Enhancing Security Operations with S.O.C Automation using SIEM & SOAR

Md Ibtesam Hossain

1. INTRODUCTION

The “SOC Automation with SIEM and SOAR” project underscores my proficiency in cybersecurity by seamlessly integrating SIEM and SOAR technologies within a simulated SOC environment. Leveraging Wazuh as the SIEM solution, Shuffle as the SOAR platform, and TheHive for incident response and case management, the project showcased a robust infrastructure designed to enhance threat detection and incident response capabilities. Through the deployment of Wazuh agents on Windows clients, real-time Sysmon logs were transmitted to the Wazuh manager, enabling proactive threat monitoring. Shuffle's customized triggers facilitated the automatic generation of alerts based on predefined rules, while advanced workflows, such as the detection of mimikatz, enriched incident data by integrating VirusTotal intelligence. The project's outcomes included reduced incident response times, bolstered threat detection capabilities, and empowered analysts with enriched contextual information, emphasizing the pivotal role of SIEM and SOAR technologies in modern cybersecurity operations.

1.2. Objectives and Goals

The primary objective of the project was to enhance the effectiveness and efficiency of security operations by implementing automated workflows for threat detection and incident response. Specific goals included improving threat detection capabilities through real-time monitoring of Sysmon logs, streamlining incident response processes by automating alert generation and case management, enriching incident data with threat intelligence from external sources such as VirusTotal. Additionally, the project aimed to power security analysts with enriched contextual information and reduce incident response times, ultimately fortifying the organization’s cybersecurity posture and resilience against emerging threats.

2. METHODOLOGIES

In this section I will provide an in-depth overview of the tools utilized, and the configuration details implemented throughout the project.

2.1. Description of the Tools

- **Wazuh as the SIEM Solution**: Wazuh, a robust open-source SIEM platform, was employed to collect, monitor, and analyze security event logs from various sources within the simulated environment. Its advanced capabilities facilitated real-time threat detection and response.
- **Shuffle as the SOAR Platform**: Shuffle, an open-source SOAR platform, was utilized to automate security workflows and orchestrate response actions based on predefined triggers and rules. It seamlessly integrated with Wazuh to enhance incident response capabilities.
- **TheHive for Incident Response and Case Management**: TheHive, a powerful open-source incident response platform, served as the central hub for managing and coordinating security incidents. It enabled security analysts to collaborate effectively and track the progress of investigations.

2.2. Configuration Details

- **Installation and Setup of Wazuh Agent on Windows Client**: A Wazuh agent was installed on the Windows client to facilitate the collection and transmission of Sysmon logs to the Wazuh manager. This agent served as the primary source of security event data within the environment.
- **Integration of Wazuh with Shuffle and TheHive**: Wazuh was seamlessly integrated with Shuffle and TheHive to enable automated alert generation and incident response workflows. Custom connectors and APIs were utilized to establish communication between the different components, ensuring smooth information exchange.
- **Customization of Alerts and Workflows**: Custom alerts and workflows were configured within Shuffle to automate specific security processes, such as alert triaging, enrichment, and response actions. These workflows were tailored to the organization's specific security requirements and operational workflows, enhancing overall efficiency and effectiveness.

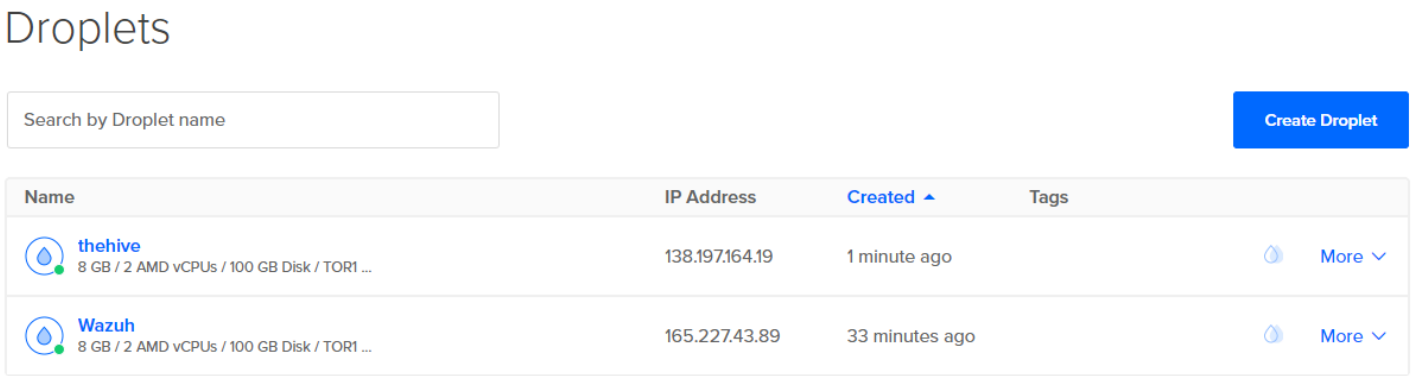
3. IMPLEMENTATION

Detailed explanation of how the project was executed from creating each VMs to installing and configuring each application is given below.

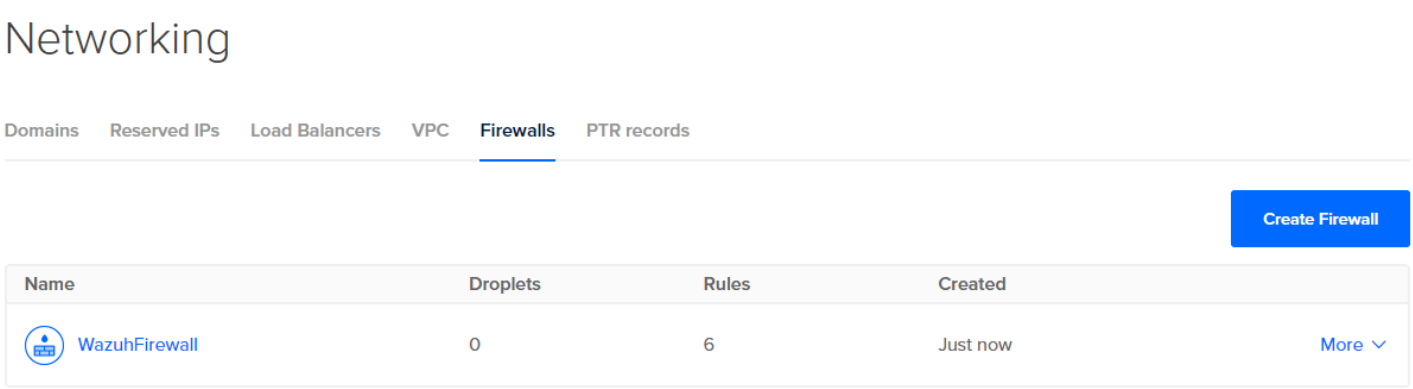
3.1. Setting up the LAB Environment

This project required at least three machines, Wazuh manager, TheHive, and the Windows client. Wazuh manager and TheHive were installed in VM using Digital Ocean cloud. Windows 10 Pro VM was created on-prem using VMWarePlayer hypervisor.

