartStore Infrastructure Cost

With 30 days cache retention, indexer footprint is reduced to 8
With 2TB per indexer (SSD), annual cost of indexers is $43K
Storage cost is $46K cost/year, with total cost =$90K
SmartStore approx cost savings: 75%

Non-SmartStore Infrastructure Costs	
Non-SmartStore Server On-demand Pricing/Hr	1.38
Non-SmartStore Server Cost/Year	$12088.8
Non-SmartStore Storage Per Node (GB)	12000
Non-SmartStore Indexers Required	31
Non-SmartStore Indexer Cost/Year	$374753
Non-SmartStore Total Cost/Year	$374753

SmartStore Infrastructure Costs	
SmartStore Server (SSD) On-demand Pricing/Hr	$0.624
SmartStore Server (SSD) Cost/Year	$5,466
SmartStore Cache Required	15500
SmartStore Min Indexers Required	8
SmartStore Indexer Cost/Year	$43,730
SmartStore remote storage pricing/GB/month	$0.021
SmartStore Remote Storage Cost/Year	$45.990
SmartStore Total Cost/Year	$89,720

More performance => Add indexers
More storage Capacity => Add storage
Cost savings go down with increase in number of indexers and increases with higher ingest rate/retention requirements

SmartStore in Production at ADP

Jon Rust

Splunk Admin, ADP

Overview - Usage

20 TB license, 11 TB avg day, 19 TB recent peak

500 TB of retention (growing since implementing S2)

600,000 searches per day

- Avg runtime 4.0s, unchanged since S2

5500 users

80 groups (each group gets a Splunk app)

1000 indexes (each group gets multiple indexes)

