U Mad Bro?

Enfranchising Your Analysts Using Bro

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Outline

- Maturity
  - Philosophy
  - Strategic direction
- Current Implementation
  - High level overview
  - Traffic taxonomy
  - Challenges
- Extending Bro
  - Custom sauce
  - Integration
  - Future state

Maturity

Paradigm Shift

Capabilities Analysis

Old School

Analysis Capabilities

New School

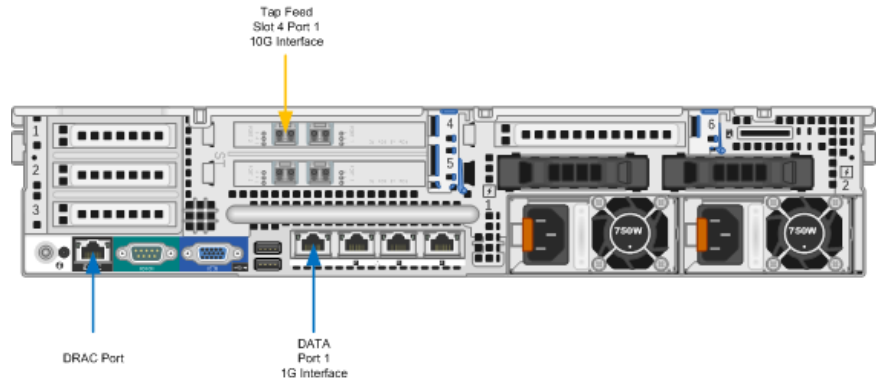
Path to Custom Solutions…

- Best in class COTS capabilities
  - Capabilities team had adopted were ‘black box’ solutions
  - Not as extendable as we’d like
  - Gaps in capabilities identified, desire to innovate past them
  - Alerting and detections not shared, creating confusion
- Seeking validation
  - Are we really seeing traffic we expect?
  - What other data points can I pivot on?
  - I noticed something interesting about this attack, can I add a custom signature?
- Sitting in the drivers seat… forging understanding and continuity
  - Engage infrastructure team, hash out a tapping infrastructure that makes sense
    - Lots of learning on both sides
      - “That’s not supposed to work that way?”
    - Establish a common language and overview of what we want and how it looks
      - Create and apply a template to our major internet points of presence
    - Building relationships with other organizations
      - It’s not always technical!