For both Wazuh manager and TheHive was created using Ubuntu 22.04 LTS (x64) image with 8 GB Memory, 2 AMD vCPUs and a storage of 100 GB Disk.



To secure these Droplets (Virtual Machines) from external adversaries while installing and configuring applications, a Firewall was deployed from the Networking Tab of the Digital Ocean. The firewall (WazuhFirewall) allowed in-bound traffic only from the on-prem Public IP.

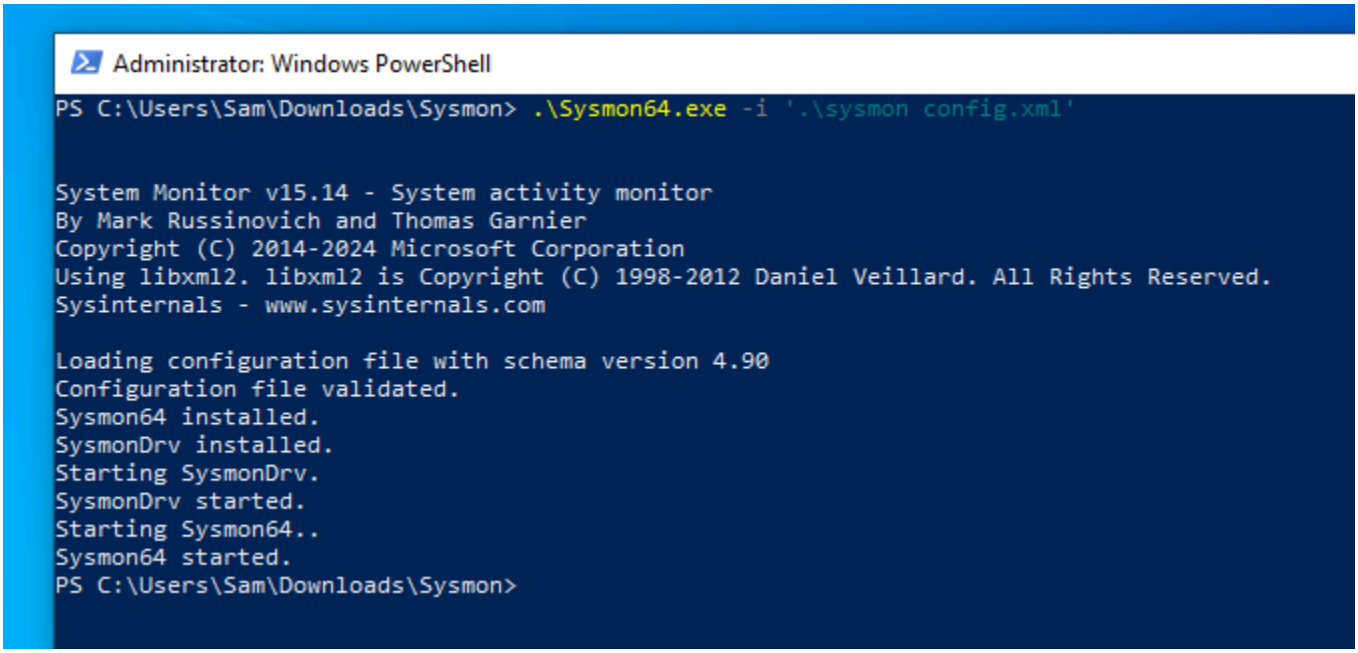


And finally, both the Wazuh and TheHive droplets were added to the Firewall to take advantage of the Traffic rules.

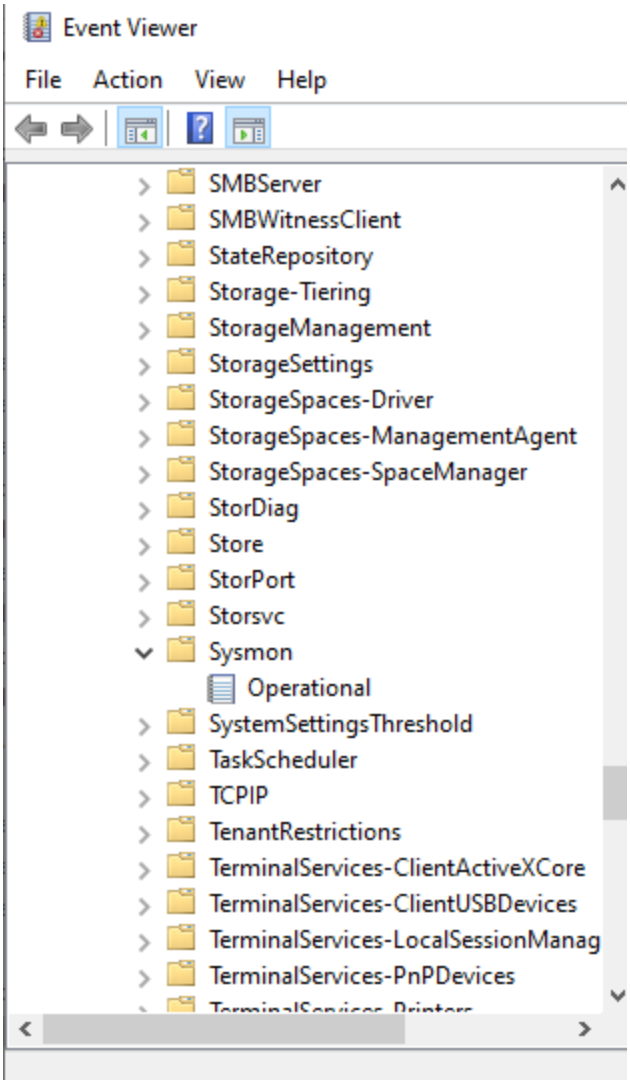
After all the VMs are in place, logged-in to both Wazuh and TheHive with SSH and performed updates and upgrades using

```
apt-get update && apt-get upgrade
```

For on-prem Windows 10 pc, 50 GB Disk, 3 GB Memory and 2 AMD vCPUs were delegated from the Host system. Sysmon was downloaded from the Microsoft Sysinternals page and installed with the sysmon-config file.