- Largest cluster has 300

Overview - Infrastructure

72 physical indexers, 2 VM (lab) in 7 environments

- Largest clusters are 25 and 29 indexers

16 VM search heads

- Largest cluster is 9

Overview – Basic Cluster

Most traffic still comes through SUF

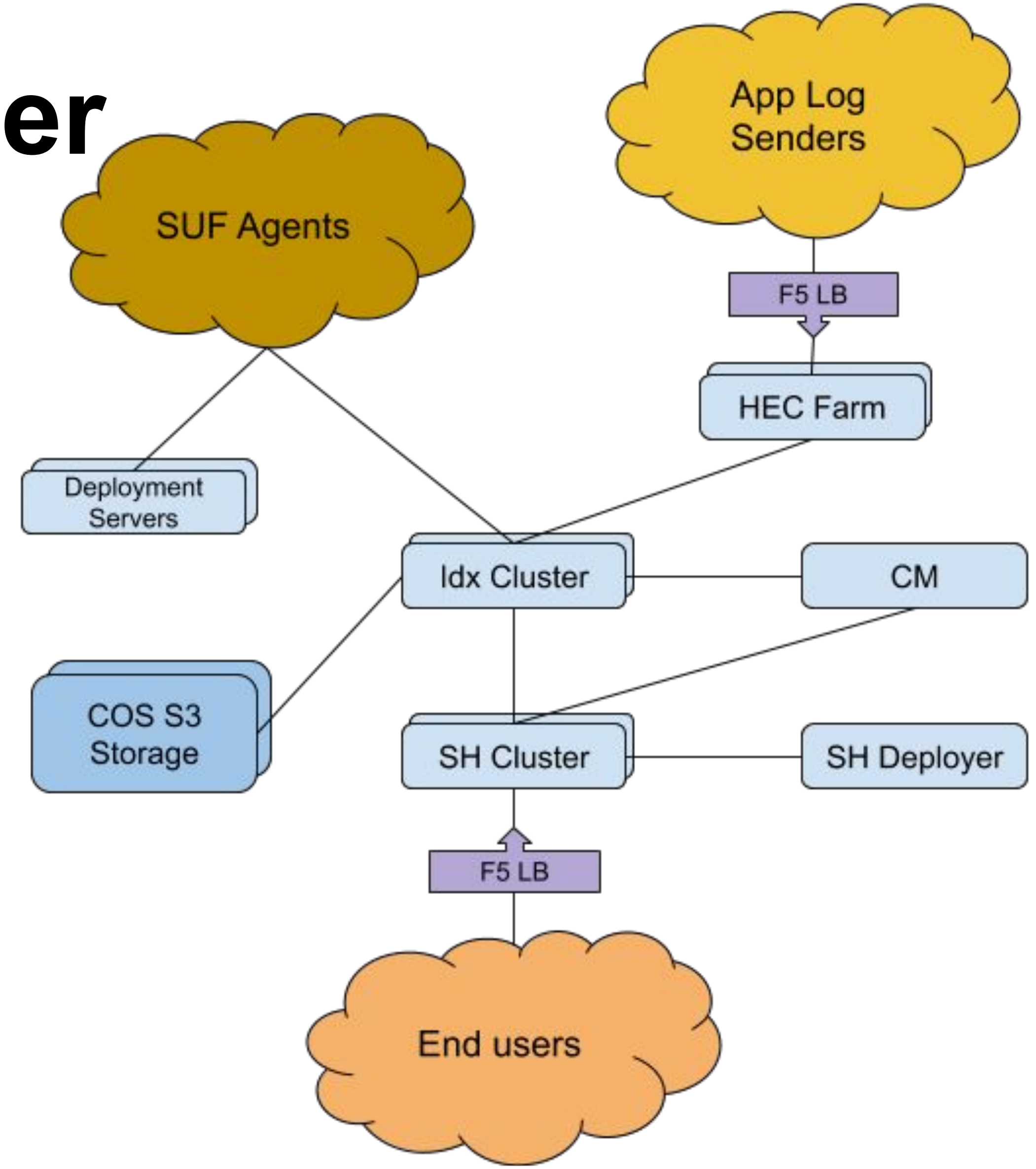
Growing HEC, close to 50% lately

Separate HEC HF farm

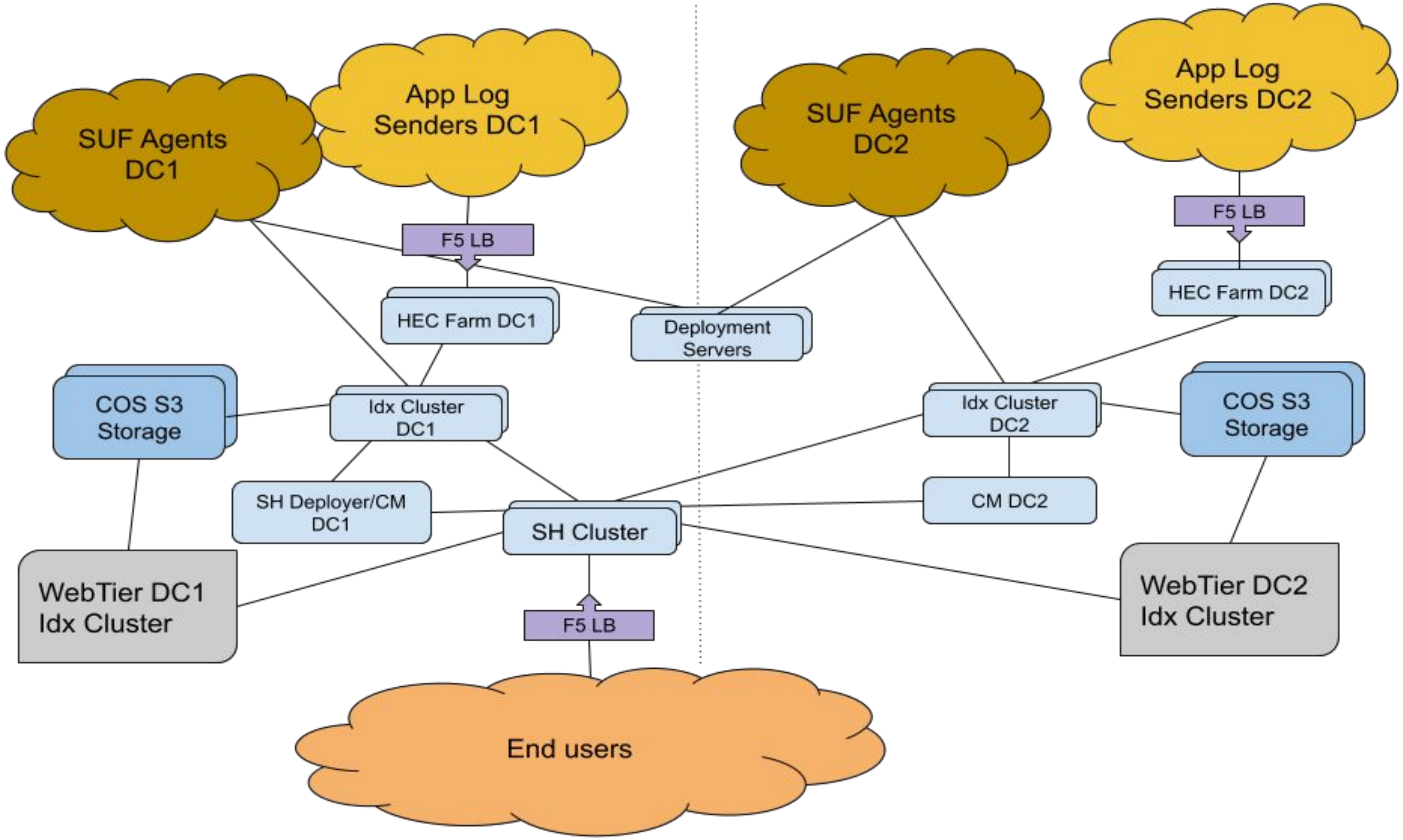
- Flexibility
- HEC overuse doesn't impact indexers

COS: Cloud Object Store from IBM

- Formerly known as CleverSafe



Overview – Production



“Indexers are too expensive”

Management unhappy with the cost of Splunk

- $50k per indexer, 20 cores
- 15 TB of usable RAID10 SSD

With SmartStore (S2)

- $12k per indexer, 36 cores
- 7 TB of usable RAID0 SSD
  - BUT! S2 redundancy
- COS disk cost is about $0.35/GB
- 2x indexer count, almost 4x core count
  - Still < 50% the $$

More than money management: Agility!

