Worst Practices…And How To Fix Them

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Who's This Dude?

Jeff Champagne

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Staff Architect

- Started with Splunk in the fall of 2014
- Former Splunk customer in the Financial Services Industry
- Lived previous lives as a Systems Administrator, Engineer, and Architect
- Loves Skiing, traveling, photography, and a good Sazerac

Am I In The Right Place?

Yes, if you…

- Are a Splunk Admin or Knowledge Manager
- Understand what a Distributed Splunk Architecture looks like
- Are familiar with the Splunk roles
  - Search Heads, Indexers, Forwarders
- Know what indexes are…and ideally buckets too
- Familiar with Index Clustering and Search Head Clustering

Agenda

- Data Collection
- Data Management
- Data Resiliency

DISCLAIMER

The stories you are about to hear are true; only the names have been changed to protect the innocent.

Lossless Syslog/UDP

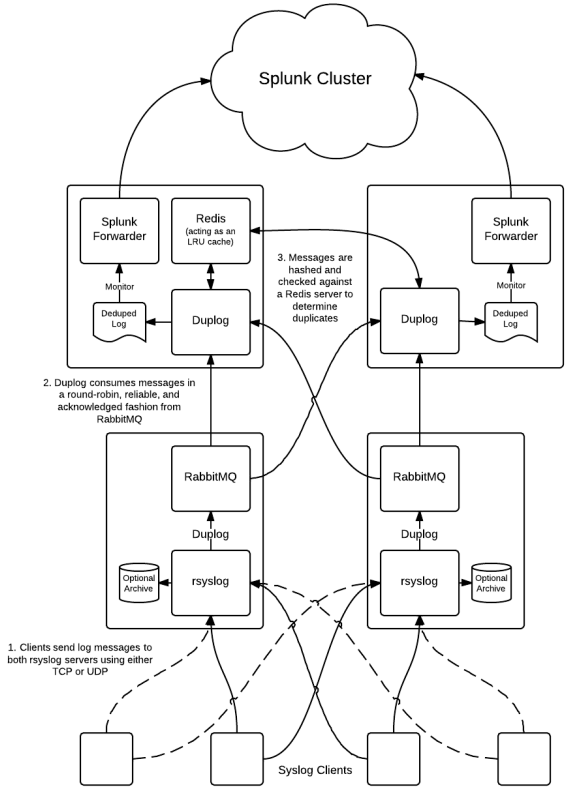
The Myth…

- Lossless data transmission over UDP does not exist
- UDP lacks error control AND flow control
  - Delivery cannot be guaranteed
  - Packets may be lost
    - They never arrived due to network issues
    - They were dropped due to a busy destination
  - Retransmits can result in duplicates
- You can engineer for redundancy
  - Loss can still happen
  - Avoid over-engineering

Worst Practice

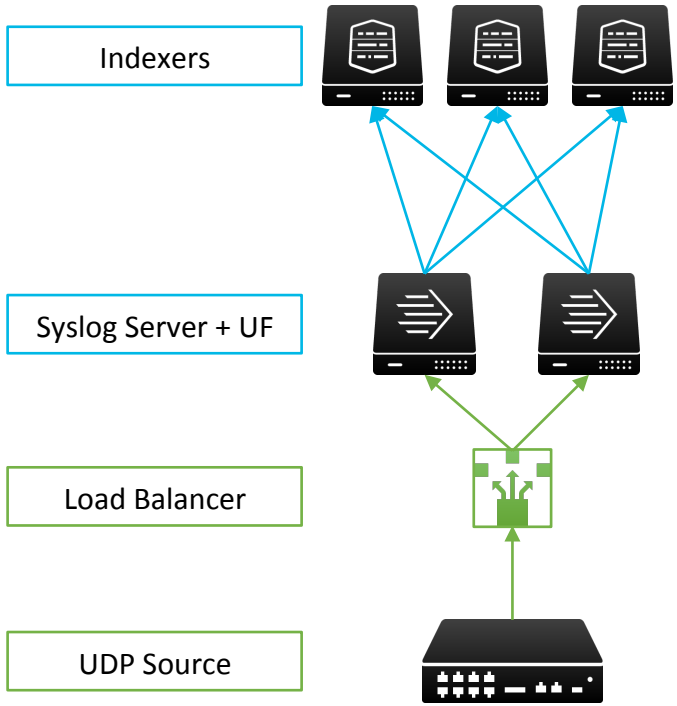
Over-Engineering

- Don’t engineer a solution for syslog that is more complex than Splunk itself!
- Loss of data is still possible
  - UDP does not guarantee delivery…make peace with it
- Design for redundancy while maintaining minimal complexity

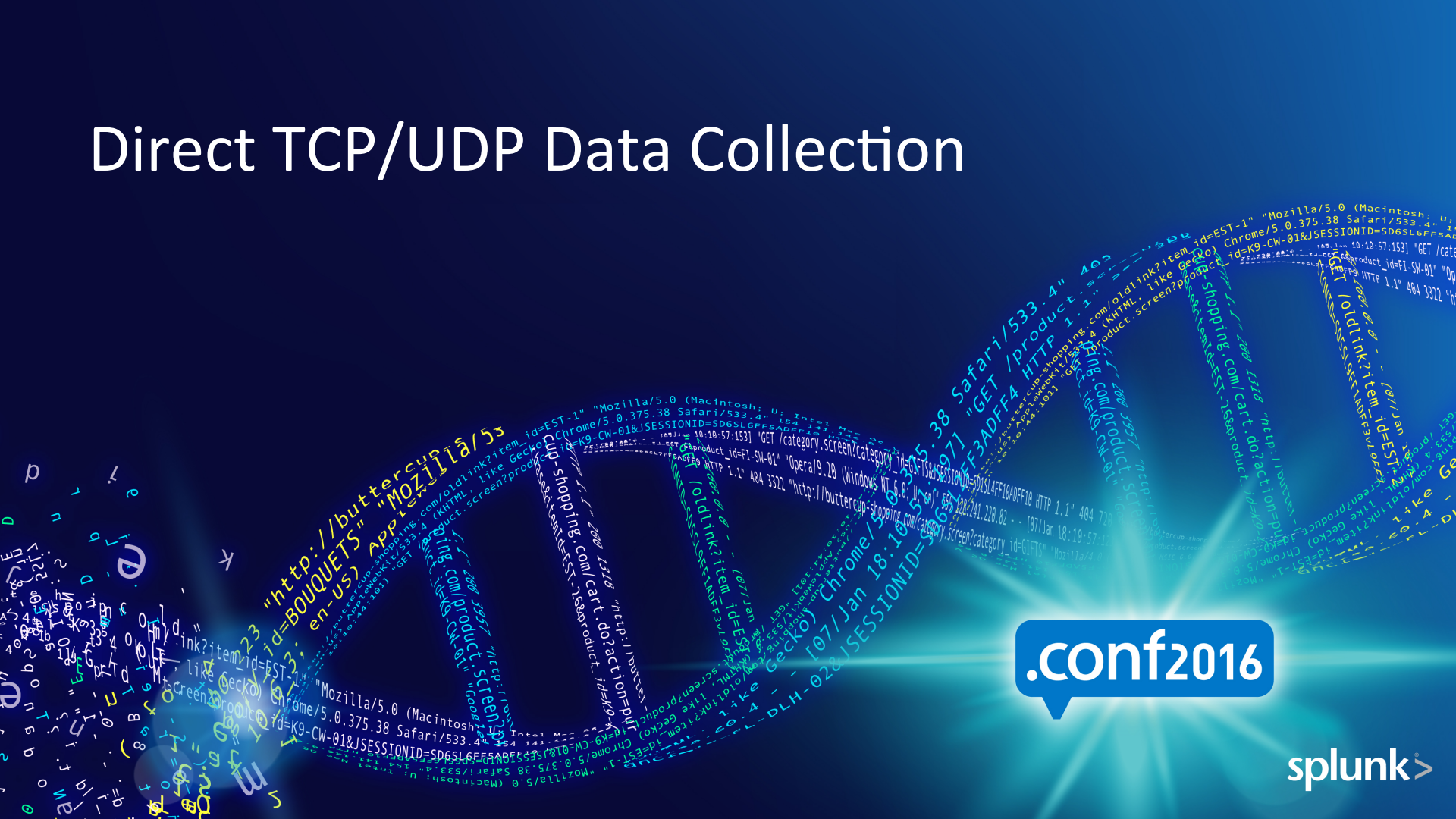


Best Practice

- Goal: Minimize loss
- K.I.S.S. – Keep it Simple…Silly
  - Incorporate redundancy without making it overly complex
- Utilize a syslog server
  - Purpose built solution
  - Gives more flexibility
    - Host extraction, log rolling/retention
- Minimize # of network hops between source and syslog server