We can verify that Sysmon was properly installed by looking through the Windows event Viewer logs given below.



3.2. Installation of Wazuh and Agent

Wazuh was installed by following the documentation provided by Wazuh in their website. The step-by-step action taken is given below.

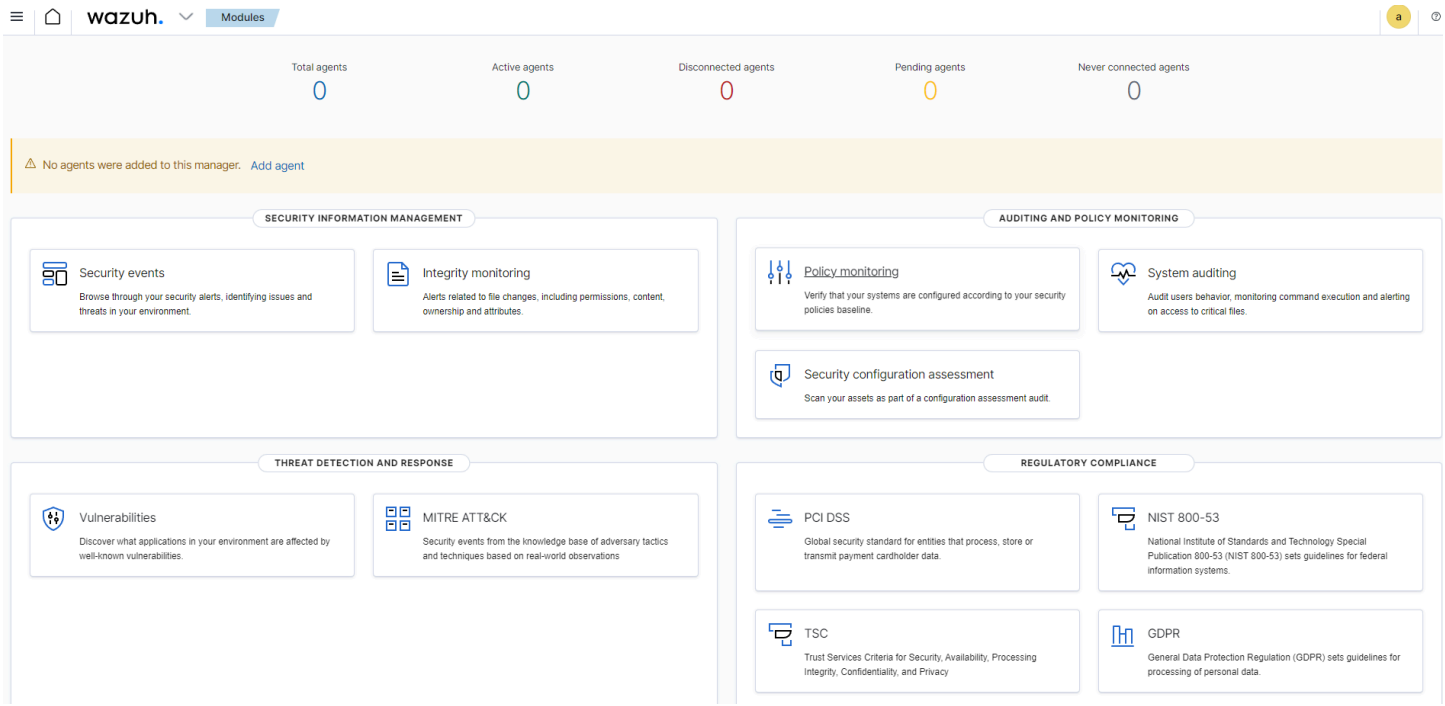
Downloaded and ran the Wazuh installation agent with the following command

```
curl -sO https://packages.wazuh.com/4.7/wazuh-install.sh && sudo bash
./wazuh-install.sh -a
```

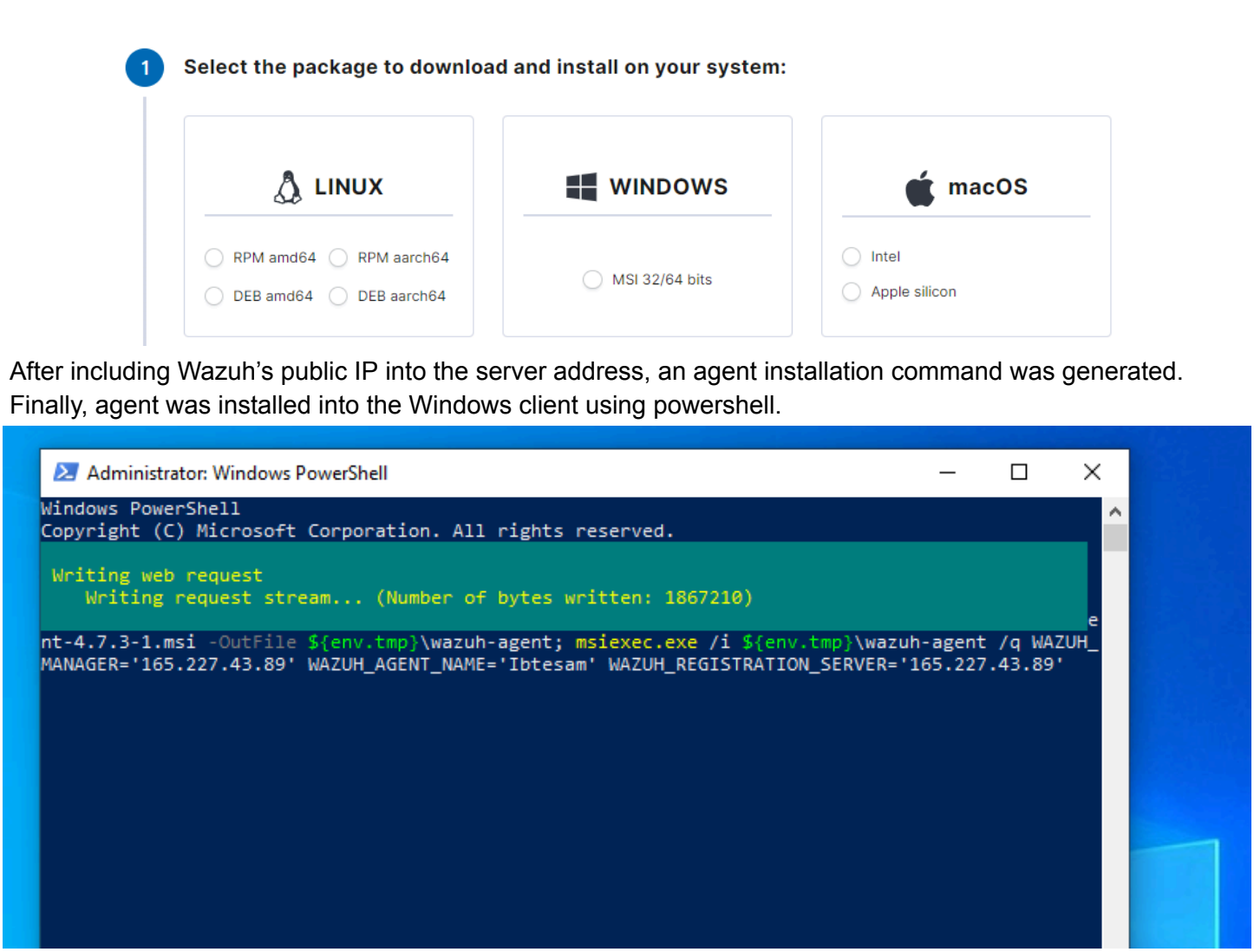
Once the assistant finishes the installation, the output shows the access credentials and a message that confirms that the installation was successful.

