Splunk for Healthcare

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splunk>

Our Focus Today Will Be Security

Think about how you can use these general concepts to query whatever data you care about

Some Healthcare Definitions

Who are the players?

- **Single-payer healthcare** is a healthcare system financed by taxes that covers the costs of essential healthcare for all residents, with costs covered by **single public system** (hence 'single-payer'). Alternatively, a **multi-payer system** is one in which **private individuals or their employers buy health insurance or healthcare services from private or public providers**

https://en.wikipedia.org/wiki/Single-payer_healthcare

- **Patients** - individuals who **receive** medical care from providers
- **Providers** - Institutions that **provide** care to patients, charge payers for that care, and buy products from vendors
- **Payers** - Institutions that **pay** providers for healthcare services, which includes insurance carriers, private employers, the government, and also individuals

http://www.mahesh-vc.com/blog/understanding-whos-paying-for-what-in-the-healthcare-industry

How Healthcare Can Benefit From Splunk

Besides easy searching...

- Providers
  - Meaningful use analysis
  - Overall patient health
  - Metrics by doctor
  - Success rates by procedure
  - Metrics on collections
- Payers
  - Common errors made by submitting providers
  - Trends on claims data
    - Breakdowns by submitter, quarter of the year, time of day, etc.
  - Metrics on payouts

athenahealth

- Founded in 1997, provides cloud based services such as network-enabled EHR, practice management and population health services
- Connecting more than 72,000 providers and health systems nationwide
- 5,000+ employees
- We were voted Forbes “Most Innovative Growth Company” and a Deloitte “Fast 500 Company” in 2014 and have earned numerous employer awards
- Three InfoSec Towers

  Risk, SIRT (Security Incident Response Team), and ITSec
- Sad fact of the day: We process over 2 million faxes a day
- We are not a payer or provider, we’re a weird mix of everything

Splunk at athenahealth

We live in Splunk

- The goal of Splunk is to take raw data and turn it into actionable context
- Easily consume data from various sources (syslog, text files, threat feeds, etc.)
- Splunk Enterprise Security (ES) for the SIRT
- Crafted alerts and reporting to look for high value targets
- If we see a bad pattern within our network, we can quickly alert and take action
- We can tweak and tailor alerts and reports over time
- Well supported: Very few issues and when we call, they answer
- Official Splunk and 3rd party apps:

Blue Coat ProxySG App For Splunk

INF Splunk App for Windows Infrastructure

ThreatStream OPTIC

Google Maps

Value to athenahealth

Why we like Splunk

- Immediate visibility (near real-time data)
- Virtually any data, even mainframe and other legacy infrastructure
- Less “alert fatigue” via very detailed and deep control
- Ability to dig in and investigate, correlate (it’s not a proprietary black hole)
- Better team efficiency - Reduce confusion and wasted time over where to look for information
- Granular permissioning
- Intuitive, easy-to-use, and responsive UI
- Designed to scale, runs on both Windows and Linux servers
- Easy win on audits: Regulators and Auditors love Splunk

How We Use It In Production

Activity monitoring within athenaNet

- Some examples of how we use Splunk within our custom SaaS application:
  - Help prove/disprove suspected compromised accounts
  - Help prove/disprove account abuse by malicious practice employees
  - Accessing of particularly sensitive information
  - Controlled prescription abuse
  - Employee activity within the application
  - Accessing sensitive records (such as celebrities)
  - Database activity

What Splunk is not...