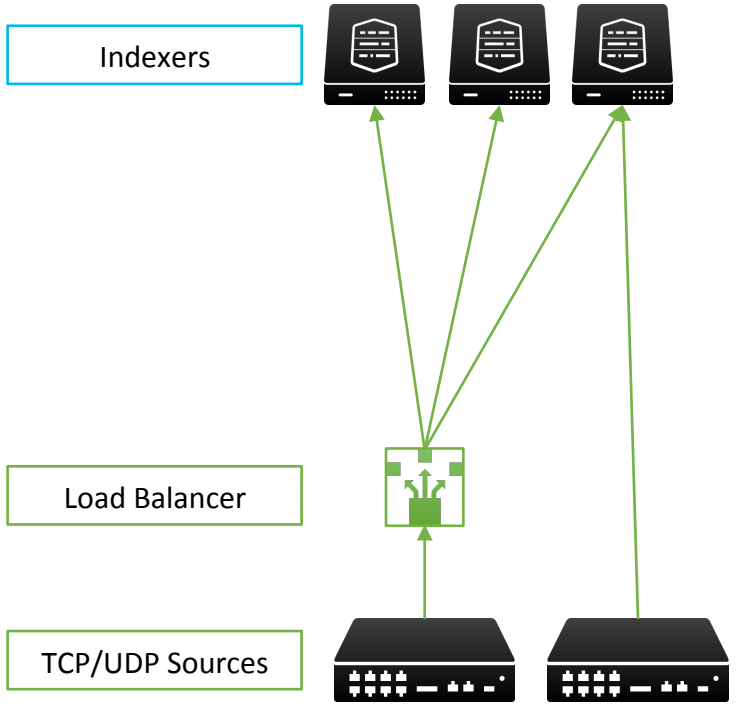


Direct TCP/UDP Data Collection



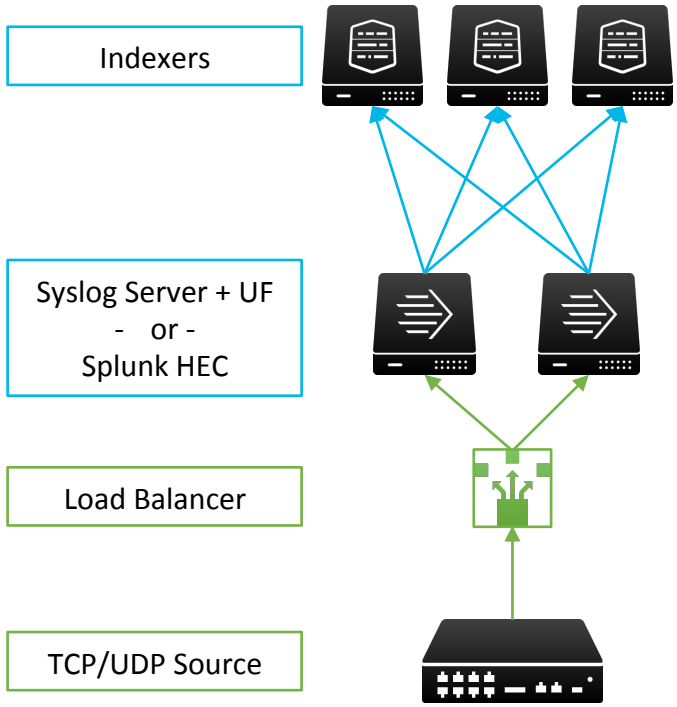
Worst Practice

- TCP/UDP stream sent to Indexers
  - Directly or via Load Balancer
- Event distribution on Indexers is CRITICAL
  - Distribute your search workload as much as possible across Indexers
- Load Balancers
  - Typically only DNS load balancing
    - Large streams can get stuck on an Indexer
  - Don't switch Indexers often enough



Best Practice

- This looks familiar…
  - It should, it's the same as the recommended UDP/Syslog configuration
- Splunk AutoLB
  - Handles distributing events across Indexers automatically
  - forceTimebasedAutoLB can be used for large files or streams
- Utilize a syslog server
  - For all the same reasons we discussed before



Forwarder Load Balancing

Load Balancing

A Primer…

- What is it?
  - Distributes events across Indexers
  - Time switching

outputs.conf

```
autoLB = true
autoLBFrequency = 30
```

- Why is it important?
  - Distributed Processing
    - Distributes workload
    - Parallel processing
- When does it break?
  - Large files
  - Continuous data streams

- How does it break?
  - Forwarder keeps sending to the same Indexer until:

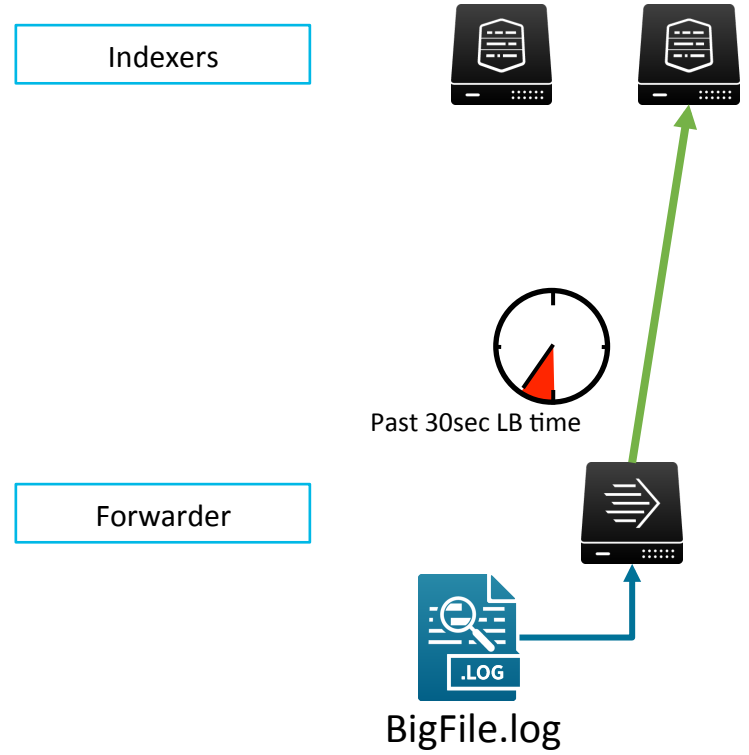
inputs.conf

```
[monitor://<path>]
time_before_close = 3
  * Secs to wait after EoF
[tcp://<remote server>:<port>]
rawTcpDoneTimeout = 10
```

  - Regardless of [autoLBFrequency]
- Why does that happen?
  - UF doesn't see event boundaries
  - We don't want to truncate events

Worst Practices

- Using the UF to monitor…
  - Very large files
  - Frequently updated files
  - Continuous data streams
- …Without modifying default autoLB behavior
  - Forwarder can become “locked” onto an Indexer
  - Settings that can help
    - [forceTimeBasedautoLB]
    - UF Event Breaking New!

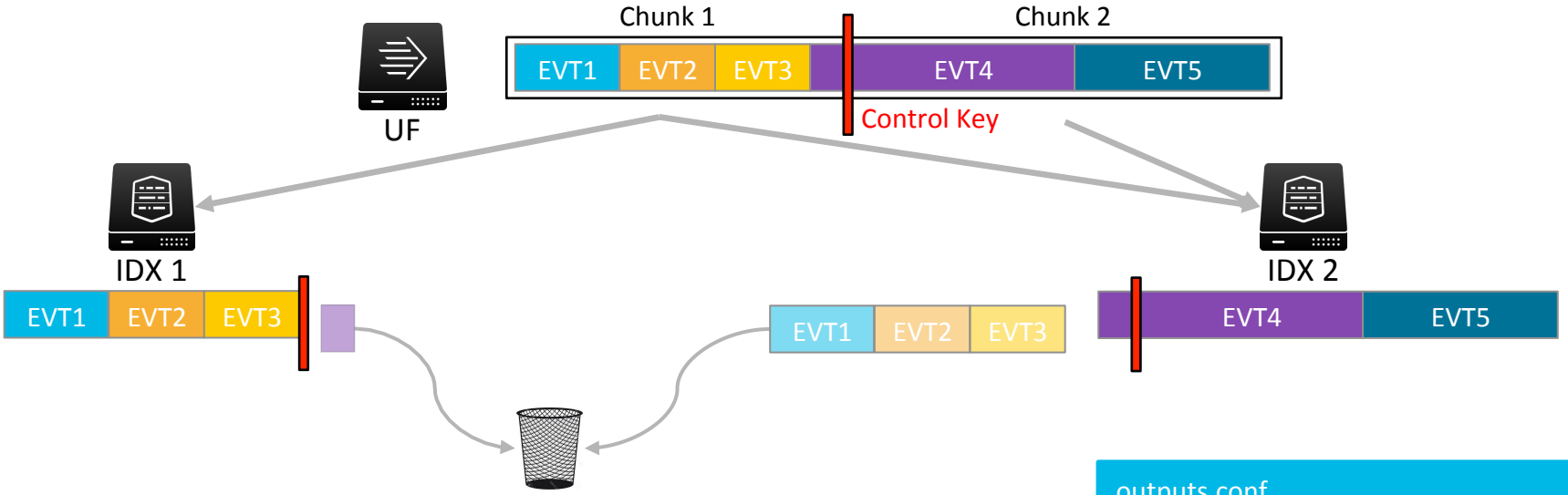


Best Practices

- If you're running 6.5 UFs…
  - Use UF event breaking 

- If you're running a pre-6.5 UF...
  - Use [forceTimebasedAutoLB]
    - Events may be truncated if an individual event exceeds size limit
  - Know the limits
    - File Inputs: 64KB
    - TCP/UDP Inputs: 8KB
    - Mod Inputs: 65.5KB (Linux Pipe Size)