Accessed the Wazuh web interface using the https://<wazuh-public-ip> and the credentials.

And with successful login we can see the home page of our Wazuh SIEM.



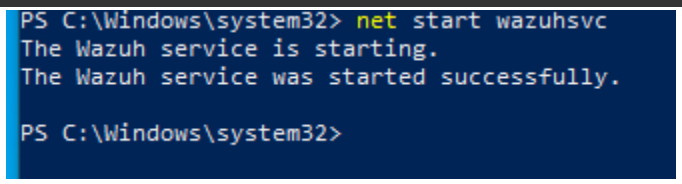
Next, agent was deployed by going to the agents option from the dropdown and selecting the Windows option.



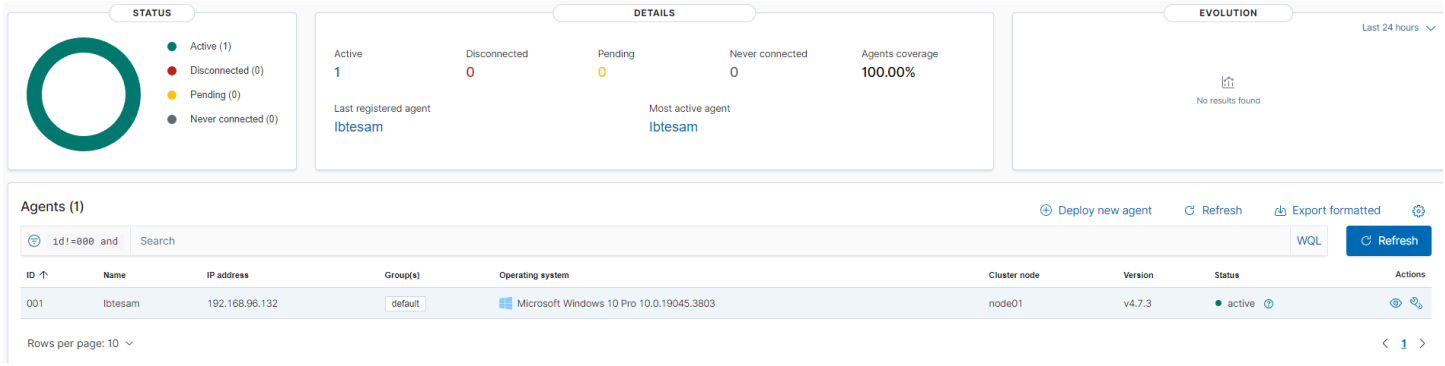
After including Wazuh's public IP into the server address, an agent installation command was generated. Finally, agent was installed into the Windows client using powershell.

After installation, wazuh agent was started using the command

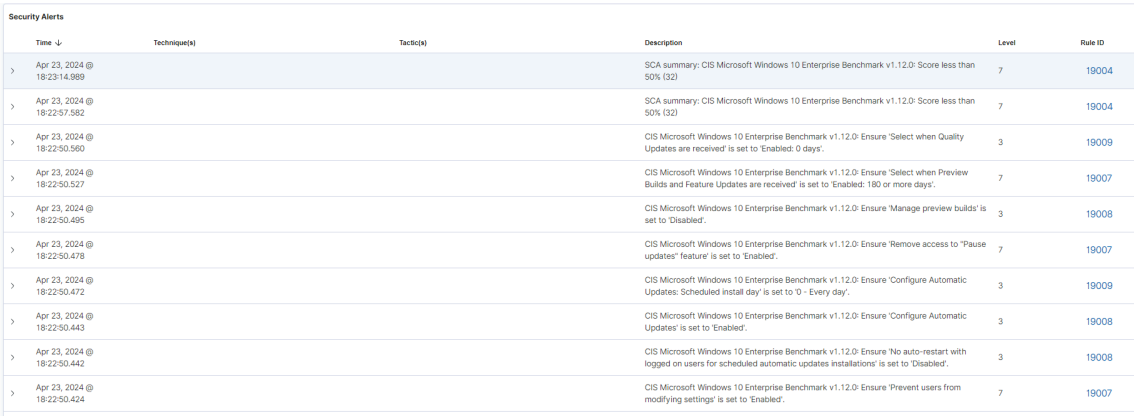
```
net start wazuhsvc
```



Heading back into the Wazuh web interface it is seen that the agent is successfully integrated.