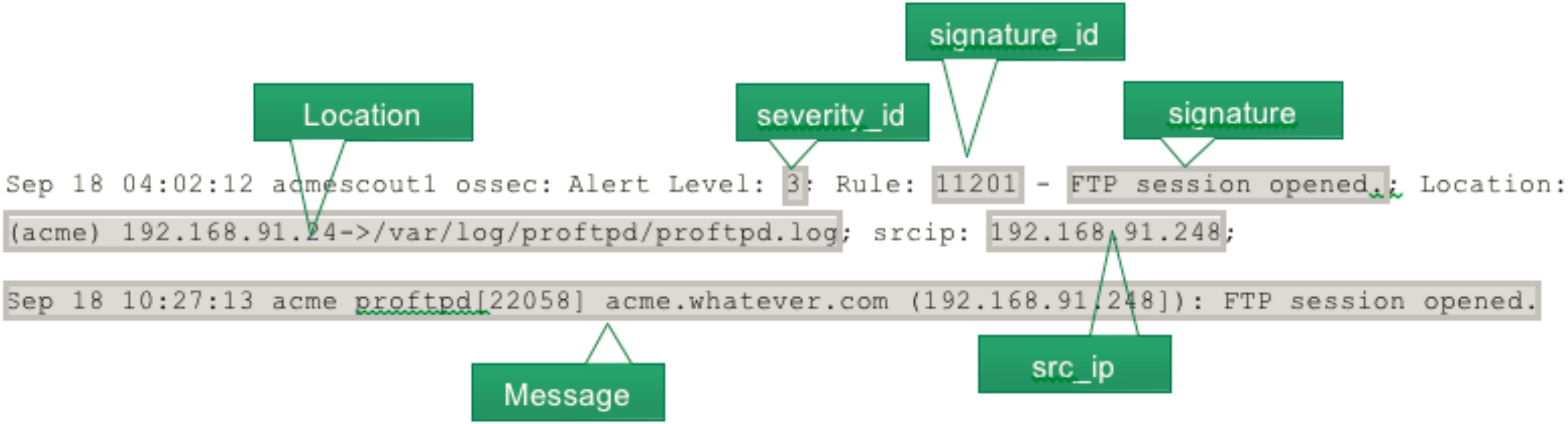
Magic, Silver Bullet, One solution, Set it and forget it

- Splunk needs to understand the data you’re throwing at it
  - Vendors change log formats constantly
  - Proprietary in-house apps and logging follow no format
- Splunk has little to no pre-canned alerts by default
  - You need to pick and chose what you want
  - There are additional apps and licenses you can buy, but they’re not magical either
- Splunk needs TLC
  - Just like all infrastructure, it needs attention and curation
  - This includes the hosted Splunk offering
- Splunk doesn’t magically get the logs, you send them to Splunk
  - Build processes need to include the syslog/Universal forwarder configuration steps

CIM Format

Why do we care? Consistent formatting allows for correlation

- Splunk attempts to classify logs as they come in
  - Many common formats are recognized: Router logs, Windows logs, Linux logs, etc.
  - If it’s not something Splunk recognizes, it makes a best guess effort
  - You can “teach” Splunk by giving it input formatting information (great for proprietary logs)
  - Some vendors (BlueCoat) change their log formats often; Splunk tries to keep up



```
Sep 18 04:02:12 acmescout1 ossec: Alert Level: 3; Rule: 11201 - FTP session opened.; Location:
(acme) 192.168.91.24->/var/log/proftpd/proftpd.log; srcip: 192.168.91.248;

Sep 18 10:27:13 acme proftpd[22058] acme.whatever.com (192.168.91.248]): FTP session opened.
```

http://docs.splunk.com/Documentation/CIM/4.8.0/User/UsetheCIMtonormalizeOSSECdata

Correlations

The real reason we love logs

- Without logs that can be correlated, it’s nearly impossible to relate events across the different platforms
- In order to correlate, it must be in CIM format!
- Example: Infection reported via anti-malware agent to Splunk
  - Alert notifies SIRT
    - End User Windows Logs: Who was on the computer? What files are on there? What was touched?
    - Web Proxy Logs: Did the machine reach out to known C&C servers?
    - File Share Logs: Did the machine read/exfiltrate or alter (ransomware) files on network shares?

