Petr Michalec

Speaker

Pracuje jako SRE v F5 Czech Republic s.r.o.

- ~30 regional datacenters, 147+ services
- (Volterra.io, Mirantis, IBM, …)

n(vi)m lover • maker • golfer • quad fpv pilot

twitter.com/epcim

Security monitoring

Purpose & requirements

- …
- Compliance with security standards:
  - PCI DSS, CIS, GDPR
  - HIPPA, NIST, FIPS, FedRAMP
- evidence collection
- data availability and traceablity
- measurement and support resources
- tools, policies, processes, reporting

Security monitoring

SecOps coverage

- prevent intrusion
- detect intrusion
- configuraion encorcement
- compliance checks & reporting
- …

Traditional approach ~2015

Topics and tools

- network IDS
- filesystem integrity
- system/service/user audit/logs
- data access & encryption
- security threads, mittigation
  - CVEs, vulerabilitties
- mallicious activity detection

- auditd, aide
- PAM, SElinux, AppArmour
- OSSEC, OpenSCAP, Inspec, …
- Enterprise SIEM tools

SaaS approaching (Snyk, Whitesource, Graylog, Thread stack, …)

New challenges

Microservices

Containers

- namespace isolation
  - container images
    - 3rd party libraries

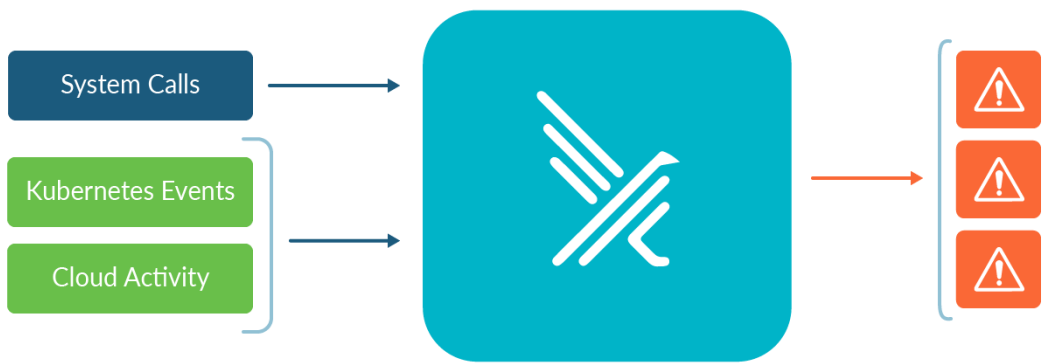
Distributed applications

- cloud environments ^n
- 3rd party base images for OS
- 3rd party accessing servers

Distributed data

Falco

May 16, 2016 - Sysdig introducing open source, behavioral security



Falco.org runtime security project detecting unexpected behavior, intrusions, and data theft in real time!

Overview

Falco

- Kernel integration
- Highly granular rules to check for activities involving
  - file and network activity
  - process execution
  - IPC, …
- Real-time metrics & notification when these rules are violated
- Less complex & faster

There are a million ways a burglar can break into your home, but once they do they're going to steal your jewelry.

…

You only need to detect the things that an attacker does once they have access to a system, rather than all the ways an attacker can gain access to a system.

Comparison to existing approaches

Falco

File integrity monitoring: (checksums)

> Watch for any OS activity that is writing to a file of interest, and be alerted in real-time.

Network monitoring (signatures)

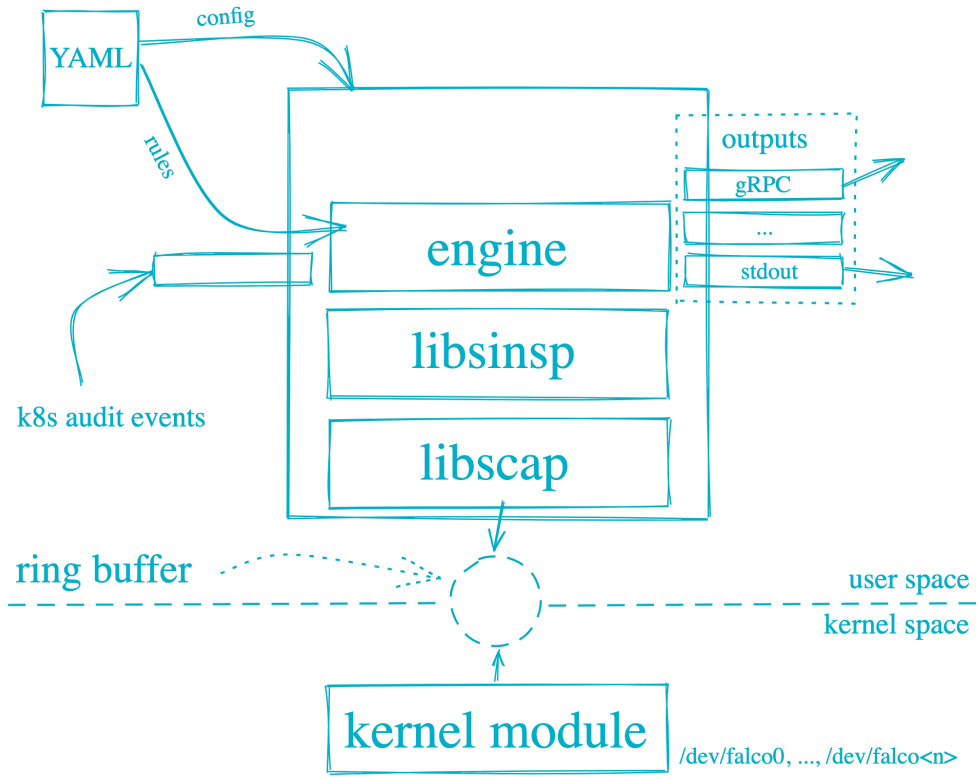
> Falco see I/O “from the inside” with an immediate correlation between applications and traffic.

Linux has multiple security modules ~ advanced access control systems with sophisticated policies and concepts. As a result, understanding and configuring them is a rather complex undertaking.

> Falco is far simpler to understand and configure, "detection-only".