forceTimebasedAutoLB



outputs.conf

```
autoLB = true
autoLBFrequency = 30
forceTimebasedAutoLB = true
```

UF Event Breaking

- Brand Spankin' New in Splunk 6.5!
  - Only available on the Universal Forwarder (UF)
- What does it do?
  - Provides lightweight event breaking on the UF
  - AutoLB processor now sees event boundaries
    - Prevents locking onto an Indexer
    - [forceTimeBasedautoLB] not needed for trained Sourcetypes
- How does it work?
  - Props.conf on UF
  - Event breaking happens for specified Sourcetypes
  - Sourcetypes without an event breaker are not processed
    - Regular AutoLB rules apply

props.conf

```
[sourcetype]
EVENT_BREAKER_ENABLE = True
EVENT_BREAKER = <regEx>
```

Intermediate Forwarders Gone Wrong

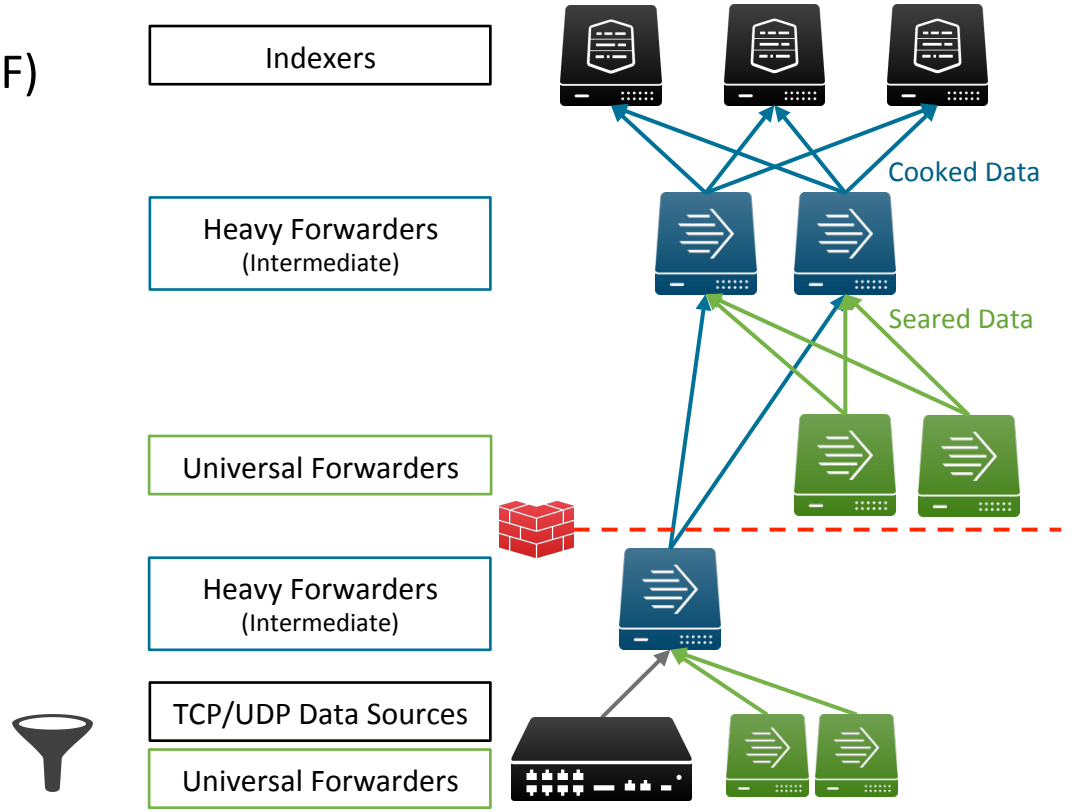
Intermediate forwarder

noun

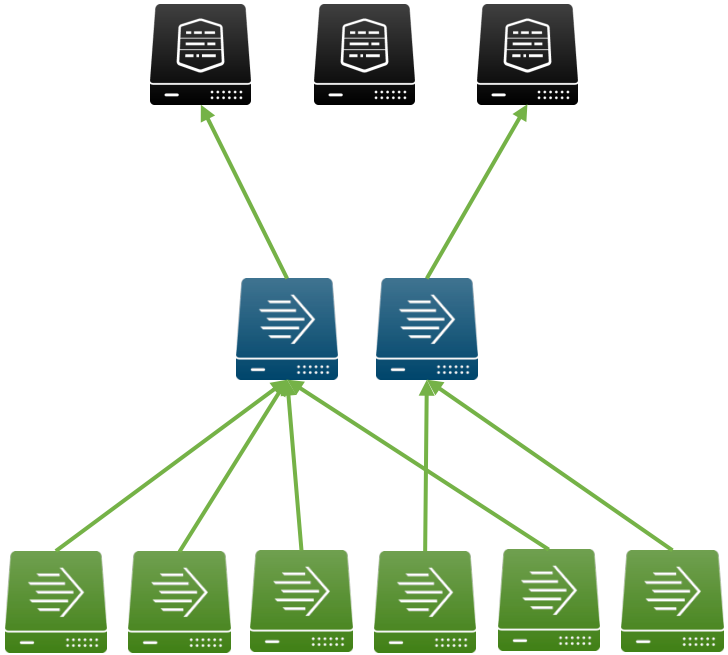
: A Splunk Forwarder, either Heavy or Universal, that sits between a Forwarder and an Indexer.

Worst Practice

- Only use Heavy Forwarders (HWF) if there is a specific need
  - You need Python
  - Required by an App/Feature
    - HEC, DBX, Checkpoint, et…
  - Advanced Routing/Transformation
    - Routing individual events
    - Masking/SED
  - Need a UI on the Forwarder
- What's Wrong with my HWFs?
  - Additional administrative burden
    - More conf files needed on HWFs
    - Increases difficulty in troubleshooting
  - Cooked Data vs. Seared
  - UFs can usually do the same thing
    - Intermediate Forwarding
    - Routing based on data stream