Current Implementation

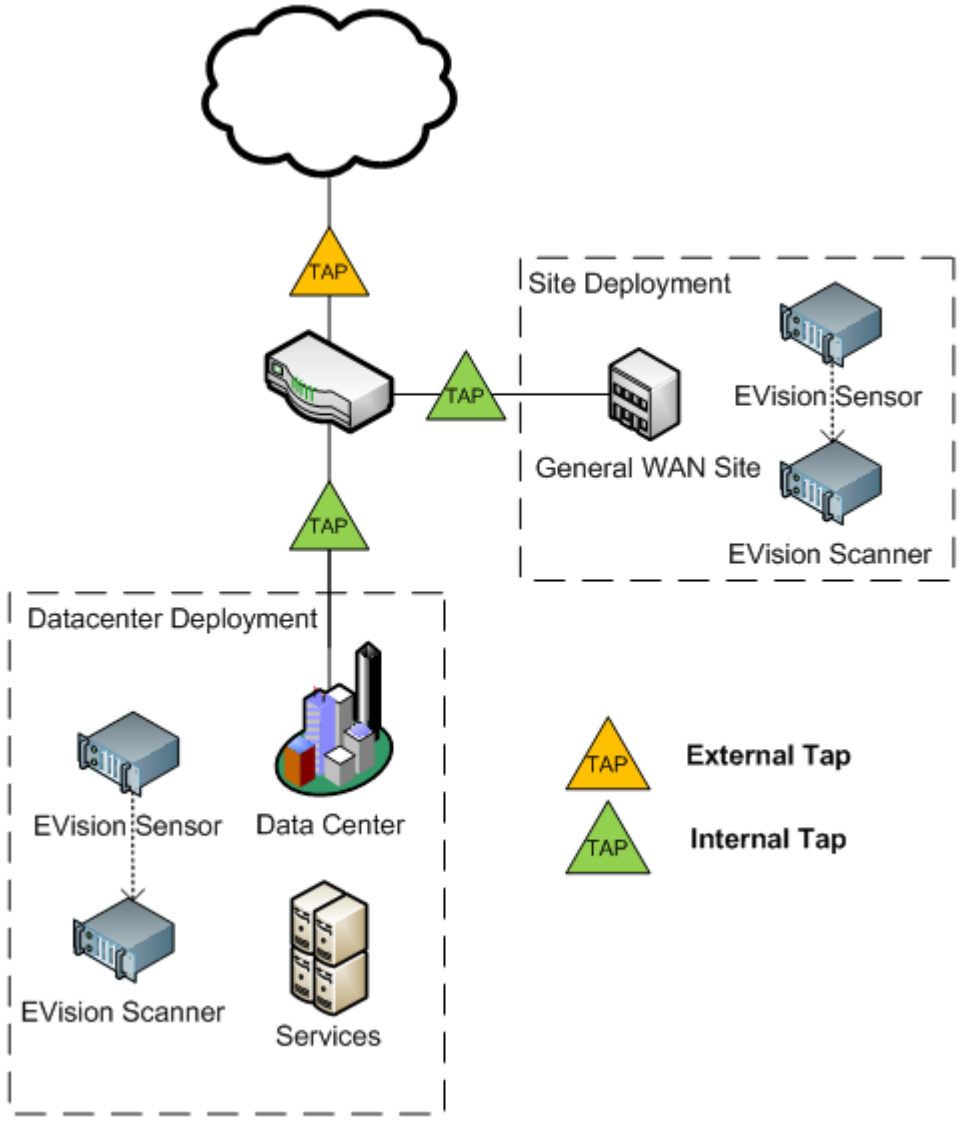
Our Vision

- Custom sensor and file scanning platform made by, for, and maintained by Emerson incident response analysts
- Hardware: Dell PowerEdge R720
  - Intel XEON E5-2670, 32 cores @ 2.60GHz, 128G RAM, 24TB SAS storage @ RAID10
  - 1 x 1Gb Management interface, 1 X 10Gb Tapping interface
- Minimal CentOS 6.5 for OS baseline
- Bro v2.4 as the network analysis framework
  - 1 manager, 2 proxies, 8 worker members per proxy
  - Currently set to generate all common logs
- PF RING v6 for software-based load balancing
- Custom built client module for file scanning and disposition
  - Files matching specified MIME types are sent off for heavy lifting to separate hardware file scanners



Regional Points of Presence

- 4 major hubs worldwide, with one or more sensors
- Each sensor is assigned a 10Gb tap port on a local Gigamon appliance
  - Gigamons are network visibility tools in their own right
  - Used to replicate and send off flow data from certain places on the network
- Sensor types
  - Internal CIRT Sensor (ICS): Monitors bidirectional traffic inside Emerson's managed IP space
  - External CIRT Sensor (ECS): Monitors bidirectional traffic outside Emerson's managed IP space
  - Hybrid CIRT Sensor (HCS): Monitors both types
  - File Scanning Framework (FSF): Receives certain file types from regional sensor to scan