How it works

Falco architecture



Kernel driver

Falco

- eBPF
- Built-in
- Module `falco.ko` (w/ DKMS)
- Userspace instrumentation (based on PTRACE2)

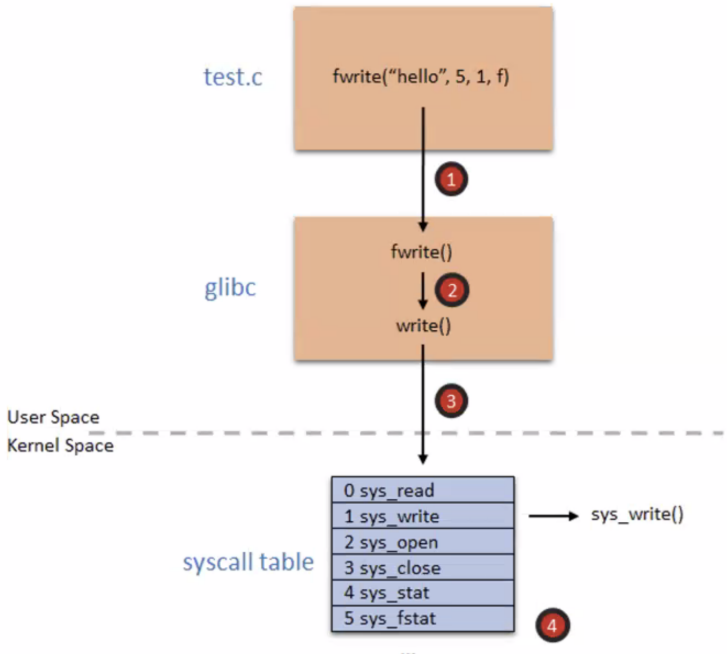
eBPF

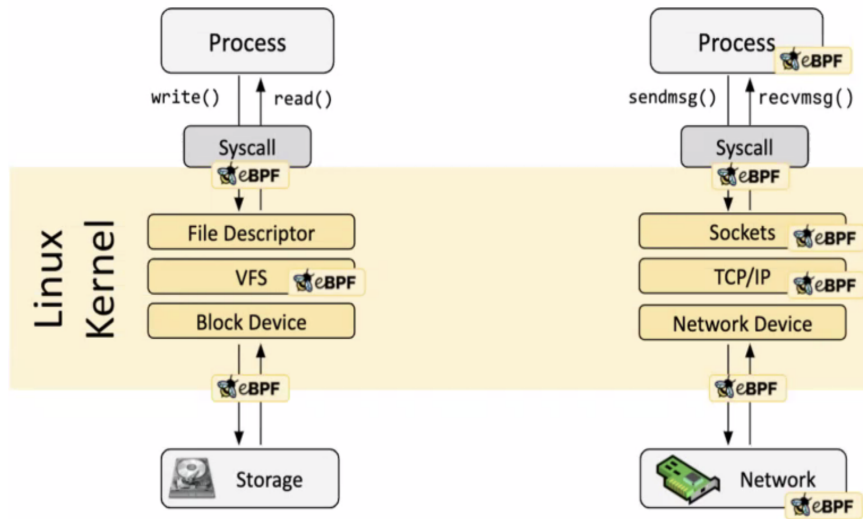
- Legacy "Berkeley Packet Filter" (BPF) - technology that among other things allows programs to analyze network traffic (and eBPF is an extended BPF JIT virtual machine in the Linux kernel).
  - raw interface to data link layers
  - permitting raw link-layer packets to be sent and received
  - can run sandboxed programs in a privileged context

BPF is a highly flexible and efficient virtual machine-like construct in the Linux kernel allowing to execute bytecode at various hook points in a safe manner. It is used in number of Linux kernel subsystems (networking, tracing, security (snadboxing))"

SysCalls

eBPF





Why?

eBPF

Enhanced Telemetry Collection -> annotation

- kernel and syscall attributes
- socket info

Performance

- lower resource impact (net, file, proc)
- avoid transfer of all audit data to userspace
- real time procesing

eBPF Verifier verifies the safety of eBPF programs

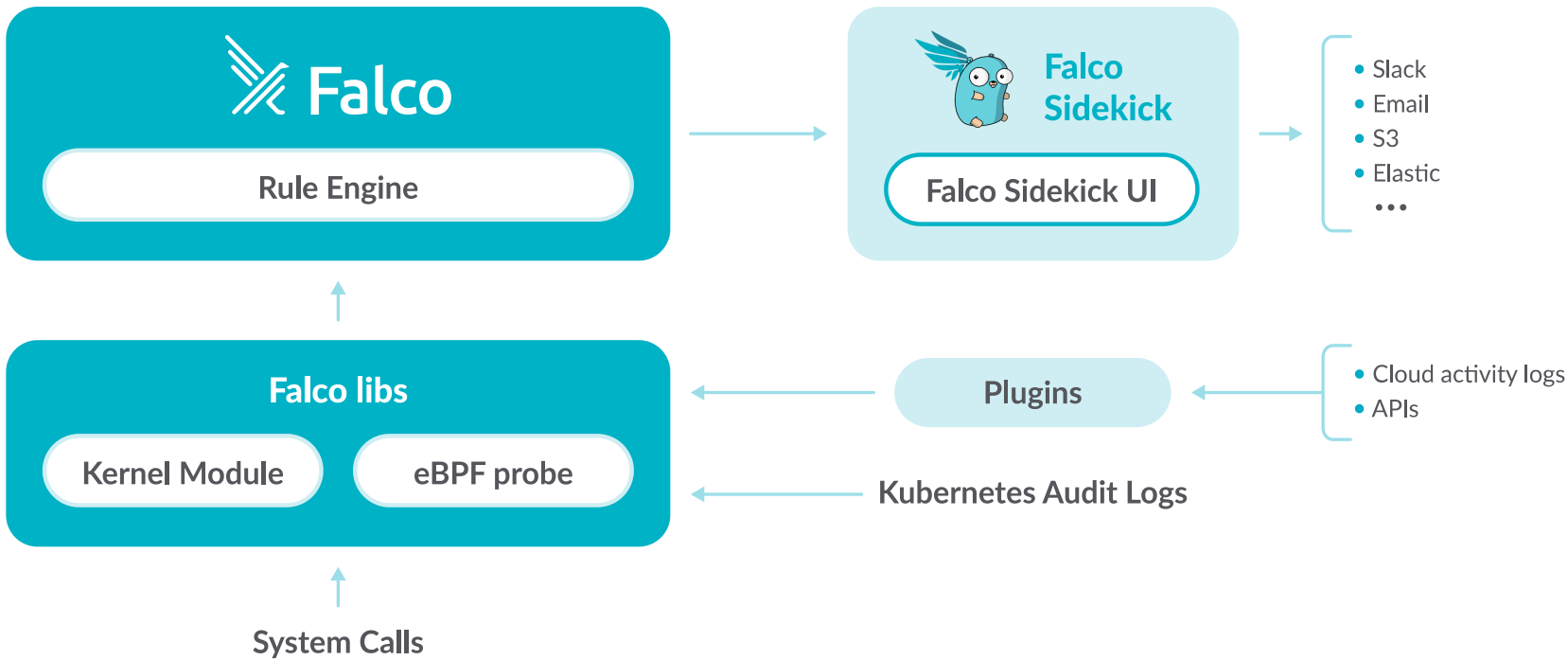
Field Class: process

Additional information about the process and thread executing the syscall event.