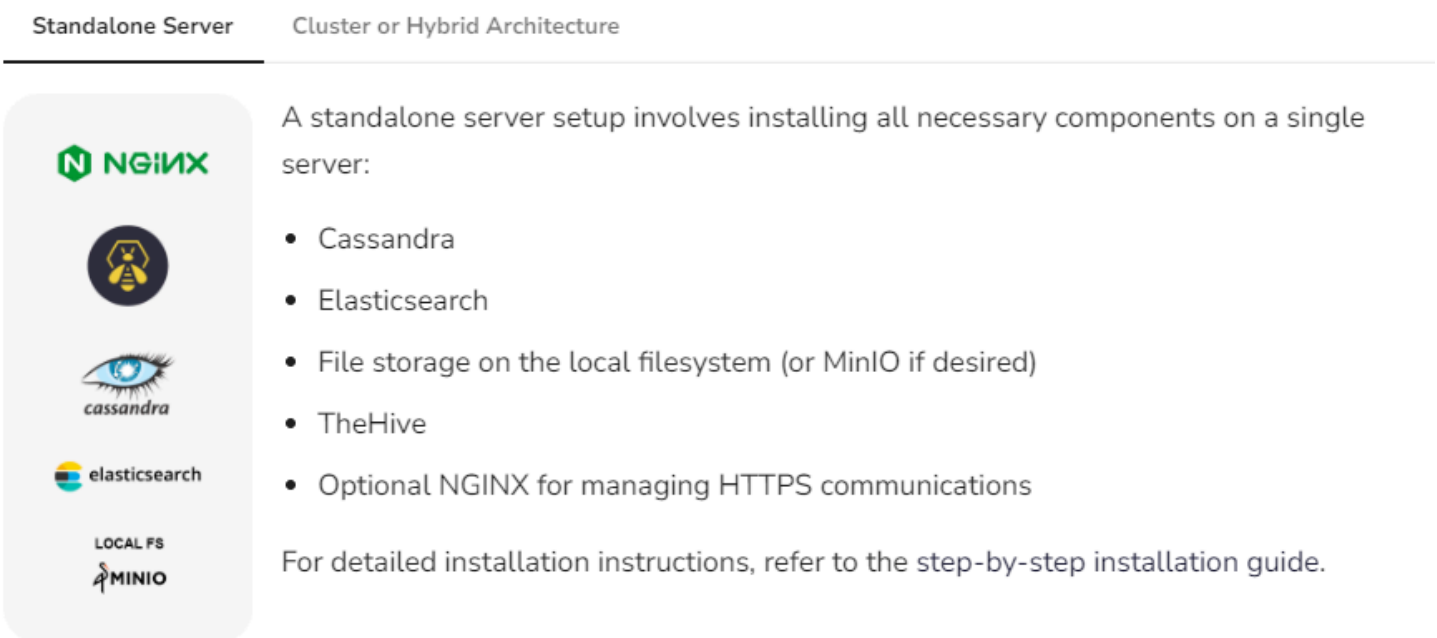
Also, the security events started to show up.



3.3. Installation of TheHive

Similar to the Wazuh, TheHive installation followed procedures outlined in their official documentation page. Step by step actions taken are given below.

TheHive is installed with the following technologies.



In this project, Java was installed first as required by TheHive, and followed by Cassandra, Elasticsearch and TheHive. For file storage, local filesystem is used.

Java installation:

```
wget -qO- https://apt.corretto.aws/corretto.key | sudo gpg --dearmor -o
/usr/share/keyrings/corretto.gpg
echo "deb [signed-by=/usr/share/keyrings/corretto.gpg] https://apt.corretto.aws stable
main" | sudo tee -a /etc/apt/sources.list.d/corretto.sources.list
sudo apt update
sudo apt install java-common java-11-amazon-corretto-jdk
echo JAVA_HOME="/usr/lib/jvm/java-11-amazon-corretto" | sudo tee -a /etc/environment
export JAVA_HOME="/usr/lib/jvm/java-11-amazon-corretto"
```

Verifying the installation by running `java-version`

```
root@thehive:~# java -version
openjdk version "11.0.23" 2024-04-16 LTS
OpenJDK Runtime Environment Corretto-11.0.23.9.1 (build 11.0.23+9-LTS)
OpenJDK 64-Bit Server VM Corretto-11.0.23.9.1 (build 11.0.23+9-LTS, mixed mode)
root@thehive:~#
```

Cassandra installation:

Adding Cassandra repository reference

```
wget -qO -  https://downloads.apache.org/cassandra/KEYS | sudo gpg --dearmor  -o
/usr/share/keyrings/cassandra-archive.gpg
```

Adding the repository to the system by appending the following line

```
echo "deb [signed-by=/usr/share/keyrings/cassandra-archive.gpg]
https://debian.cassandra.apache.org 40x main" |  sudo tee -a
/etc/apt/sources.list.d/cassandra.sources.list
```

Installing the package

```
sudo apt update
sudo apt install cassandra
```

Elasticsearch Installation:

Adding elasticsearch repository references

```
wget -qO - https://artifacts.elastic.co/GPG-KEY-elasticsearch |  sudo gpg --dearmor -o
/usr/share/keyrings/elasticsearch-keyring.gpg
sudo apt-get install apt-transport-https
```

Adding repository to the system by appending the following line

```
echo "deb [signed-by=/usr/share/keyrings/elasticsearch-keyring.gpg]
https://artifacts.elastic.co/packages/7.x/apt stable main" |  sudo tee
/etc/apt/sources.list.d/elastic-7.x.list
```

Installing the package

```
sudo apt update
sudo apt install elasticsearch
```

TheHIve installation:

Getting the repository

```
wget -O- https://archives.strangebee.com/keys/strangebee.gpg | sudo gpg --dearmor -o
/usr/share/keyrings/strangebee-archive-keyring.gpg
```

Installing TheHive package by running

```
echo 'deb [arch=all signed-by=/usr/share/keyrings/strangebee-archive-keyring.gpg]
https://deb.strangebee.com thehive-5.3 main' |sudo tee -a
/etc/apt/sources.list.d/strangebee.list
sudo apt-get update
sudo apt-get install -y thehive
```

Local Filesystem:

Creating directory

```
sudo mkdir -p /opt/thp/thehive/files
```

TheHive requires that the user and group thehive:thehive has permission on the filepath of the storage. So changed the file permission by running

```
chown -R thehive:thehive /opt/thp/thehive/files
```

```
root@thehive:~# ls -la /opt/thp
total 12
drwxr-xr-x 3 root root 4096 Apr 23 22:24 .
drwxr-xr-x 5 root root 4096 Apr 23 22:24 ..
drwxr-xr-x 5 root root 4096 Apr 23 22:24 thehive
root@thehive:~# chown -R thehive:thehive /opt/thp
root@thehive:~# ls -la /opt/thp
total 12
drwxr-xr-x 3 thehive thehive 4096 Apr 23 22:24 .
drwxr-xr-x 5 root    root    4096 Apr 23 22:24 ..
drwxr-xr-x 5 thehive thehive 4096 Apr 23 22:24 thehive
```