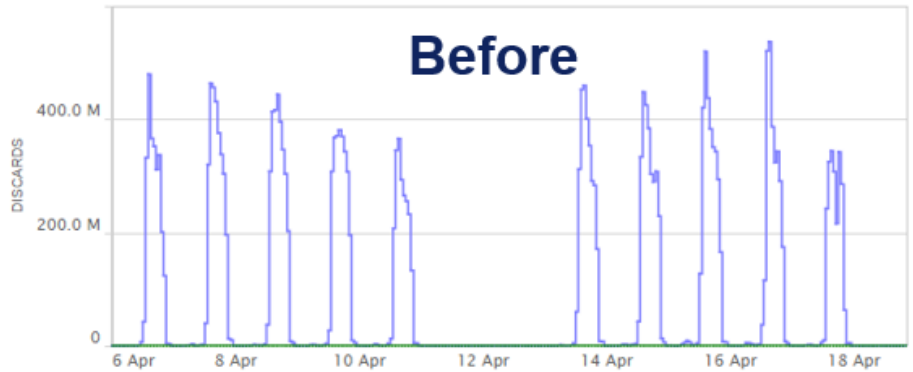


High Level Concept Diagram

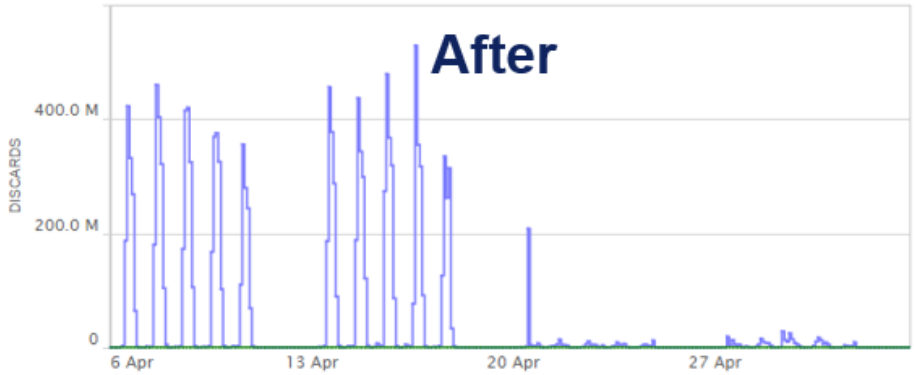
Software & Scalability: Challenges & Solutions

- So why the large amount of packet discards?
  - 10-12% per hour drop rate peak
  - Plenty of bandwidth overhead (2.2Gbps on 10Gb)
  - Number of concurrent connections was excessive
- Load balancing on Gigamon for ICS feed
  - Horizontally scale with ICS-1 and ICS-2
  - 10-12% down to <1% drop rate
- Kernel upgrades and PF RING
- CPU pinning and worker nodes

Avg packet discards/hour (Apr 6th – 18th)



Avg packet discards/hour (Apr 6th – May 3rd)