Name	Type	Description
`proc.pid`	INT64	the id of the process generating the event.
`proc.exe`	CHARBUF	the first command line argument (usually the executable name or a custom one).
`proc.name`	CHARBUF	the name (excluding the path) of the executable generating the event.
`proc.args`	CHARBUF	the arguments passed on the command line when starting the process generating the event.
`proc.env`	CHARBUF	the environment variables of the process generating the event.
`proc.cmdline`	CHARBUF	full process command line, i.e. proc.name + proc.args.
`proc.exeline`	CHARBUF	full process command line, with exe as first argument, i.e. proc.exe + proc.args.
`proc.cwd`	CHARBUF	the current working directory of the event.
`proc.nthreads`	UINT32	the number of threads that the process generating the event currently has, including the main process thread.
`proc.nchilds`	UINT32	the number of child threads that the process generating the event currently has. This excludes the main process thread.
`proc.ppid`	INT64	the pid of the parent of the process generating the event.
`proc.pname`	CHARBUF	the name (excluding the path) of the parent of the process generating the event.

Deployment

Falco components



Deployment

Configuration

Deployment

- Falco-sidekick, prom. exporter
- Falco-sidekick UI
- Grafana dashboards
- …, SysFlow, ELK
- …, Plugins

Daemonset

- Falco

  (only `falco-driver-loader` needs to be run with `securityContext: priviledged`)

What to enable?

- driver-loader (DKMS, private builds)
- docker, containerd, cri-o
- w/k8s metadata, audit
- custom rules
- threadiness, maxBurst, eventDrops
- priority/severity level

Language

Syntax, github.com/falcosecurity/charts/falco/rules

Macros

- name (identificator)
- condition (filter)

Lists

- name (identificator)
- items:

Rules

- `name` (identificator)
- desc
- `condition` (filter expression, macro)
- `output` (formated message with **core details**)
- priority (severity of rule)
- tag
- append
- exceptions (new, not used in upsteream)

Primitives

Rules

Shell executed in container

```
container.id != host and proc.name = bash
```

Overwirite system bins

```
fd.directory in (/bin, /bin/sbin, /usr/bin, /usr/sbin)
and write
```

Container namespace change

```
evt.type = setns and not proc.name in (docker)
```

Process access camera

```
ect.type = open and fd.name = /dev/video0 and not proc.name in (skype, zoom, webex)
```

Macros & Lists

Rules

```
- list: _container_engine_binaries
  items: [dockerd, containerd, containerd-shim, "runc:[0:PARENT]","runc:[1:CHILD]", "runc:[2:INIT]"]
```

```
- macro: docker_authorized_binaries
  condition: >
    proc.name in (_container_engine_binaries)
    or proc.pname in (_container_engine_binaries)

  " [CVE-2019-11246 on Mitre](https://cve.mitre.org/cgi-bin/cvename.cgi?name=CVE-2019-11246)
- macro: safe_kubectl_version
  condition: (
              jevt.value[/useragent] startswith "kubectl/v1.20" or
              jevt.value[/useragent] startswith "kubectl/v1.19"
               ...
            )
```

Filesystem integrity

Rules

```
- rule: Detect Write Below /etc/hosts
  desc: an attempt to write to /etc/hosts file (CVE-2020-8557)
  condition: open_write and container and fd.name=/etc/hosts
  output: "File /etc/hosts opened for writing (user=%user.name command=%proc.cmdline parent=%proc.pname \
           pcmdline=%proc.pcmdline file=%fd.name program=%proc.name gparent=%proc.aname[2] \
           ggparent=%proc.aname[3] gggparent=%proc.aname[4] container_id=%container.id image=%container.image.repository
  priority: ERROR
  tags: [filesystem, mitre_persistence]
```

Detect su, sudo

Rules

```
- rule: Detect su or sudo
  desc: detect sudo activities
  condition: >
    spawned_process
    and activity_under_escalated_privilege
    and not in (sre_known_infraops_actions, sre_known_managed_cloud_actions)
  output: >
    Privilege escalation activity (user=%user.name auser=%user.loginname command=%proc.cmdline ppid=%proc.ppid apid=%pro
  priority: WARNING
  tags: [process, sudo, su]
```

```
- macro: activity_under_escalated_privilege
  condition: >
    proc.name in (sudo, su)
    or proc.pname in (sudo, su)
    or proc.aname[1] in (sudo, su)
     ...
```

```
- rule: Privilege escalation
  condition: sf.pproc.uid != 0 and sf.proc.uid = 0 and not entrypoint
```

Compromised server process

Rules

HitchSQL injection attack?

```
condition: spawn_process and proc.name = mysqld and not proc_is_new
```

```
- macro: spawn_process
  condition: syscall.type = execve

- macro: proc_is_new
  condition: proc.duration ⩽ 5000000000
```

Howto rules

What we tweaked?

```yaml
# override upstream defined macro
- macro: user_known_read_sensitive_files_activities
  condition: >
    (sre_authorized_activities)
```

```
rules/
├── falco_rules.preload.yaml
├── falco_rules-10-exceptions.yaml
├── falco_rules-20-security.yaml
├── falco_rules-30-apps.yaml
├── falco_rules-40-fim.yaml
└── falco_rules-50-cve.yaml
```

- macro: `failed_k8s_annotation`
- macro: `sre|host|infra_authz_activities`
- macro: `sre|aws|gcp_known_vendoractions`
- macro: `sre_known_ports`
- list: `sre|aws|gcp_known_commands`
- list: ...