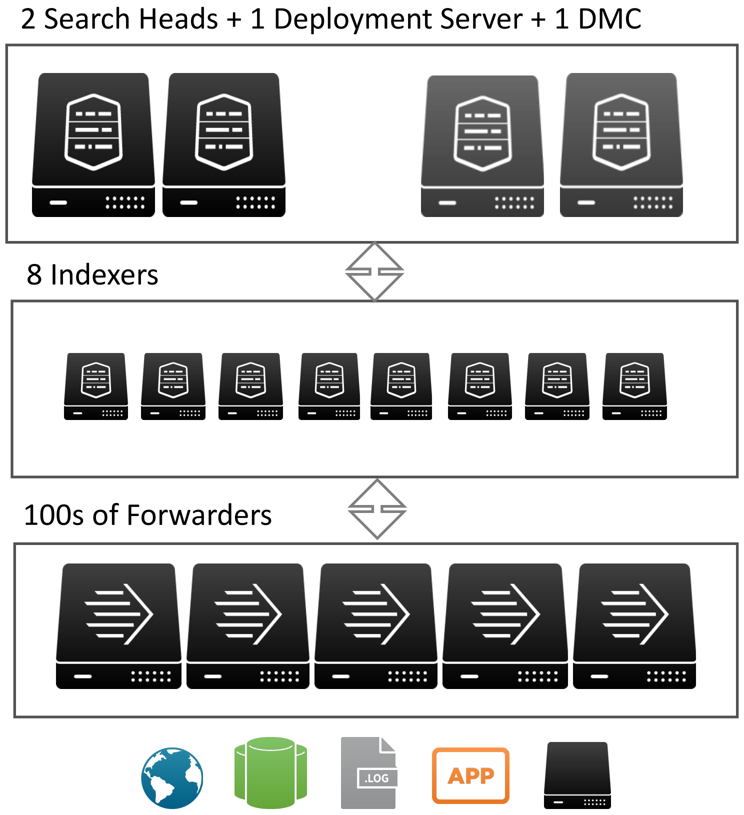
How does it work under the hood?

Trust is important: How do we ensure we don’t lose them?