The Funnel Effect



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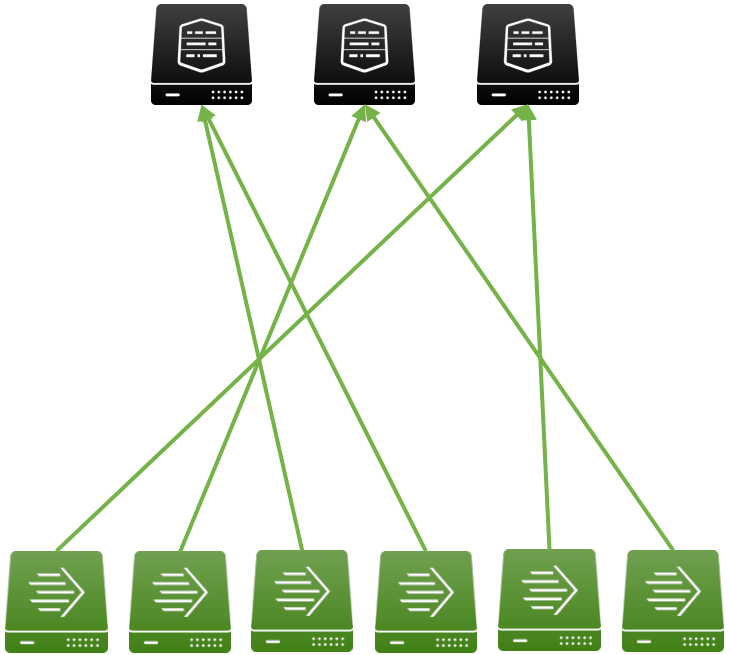
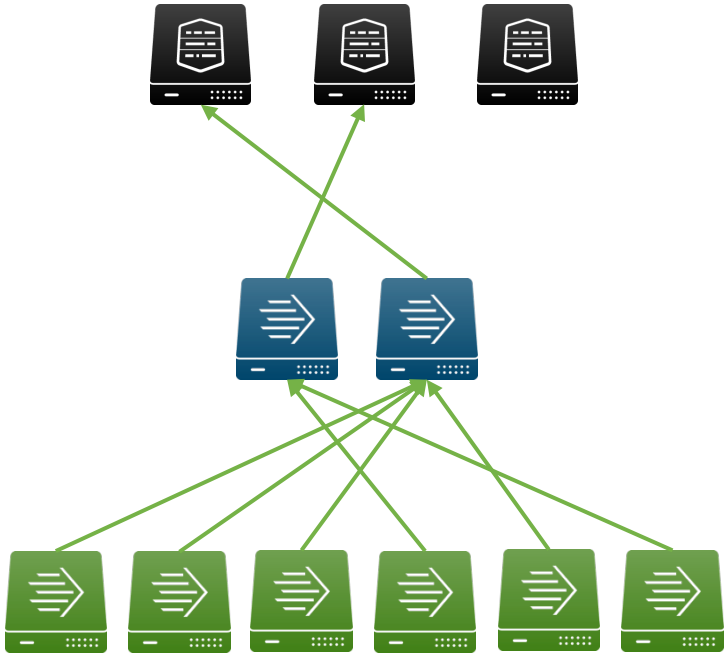


The Funnel Effect



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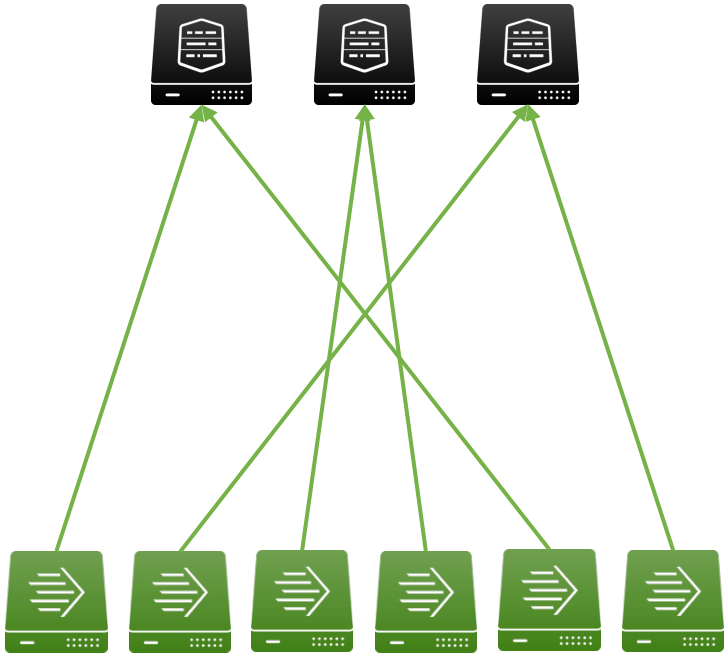
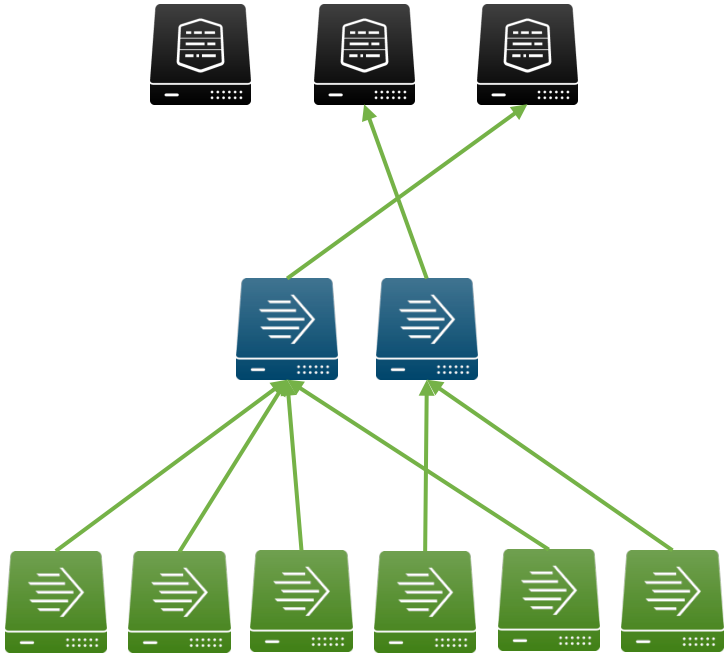


The Funnel Effect



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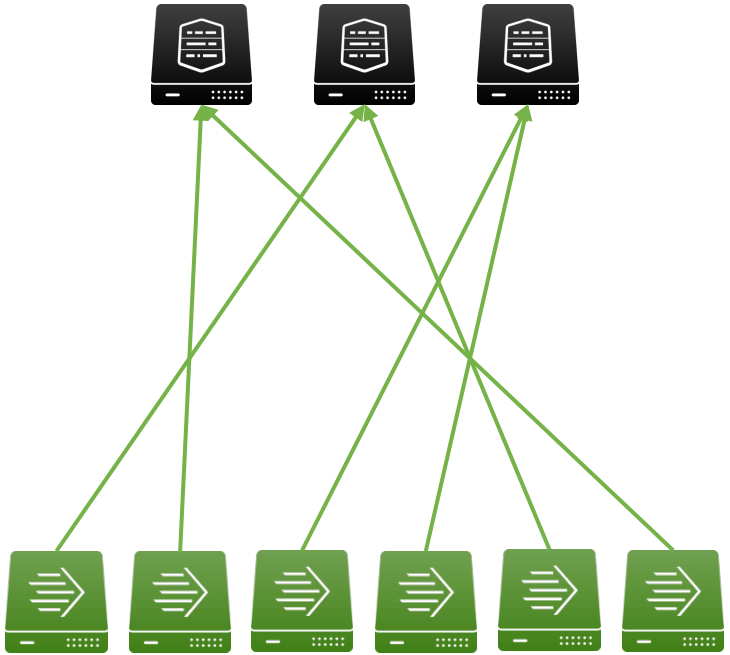
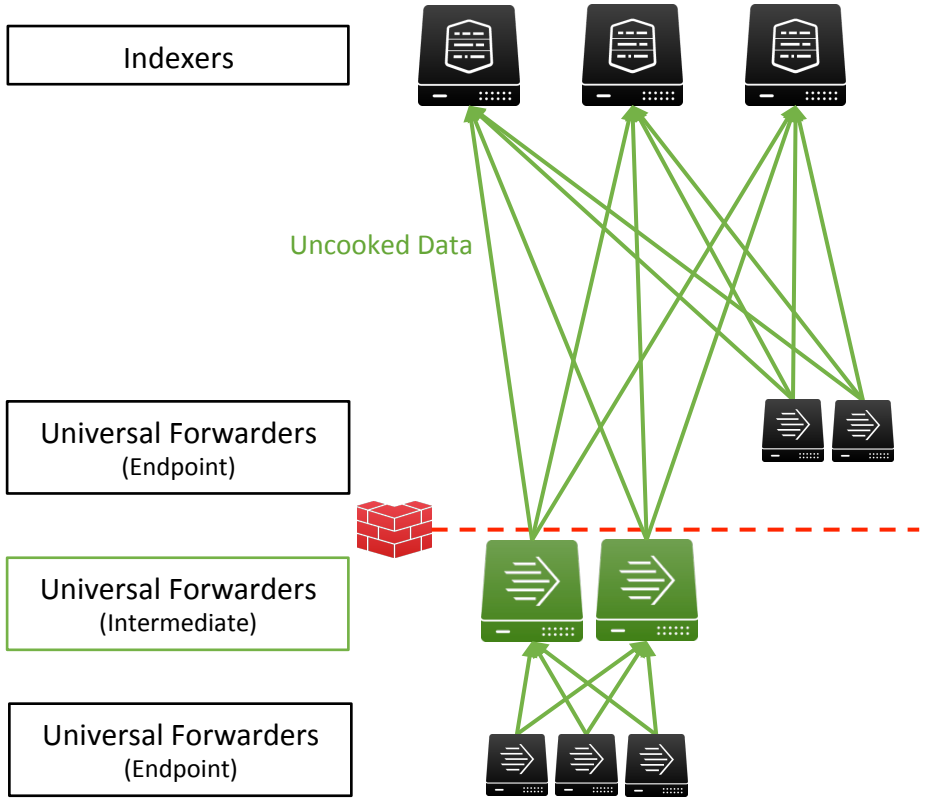


Best Practice

- Intermediate Forwarders
  - Limit their use
  - Most helpful when crossing network boundaries
  - Utilize forwarder parallelization
    - Avoid the “funnel effect”
- UFs → Indexers
  - Aim for 2:1 ratio
    - Parallelization or Instances
  - More UFs avoids Indexer starvation
- UF vs. HWF
  - Seared data vs. cooked
  - Less management required for conf files



Want To Know More?