Falco sidekick

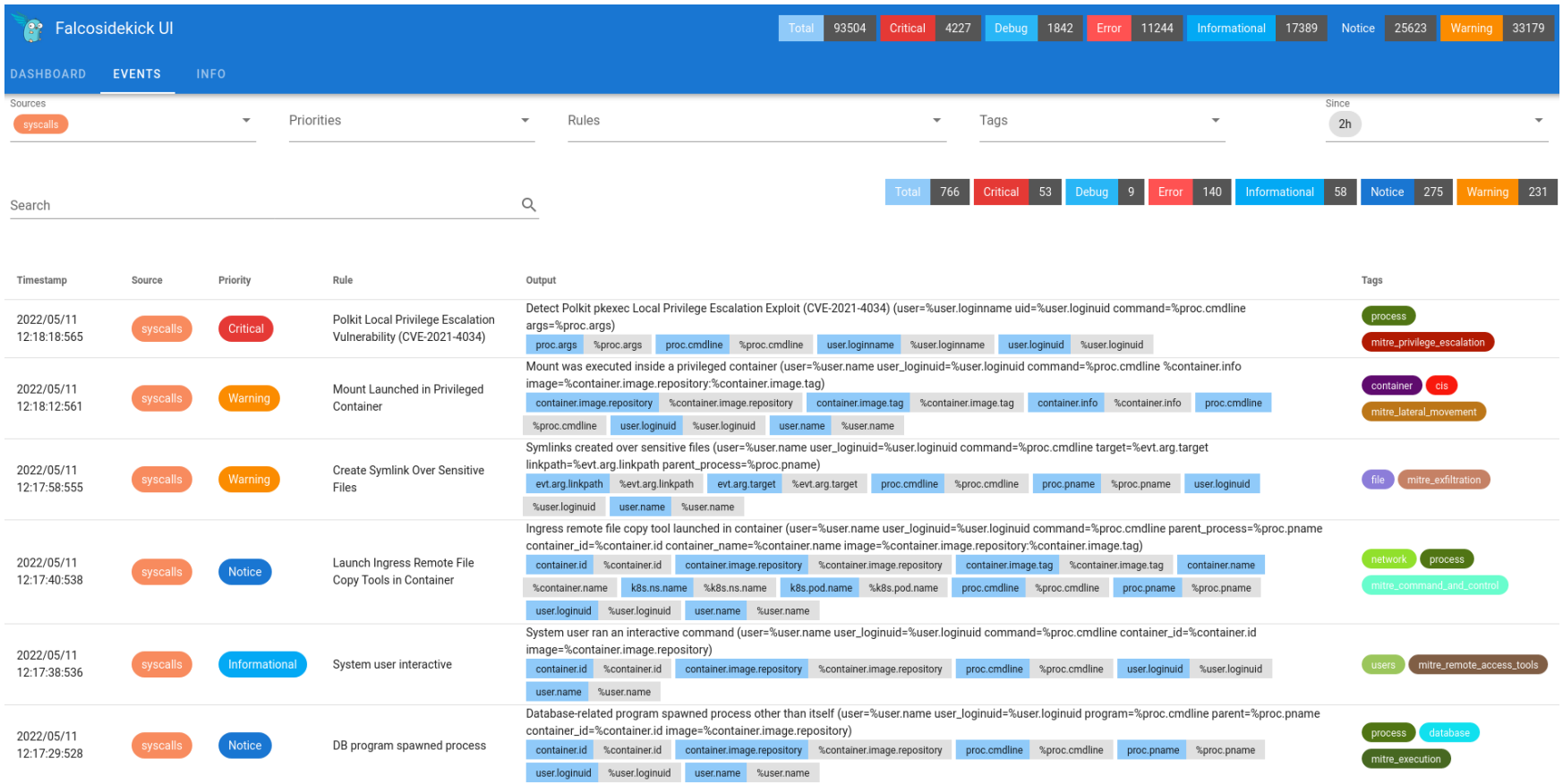
Integrations

https://github.com/falcosecurity/falcosidekick

```
alertmanager:
  hostport: http://{domain or ip}:{port}
  minimumpriority: "error"              # emergency|alert|critical|error|warning|notice|informational|debug
  endpoint: "/api/v2/alerts"
  expiresafter: "900"
```

Slack • Rocketchat • Mattermost • Teams • Datadog • Discord • AlertManager • Elasticsearch • Loki • NATS • STAN (NATS Streaming) • Influxdb • AWS Lambda • AWS SQS • AWS SNS • AWS CloudWatch • AWS S3 • SMTP (email) • Opsgenie • StatsD • DogStatsD • Webhook • Azure Event Hubs • Prometheus • GCP PubSub • GCP Storage • Google Chat • Apache Kafka • PagerDuty • Kubeless • OpenFaaS