- Increase or decrease peer count very quickly
- Random other example, “re-RAID project Q12019”
  - Management forced us to use RAID5 during initial build-out
  - RAID5 needs to die in a fire
  - We eventually hit the IO wall
  - With S2, rebuilding RAID volumes was pretty painless!

splunk offline

Take mount offline, rebuild the volume as RAID10

splunk restart

<repeat for each indexer>

12 indexers in the cluster, less than 2 hours of work, <u>no service interruption</u>

But how does it search?

Most common searches are unchanged

- Recent data is in cache, performs exactly as before but faster with more h/w
- Historic searches are okay, depends
  - Big window searches over old data can trigger large downloads from remote store
- We've had zero complaints about search performance since updating to S2
  - Most users have no idea

Was migration difficult?

Mostly turn-key

- A few beta/early release issues (since solved)
- When migrating a cluster
  - Chose 1 index first and verified
  - Good? Chose 5 more and verified
  - Good? Rolled the rest
- Upload concurrency during migration
  - We turned this down (from default of 8, to 4)
  - Our COS infra wasn't designed to handle so much upload data all at once
  - Consider your network and S3 limits before migration
  - Normal day-to-day use spreads out uploads pretty nicely

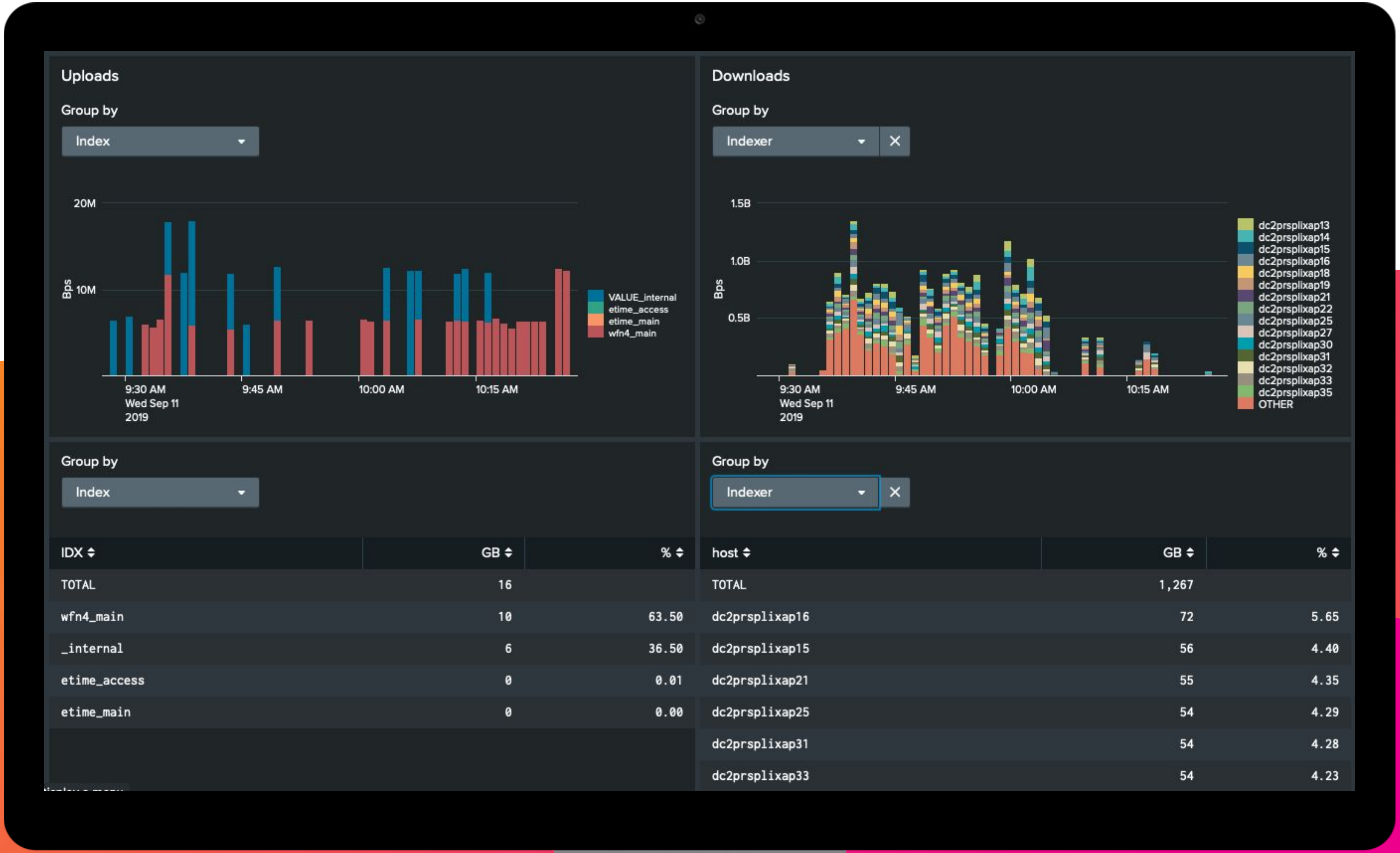
Sample config

```
[volume:remote_store]
storageType                 = remote
path                        = s3://splunk-s2-webtier-dc2
remote.s3.access_key        = **key**
remote.s3.secret_key        = **key**
remote.s3.endpoint          = https://internalS3.endpoint
remote.s3.signature_version = v2

[some_index]
remotePath                  = volume:remote_store/$_index_name
homePath                    = volume:hot/$_index_name
maxGlobalDataSizeMB         = 175000
frozenTimePeriodInSecs      = 12096000
# required, but only used during migration; no data will land here after migration
coldPath                    = volume:cold/$_index_name
```