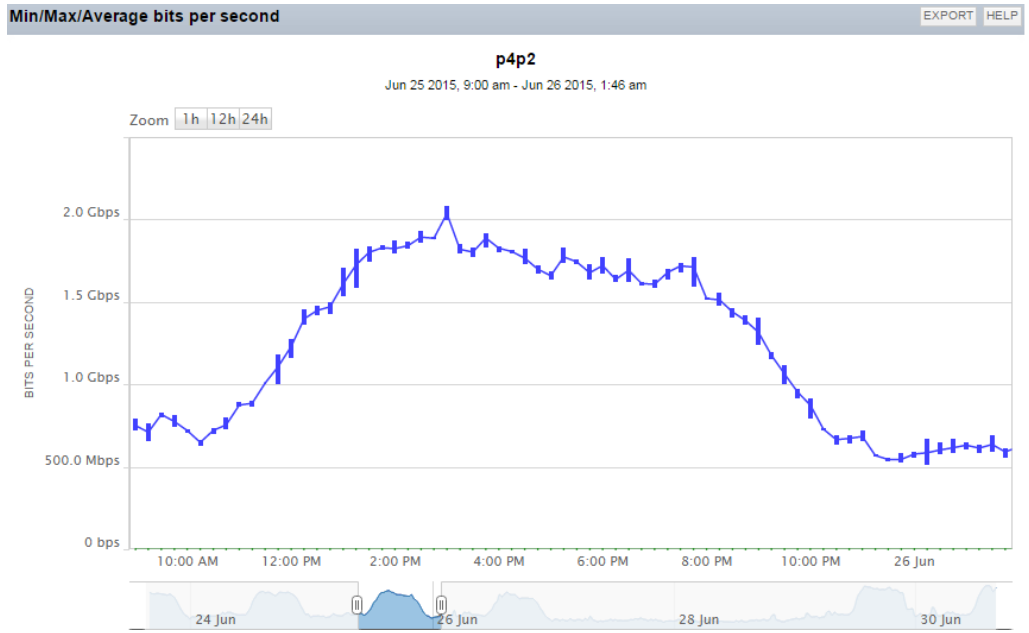
Sensor Load & Bandwidth Utilization

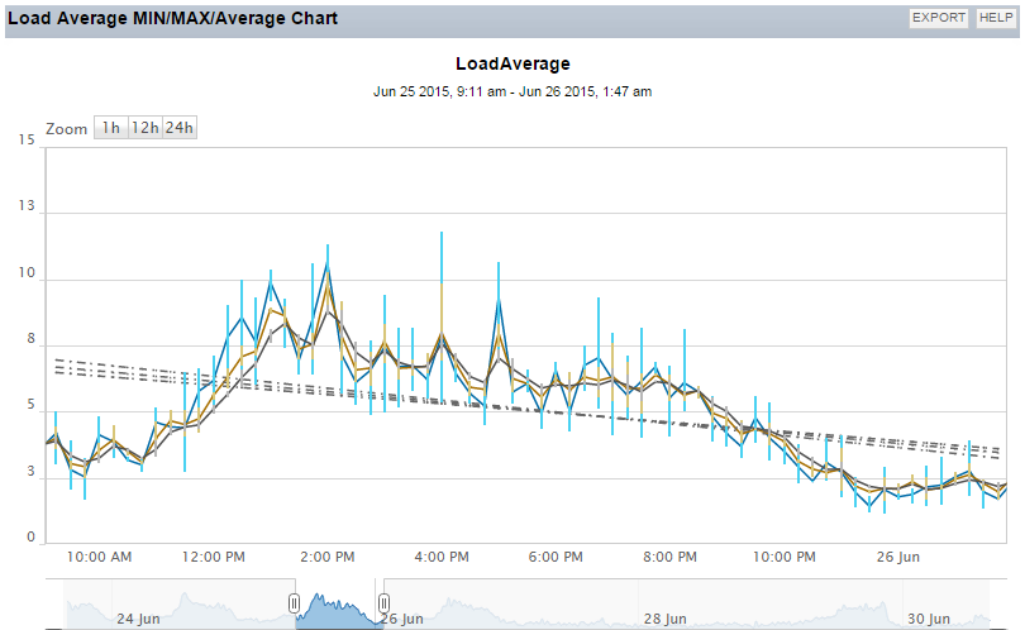
2 ICS sensors in main hub

- Plus 1 ECS sensor and 1 FSF scanner
- Highest loads are seen on this hub's ICS sensors
- All other hubs and sites can handle ingress and egress traffic on a single HCS (hybrid) sensor on-site

Sample from 1 ICS sensor (0900 – 2400 UTC)

- Average capture interface traffic peaks at 2.2 Gbps
- Interface utilization peaks at 21% on average
- CPU Load average peaks at around 11 out of 32 total cores





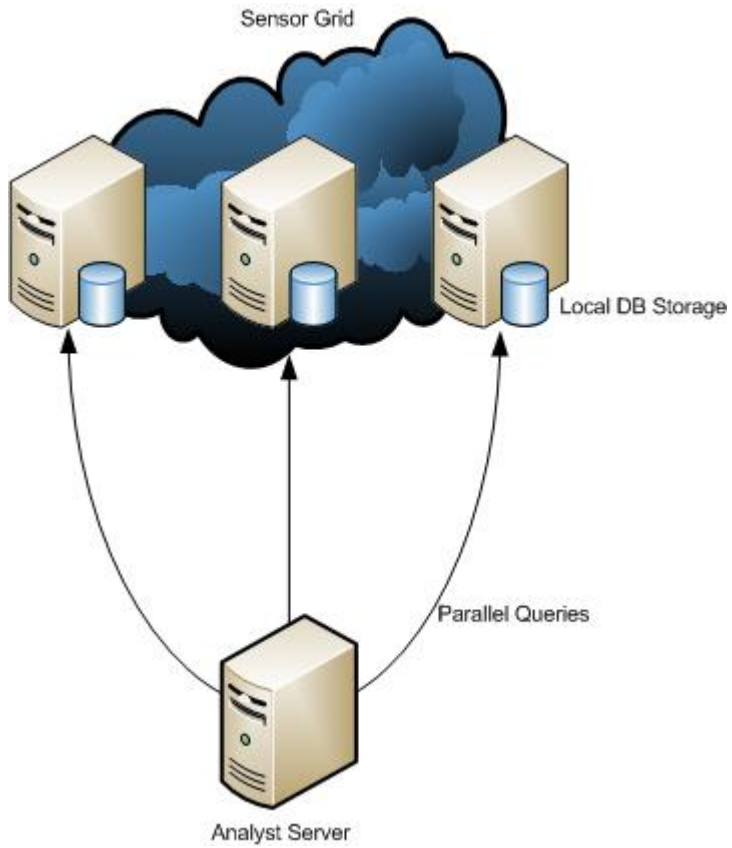
Extending Capabilities

Querydb

- **Makes Bro data queryable**
  - **KISS Principle**
  - **Command line based**
  - **Vast volumes of data, difficult to search through**
  - **Increased queriability equals increased utility**
- **Aim at quickly answering common questions for IP addresses and domains**
  - **Have I seen this indicator? If so, where, and when…?**
  - **Pivot for more information**
- **Keeps analysts on the Linux command line**
  - **Consistent with strategic direction for analyst development**