Dashboards and alerting

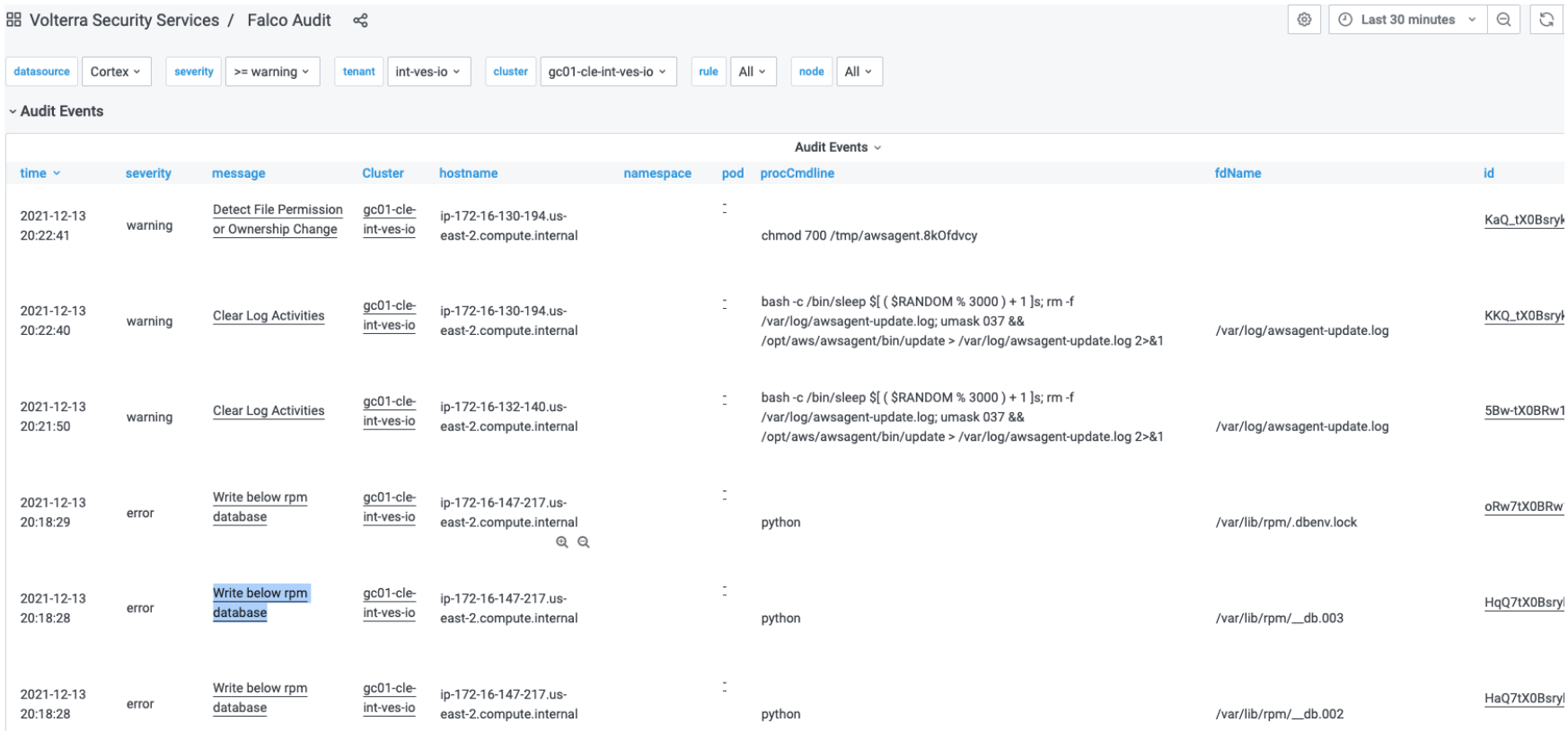


Elasticsearch

Record detail

output_fields	{ "user.uid": 2201, "proc.cmdline": "uname -o", "proc.ppid": 6271, "proc.env": "XDG_SESSION_ID=5471 HOSTNAME=master-0 SELINUX_ROLE_REQUESTED= TERM=xterm-256color SHELL=/bin/bash HISTSIZE=1000 SSH_CLIENT=10.54.80.50 51390 22 SELINUX_USE_CURRENT_RANGE= SSH_TTY=/dev/pts/0 USER=vesop MAIL=/var/spool/mail/vesop PATH=/usr/local/bin:/usr/bin:/usr/local/sbin:/usr/sbin PWD=/home/vesop SELINUX_LEVEL_REQUESTED= HISTCONTROL=ignoredups SHLVL=1 HOME=/home/vesop DNSServiceIP=10.3.0.10 LOGNAME=vesop SSH_CONNECTION=10.54.80.50 51390 10.63.51.10 22 KUBERNETES_VERSION=v1.15.0 XDG_RUNTIME_DIR=/run/user/2201 _=/usr/bin/uname", "proc.aname[2]": "bash", "container.id": "host", "proc.aname[3]": "sshd", "proc.pid": 6273, "proc.aname[4]": "sshd", "user.loginuid": 2201, "group.gid": 2201, "proc.pcmdline": "bash", "evt.time": 1654426400432897300 }
t severity	warning
t site	ty8-tky
⚠ source	syscall
t source_type	kafka
t stream	stdout
t tag	kube.app.falco.falco
t tags	group, process, user

Falco Audit in Grafana



Plugins

Addded recently (>= v0.31)

External sources

- API noundaries, hardly extensible
- Falco must expose a web server
- TLS to manage
- Doesnt work with managed K8s

Features

- dynamic shared libraries -> any language
- allows falco to collect and extract fields from streams of events
- source / extractor plugins

- K8s audit
- AWS CloudTrail
- JSON
- comming (okta, github, docker, seccompagent)

K8s audit rules

https://github.com/falcosecurity/plugins/tree/master/plugins/k8saudit

An attempt to start a pod using the host pid NS.

```
condition: kevt and pod and kcreate
  and ka.req.pod.host_pid intersects (true)
```

Detect pod starting a privileged container

```
condition: kevt
  and pod
  and kcreate
  and ka.req.pod.containers.privileged intersects (true)
  and not ka.req.pod.containers.image.repository
    in (falco_privileged_images)
```

Updated role binding

```
condition: kevt
  and clusterrolebinding
  and kcreate and ka.req.binding.role=cluster-admin
```

Credentials in configmap

```
- macro: contains_private_credentials
  condition: >
   (ka.req.configmap.obj contains "access_key" or
    ka.req.configmap.obj contains "access-key" or
    ka.req.configmap.obj contains "token" or
    ka.req.configmap.obj contains "secret" or
    ka.req.configmap.obj contains "pass")
```

CloudTrail

Plugin

```
- rule: Console Login Without MFA
  desc: Detect a console login without MFA.
  condition:
    ct.name="ConsoleLogin" and not ct.error exists
    and ct.user.identitytype!="AssumedRole"
      and json.value[/responseElements/ConsoleLogin]="Success"
        and json.value[/additionalEventData/MFAUsed]="No"
  output:
    Detected a console login without MFA
    (requesting user=%ct.user,
     requesting IP=%ct.srcip,
     AWS region=%ct.region)
  priority: CRITICAL
```

What is next step?

```
- rule: Pet detection, custom plugin
  condition: video.entities[animal] > 0
```

Sysflow.io

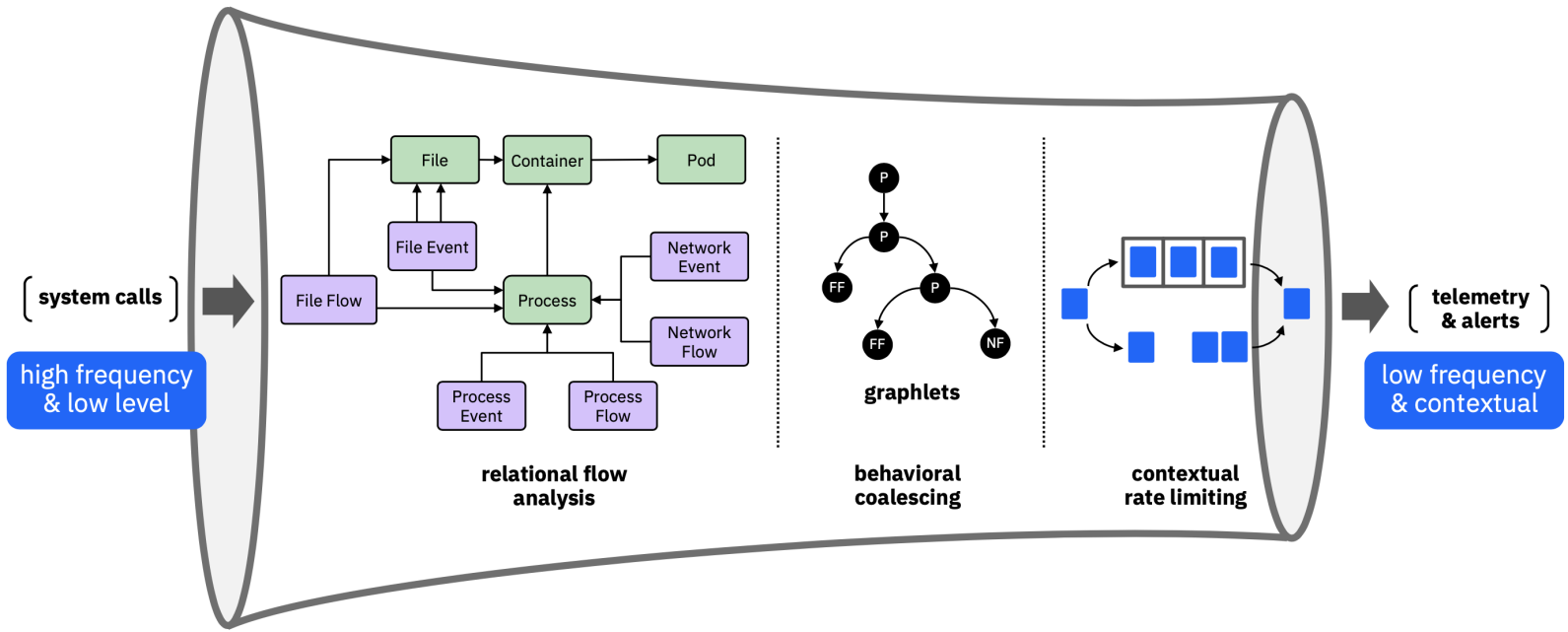
```
- rule: Impair Defenses: Disable or Modify System Firewall
  desc: Detects disabling security tools
  condition: sf.opflags = EXEC and
             ((sf.proc.name in (service_cmds) and
               sf.proc.args pmatch (security_services) and sf.proc.args pmatch (stop_cmds)) or
             ( sf.proc.name = setenforce and sf.proc.args = '0'))
  prefilter: [PE]
```

```
- rule: Large network data transfer with database endpoint
  condition: ( sf.opflags contains RECV and sf.net.dport = 3306 and sf.flow.rbytes > 1024 ) or
             ( sf.opflags contains SEND and sf.net.sport = 3306 and sf.flow.wbytes > 1024 )
  prefilter: [NF]
```