Splunk at athenahealth

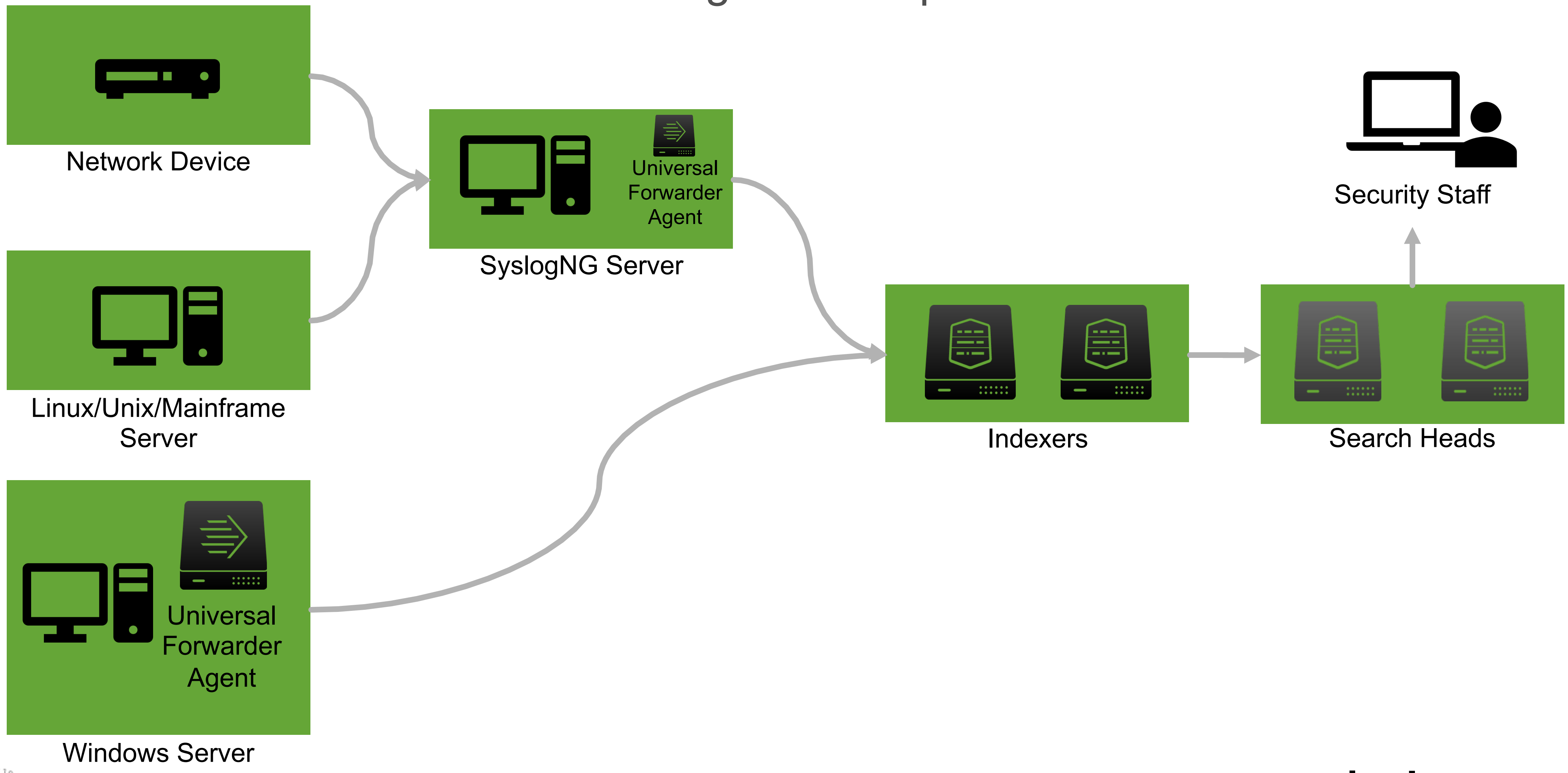
What the environment looks like

- Over ten “power users”, many regular IT staff users
- Anti-malware, anti-virus, system data, system logs, VPN/firewall/router logs, O365, various other unstructured data
- >500GB/day license
- Example: 964,201,274 events/day
- Goal: Retain up to two years of searchable data
- Retention varies by the type and value of the data
- Windows logs are the most verbose
- There are ways to ignore verbose data you don’t need