Querydb

- Components
  - Aggregator - Runs on each sensor and gets all unique IP addresses and domains for each rotation interval
  - Database - Two MongoDB collections for connections and domains
    - TTL index
  - Frontend - Small python script that pulls sources based on query



Querydb

Search Sub-domains Filter begin and end date Filter appliance

```
emr-querydb -sd avalanche.nhl.com blues.nhl.com -b 2015-06-28 -e 2015-06-29 -a stl-1_ecs
```

Check for communication to domains and sub domains between dates, show only results from specific appliance…

```
avalanche.nhl.com|stl-1_ecs|2015-06-29|dns.11:00:00-12:00:00.log.gz
blues.nhl.com|stl-1_ecs|2015-06-29|dns.11:00:00-12:00:00.log.gz
avalanche.nhl.com|stl-1_ecs|2015-06-29|dns.13:00:00-14:00:00.log.gz
blues.nhl.com|stl-1_ecs|2015-06-29|dns.13:00:00-14:00:00.log.gz
video.blues.nhl.com|stl-1_ecs|2015-06-29|dns.13:00:00-14:00:00.log.gz
avalanche.nhl.com|stl-1_ecs|2015-06-29|dns.14:00:00-15:00:00.log.gz
blues.nhl.com|stl-1_ecs|2015-06-29|dns.14:00:00-15:00:00.log.gz
```