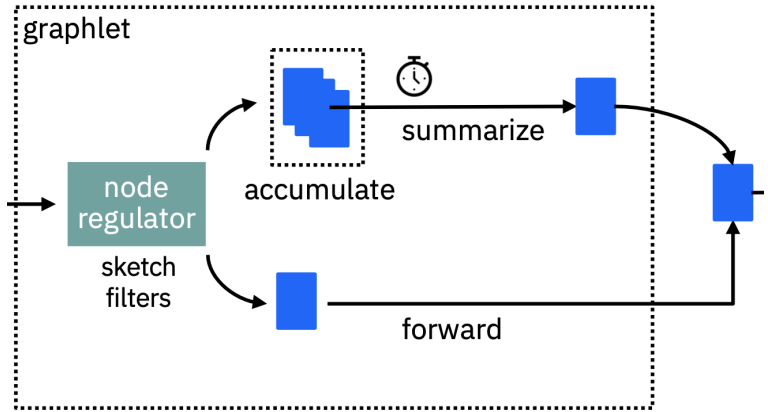
```
- rule: Privilege escalation
  condition: sf.pproc.uid != 0 and sf.proc.uid = 0 and not entrypoint
```

SysFlow.io

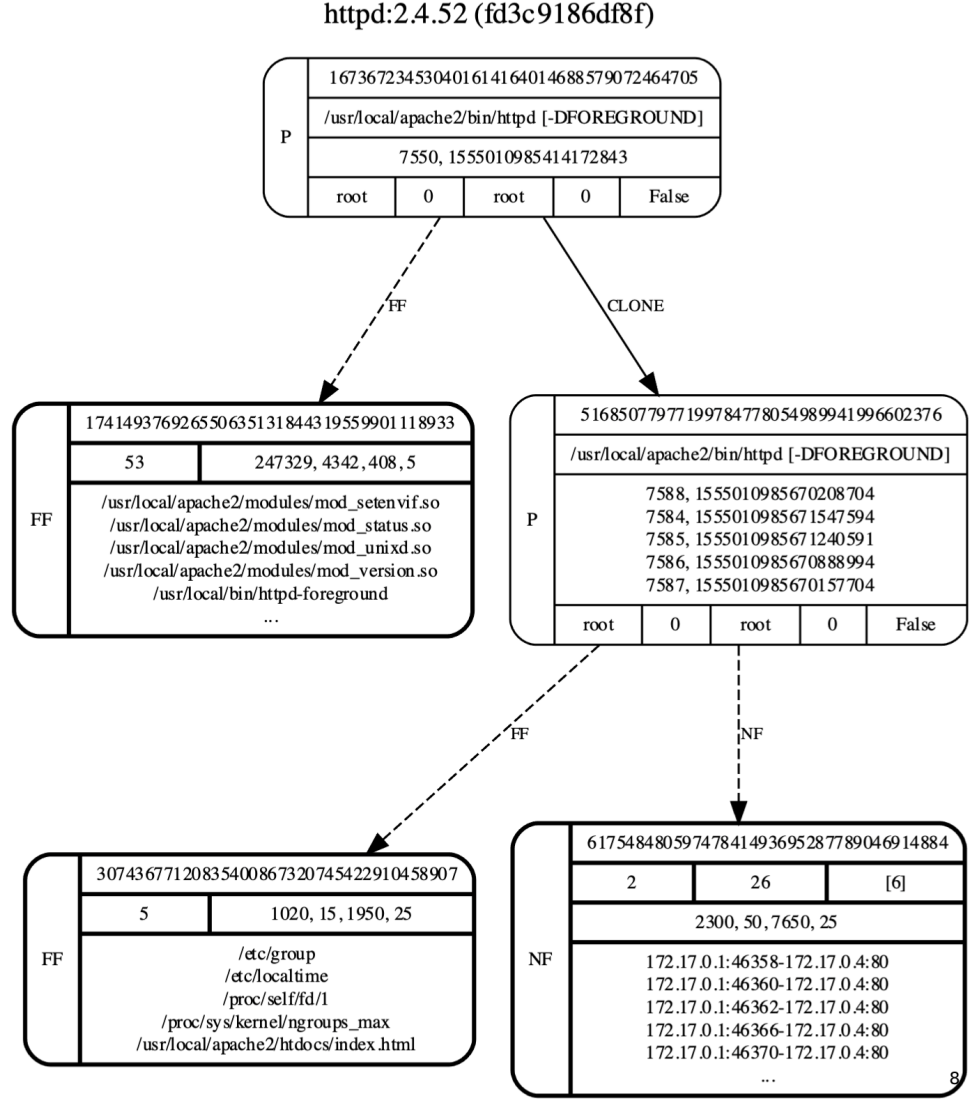
cloud-native system telemetry framework



SysFlow.io



- Rate modulation
- Node-level regulators
  - HyperLogLog sketch
  - Count-min sketch