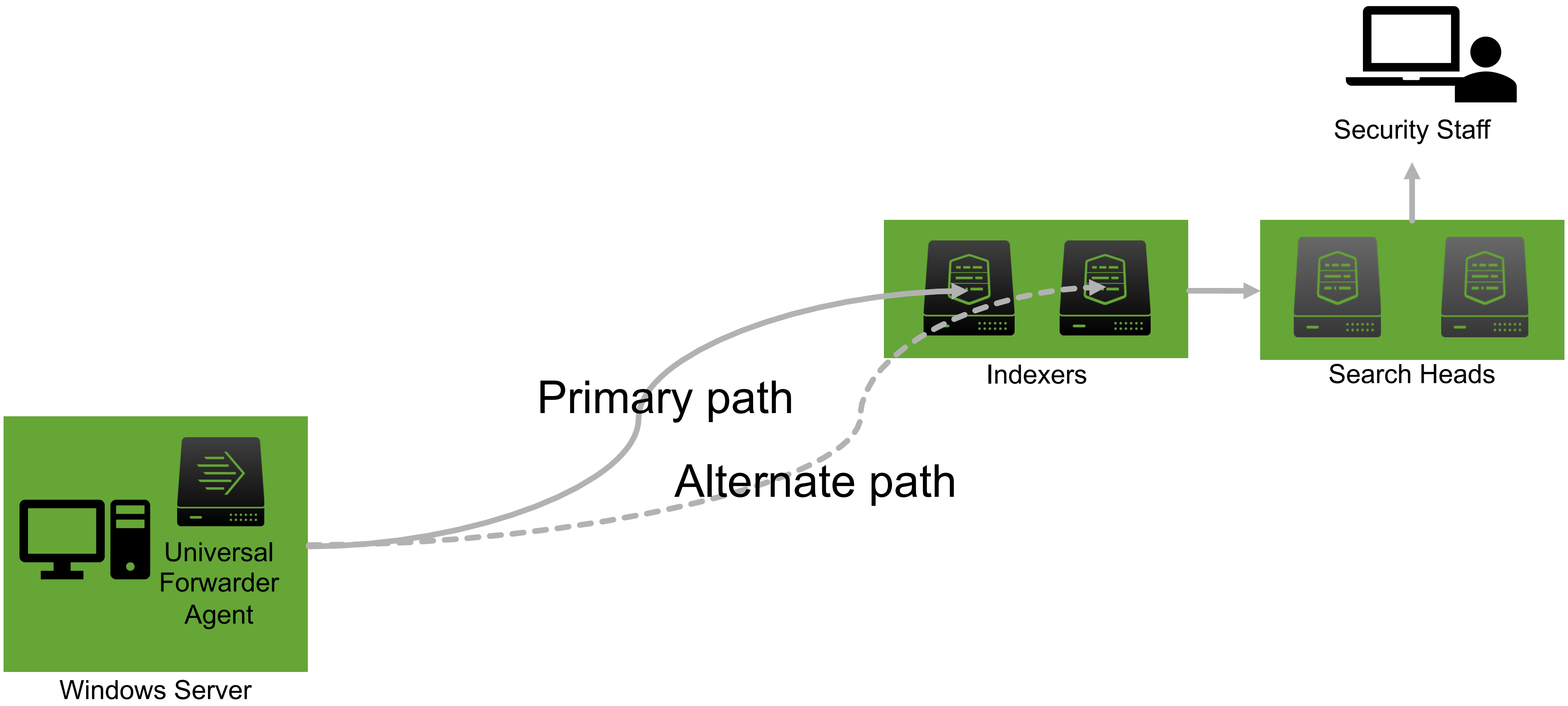
General Workflow of Splunk

How data gets into Splunk


Network Device
Linux/Unix/Mainframe Server
Universal Forwarder Agent
Windows Server
Universal Forwarder Agent
SyslogNG Server
Indexers
Search Heads
Security Staff

