MALWARE DOWNLOAD AND INCIDENT RESPONSE EVALUATION USING PFSENSE AND WAZUH

SOC ANALYST TASK WEEK 03
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ABSTRACT

This report documents a malware simulation exercise conducted on August 15th, 2024, to evaluate the performance of a pfSense firewall and Wazuh SIEM system. The exercise involved a Kali Linux VM downloading a freely available malware sample from eicar.org. The pfSense firewall, configured with specific rules to block known malware, successfully intercepted the download attempt. Wazuh SIEM monitored and logged the event, capturing detailed information for analysis. The report includes a thorough examination of Indicators of Compromise (IOCs) and Indicators of Attack (IOAs) identified during the exercise. It also presents a detailed incident response plan following industry standards, covering detection, analysis, containment, eradication, and recovery steps. The results validate the effectiveness of the security measures in place and provide a structured approach for future incident management.

Pre-requisites:

- Ensure that pfSense is properly installed and configured.
- Ensure a virtual machine is prepared (I used Kali Linux).
- Verify that Wazuh is installed and configured.
- Ensure that pfSense has been integrated as an agent in Wazuh. For detailed instructions, refer to the documentation here: https://benheater.com/integrating-pfsense-with-wazuh/

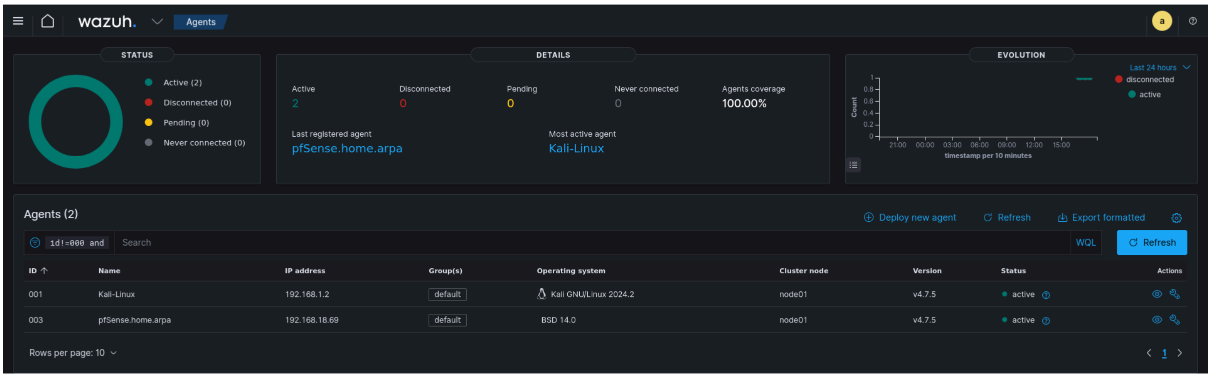
Here are the details and IPs of components used in the task.

- Kali Linux: 192.168.1.2
- Wazuh Manager: 192.168.18.68
- pfSense LAN IP: 192.168.1.1
- pfSense LAN IP: 192.168.18.69

STEPS:

1. Connecting to the Wazuh Dashboard via Kali Linux

The agents for Kali Linux and pfSense are both configured and operational.



Active (2)
Disconnected (0)
Pending (0)
Never connected (0)

Active	Disconnected	Pending	Never connected	Agents coverage
2	0	0	0	100.00%

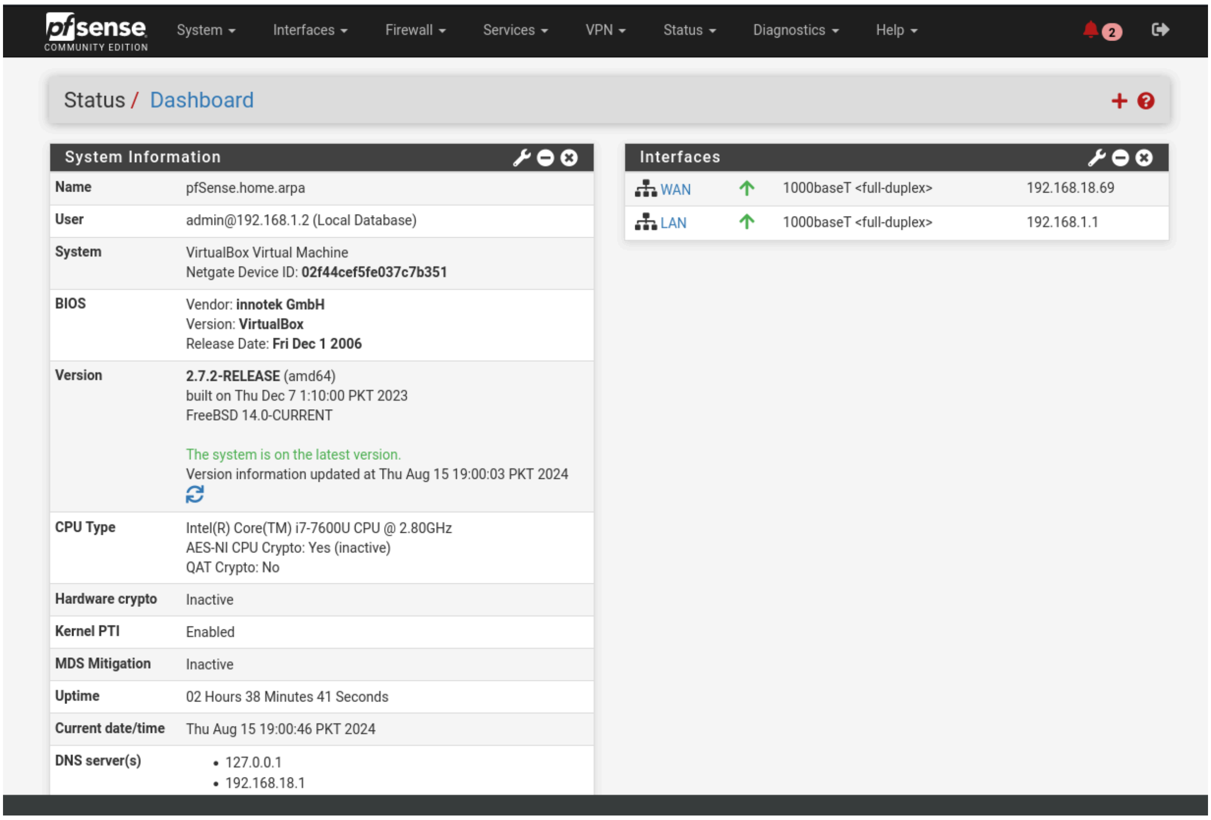
Last registered agent: pfSense.home.arpa
Most active agent: Kali-Linux