- **Harnessing Performance and Scalability with Parallelization**
  by Tameem Anwar, Abhinav, Sourav Pal
  - Tuesday, Sept 27th 5:25PM – 6:10PM

Data Onboarding

Sourcetype Recognition

- Avoid automatic sourcetype recognition where possible
- Specify the sourcetype in *inputs.conf*

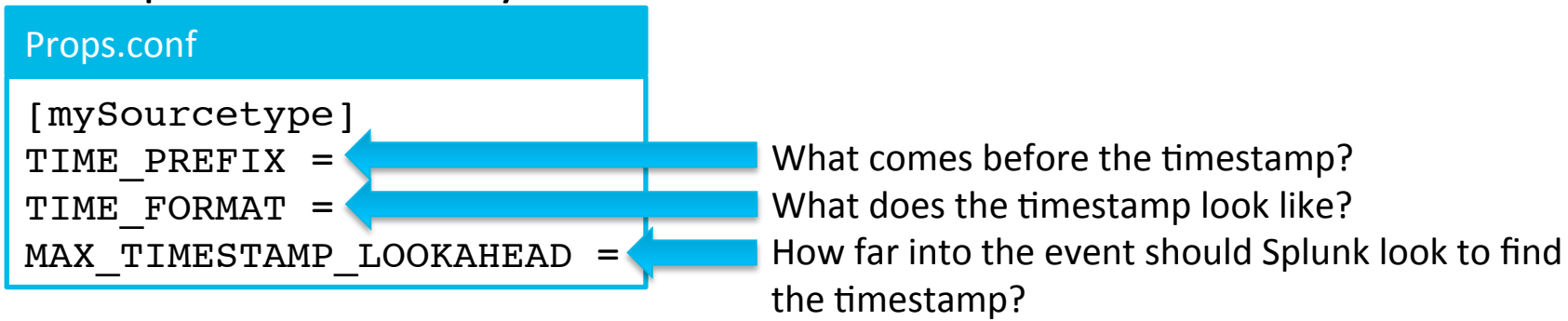
Inputs.conf

```
[monitor:///var/log]
sourcetype = mylog
```

- Don't let Splunk guess for you
  - Requires additional processing due to RegEx matching
  - "too small" sourcetypes may get created

Timestamps

- Don’t let Splunk guess
  - Are you sensing a theme?
  - Side Effects
    - Incorrect Timestamp/TZ extraction
    - Missing/Missed Events
    - Bucket Explosion
- These parameters are your friends



Event Parsing

- Line Breaking
  - Avoid Line Merging
    - SHOULD_LINEMERGE = true
    - BREAK_ONLY_BEFORE_DATE, BREAK_ONLY_BEFORE, MUST_BREAK_AFTER, MUST_NOT_BREAK_AFTER, etc…
  - LINE_BREAKER is much more efficient

Props.conf

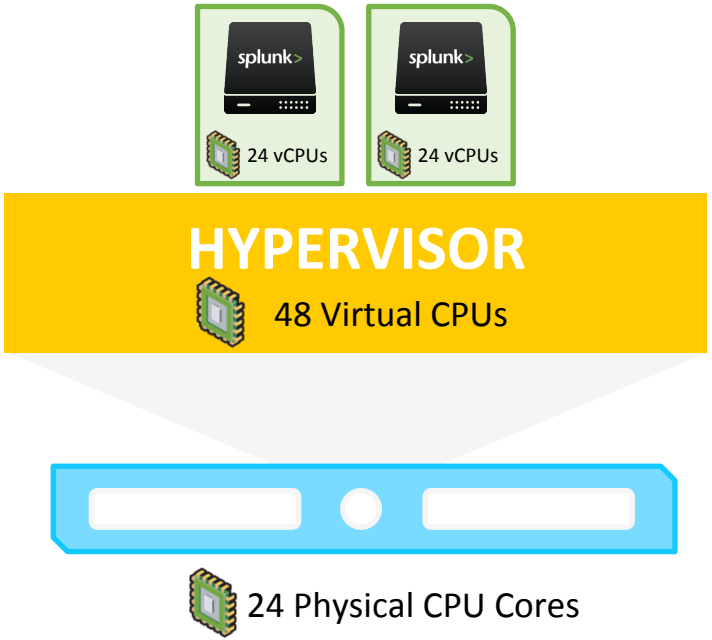
```
[mySourcetype]
SHOULD_LINEMERGE = false
LINE_BREAKER =
```

    - Uses RegEx to determine when the raw text should be broken into individual events

Virtualization

Worst Practice

- Who can spot the problem?
- vCPUs != Physical Cores
- Intel Hyper-threading
  - Doubles # of *logical* CPUs
  - Can improve performance 10-15%
    - Average gain
    - Some scenarios is 0% (dense searches)
    - Some scenarios it is more than 15%
  - Not magic

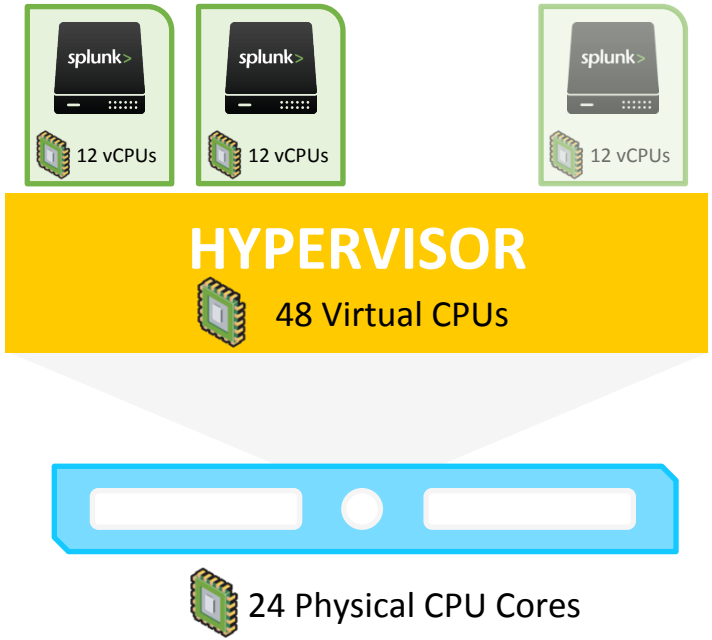


Best Practice

- Beware of Oversubscription
  - % Ready should be <2%
  - With available resources, consider adding VMs
- VM vCPU Allocation
  - Do not exceed physical cores
  - Allocate wide & flat
    - 1 core per virtual socket
- Know your NUMA boundaries
  - Align vCPU/Memory allocation
  - Smaller VMs are easier to align
- Don't put multiple Indexers on the same Host
  - Disk I/O is a big bottleneck, Indexers need a lot
- Consider increasing SH concurrency limits
  - Only if CPU utilization is low

Limits.conf

```
[search]
base_max_searches = 6
max_searches_per_cpu = 1
```



Indexed Extractions And Accelerations

What Is An Indexed Extraction?