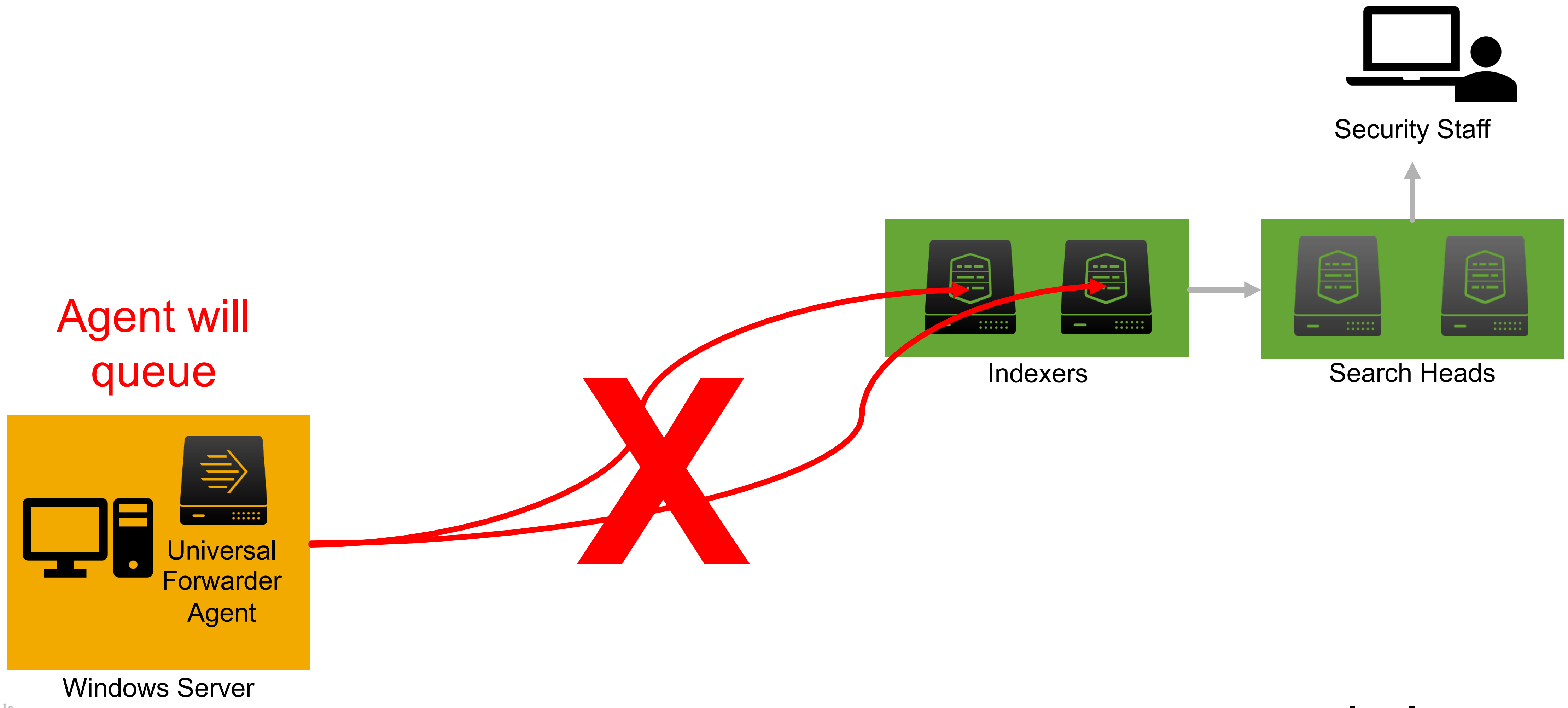
General Workflow of Splunk

Universal Forwarder: How it really works



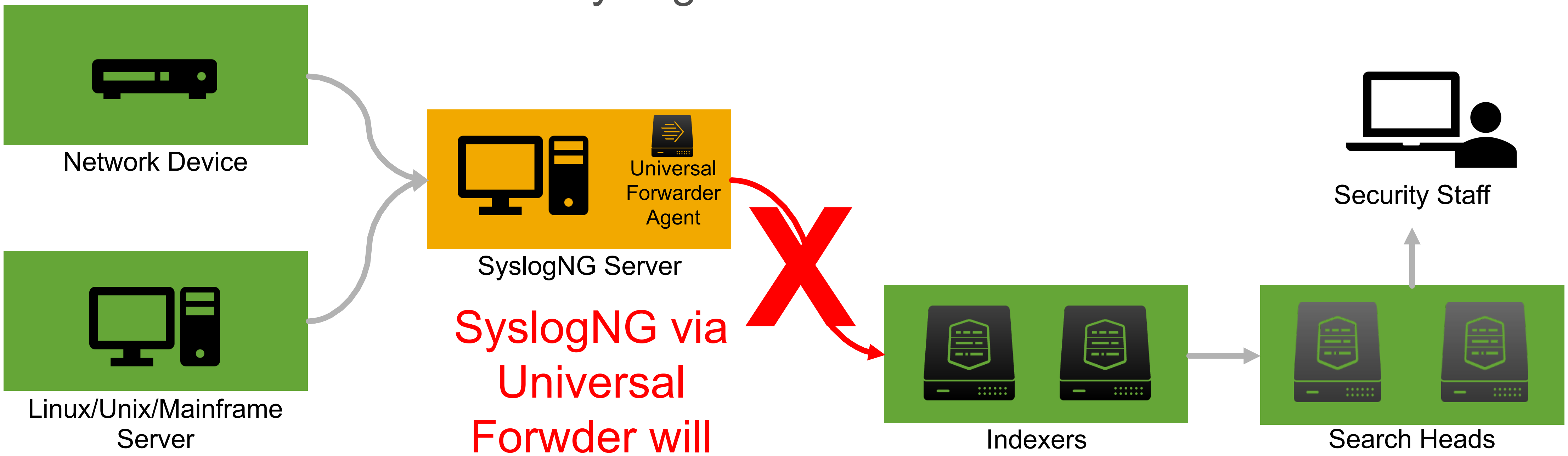
General Workflow of Splunk

Universal Forwarder: Worst Case



General Workflow of Splunk

syslog: Worst Case



SyslogNG via Universal Forwder will queue

Hardware

No need for fancy SAN, NAS, etc. Keep it simple!

Commodity Linux servers that our systems team runs for us

- Indexers
  - The most important thing for the indexers is IOPS (fast hard drives)
  - Server(s) with SSDs in RAID5 configuration
  - You can do spinning disks in RAID10, but it’s much slower
  - We have a mix of SSD and rusting disk: New data is written to SSDs and after a few days it’s moved to slower and cheaper HDDs since most people are searching only recent events
- Search Heads
  - Server(s) with minimal hard drive requirements and lots of CPU and RAM

Splunk offers a hosted solution in AWS

Alerts

The known unknowns

- The obvious...bad things
  - Malware, IDS alerts, Data exfiltration
- Splunk licensing issues
  - More likely to catch “real time” as people are ingesting data
  - Daily isn’t enough and runs at midnight; we monitor 4 times a day
- Servers not reporting into Splunk
  - Network issues and reporting services dying (Carbon Black bug)
  - Server maintenance and deprecation
- General IT problems
  - Active Directory Account lockouts and RSA token lockouts (goes to Support)
  - Service Account Lockouts