Agents (2)

`id!=000 and` Search

ID	Name	IP address	Group(s)	Operating system	Cluster node	Version	Status	Actions
001	Kali-Linux	192.168.1.2	default	Kali GNU/Linux 2024.2	node01	v4.7.5	active	
003	pfSense.home.arpa	192.168.18.69	default	BSD 14.0	node01	v4.7.5	active	

2. Setting up an alias for the designated malware file in pfsense



Status / Dashboard

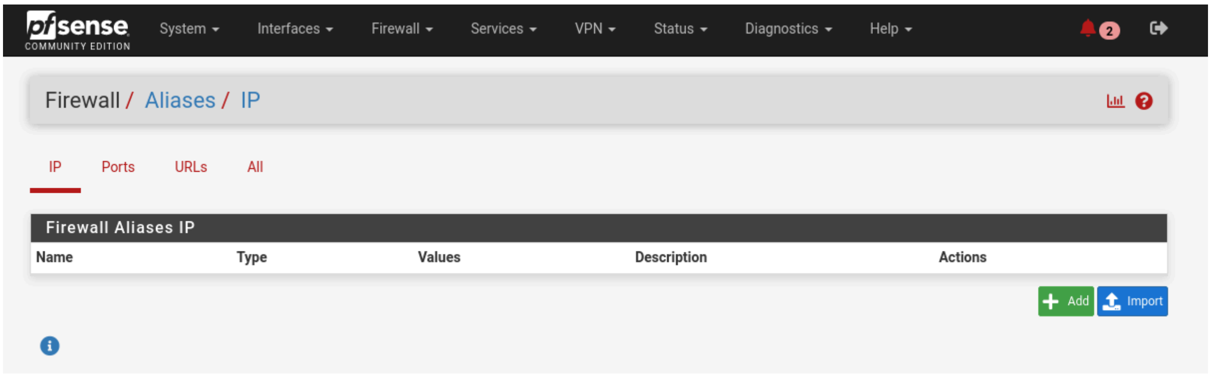
System Information

Name	pfSense.home.arpa
User	admin@192.168.1.2 (Local Database)
System	VirtualBox Virtual Machine Netgate Device ID: **02f44cef5fe037c7b351**
BIOS	Vendor: **innotek GmbH** Version: **VirtualBox** Release Date: **Fri Dec 1 2006**
Version	**2.7.2-RELEASE** (amd64) built on Thu Dec 7 1:10:00 PKT 2023 FreeBSD 14.0-CURRENT The system is on the latest version. Version information updated at Thu Aug 15 19:00:03 PKT 2024
CPU Type	Intel(R) Core(TM) i7-7600U CPU @ 2.80GHz AES-NI CPU Crypto: Yes (inactive) QAT Crypto: No
Hardware crypto	Inactive
Kernel PTI	Enabled
MDS Mitigation	Inactive
Uptime	02 Hours 38 Minutes 41 Seconds
Current date/time	Thu Aug 15 19:00:46 PKT 2024
DNS server(s)	• 127.0.0.1 • 192.168.18.1

Interfaces

WAN	↑	1000baseT <full-duplex>	192.168.18.69
LAN	↑	1000baseT <full-duplex>	192.168.1.1

Go to Firewall → Aliases

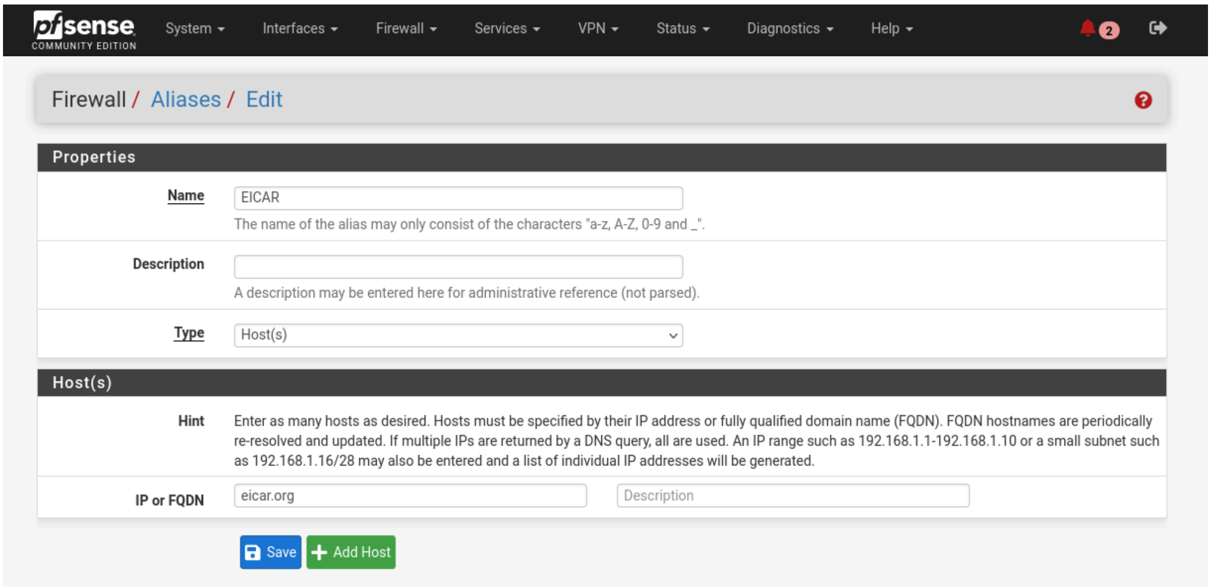


Firewall / Aliases / IP

Firewall Aliases IP

Name	Type	Values	Description	Actions

Select “Add” to create an alias. Assign a name to the alias, such as “EICAR.” Choose the “Host(s)” type to detect any domain related to the specified IP/FQDN, which in this case is “eicar.org.” Click “Save” to finalize the configuration.



Firewall / Aliases / Edit

Properties

Name: EICAR
The name of the alias may only consist of the characters "a-z, A-Z, 0-9 and _".

Description:
A description may be entered here for administrative reference (not parsed).

