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Who’s This Dude?

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- 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

- 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:

```
outputs.conf
autoLB = true
autoLBFrequency = 30
```

- 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!

Indexers

Forwarder

Past 30sec LB time

BigFile.log
Best Practices

• If you’re running 6.5 UF...  
  – 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

```
autolB = true
autolBFrequency = 30
forceTimebasedAutoLB = true
```

outputs.conf
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

```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
The Funnel Effect
The Funnel Effect

-VS-
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 UFss 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 \textit{inputs.conf}

\begin{verbatim}
[monitor:///var/log]
sourcetype = mylog
\end{verbatim}

- 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

```conf
[mySourcetype]
TIME_PREFIX =
TIME_FORMAT =
MAX_TIMESTAMP_LOOKAHEAD =
```

What comes before the timestamp?  What does the timestamp look like?  How far into the event should Splunk look to find the timestamp?
Event Parsing

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

```
[mySourcetype]
SHOULD_LINE_MERGE = 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
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
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

Dedicated Indexes for Sourcetypes

This deployment has too few Indexes...

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 and 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