Dashboard: SmartStore Traffic

https://github.com/camrunr/s2_traffic_report



Uploads

Group by: Index

Downloads

Group by: Indexer

Group by: Index

IDX ⬍	GB ⬍	% ⬍
TOTAL	16	
wfn4_main	10	63.50
_internal	6	36.50
etime_access	0	0.01
etime_main	0	0.00

Group by: Indexer

host ⬍	GB ⬍	% ⬍
TOTAL	1,267	
dc2prsplixap16	72	5.65
dc2prsplixap15	56	4.40
dc2prsplixap21	55	4.35
dc2prsplixap25	54	4.29
dc2prsplixap31	54	4.28
dc2prsplixap33	54	4.23

Splunk SmartStore and IBM Cloud Object Storage

A Gamechanger for Your Splunk Environment

Jane Jokl

Offering Manager, IBM Cloud Object Storage Solutions

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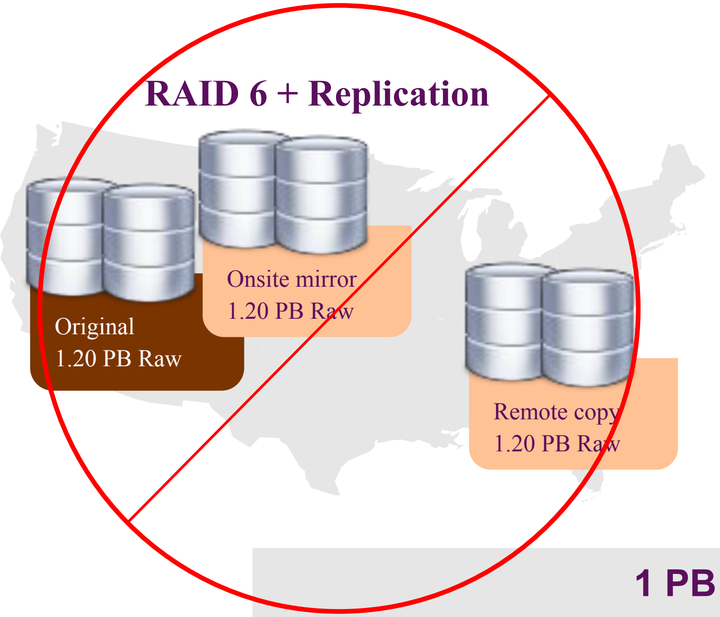
Topics

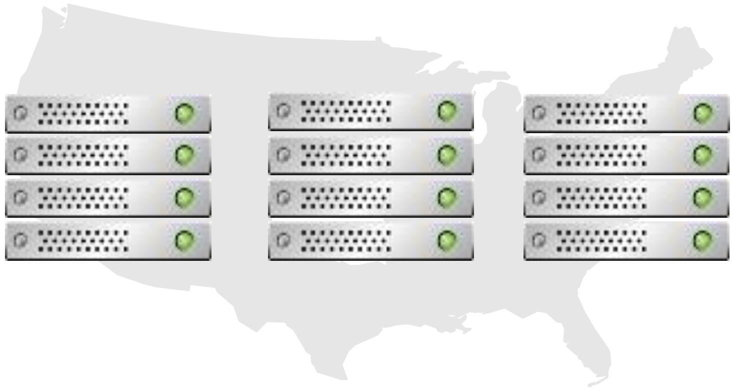
- Brief Overview of IBM Cloud Object Storage
- Solution Highlights
- Key Takeaways

Efficiency of IBM Cloud Object Storage

Example: How to build a highly reliable storage system for 1 Petabyte of usable data?