Type: Host(s)

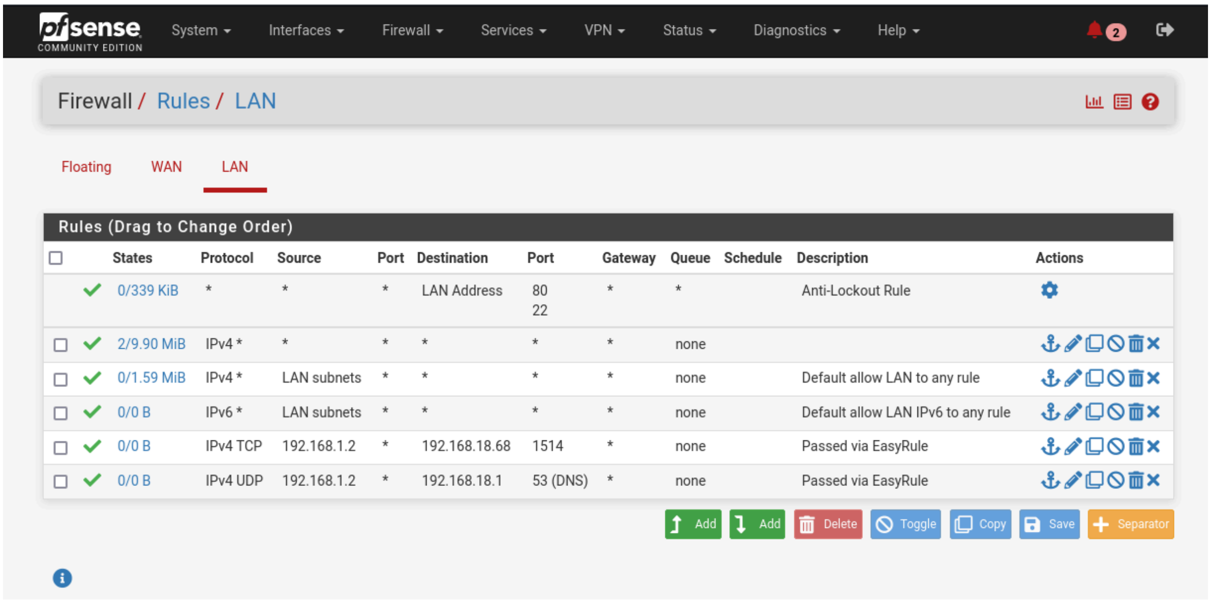
Host(s)

Hint: Enter as many hosts as desired. Hosts must be specified by their IP address or fully qualified domain name (FQDN). FQDN hostnames are periodically re-resolved and updated. If multiple IPs are returned by a DNS query, all are used. An IP range such as 192.168.1.1-192.168.1.10 or a small subnet such as 192.168.1.16/28 may also be entered and a list of individual IP addresses will be generated.

IP or FQDN: eicar.org | Description

3. Creating firewall rule to block the malware download

Go to Firewall → Rules → LAN and click on “Add” to add a new rule.

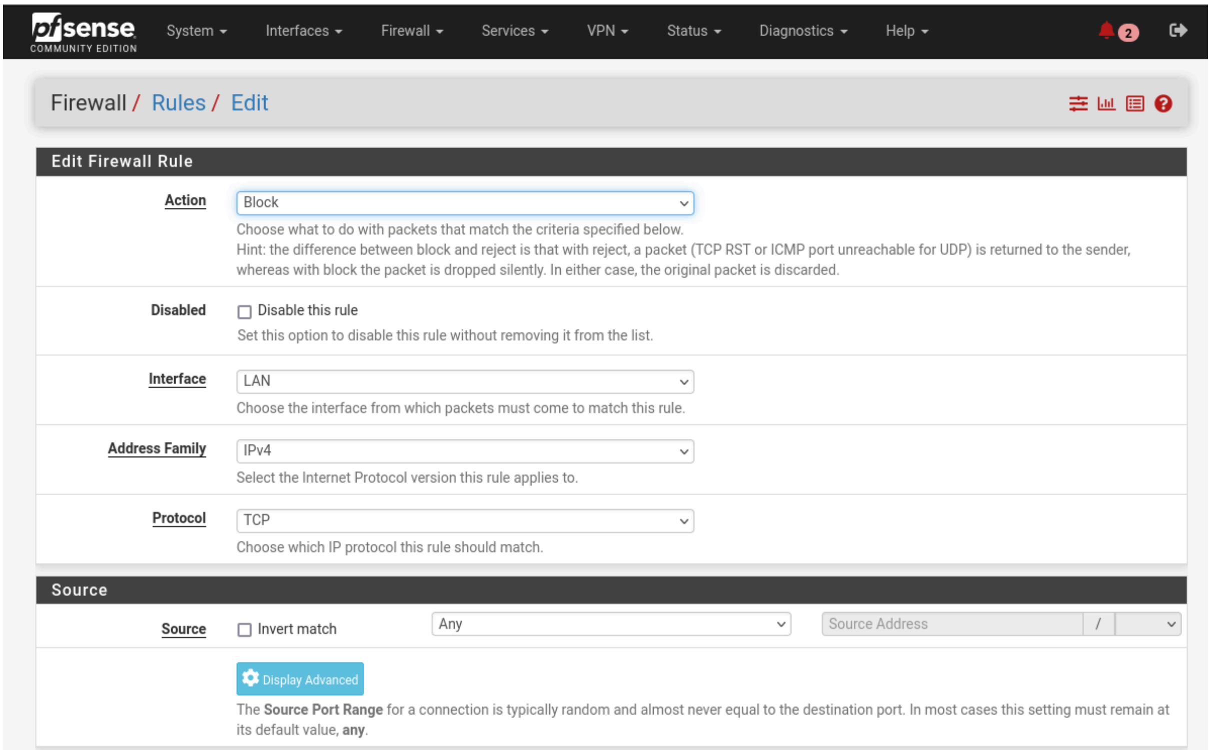


Firewall / Rules / LAN

Rules (Drag to Change Order)

□		States	Protocol	Source	Port	Destination	Port	Gateway	Queue	Schedule	Description	Actions
	✓	0/339 KiB	*	*	*	LAN Address	80 22	*	*		Anti-Lockout Rule	
□	✓	2/9.90 MiB	IPv4 *	*	*	*	*	*	none			
□	✓	0/1.59 MiB	IPv4 *	LAN subnets	*	*	*	*	none		Default allow LAN to any rule	
□	✓	0/0 B	IPv6 *	LAN subnets	*	*	*	*	none		Default allow LAN IPv6 to any rule	
□	✓	0/0 B	IPv4 TCP	192.168.1.2	*	192.168.18.68	1514	*	none		Passed via EasyRule	
□	✓	0/0 B	IPv4 UDP	192.168.1.2	*	192.168.18.1	53 (DNS)	*	none		Passed via EasyRule	

Set the action to “Block,” configure the interface to “LAN,” and leave the source as “Any.”