3.4. Configuring Wazuh

For this project only Sysmon logs were selected for the log ingestion. To add this property, the agent ossec config file was edited by adding the following configuration

```
<!-- Log analysis -->
<localfile>
  <location>Microsoft-Windows-Sysmon/Operational</location>
  <log_format>eventchannel</log_format>
</localfile>
```

Also, to enable all logs the ossec config file in the Wazuh server was also changed by adding following parameters

```
<ossec_config>
  <global>
    <jsonout_output>yes</jsonout_output>
    <alerts_log>yes</alerts_log>
    <logall>yes</logall>
    <logall_json>yes</logall_json>
```

This **logall** option generates log archives

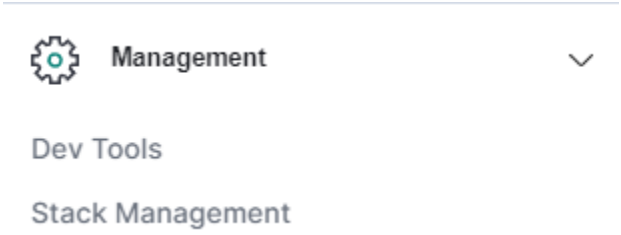
```
root@Wazuh:~# cd /var/ossec/logs/archives/
root@Wazuh:/var/ossec/logs/archives# ls
2024  archives.json  archives.log
```

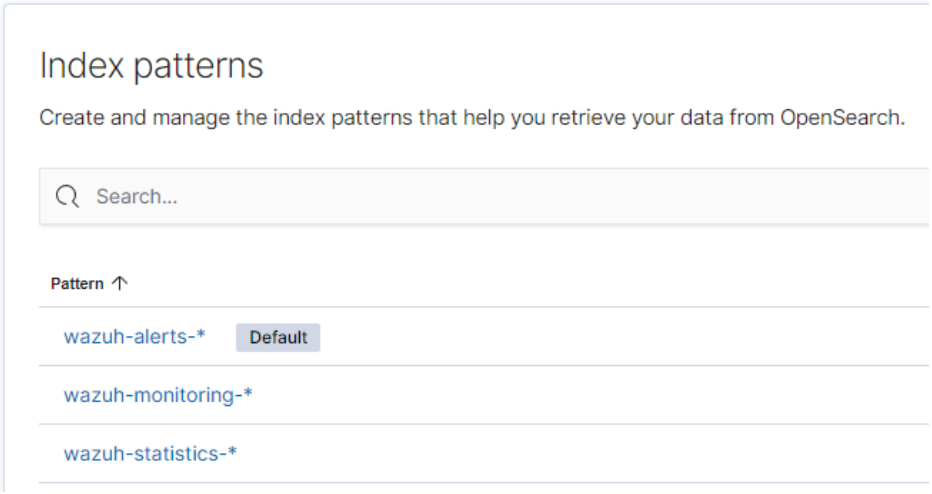
According to Wazuh documentation, this new change should be updated for the filebeat yml file as well.

```
root@Wazuh:/var/ossec/logs/archives# nano /etc/filebeat/filebeat.yml
```

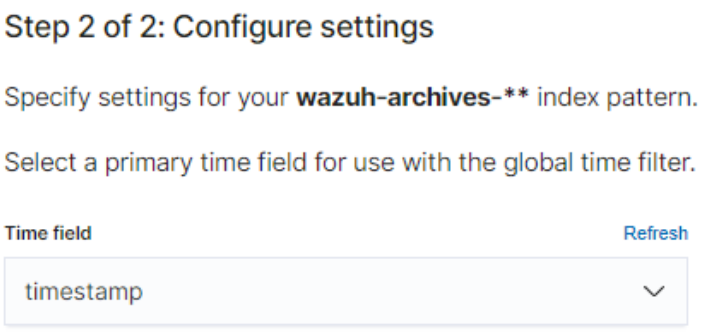
```
filebeat.modules:
  - module: wazuh
    alerts:
      enabled: true
    archives:
      enabled: false
```

Returning to the Wazuh web interface a new index pattern was created to detect all the new logs from the logall archives. This option can be found at the Stack Management link under Management from the sidebar.





Adding new index: **wazuh-archives-***



3.5. Configuring TheHive

TheHive configuration starts with configuring Cassandra. This file is at the `/etc/cassandra/cassandra.yaml`

```
cluster_name: 'thp'
listen_address: 'xx.xx.xx.xx' # address for nodes
rpc_address: 'xx.xx.xx.xx' # address for clients
seed_provider:
    - class_name: org.apache.cassandra.locator.SimpleSeedProvider
    parameters:
        # Ex: "<ip1>,<ip2>,<ip3>"
        - seeds: 'xx.xx.xx.xx' # self for the first node
data_file_directories:
- '/var/lib/cassandra/data'
commitlog_directory: '/var/lib/cassandra/commitlog'
saved_caches_directory: '/var/lib/cassandra/saved_caches'
hints_directory:
- '/var/lib/cassandra/hints'
[..]
```

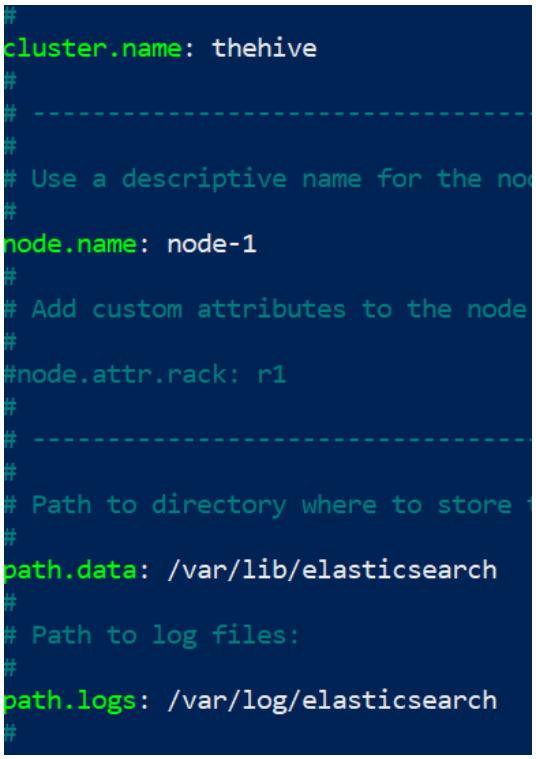
Here, the cluster_name and the seed_provider option was modified. Wazug requires either the listen address to be modified or the seed. The seed was used as it provided smooth configuration without any bugs. Everything was kept default. Finally started Cassandra and made sure it was running.

```
root@thehive:~# systemctl start cassandra.service
root@thehive:~# systemctl status cassandra.service
● cassandra.service - LSB: distributed storage system for structured data
     Loaded: loaded (/etc/init.d/cassandra; generated)
     Active: active (running) since Tue 2024-04-23 22:34:08 UTC; 12s ago
       Docs: man:systemd-sysv-generator(8)
    Process: 25610 ExecStart=/etc/init.d/cassandra start (code=exited, status=0/SUCCE
      Tasks: 51 (limit: 9492)
     Memory: 2.1G
        CPU: 16.111s
     CGroup: /system.slice/cassandra.service
             └─25710 /usr/bin/java -ea -da:net.openhft... -XX:+UseThreadPriorities -X

Apr 23 22:34:08 thehive systemd[1]: Starting LSB: distributed storage system for stru
Apr 23 22:34:08 thehive systemd[1]: Started LSB: distributed storage system for struc
root@thehive:~#
```