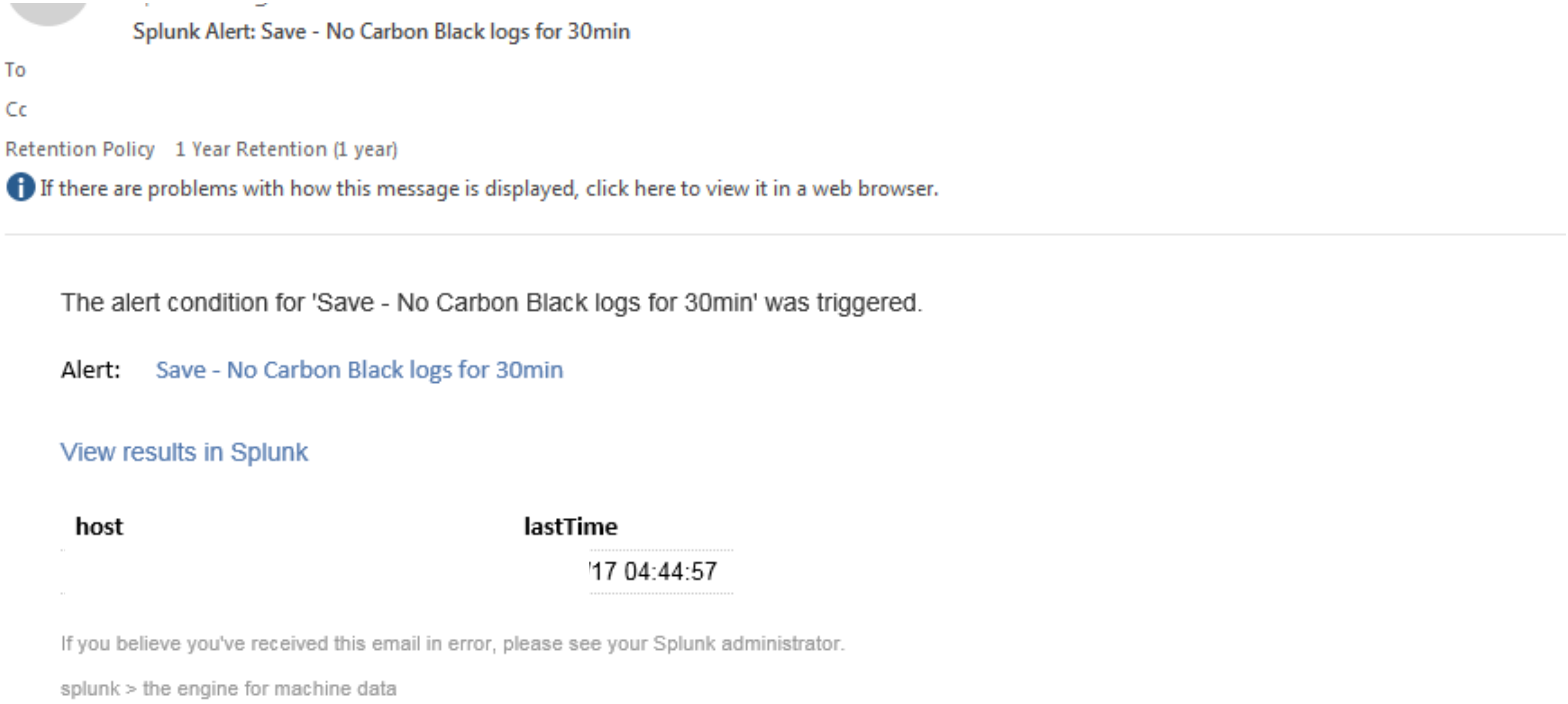
Action by severity:

- E-mail
- Slack (webhooks)
- Page via PagerDuty, OpsGenie, etc.
- Notify our NOC, who calls us day or night

Alerts must be clear and actionable or they’re a waste!
https://www.pagerduty.com/blog/lets-talk-about-alert-fatigue/

Example Of An Actual Alert

Improve your awareness and visibility



Splunk Alert: Save - No Carbon Black logs for 30min

To

Cc

Retention Policy 1 Year Retention (1 year)

If there are problems with how this message is displayed, click here to view it in a web browser.

The alert condition for 'Save - No Carbon Black logs for 30min' was triggered.