Firewall / Rules / Edit

Edit Firewall Rule

Action: Block
Choose what to do with packets that match the criteria specified below.
Hint: the difference between block and reject is that with reject, a packet (TCP RST or ICMP port unreachable for UDP) is returned to the sender, whereas with block the packet is dropped silently. In either case, the original packet is discarded.

Disabled: □ Disable this rule
Set this option to disable this rule without removing it from the list.

Interface: LAN
Choose the interface from which packets must come to match this rule.

Address Family: IPv4
Select the Internet Protocol version this rule applies to.

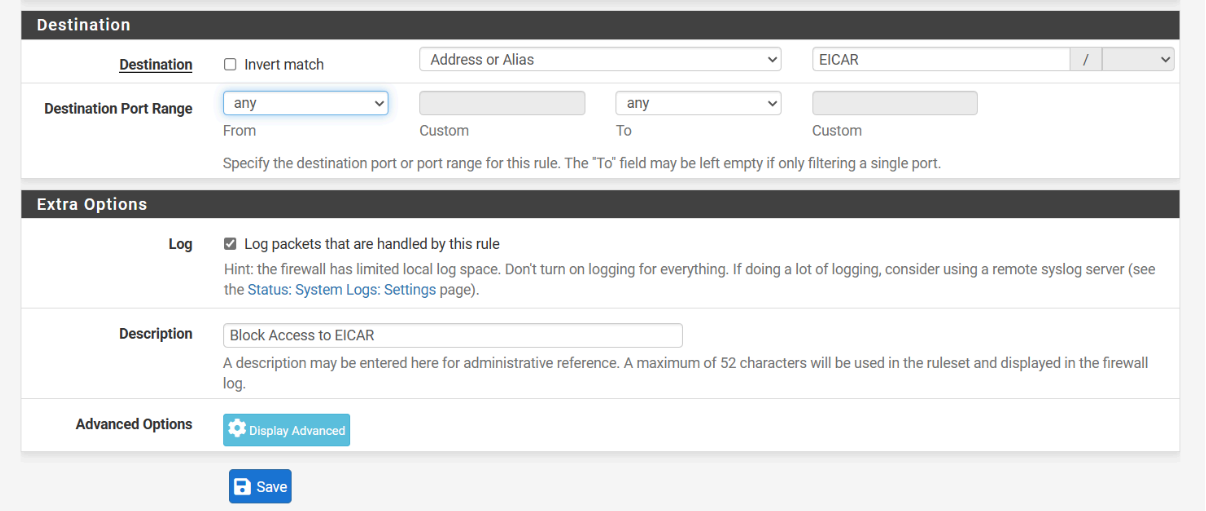
Protocol: TCP
Choose which IP protocol this rule should match.

Source

Source: □ Invert match   Any   Source Address /

The **Source Port Range** for a connection is typically random and almost never equal to the destination port. In most cases this setting must remain at its default value, **any**.

Choose “Address or Alias” for the destination and select the “EICAR” alias from the prior setup. Enable logging to ensure pfSense captures the activity. Provide a description and click “Save” to finalize.



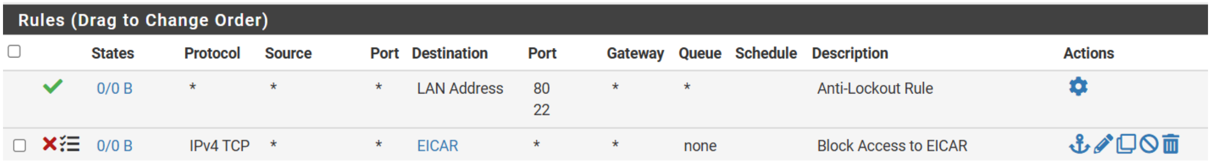
Destination

Destination	☐ Invert match · Address or Alias · EICAR /
Destination Port Range	any (From) · Custom · any (To) · Custom Specify the destination port or port range for this rule. The "To" field may be left empty if only filtering a single port.

Extra Options

Log	☑ Log packets that are handled by this rule Hint: the firewall has limited local log space. Don't turn on logging for everything. If doing a lot of logging, consider using a remote syslog server (see the Status: System Logs: Settings page).
Description	Block Access to EICAR A description may be entered here for administrative reference. A maximum of 52 characters will be used in the ruleset and displayed in the firewall log.
Advanced Options	Display Advanced

The rule is created successfully



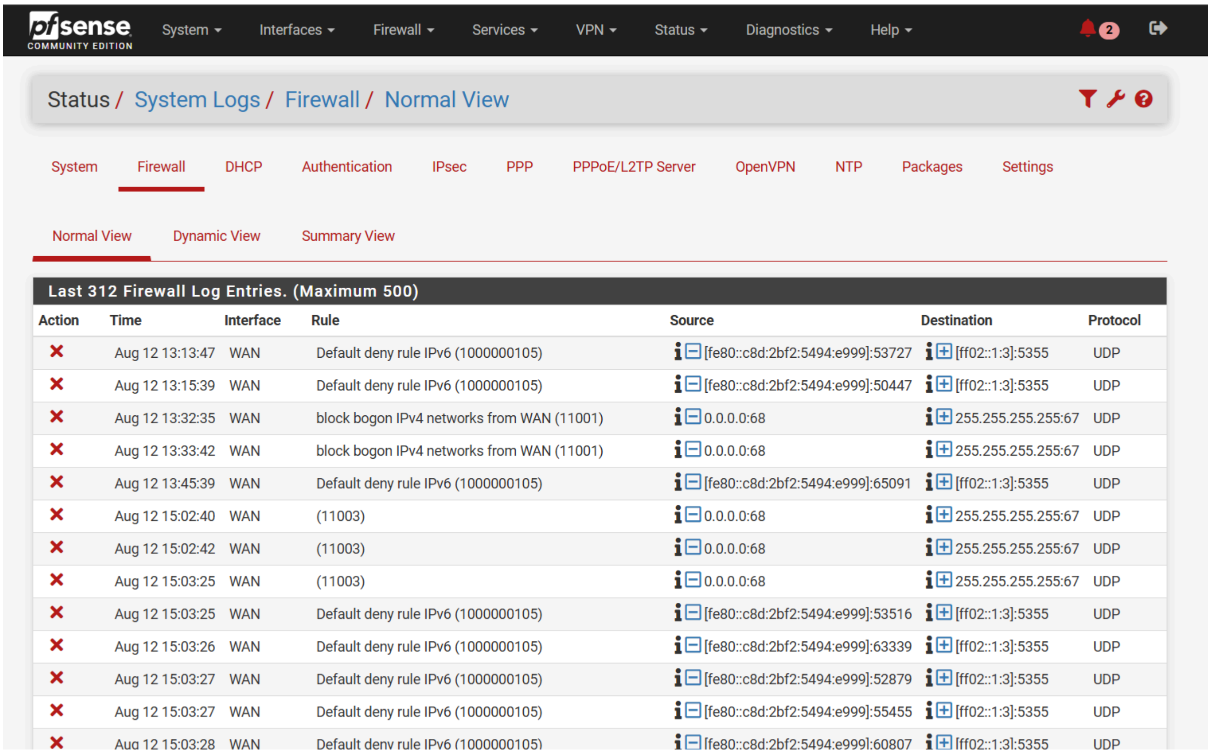
Rules (Drag to Change Order)