RAID 6 + Replication



Software Defined Solutions

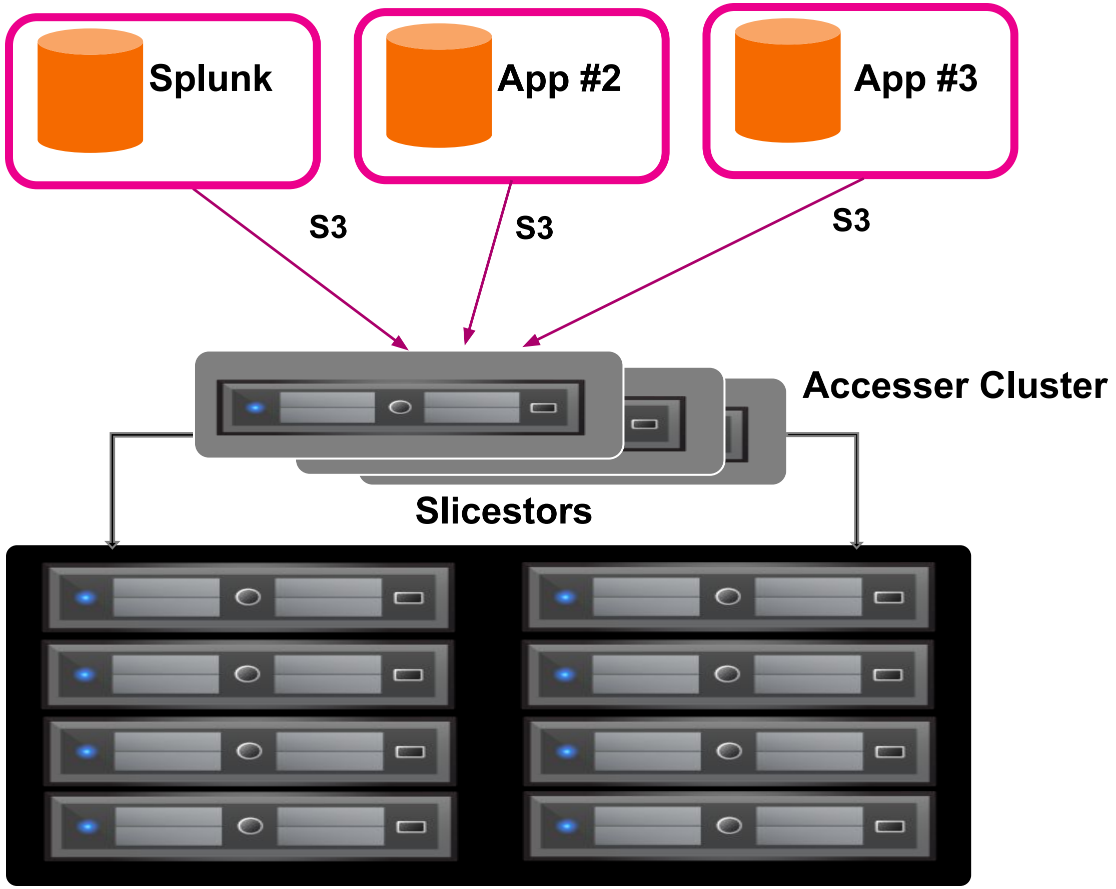
1 PB	Usable Storage	1 PB
3.6 PB	Raw Storage	1.7 PB
900	4TB Disks	432
3.6x	Racks Required	1.7x
3.6x	Floor Space	1.7x
3 FTE	Ops Staffing	.5 FTE
Replication/backup	Extra Software	None

$

70%

+

Why is Cloud Object Storage a good fit for Unstructured Data?



IBM Cloud Object Storage Industry Leader

IDC and Gartner Market leader for over 6 years

Simplified Distributed Architecture

Access from anywhere
Reduce points of failure
Enhanced durability w/ consistency checks

Simplify management

Much less to tune (no controller nodes or replication)
No snapshots or backup copies

Virtually infinite scalability

Scale Capacity to Exabytes
Flexible addition/removal

Reduced cost

Commodity hardware
Single copy protection

No file system limitations

Number of files per directories – no limit
Total objects in a volume and max size
Single volume max capacity