- Splunk stores the Key-Value pair inside the TSIDX
  - Created at index-time
  - Lose Schema-on-the-fly flexibility
  - Can improve search performance
    - Can also negatively impact performance
- Example
  - KV Pair: *Trooper=TK421*
  - Stored in TSIDX as: *Trooper::TK421*

Worst Practice

Indexed Extractions Gone Wild

- Indexing all ”important” fields
  - Unique KV pairs are stored in the TSIDX
  - KV Pairs with high cardinality increase the size of the TSIDX
    - Numerical values, especially those with high precision
  - Large TSIDX = slow searches
- Statistical queries vs. filtering events
  - Indexed extractions are helpful when filtering raw events
  - Accelerated Data Models are a better choice for statistical queries
    - A subset of fields/events are accelerated
    - Accelerations are stored in a different file from the main TSIDX

Best Practice
Indexed Extraction Considerations

- The format is fixed or unlikely to change
  - Schema on the fly doesn't work with indexed extractions
- Values appear outside of the key more often than not

```
index=myIndex Category=X1
```

```
2016-11-12 1:02:01 PM INFO Category=X1 ip=192.168.1.65 access=granted message=Access granted to X1 system
2016-11-15 12:54:12 AM INFO Category=F2 ip=10.0.0.66 message=passing to X1 for validation
```

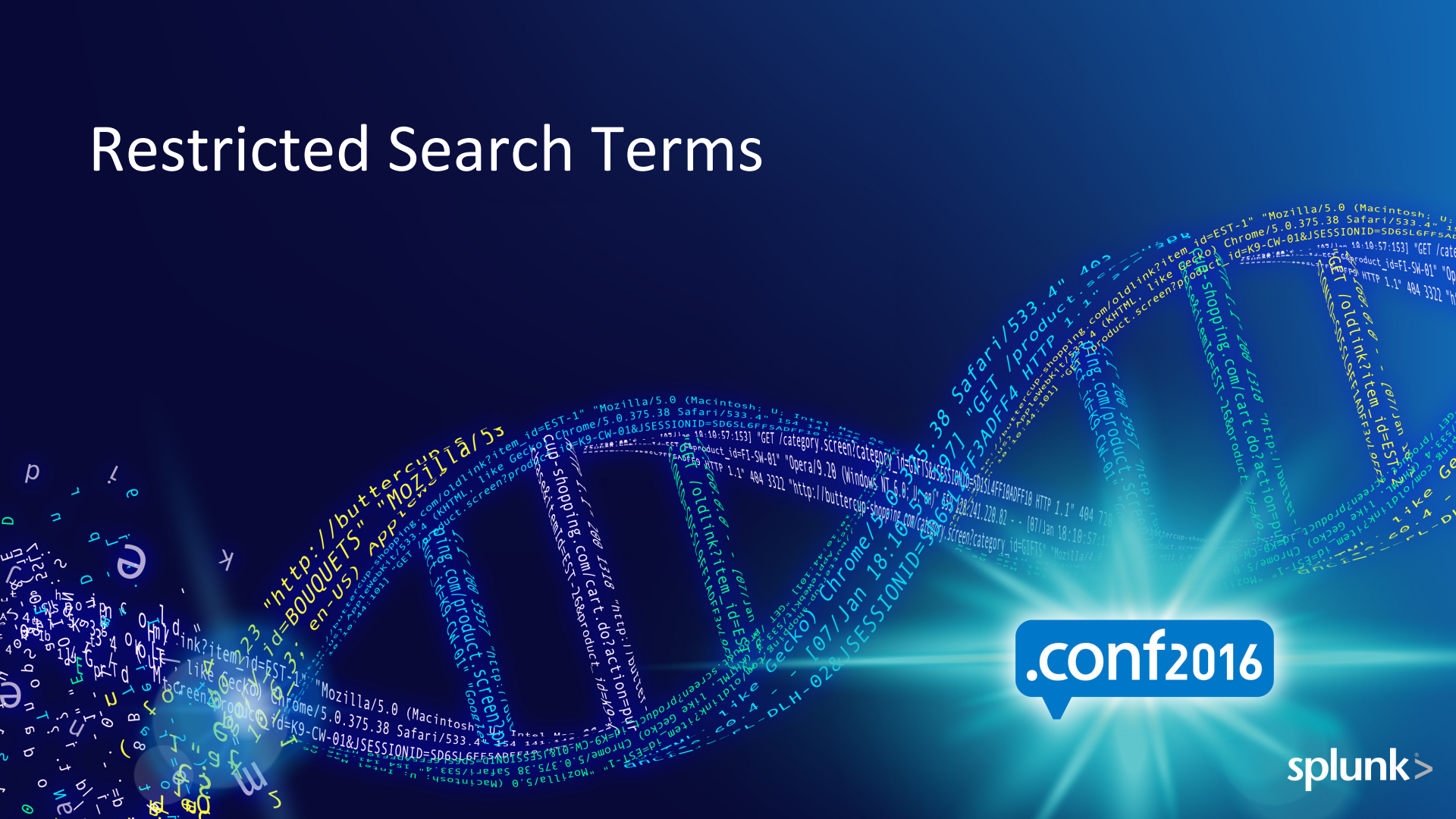
- Almost always filter using a specific key (field)
  - Categorical values (low cardinality)
  - Don't index KV pairs with high cardinality
- Frequently searching a large event set for rare data
  - KV pair that appears in a very small % of events
  - **foo!=bar** or **NOT foo=bar** and the field **foo** *nearly always* has the value of **bar**
- Don't go nuts!
  - Lots of indexed extractions = large indexes = slow performance
  - An Accelerated Data Model may be a better choice

Want To Know More?

Fields, Indexed Tokens and You by Martin Müller

- Wednesday, Sept 28th 11:00AM – 11:45PM

Restricted Search Terms



What Are Restricted Search Terms?

- Filtering conditions
  - Added to every search for members of the role as AND conditions
    - All of their searches MUST meet the criteria you specify
  - Terms from multiple roles are OR'd together
- Where do I find this?
  - Access Controls > Roles > *[Role Name]* > Restrict search terms
- Not secure unless filtering against Indexed Extractions
  - Users can override the filters using custom Knowledge Objects
  - Indexed Extractions use a special syntax
    - key::value
      Ex: sourcetype::bluecoat

Worst Practice

- Inserting 100s or 1,000s of filtering conditions
  - Hosts, App IDs
- "Just-In-Time" Restricted Terms
  - Built dynamically on the fly
    - Custom search commands/Macros
  - Can be complex/delay search setup

```
host=Gandalf OR host=frodo OR host=Samwise OR host=Aragorn OR
host=Peregrin OR host=Legolas OR host=Gimli OR host=Boromir OR
host=Sauron OR host=Gollum OR host=Bilbo OR host=Elrond OR
host=Treebeard OR host=Arwen OR host=Galadriel OR host=Isildur
OR host=Figwit OR host=Lurtz OR host=Elendil OR host=Celeborn
```

Best Practice

- Filter based on categorical fields that are Indexed
  - Remember…low cardinality
  - Indexed extractions are secure, Search-time extractions are not
    - Use key::value format
- Less is more
  - Reduce the # of KV-Pairs you're inserting into the TSIDX
    - Larger TSIDX = slower searches
  - Limit the # of filters you're inserting via Restricted Search Terms
    - Find ways to reduce the # of roles a user belongs to
    - Don't create specific filters for data that doesn't need to be secured
      - Use an "All" or "Unsecured" category

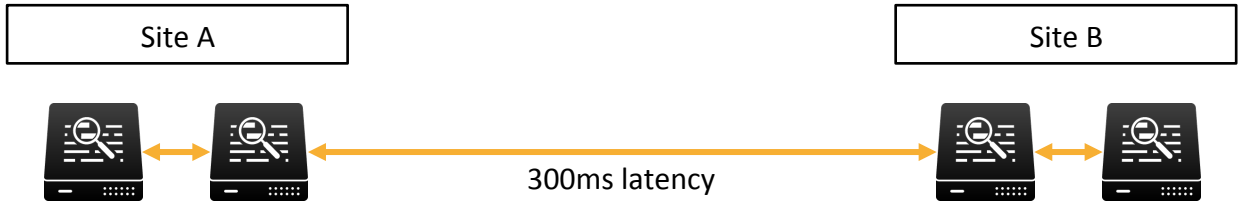
Multi-Site Search Head Clusters

Search Head Clustering

A Primer…

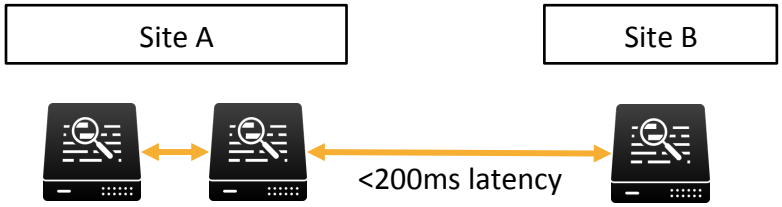
- SHC members elect a captain from their membership
- Minimum of 3 nodes required
  - Captain election vs. static assignment
- Odd # of SHC members is preferred
- Captain Manages
  - Knowledge object replication
  - Replication of scheduled search artifacts
  - Job scheduling
  - Bundle replication
- Multi-Site SHC does not exist
  - What?!
  - SHC is not site-aware
    - You're creating a stretched-SHC