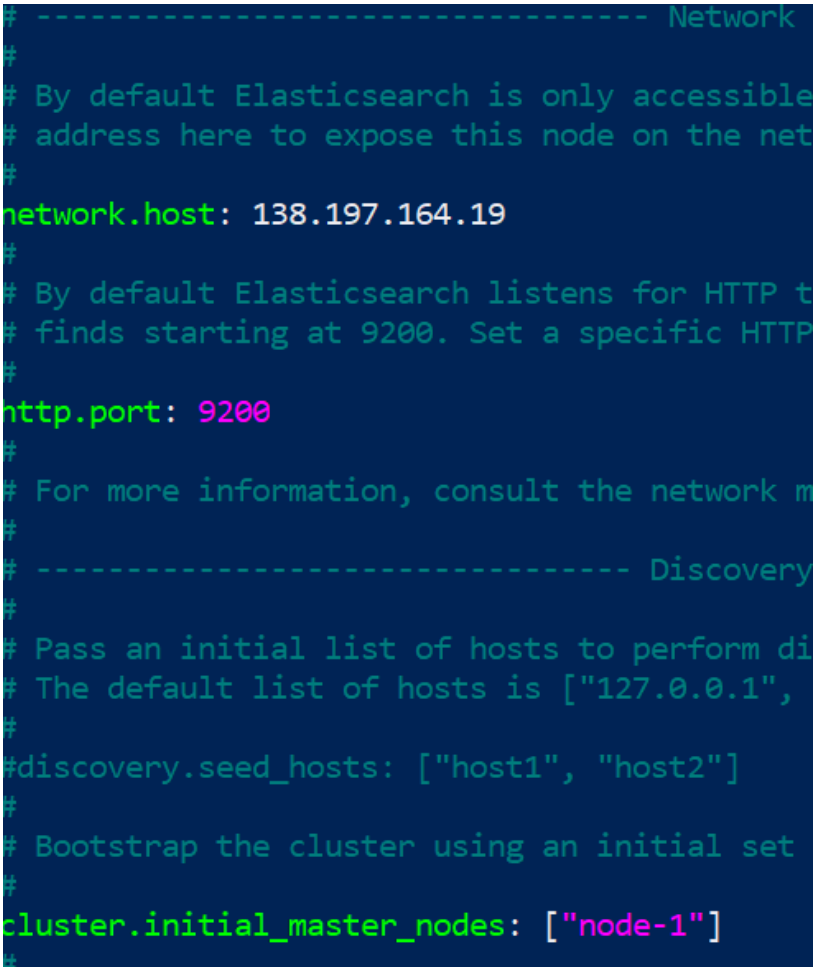
After that, elasticsearch was configured using the elasticsearch.yml file in the directory

```
/etc/elasticsearch/elasticsearch.yml
```

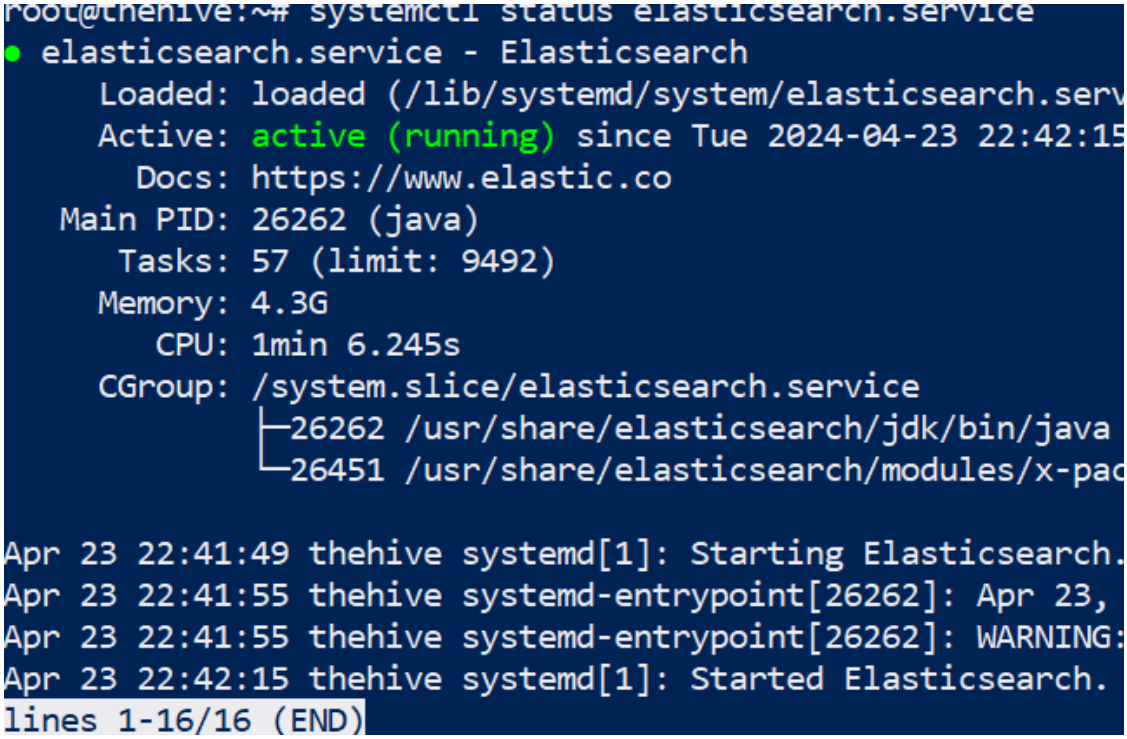
Added cluster name “thehive” and node name as “node-1”. Confirmed path data and logs are correct.