Custom metadata

Ready for AI/Analytics
Stored with object for new use cases

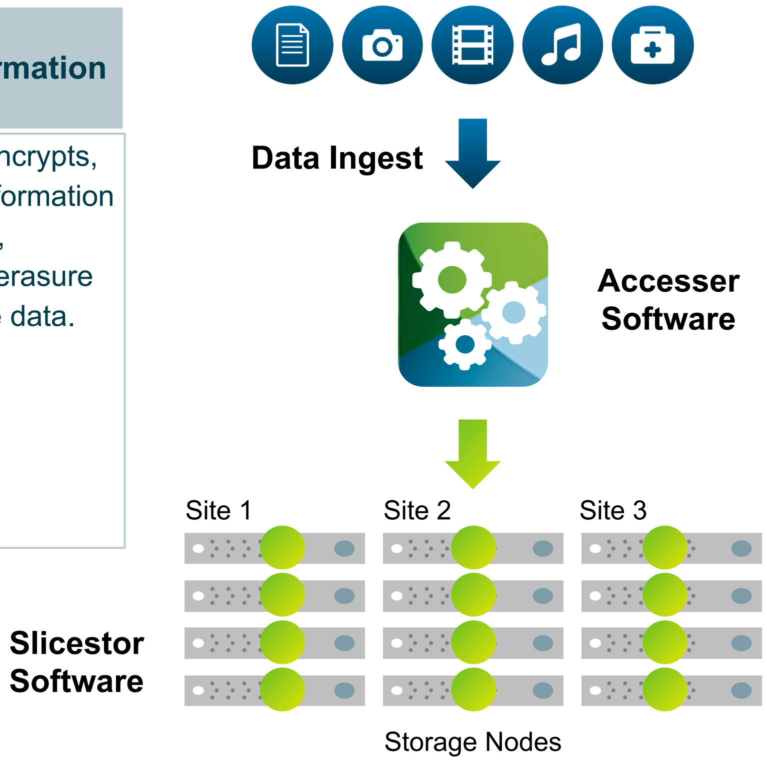
Notes:

- All deployment models supported – On Premise, Hybrid, Public Cloud
- Available as Software only; Supported on approved customer x86 platforms
- IBM appliances also available

How IBM Cloud Object Storage Works

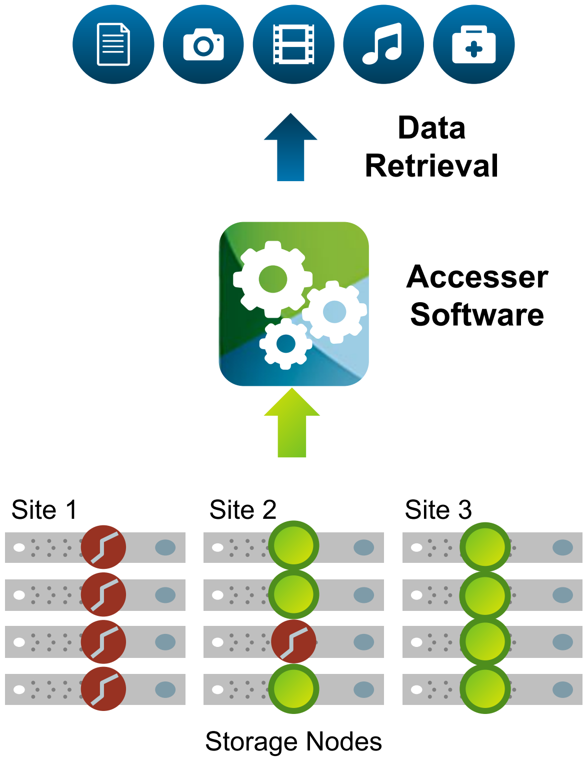
Content Transformation

IBM COS software encrypts, slices and applies Information Dispersal Algorithms, otherwise known as erasure coding policies to the data.



Physical Distribution

Slices are distributed to separate disks on industry standard x86 hardware across geographic locations.