Worst Practice



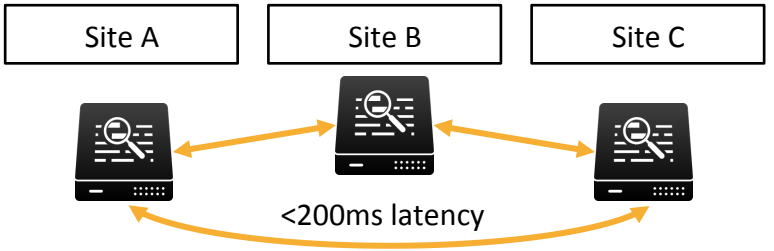
- Captain Election not possible with site or link failure
  - No site has node majority
    - Original SHC size: 4 Nodes
    - Node Majority: 3 Nodes
  - Odd # of SHC members is preferred
- WAN Latency is too high
  - We've tested up to 200ms

Best Practices



Two Sites: Semi-Automatic Recovery

- Site A has node majority
  - Captain can be elected in Site A if Site B fails
  - Captain must be statically assigned in Site B if Site A fails
- WAN latency is <200ms



Three Sites: Fully Automatic Recovery

- Node majority can be maintained with a single site failure
- Keep Indexers in 2 sites
  - Simplifies index replication
  - Avoid sending jobs to SH in 3rd site

server.conf

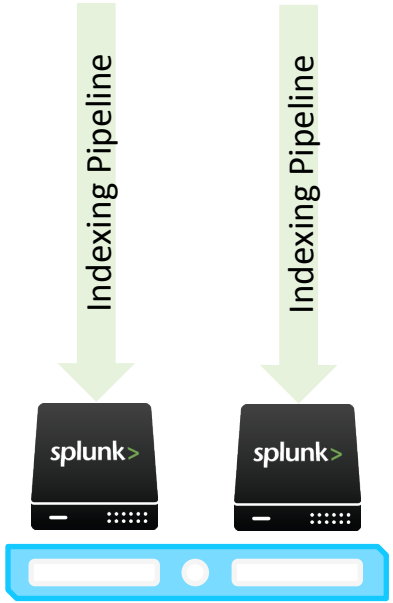
```
[shclustering]
adhoc_searchhead = true
```

Multi-Instance Indexers

Worst Practice

Two instances of Splunk on the same server

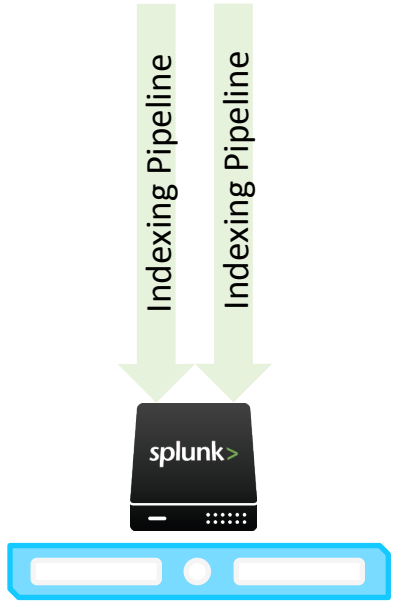
- Why would someone do this?
  - Prior to 6.3 Splunk was not able to fully utilize servers with high CPU density
- Additional Management & Overhead
  - Instances must be managed independently
    - More conf files
  - Unnecessary processes running for each instance
- Instances compete for system resources
  - CPU time, Memory, I/O



Best Practice

Single Instances with Parallelization

- Parallelization is your friend
  - Available in Splunk 6.3+
  - Single instance to manage
  - Multiple pipelines can be created for various features
    - Indexing, Accelerations, and Batch Searching
- Pay attention to system resources
  - Don't enable if you don't have excess CPU cores and I/O capacity

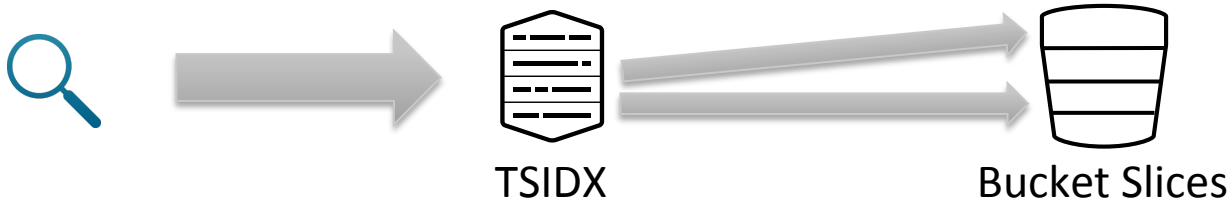


Index Management

Search Goals

How do I make my searches fast?

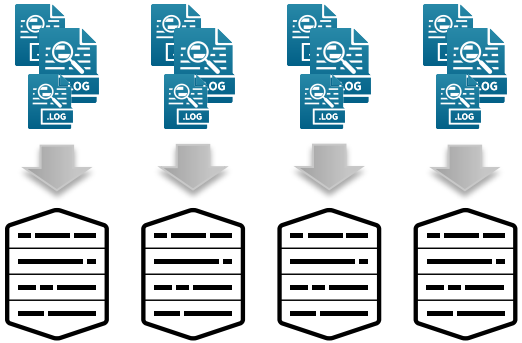
- Find what we're looking for quickly in the Index (TSIDX)
  - Lower cardinality in the dataset = fewer terms in the lexicon to search through
- Decompress as few bucket slices as possible to fulfill the search
  - More matching events in each slice = fewer slices we need to decompress
- Match as many events as possible
  - Unique search terms = less filtering after schema is applied
  - Scan Count vs. Event Count



Worst Practice

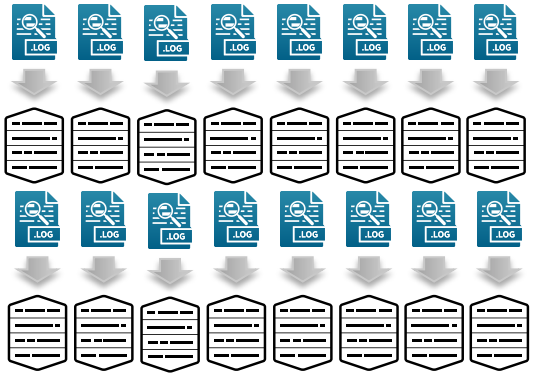
Goldilocks for Your Splunk Deployment

Mix of data in a handful of Indexes



This deployment has too few Indexes…

Dedicated Indexes for Sourcetypes



This deployment has too many Indexes…

Too Few Indexes

- What do we write to the Index (TSIDX)?
  - Unique terms
  - Unique KV Pairs (Indexed Extractions)
- Higher data mix can mean higher cardinality
  - More unique terms = Larger TSIDX
- Larger TSIDX files take longer to search
- More raw data to deal with
  - Potentially uncompressing more bucket slices
  - Searches can become less dense
    - Lots of raw data gets filtered out after we apply schema

Too Many Indexes

If small indexes are faster, why not just create a lot of them?

- Complex to manage
- Index Clustering has limitations
  - Cluster Master can only manage so many buckets
    - Total buckets = original and replicas
  - **6.3 & 6.4:** 1M Total buckets
  - **6.5:** 1.5M Total buckets
- What if I'm not using Index Clustering?
  - Create as many indexes as you want!

Best Practice

When to Create Indexes

- Retention
  - Data retention is controlled per index
- Security Requirements
  - Indexes are the best and easiest way to secure data in Splunk
- Keep “like” data together in the same Index
  - Service-level Indexes
    - Sourcetypes that are commonly searched together
    - Match more events per bucket slice
  - Sourcetype-Level Indexes
    - Data that has the same format
    - Lower cardinality = smaller TSIDX

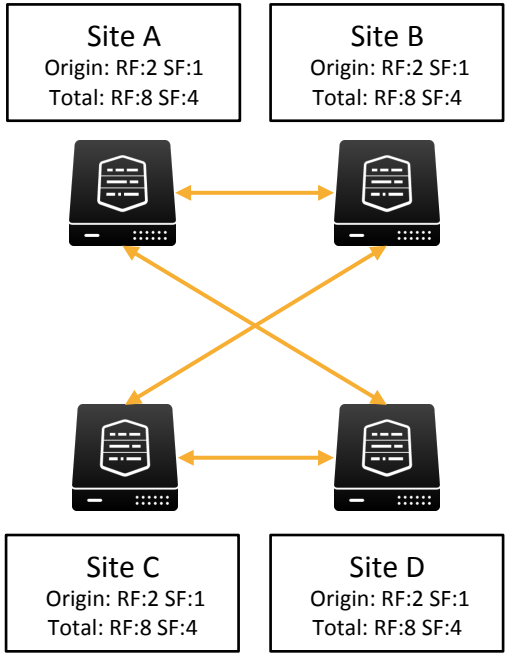
What If I Need Thousands Of Indexes To Secure My Data?