Learn More

Documentation · GitHub · Blog

- SysFlow is a cloud-native system telemetry framework that enables the creation of security analytics on a scalable, pluggable open-source platform
  - SysFlow telemetry
  - SysFlow & Sidekick analytics PoC
  - SysFlow policies & examples
- Plugin Pet surveillance with falco PoC
- Employ AI/ML for anomaly detection

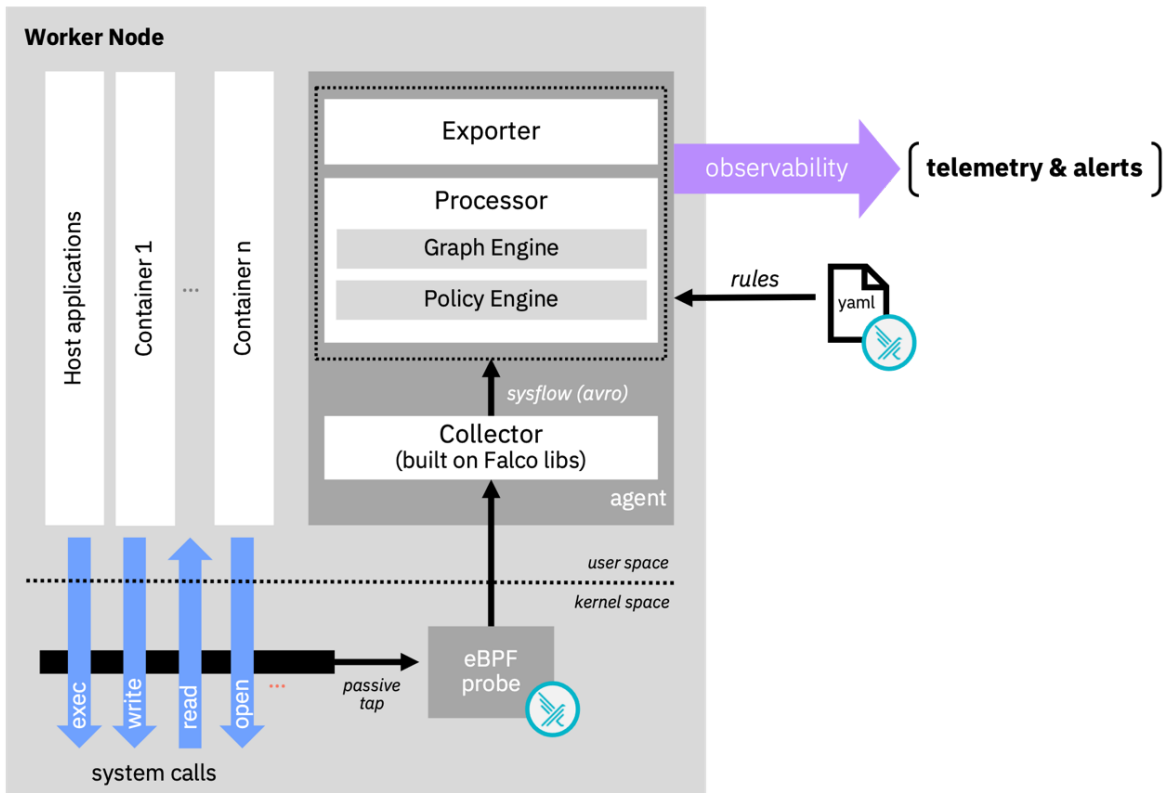
END

Backup slides

Falco architectural overview

Backup slides

SysFlow architectural overview



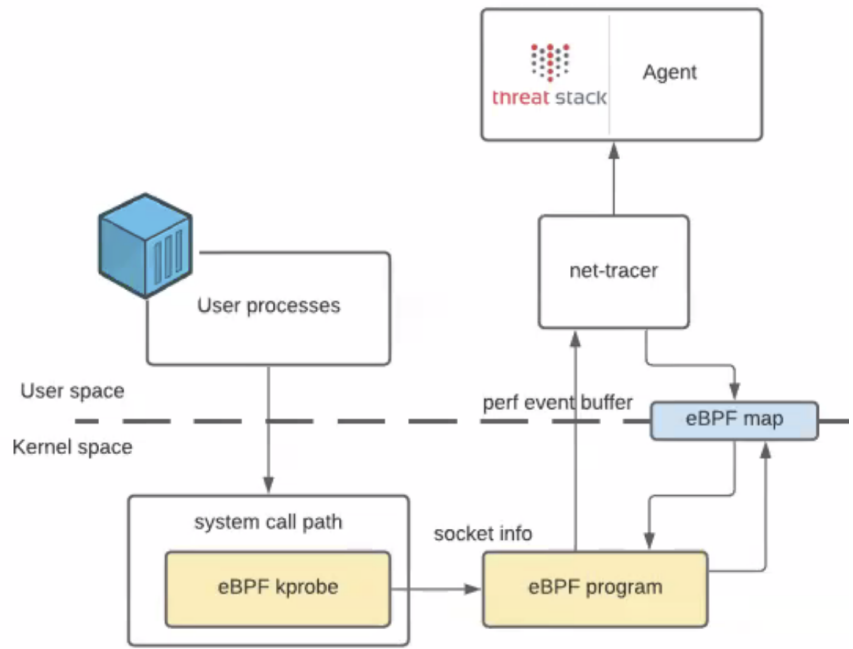
Backup slides

eBPF network observability

The agent attaches eBPF programs to kprobes to trace TCP (connect/accept) and UDP (connect) activity.