Domain | Appliance | Date | Log File

Query each http log for domain and fetch results

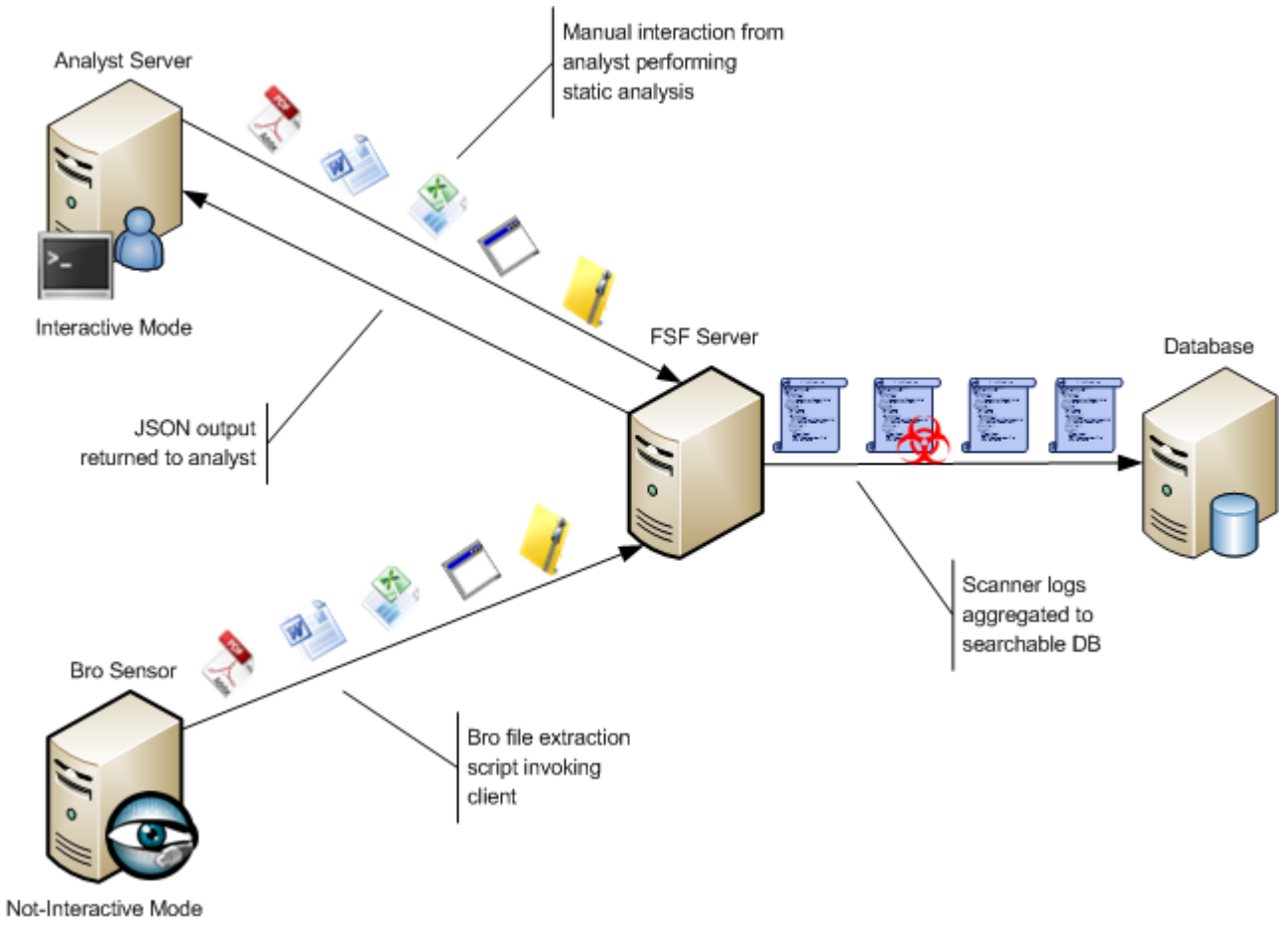
```
emr-querydb -sd avalanche.nhl.com blues.nhl.com -b 2015-06-28 -e 2015-06-29 -a stl-1_ecs -p -l http | less
ts      uid     id.orig_h       id.orig_p       id.resp_h       id.resp_p       trans_depth     method  host    uri     referrer
        user_agent      request_body_len        response_body_len       status_code     status_msg      info_code       info_msg
        filename        tags    username        password        proxied orig_fuids      orig_mime_types resp_fuids      resp_mime_typ
es
06/29/2015 13:22:22 UTC C4YnPC3VD358ofsoTd      [redacted]      58096   184.51.115.17   80      1       GET     blues.nhl.com   /club
/news.htm?id=772815        https://www.facebook.com/       Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/537.36 (KHTML, like Gecko)
 Chrome/43.0.2357.130 Safari/537.36   0       68292   200     OK      -       -       -       (empty) -       -       -       -
        -       Fx2P7V2N4ZTpSATuAc      text/html
06/29/2015 13:22:22 UTC C4YnPC3VD358ofsoTd      [redacted]      58096   184.51.115.17   80      2       GET     blues.nhl.com   /v2/c
ss/club.css?v=8.37 http://blues.nhl.com/club/news.htm?id=772815    Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/537.36 (KHTML, lik
e Gecko) Chrome/43.0.2357.130 Safari/537.36   0       17343   200     OK      -       -       -       (empty) -       -       -
        -       -       F8neeA3sTu3x8xys2j      text/plain
```

File Scanning Framework

- Extract various file types we are interested in off the wire
- Recursively scan object and sub objects of files
  - Get more file metadata
  - Increase utility of custom Yara signatures
    - Scan files with signatures we develop through our own research
    - Let Yara detection drive some action by a module on the file
- Increase the value of malware reverse engineering efforts
  - Make the adversary pay for every byte they send us
  - Make it more expensive for the adversary to succeed
    - Cyber Kill Chain® approach
- Increase the value of threat intelligence sources that share malware
- Enable the analyst to define what is actionable cyber intelligence
  - Opportunity for more advanced and creative threat detections