☐		States	Protocol	Source	Port	Destination	Port	Gateway	Queue	Schedule	Description	Actions
	✓	0/0 B	*	*	*	LAN Address	80 22	*	*		Anti-Lockout Rule	⚙
☐	✗	0/0 B	IPv4 TCP	*	*	EICAR	*	*	none		Block Access to EICAR	

4. Downloading the malware and monitoring logs in pfsense

Visit https://www.eicar.org/download-anti-malware-testfile/#top in your browser to download the malware; EICAR Test File. The URL doesn't load, hence blocking the malware download based on the alias and firewall rule created. This will cause pfSense to generate logs.

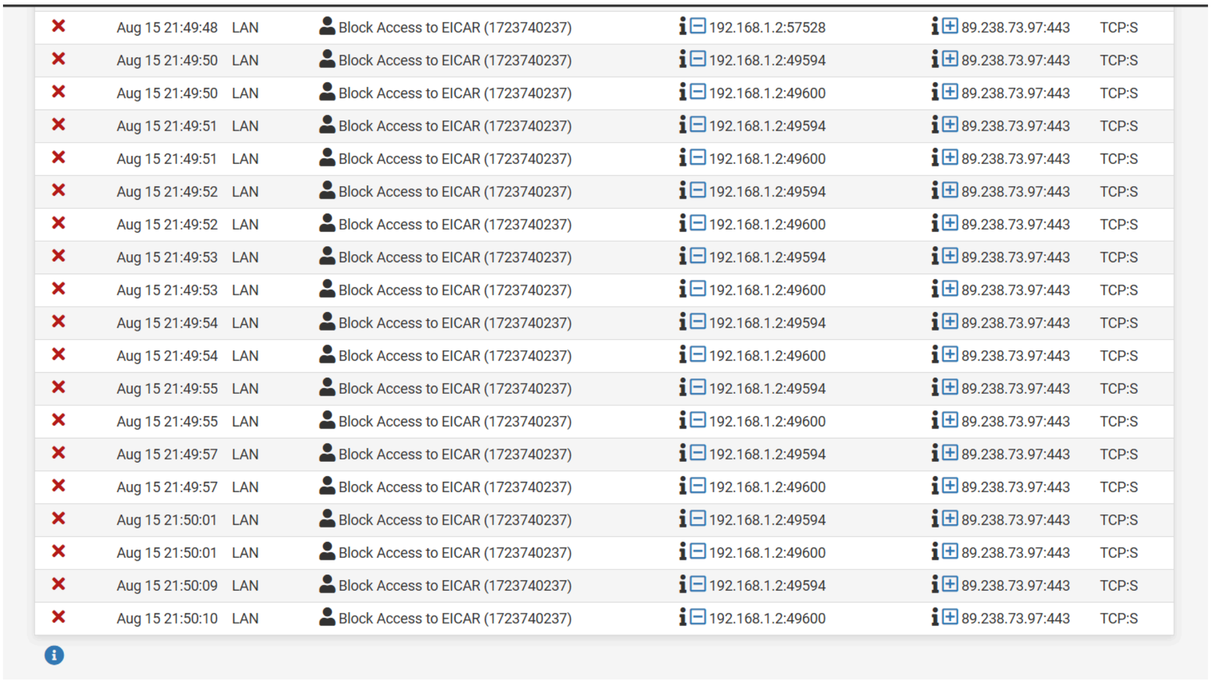
Go to Status → System Logs → Firewall to view the logs.



Last 312 Firewall Log Entries. (Maximum 500)

Action	Time	Interface	Rule	Source	Destination	Protocol
✕	Aug 12 13:13:47	WAN	Default deny rule IPv6 (1000000105)	[fe80::c8d:2bf2:5494:e999]:53727	[ff02::1:3]:5355	UDP
✕	Aug 12 13:15:39	WAN	Default deny rule IPv6 (1000000105)	[fe80::c8d:2bf2:5494:e999]:50447	[ff02::1:3]:5355	UDP
✕	Aug 12 13:32:35	WAN	block bogon IPv4 networks from WAN (11001)	0.0.0.0:68	255.255.255.255:67	UDP
✕	Aug 12 13:33:42	WAN	block bogon IPv4 networks from WAN (11001)	0.0.0.0:68	255.255.255.255:67	UDP
✕	Aug 12 13:45:39	WAN	Default deny rule IPv6 (1000000105)	[fe80::c8d:2bf2:5494:e999]:65091	[ff02::1:3]:5355	UDP
✕	Aug 12 15:02:40	WAN	(11003)	0.0.0.0:68	255.255.255.255:67	UDP
✕	Aug 12 15:02:42	WAN	(11003)	0.0.0.0:68	255.255.255.255:67	UDP
✕	Aug 12 15:03:25	WAN	(11003)	0.0.0.0:68	255.255.255.255:67	UDP
✕	Aug 12 15:03:25	WAN	Default deny rule IPv6 (1000000105)	[fe80::c8d:2bf2:5494:e999]:53516	[ff02::1:3]:5355	UDP
✕	Aug 12 15:03:26	WAN	Default deny rule IPv6 (1000000105)	[fe80::c8d:2bf2:5494:e999]:63339	[ff02::1:3]:5355	UDP
✕	Aug 12 15:03:27	WAN	Default deny rule IPv6 (1000000105)	[fe80::c8d:2bf2:5494:e999]:52879	[ff02::1:3]:5355	UDP
✕	Aug 12 15:03:27	WAN	Default deny rule IPv6 (1000000105)	[fe80::c8d:2bf2:5494:e999]:55455	[ff02::1:3]:5355	UDP
✕	Aug 12 15:03:28	WAN	Default deny rule IPv6 (1000000105)	[fe80::c8d:2bf2:5494:e999]:60807	[ff02::1:3]:5355	UDP

Scroll to the bottom to view the logs generated by this activity.