Alert: Save - No Carbon Black logs for 30min

View results in Splunk

host	lastTime
	'17 04:44:57

If you believe you've received this email in error, please see your Splunk administrator.

splunk > the engine for machine data

Deployment and Configuration Management

Keeping the environment consistently configured

- Audit requirement to put client on all new server builds
  - This is a good thing, it means buy in from the business
- Universal forwarder install is automated using Puppet and PowerShell
- Install uses deployment server to pull down configuration settings
- Server classes are broken down by OS
  - We don’t get much fancier than that, keep it simple
- Distributed Management Console (DMC) is used to monitor system health monitoring
  - Replaces other apps like Splunk on Splunk (SOS)

Consuming AWS logs into Splunk

To The Cloud!

- In the AWS VPC, we have multiple forwarders
  - Typical universal forwarder install on each EC2 instance
  - We chose to have the individual server universal forwarders report to a central set of heavy forwarders for compression and transform reasons
- 3rd party apps:
  - API: Install Splunk app that brings in logs like Amazon Cloud Trail, O365, CASB, etc. into Splunk
  - Syslog: 3rd party syslog servers (like Cylance) send data to a publicly facing forwarder in our DMZ with special ACLs, which then populates the indexers
- Other services like Azure are on our roadmap and are consumed in a very similar manner

Lookups

More information is better

- A lookup is a CSV file used to populate more information based upon a value you look up
  - Example: AD has a field with a site code, which a lookup table could add a value that tells you the office location

Name	Site Code	Location
Jake McAleer	39	Watertown, MA

- A great way to simplify searching and adding more context for users
- Search populate lookups which populate second searches
  - Example: Find service account list -> Report of service accounts locked out
  - The lookup tables are automated so it’s always up to date
- Example of how we use it:
  - Service account lookup to pull in description and who owns the account

DNS Logs via Stream

Network tap to suck up DNS data out of band

- We have over 1TB/day of DNS logs on very busy servers, so traditional universal forwarders were out of the question
  - Too much data
  - Too much load on the servers
  - We don’t want to be even possibly associated with jeopardizing production
- An out of band network tap sending data to a heavy forwarder running the stream app, which acts as a tcpdump type collector
- From there, we suck down the DNS logs we want into Splunk with the ability to filter out logs we don’t need and we do it all without impacting production
- “Estimate mode” helps you determine how much license it will use
- DNS logs are awesome, they help with all sorts of incident investigation

Get people hooked!

Make it searchable by your users for diagnostics and they'll love it!

- Linux server logs
- Windows server and domain controller logs (including account lockouts)
- Virtual Server Infrastructure (ESXi, OpenStack, etc.)
- DHCP and DNS logs
- SSO logs (PingFed, Okta, Azure, etc.)
- In-house developed application logs, SFTP server logs
- VPN, firewall, and router logs
- Two-factor, web proxy, and MDM logs
- Endpoint logs (anti-virus, anti-malware, Bit9, Carbon Black, etc.)
- AWS, Azure, and other IaaS/SaaS providers

General Tips and Tricks For Splunk

Lessons we learned the hard way

- Permissioning in cloud management platforms like AWS is very granular and took some back and forth to get just right so we could scrape the data we needed
- CI/CD pipeline overwriting our changes
  - Puppet, etc. was accidentally overwriting the work we were doing to test out changes in AWS
- Stream helps with out-of-band collection (we use it for DNS)
- Test before upgrading....many software updates break CIM format
  - Make sure your fields are populating correctly post upgrade
- Clean up old apps you don’t use; they suck up resources
- Use the main index (udp/514) as a catch-all to find misconfigured apps
  - Our main index should always be empty
  - Same concept in syslog-ng so we always capture it, but we’re aware where in the ingestion process it’s misconfigured and needs rework

Interesting Work To Check Out

Shout outs to others

- **BSidesCharm 2017 T201 Weaponizing Splunk Using Blue Teams for Evil by Ryan Hays**
  - https://www.youtube.com/watch?v=QmpoWwG0IPs
  - https://github.com/TBGSecurity/weaponize_splunk

- **JA3 TLS Client Fingerprinting**
  - https://engineering.salesforce.com/open-sourcing-ja3-92c9e53c3c41
  - Referenced yesterday at "Hunting the Known Unknowns: Finding Evil With SSL Traffic"

- **Setting up Splunk to use SSO**
  - https://www.splunk.com/blog/2013/03/28/splunkweb-sso-samlv2.html