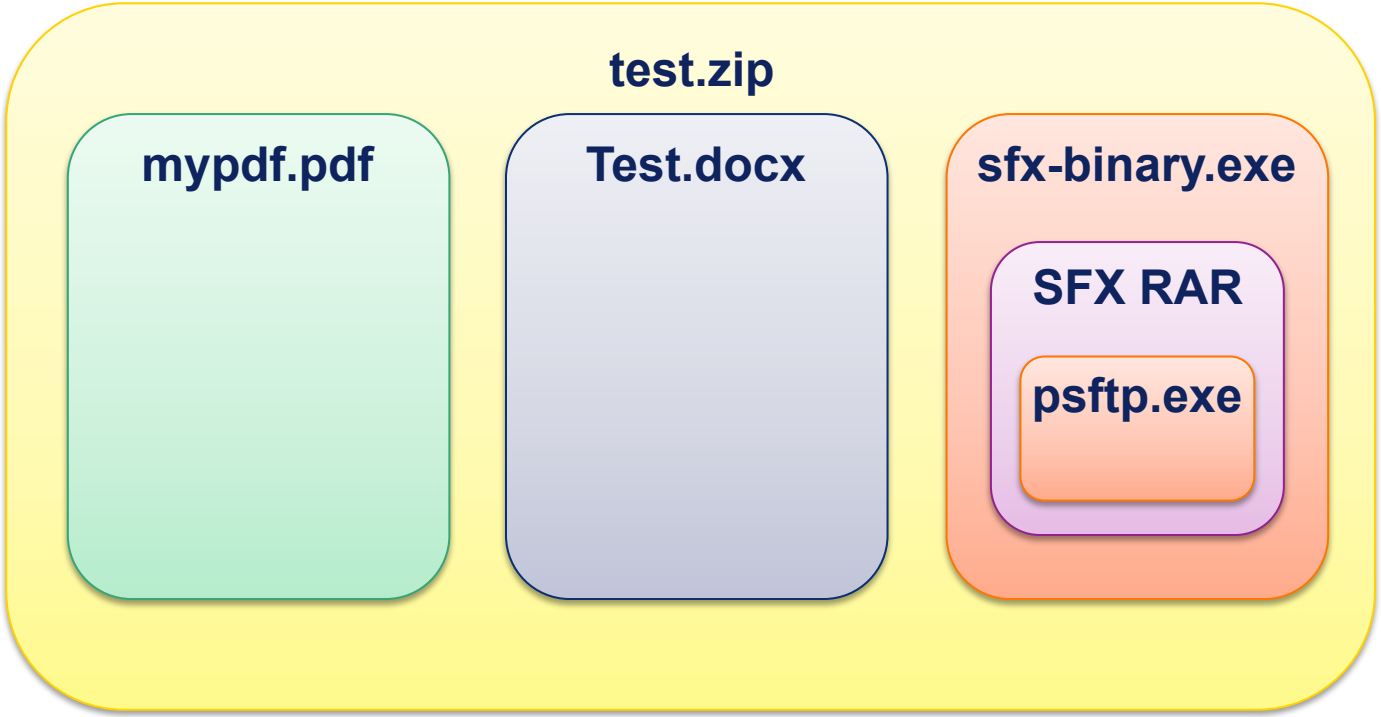
Cyber Kill Chain® White Paper: Intelligence-Driven Computer Network Defense

File Scanning Framework



File Scanning Framework

- *Demo…*



Recursively process objects, extract metadata and enrich intelligence…

File Scanning Framework

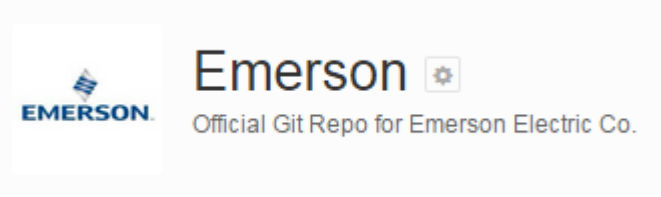
- **LaikaBOSS**
  - https://github.com/lmco/laikaboss
  - http://lockheedmartin.com/content/dam/lockheed/data/isgs/documents/LaikaBOSS%20Whitepaper.pdf
- **MITRE Multiscanner**
  - https://github.com/MITRECND/multiscanner
  - http://www.mitre.org/capabilities/cybersecurity/overview/cybersecurity-blog/multiscanner-a-tool-to-help-work-the-malware
- **Viper**
  - http://viper.li/
  - https://github.com/viper-framework/viper

Key Takeaways

- **Relying solely on COTS only solutions Isn't the best idea**
  - Rob analysts of the opportunity to solve the problem for themselves
  - May find yourself handcuffed to a capability that doesn't meet your needs
  - Enable yourself to solve world class problems

- **Adopting Bro as a Network Analysis Framework has been a key enabler**
  - Gain visibility into network traffic
  - Augment standalone analysis
  - Extend team capabilities, put analyst in drivers seat

- **Introducing… Emerson GitHub!**
  - We've done a lot to extend capabilities of Bro
  - We've written standalone tools of our own
  - https://github.com/EmersonElectricCo



Questions?

- **Thanks for your kind attention!**