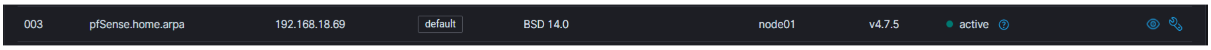


✕	Aug 15 21:49:48	LAN	Block Access to EICAR (1723740237)	192.168.1.2:57528	89.238.73.97:443	TCP:S
✕	Aug 15 21:49:50	LAN	Block Access to EICAR (1723740237)	192.168.1.2:49594	89.238.73.97:443	TCP:S
✕	Aug 15 21:49:50	LAN	Block Access to EICAR (1723740237)	192.168.1.2:49600	89.238.73.97:443	TCP:S
✕	Aug 15 21:49:51	LAN	Block Access to EICAR (1723740237)	192.168.1.2:49594	89.238.73.97:443	TCP:S
✕	Aug 15 21:49:51	LAN	Block Access to EICAR (1723740237)	192.168.1.2:49600	89.238.73.97:443	TCP:S
✕	Aug 15 21:49:52	LAN	Block Access to EICAR (1723740237)	192.168.1.2:49594	89.238.73.97:443	TCP:S
✕	Aug 15 21:49:52	LAN	Block Access to EICAR (1723740237)	192.168.1.2:49600	89.238.73.97:443	TCP:S
✕	Aug 15 21:49:53	LAN	Block Access to EICAR (1723740237)	192.168.1.2:49594	89.238.73.97:443	TCP:S
✕	Aug 15 21:49:53	LAN	Block Access to EICAR (1723740237)	192.168.1.2:49600	89.238.73.97:443	TCP:S
✕	Aug 15 21:49:54	LAN	Block Access to EICAR (1723740237)	192.168.1.2:49594	89.238.73.97:443	TCP:S
✕	Aug 15 21:49:54	LAN	Block Access to EICAR (1723740237)	192.168.1.2:49600	89.238.73.97:443	TCP:S
✕	Aug 15 21:49:55	LAN	Block Access to EICAR (1723740237)	192.168.1.2:49594	89.238.73.97:443	TCP:S
✕	Aug 15 21:49:55	LAN	Block Access to EICAR (1723740237)	192.168.1.2:49600	89.238.73.97:443	TCP:S
✕	Aug 15 21:49:57	LAN	Block Access to EICAR (1723740237)	192.168.1.2:49594	89.238.73.97:443	TCP:S
✕	Aug 15 21:49:57	LAN	Block Access to EICAR (1723740237)	192.168.1.2:49600	89.238.73.97:443	TCP:S
✕	Aug 15 21:50:01	LAN	Block Access to EICAR (1723740237)	192.168.1.2:49594	89.238.73.97:443	TCP:S
✕	Aug 15 21:50:01	LAN	Block Access to EICAR (1723740237)	192.168.1.2:49600	89.238.73.97:443	TCP:S
✕	Aug 15 21:50:09	LAN	Block Access to EICAR (1723740237)	192.168.1.2:49594	89.238.73.97:443	TCP:S
✕	Aug 15 21:50:10	LAN	Block Access to EICAR (1723740237)	192.168.1.2:49600	89.238.73.97:443	TCP:S

The malware download attempt is successfully blocked by the firewall from the source IP 192.168.1.2 to the destination IP 89.238.73.97 (EICAR's IP).

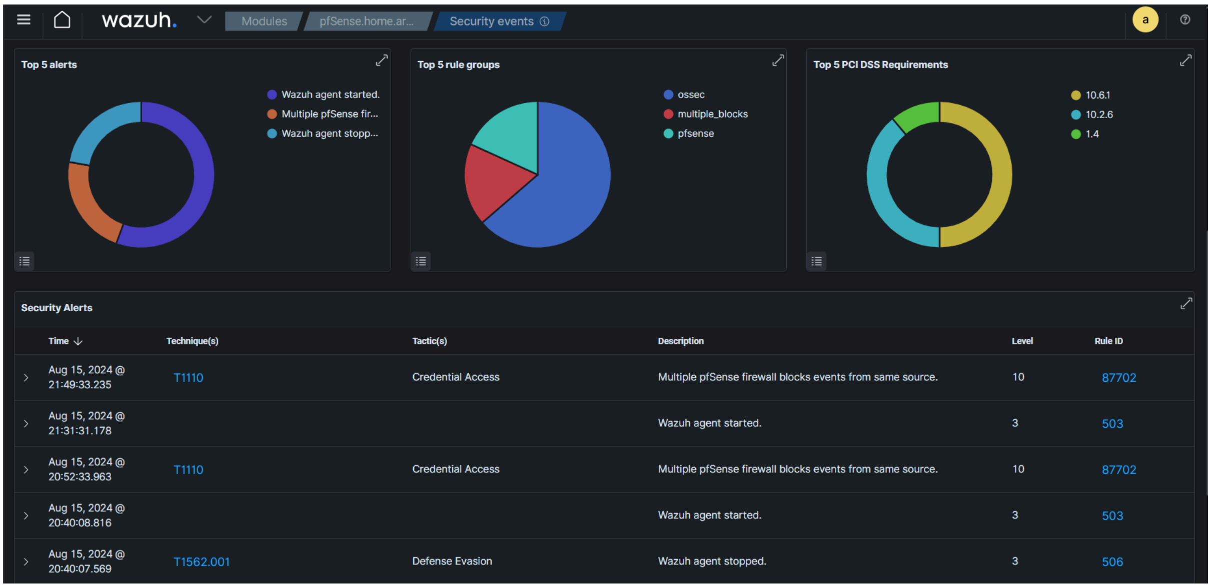
5. Monitoring logs in Wazuh

Head to the pfsense agent on your Wazuh dashboard to view the pfsense logs on Wazuh