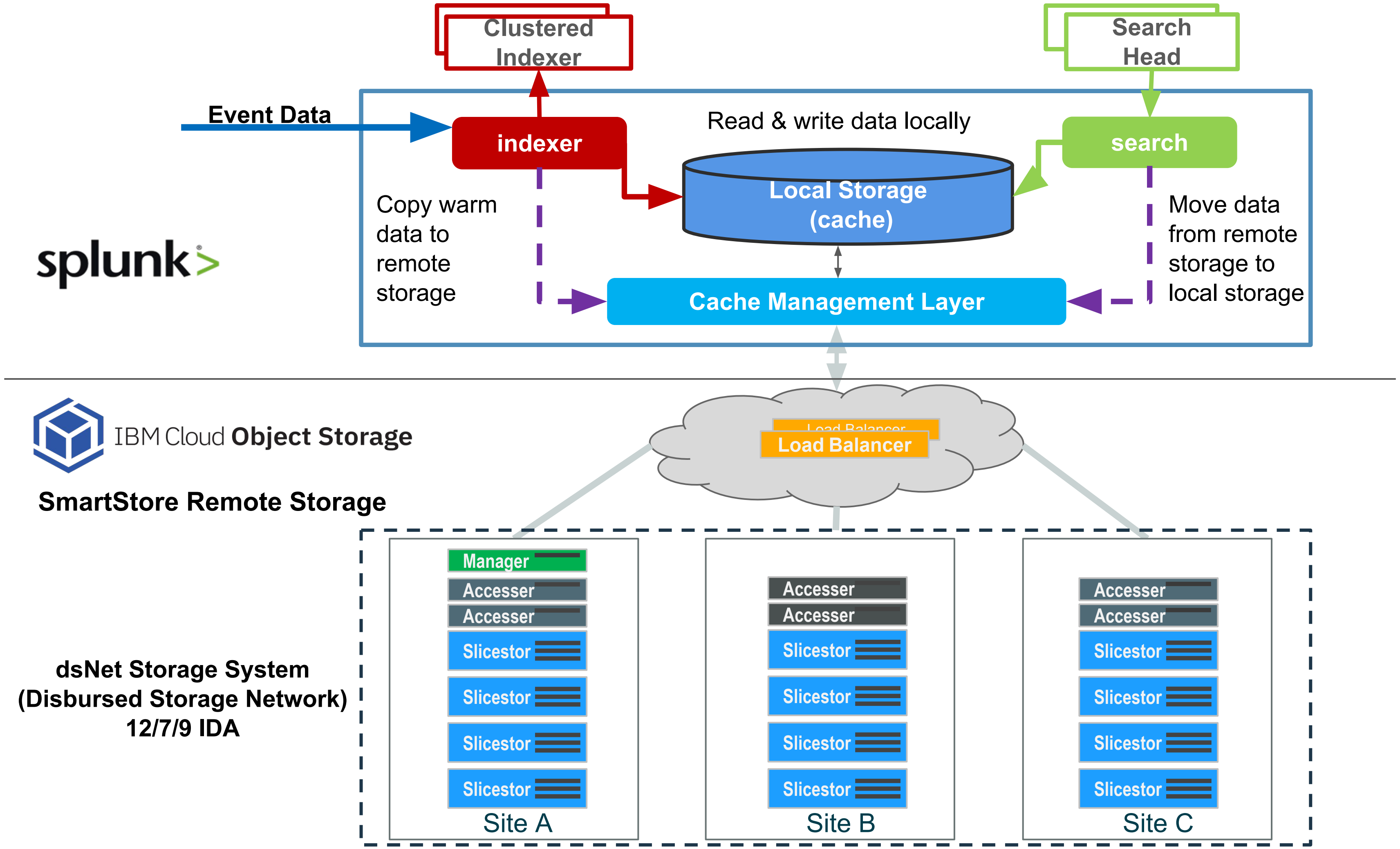
Reliable Retrieval

An operator defined subset of slices is needed to retrieve data bit perfectly in real time.

Benefits

The level of resiliency is fully customizable resulting in a massively reliable and efficient way to store data at scale as opposed to RAID and replication techniques.

Example of 1PB Data Use Case with SmartStore and COS



COS Configuration

- IDA: 12/7/9
- Data Reliability: 10 9's
- Expansion: 1.71
- 12 TB HDDs
- Usable: 1008 TB
- Primary Raw: 1728 TB
- Managers: 1
- Accessers: 6
- Slicestors: 12

- Number of Accessers can be scaled to handle throughput
- Each accesser handles approx 750MB/sec; varies depending on object size
- Slicestors can be scaled for capacity

Highlights of Splunk SmartStore with IBM COS

Splunk administrators can seamlessly increase storage as well as storage performance with IBM COS without having to scale up compute at the same time

Both Splunk and IBM COS highly flexible and extremely scalable without any downtime

- Scaling COS performance is as simple as adding more Accessers serving the storage pool
- If the dsNet becomes storage pool constrained, IBM COS allows realtime addition of additional sets of Slicestors to the storage pool to increase storage pool performance
- Additional method of scaling performance from a COS perspective: use SmartStore's ability to have different endpoints for each volume; Ex: One set of indices use one dsNet, and other indices use another dsNet

Performance

- Can be as performant as Splunk's traditional architecture – minimal performance delta with SmartStore remote storage
- ADP use case success story

Benefits of On Prem deployments

- Less capacity costs
- No retrieval charges (egress bandwidth and operational requests)
- Higher reliability
- Data in your control
- Performance you control and more predictable

Unlock the Value of Splunk SmartStore with IBM COS Key Takeaways

Take advantage of the SmartStore feature in Splunk Enterprise which has native S3 integration with IBM Cloud Object Storage

Lower TCO

- Scale Warm tier (IBM COS) independent of adding more indexing servers
- Optimize Hot tier Servers for Performance

Extend Data Retention and Maximize Data Accessibility

- Hot tier remains the same as classic architecture
- Everything else is IBM COS which is WARM and SEARCHABLE (Warm/Cold = Warm)