- Don't. ☺
  - More indexes = more buckets = bad for your Index Cluster
- Look for ways to reduce the complexity of your security model
  - Organize by Service
    - Collection of apps/infrastructure
  - Organize by groups
    - Org, Team, Cluster, Functional Group
- Consider Indexed Extractions & Restricted Search Terms
  - More on this later…

Index Replication

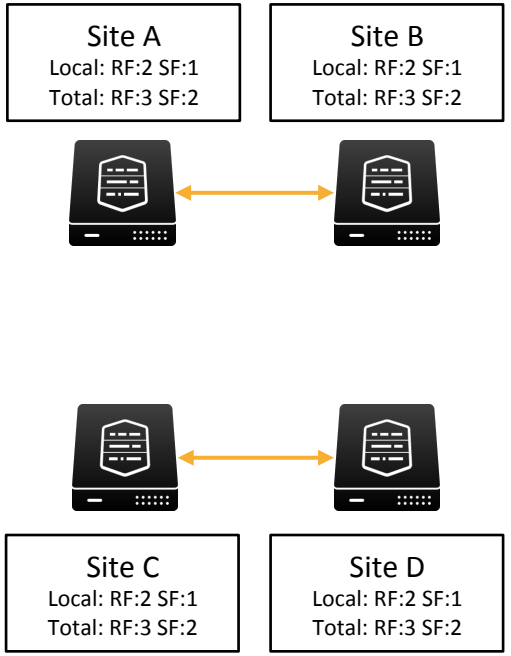
Worst Practice

- Lots of Replicas & Sites
  - 8 Replicas in this example
  - 4 Sites
- Index Replication is Synchronous
  - Bucket slices are streamed to targets
  - Excess replication can slow down the Indexing pipeline
- Replication failures cause buckets to roll from hot to warm prematurely
  - Creates lots of small buckets



Best Practice

- Reduce the number of replicas
  - 2 Local copies and 1 remote is common
- Reduce the number of remote sites
  - Disk space is easier to manage with 2 sites
- WAN Latency
  - Recommended: <75ms
  - Max: 100ms
- Keep an eye on replication errors
  - Avoid small buckets



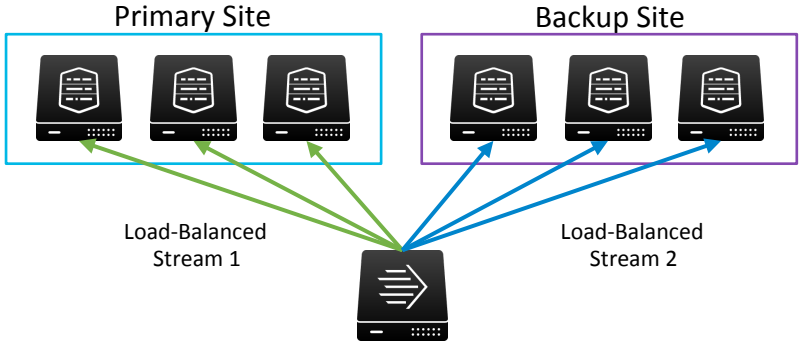
High Availability: MacGyver Style


He is the DR plan

Some Worst Practices

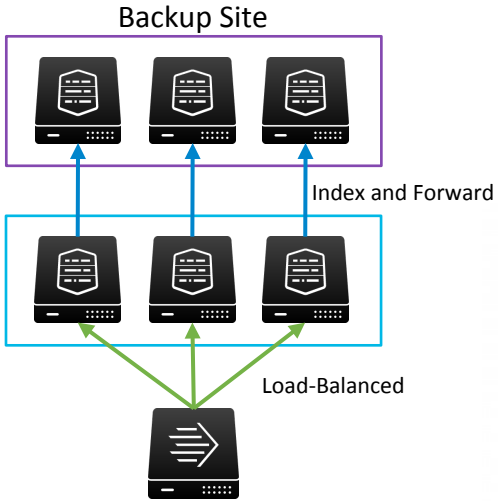
Cloned Data Streams

- Data is sent to each site
- Inconsistency is likely
  - If a site is down, it will miss data
- Difficult to re-sync sites



Index and Forward

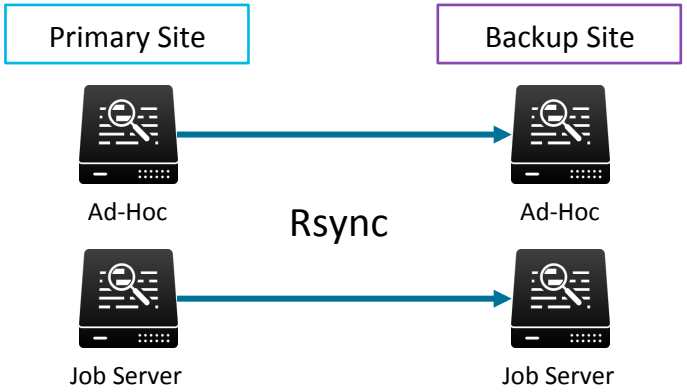
- RAID1-style HA
  - Failover to backup Indexer
- Forwarders must be redirected manually
- Complex recovery



Another Worst Practice

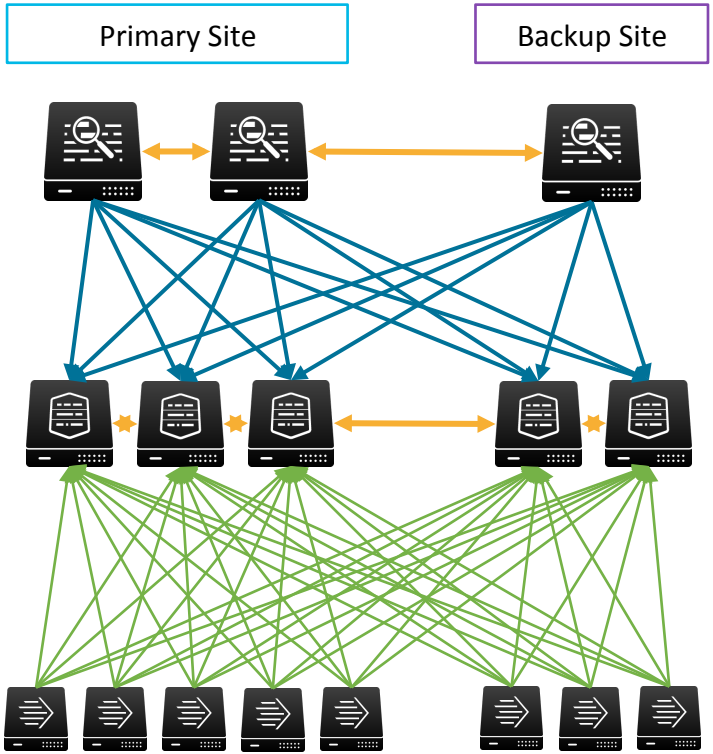
Rsync & Dedicated Job Servers

- Wasted ”standby” capacity in DR
- Inefficient use of resources between Ad-Hoc and Job Servers
- Conflict management is tricky if running active-active
- Search artifacts are not proxied or replicated
  - Jobs must be re-run at backup site



Some Best Practices

- Index Clustering
  - Indexes are replicated
  - Failure recovery is automatic
- Search Head Clustering
  - Relevant Knowledge Objects are replicated
  - Search artifacts are either proxied or replicated
  - Managed Job scheduling
    - No dedicated job servers
    - Failure recovery is automatic
- Forwarder Load Balancing
  - Data is spread across all sites
  - Replicas are managed by IDX Clustering
  - DNS can be used to ”failover” forwarders between sites or sets of Indexers



Want To Know More?

- **Indexer Clustering Internals, Scaling, and Performance** by Da Xu, Chole Yeung
  - Tuesday, Sept 27th 3:15 PM – 4:00 PM

- **Architecting Splunk for High Availability and Disaster Recovery** by Dritan Bitincka
  - Tuesday, Sept 27th 5:25PM – 6:10PM

What Now?

Related breakout sessions and activities…

- **Best Practices and Better Practices for Admins** by Burch Simon
  - Tuesday, Sept 27th 11:35AM – 12:20PM
- **It Seemed Like a Good Idea at the Time…Architectural Anti-Patterns** by David Paper Duane Waddle
  - Tuesday, Sept 27th 11:35AM – 12:20PM
- **Observations and Recommendations on Splunk Performance** by Dritan Bitincka
  - Wednesday, Sept 28th 12:05PM – 12:50PM

THANK YOU

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