003	pfSense.home.arpa	192.168.18.69	default	BSD 14.0	node01	v4.7.5	● active

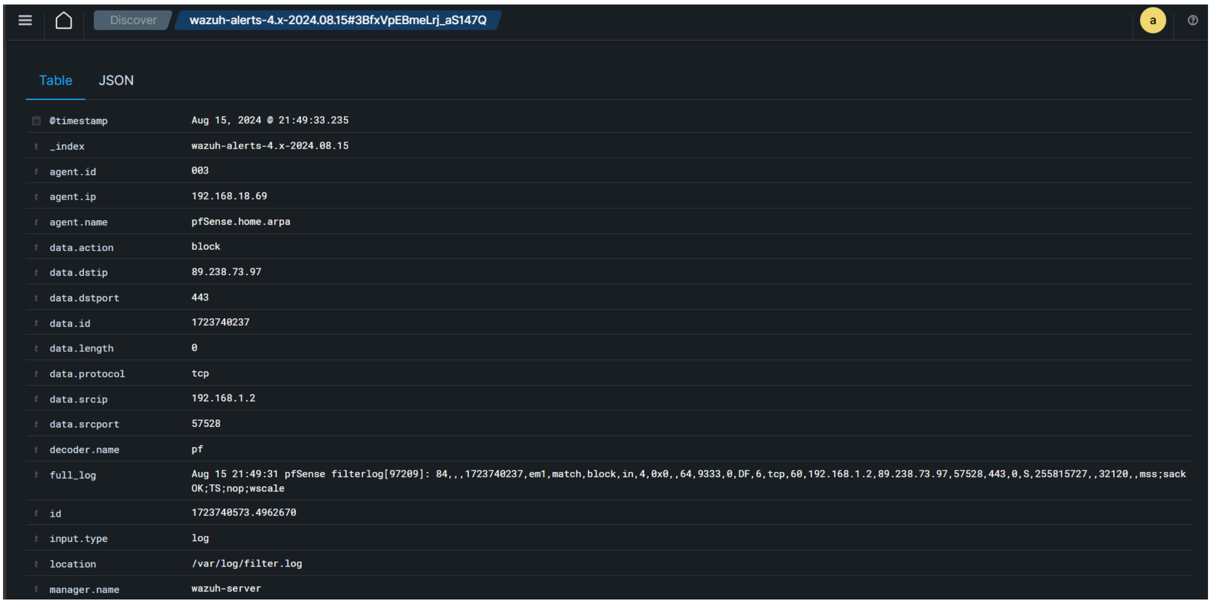
Here you can see the logs in security events as “Multiple pfSense firewall blocks events from same source”



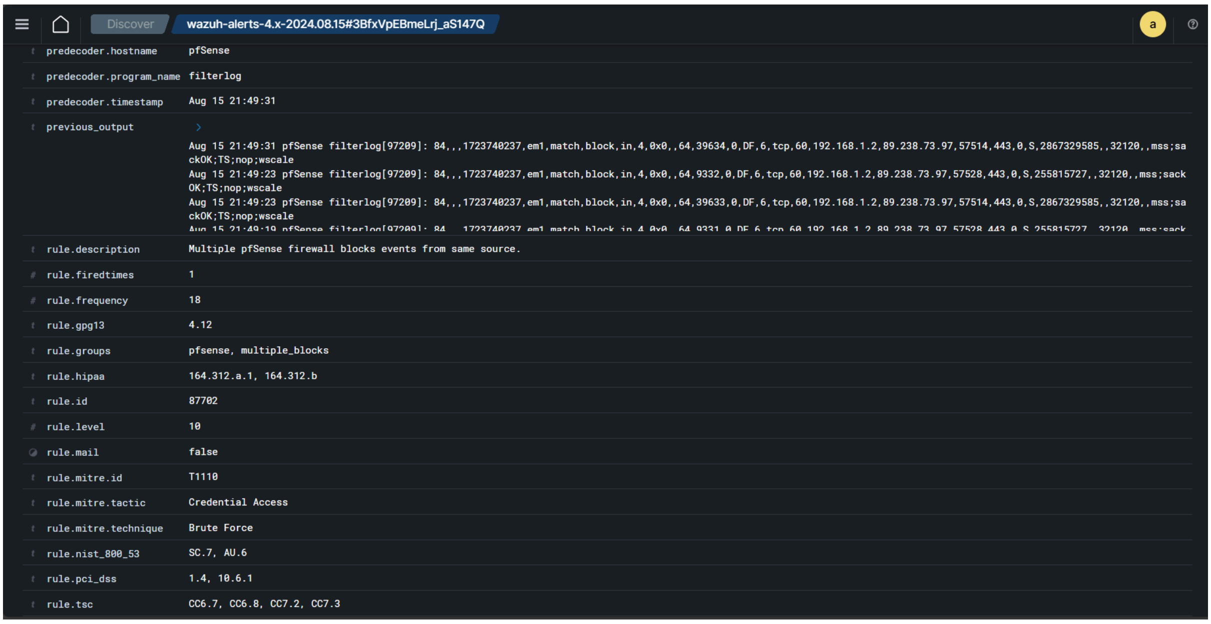
Security Alerts

Time ↓	Technique(s)	Tactic(s)	Description	Level	Rule ID
Aug 15, 2024 @ 21:49:33.235	T1110	Credential Access	Multiple pfSense firewall blocks events from same source.	10	87702
Aug 15, 2024 @ 21:31:31.178			Wazuh agent started.	3	503
Aug 15, 2024 @ 20:52:33.963	T1110	Credential Access	Multiple pfSense firewall blocks events from same source.	10	87702
Aug 15, 2024 @ 20:40:08.816			Wazuh agent started.	3	503
Aug 15, 2024 @ 20:40:07.569	T1562.001	Defense Evasion	Wazuh agent stopped.	3	506

Examining the details reveals that access was blocked from the source IP 192.168.1.2 to the destination IP 89.238.73.97 (EICAR’s IP), effectively stopping the malware download.



@timestamp	Aug 15, 2024 @ 21:49:33.235
_index	wazuh-alerts-4.x-2024.08.15
agent.id	003
agent.ip	192.168.18.69
agent.name	pfSense.home.arpa
data.action	block
data.dstip	89.238.73.97
data.dstport	443
data.id	1723740237
data.length	0
data.protocol	tcp
data.srcip	192.168.1.2
data.srcport	57528
decoder.name	pf
full_log	Aug 15 21:49:31 pfSense filterlog[97209]: 84,,,1723740237,em1,match,block,in,4,0x0,,64,9333,0,DF,6,tcp,60,192.168.1.2,89.238.73.97,57528,443,0,S,255815727,,32120,,mss;sackOK;TS;nop;wscale
id	1723740573.4962670
input.type	log
location	/var/log/filter.log
manager.name	wazuh-server