Agility of Infrastructure – Data not tied to Servers; No Downtime; Seamless Scalability

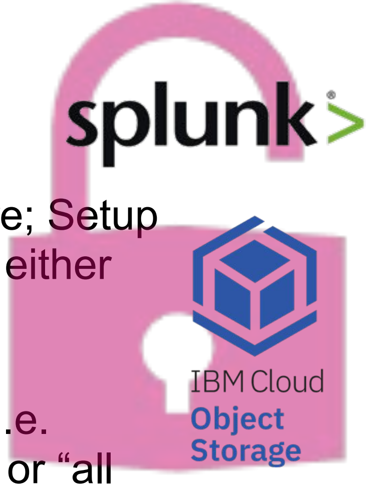
Take advantage of intrinsic HA capabilities provided by IBM COS as Warm tier remote storage

Simplify Data Management and Deployment model with only 2 tiers – Hot and Warm

Architected for Massive Scale

No size limitations on ingest with SmartStore; Setup parameters will need to be set according to either architecture

Can be implemented on a per Index basis, i.e. deployments do not have to be “all Classic” or “all SmartStore”



Key Takeaways

Splunk SmartStore

1. Decoupled compute and storage w/ SmartStore provides scale and performance at low cost

2. Supported with both cloud and on-prem object storage

3. Drives business insights with longer retention and large data volumes

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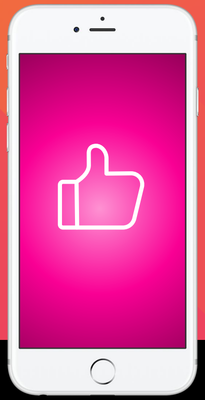
Thank You!



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Q&A

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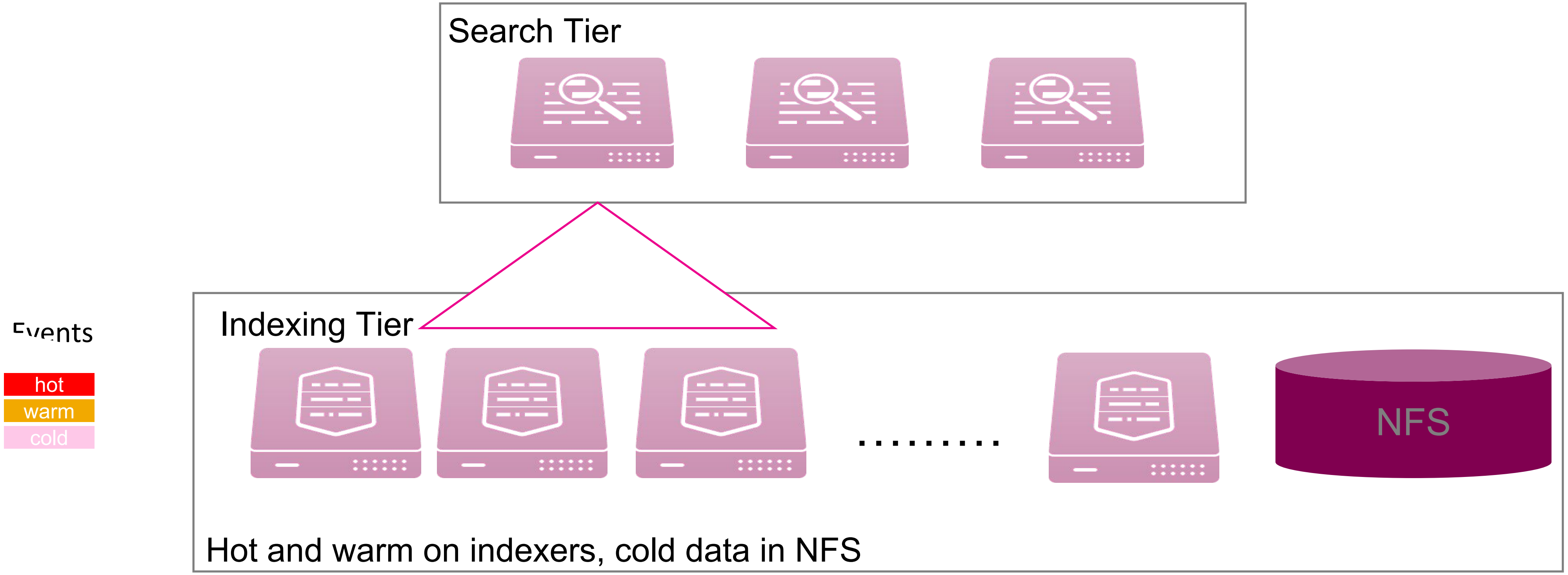
Alternatives



Hot and warm on indexers, cold data in NFS

Option #1: Reduce data retention or reduce ingest rate
Option #2: Multiple data copies in NFS (dedup offers respite)

- Searches over older datasets limited by NFS network bandwidth