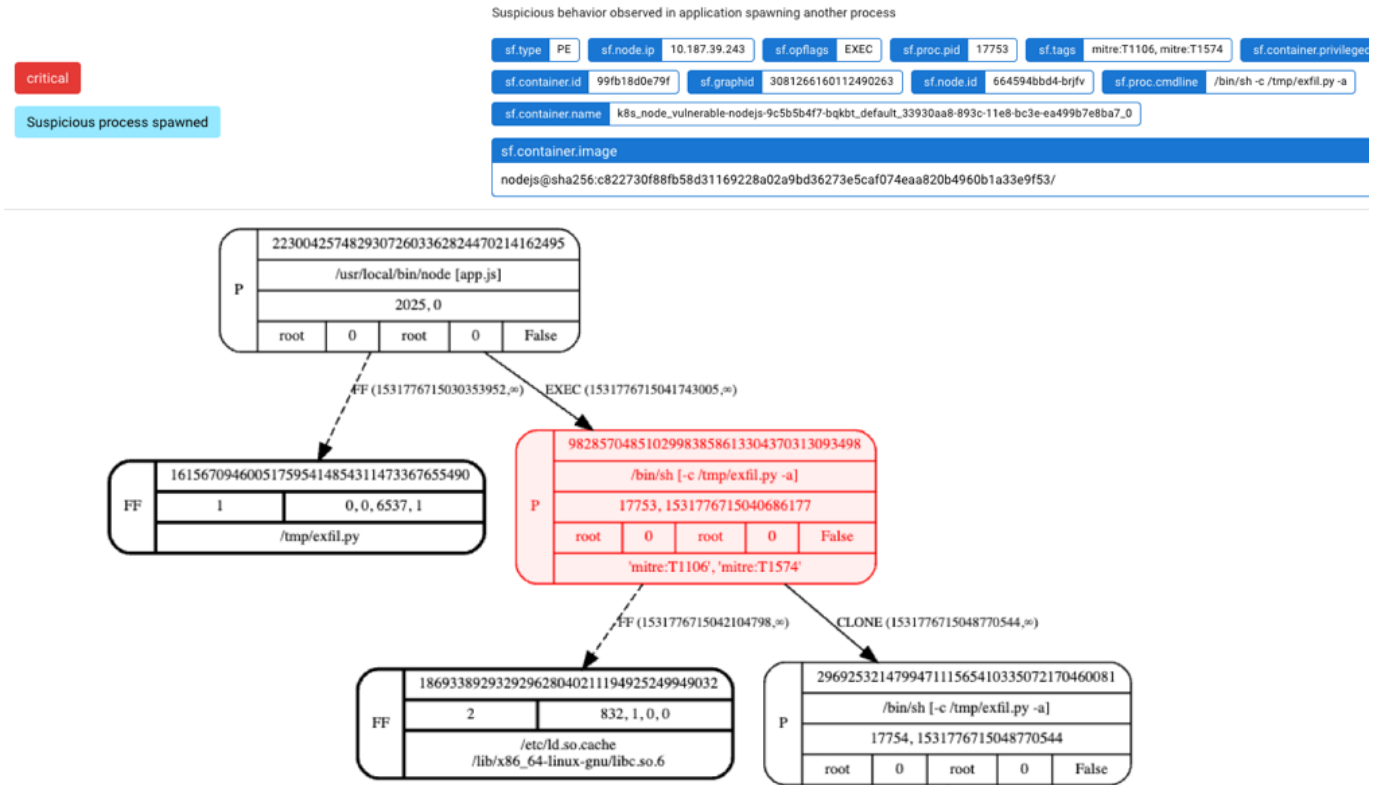
Uses telemetry from eBPF sensor to augment audit events.

Additional DNS sensor provides reverse DNS information



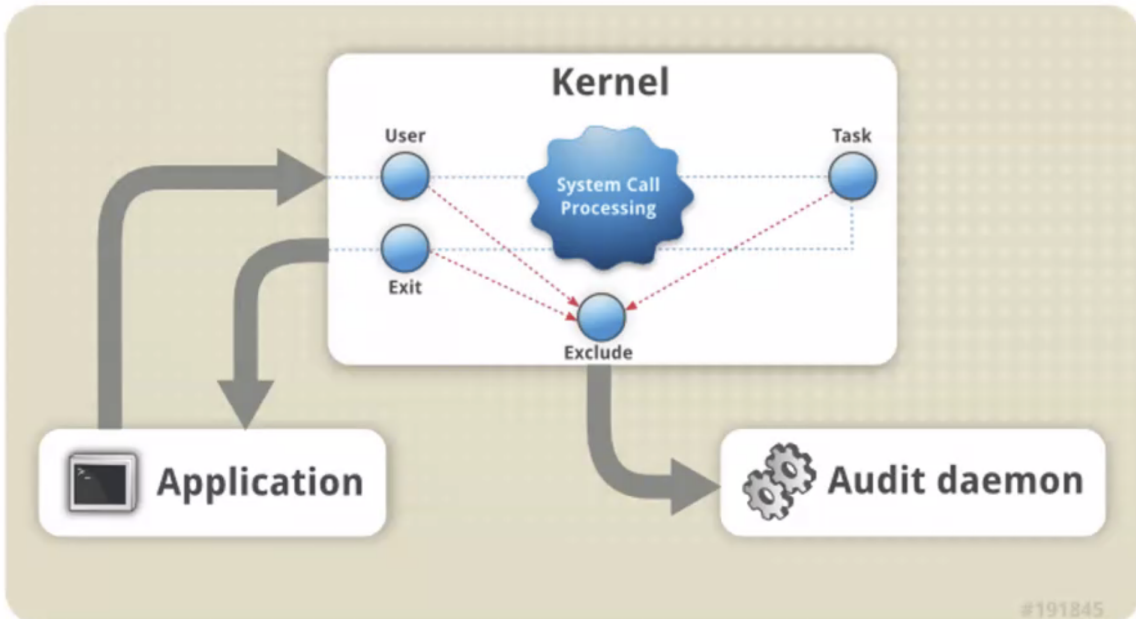
Backup slides

SysFlow.io integration to sidekick



Backup slides

AuditD comparison



Backup slides

Inbound ssh rule

```
- rule: Inbound SSH Connection
  desc: Detect Inbound SSH Connection
  condition: >
    ((evt.type in (accept,listen) and evt.dir=<) or
      (evt.type in (recvfrom,recvmsg))) and ssh_port
      and not is_kubernetes
  output: >
    Inbound SSH connection (user=%user.name client_ip=%fd.cip client_port=%fd.cport server_ip=%fd.sip)
  priority: WARNING
  tags: [ssh, network]
```

Backup slides

K8s audit -> plugin

- Removed K8S audit logs from Falco [#1952] (https://github.com/falcosecurity/falco/pull/1952)
- Now under plugins: https://github.com/falcosecurity/plugins

```
- rule: Attach/Exec Pod
  desc: Detect any attempt to attach/exec to a pod
  condition: |
    kevt_started and pod_subresource and kcreate and ka.target.subresource in (exec,attach)
    and not user_known_exec_pod_activities
```

```
- list: falco_hostpid_images
  items: []

- rule: Create HostPid Pod
  desc: Detect an attempt to start a pod using the host pid namespace.
  condition: |
    kevt and pod and kcreate and ka.req.pod.host_pid intersects (true)
    and not ka.req.pod.containers.image.repository in (falco_hostpid_images)
```

Backup slides

Rules from helm chart

https://github.com/falcosecurity/falco/tree/master/rules

```
rules-traefik.yaml: |-
  - macro: traefik_consider_syscalls
    condition: (evt.num < 0)

  - macro: app_traefik
    condition: container and container.image startswith "traefik"

  # Restricting listening ports to selected set

  - list: traefik_allowed_inbound_ports_tcp
    items: [443, 80, 8080]
```

Dashboards and alerting