predecoder.hostname	pfSense
predecoder.program_name	filterlog
predecoder.timestamp	Aug 15 21:49:31
previous_output	Aug 15 21:49:31 pfSense filterlog[97209]: 84,,,1723740237,em1,match,block,in,4,0x0,,64,39634,0,DF,6,tcp,60,192.168.1.2,89.238.73.97,57514,443,0,S,2867329585,,32120,,mss;sackOK;TS;nop;wscale Aug 15 21:49:23 pfSense filterlog[97209]: 84,,,1723740237,em1,match,block,in,4,0x0,,64,9332,0,DF,6,tcp,60,192.168.1.2,89.238.73.97,57528,443,0,S,255815727,,32120,,mss;sackOK;TS;nop;wscale Aug 15 21:49:23 pfSense filterlog[97209]: 84,,,1723740237,em1,match,block,in,4,0x0,,64,39633,0,DF,6,tcp,60,192.168.1.2,89.238.73.97,57514,443,0,S,2867329585,,32120,,mss;sackOK;TS;nop;wscale Aug 15 21:49:19 pfSense filterlog[97209]: 84,,,1723740237,em1,match,block,in,4,0x0,,64,9331,0,DF,6,tcp,60,192.168.1.2,89.238.73.97,57528,443,0,S,255815727,,32120,,mss;sack
rule.description	Multiple pfSense firewall blocks events from same source.
rule.firedtimes	1
rule.frequency	18
rule.gpg13	4.12
rule.groups	pfsense, multiple_blocks
rule.hipaa	164.312.a.1, 164.312.b
rule.id	87702
rule.level	10
rule.mail	false
rule.mitre.id	T1110
rule.mitre.tactic	Credential Access
rule.mitre.technique	Brute Force
rule.nist_800_53	SC.7, AU.6
rule.pci_dss	1.4, 10.6.1
rule.tsc	CC6.7, CC6.8, CC7.2, CC7.3

IOCs and IOAs

Incident Overview

- **Incident Date and Time:** August 15th, 2024, 15:35 UTC
- **Source IP Address:** 192.168.1.2 (Kali Linux VM)
- **Destination IP Address:** 89.238.73.97 (EICAR server)
- **Malware URL:** https://www.eicar.org/download-anti-malware-testfile/#top
- **Reported by:** Simra Fatima
- **Reported to:** ITSOLERA SOC Department

Incident Summary

On August 15th, 2024, at 15:35 UTC, the Kali Linux VM (IP: 192.168.1.2) attempted to download the EICAR test file from eicar.org (IP: 89.238.73.97). The pfSense firewall, configured with rules to block known malware test files, successfully intercepted this attempt. The event was logged and alerted by the Wazuh SIEM system, demonstrating the effectiveness of both the firewall and SIEM in detecting and responding to potential threats.

Indicators of Compromise (IOCs)

IP Addresses:

- **Source IP:** 192.168.1.2
- **Description:** IP address of the Kali Linux VM initiating the download attempt.

- **Destination IP:** 89.238.73.97
- **Description:** IP address of the server hosting the EICAR test file.

Domain Names:

- **Domain:** eicar.org
- **Description:** Domain associated with the EICAR test file, used for evaluating malware detection systems.

Malicious files or URLs Accessed:

- **Malware-URL:**https://www.eicar.org/download-anti-malware-testfile/#top
- **Description:** URL used to attempt the download of the EICAR test file, a known test file used to assess the effectiveness of security defenses.

Indicators of Attack (IOAs)

- **Malware Test File Download Attempt:**
  - ➢ **Behavior:** Attempt to download the EICAR test file.
  - ➢ **Intent:** Test or bypass network defenses.
  - ➢ **Technique:** Direct download from a known test domain.

- **Credential Access Attempts:**
    - ➢ **Behavior:** Detected unauthorized access attempts.
    - ➢ **Intent:** Gain unauthorized access to systems or data.
    - ➢ **Technique:** Brute force or credential dumping methods.

- **Defense Evasion Techniques:**
    - ➢ **Behavior:** Actions to avoid detection by security systems.
    - ➢ **Intent:** Reduce likelihood of triggering security alerts.
    - ➢ **Technique:** Obfuscation or disabling security tools.

- **Connection to Suspicious Domain:**
    - ➢ **Behavior:** Connection attempt to eicar.org.
    - ➢ **Intent:** Validate network defenses or test response mechanisms.
    - ➢ **Technique:** Utilizing domains known for test files.

- **Firewall Rule Triggered:**
    - ➢ **Behavior:** Firewall rules activated to block the connection.
    - ➢ **Intent:** Intercept and neutralize the potential threat.
    - ➢ **Technique:** Rule-based blocking based on test file signatures.

Incident Response Plan

1. Detection

- **Standards:** Follow NIST SP 800-61 for incident detection procedures.
- **Action:** Use Wazuh SIEM to monitor for and alert on suspicious activities and traffic patterns.
- **Tools:** Wazuh SIEM and pfSense firewall logs.

2. Analysis

- **Standards:** Align with NIST SP 800-86 for forensic analysis.
- **Action:** Investigate and validate the nature of the alert. Correlate with known IOCs and attack patterns.
- **Tools:** Log analysis from Wazuh and pfSense.

3. Containment

- **Standards:** Refer to NIST SP 800-61 for containment strategies.
- **Action:** Implement immediate measures to prevent further interactions with the threat source. Block relevant IP addresses and domains.
- **Tools:** pfSense firewall rules and network access controls.

4. Eradication

- **Standards:** Follow NIST SP 800-61 for eradication procedures.
- **Action:** Remove any residual threats from affected systems and apply patches as needed.
- **Tools:** System cleanup and updates.

5. Recovery

- **Standards:** Adhere to NIST SP 800-61 for recovery processes.
- **Action:** Restore systems to normal operation. Ensure that all security measures are effective and monitor for signs of residual threats.
- **Tools:** System monitoring and validation.

6. Post-Incident Review

- **Standards:** Align with ISO/IEC 27035 for post-incident analysis.
- **Action:** Conduct a review of the incident, assess response effectiveness, and update incident response plans as needed.
- **Tools:** Incident review documentation and lessons learned.

Report Sharing

- **Document Compilation:** This report, including detailed IOCs and IOAs, and compliance by regulatory standards will be compiled into a comprehensive incident response plan.
- **Review and Implementation:** The document will be shared with relevant stakeholders for review and implementation of the incident response procedures.

Behavioral Analysis

The incident involved a simulated malware download attempt detected and blocked by network defenses. Credential Access and Defense Evasion tactics were identified, suggesting advanced persistent threat (APT) behavior aimed at unauthorized access and evasion.

Impact Assessment

The incident was contained effectively with no malware entering the network. The pfSense firewall and Wazuh SIEM systems successfully detected and responded to the threat, demonstrating their capability in real-time threat management.

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