Added the public IP of the thehive as network host and thehive requires port 9200 as default port.



Finally started elasticsearch and confirmed it was running.



TheHive is finally configured by using the application.conf file found inside the `/etc/thehive/application.conf`

```
# Database and index configuration
# By default, TheHive is configured to connect to local Cassandra 4.x and a
# local Elasticsearch services without authentication.
db.janusgraph {
storage {
    backend = cql
    hostname = ["127.0.0.1"]
    # Cassandra authentication (if configured)
    # username = "thehive"
    # password = "password"
    cql {
    cluster-name = thp
    keyspace = thehive
    }
}
index.search {
    backend = elasticsearch
    hostname = ["127.0.0.1"]
    index-name = thehive
}
}
```

Here, changed the host name and the cluster name as following

```
# local Elasticsearch services without authenti
db.janusgraph {
  storage {
    backend = cql
    hostname = ["138.197.164.19"]
    # Cassandra authentication (if configured)
    # username = "thehive"
    # password = "password"
    cql {
      cluster-name = ibtesam
      keyspace = thehive
    }
  }
  index.search {
    backend = elasticsearch
    hostname = ["138.197.164.19"]
    index-name = thehive
  }
}
```

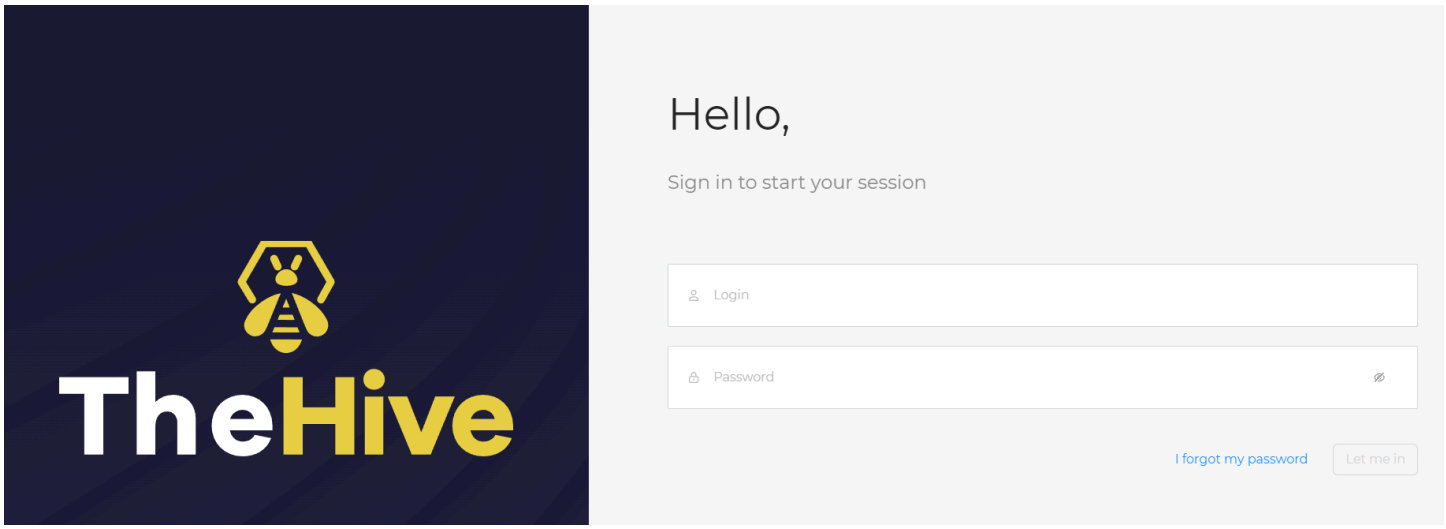
Lastly made sure the application base url reflects the current address.

```
# Attachment storage configuration
# By default, TheHive is configured to store files locally in the folder.
# The path can be updated and should belong to the user/group running thehiv
storage {
  provider = localfs
  localfs.location = /opt/thp/thehive/files
}

# Define the maximum size for an attachment accepted by TheHive
play.http.parser.maxDiskBuffer = 1GB
# Define maximum size of http request (except attachment)
play.http.parser.maxMemoryBuffer = 10M

# Service configuration
application.baseUrl = "http://138.197.164.19:9000"
play.http.context = "/"

# Additional modules
#
# TheHive is strongly integrated with Cortex and MISP.
# Both modules are enabled by default. If not used, each one can be disabled
# commenting the configuration line.
scalligraph.modules += org.thp.thehive.connector.cortex.CortexModule
scalligraph.modules += org.thp.thehive.connector.misp.MispModule
```

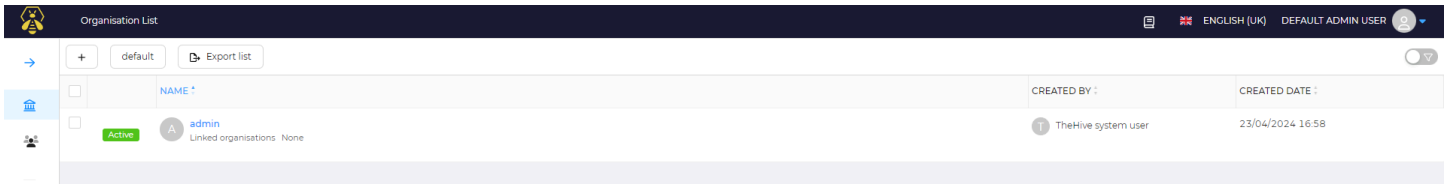
Confirmed thehive was started and running.

```
root@thehive:~# systemctl status thehive
● thehive.service - Scalable, Open Source a
     Loaded: loaded (/lib/systemd/system/th
     Active: active (running) since Tue 202
       Docs: https://thehive-project.org
   Main PID: 27533 (java)
      Tasks: 82 (limit: 9492)
     Memory: 586.0M
        CPU: 57.729s
     CGroup: /system.slice/thehive.service
             └─27533 java -Dfile.encoding=U

Apr 23 22:57:06 thehive systemd[1]: Started
lines 1-12/12 (END)
```

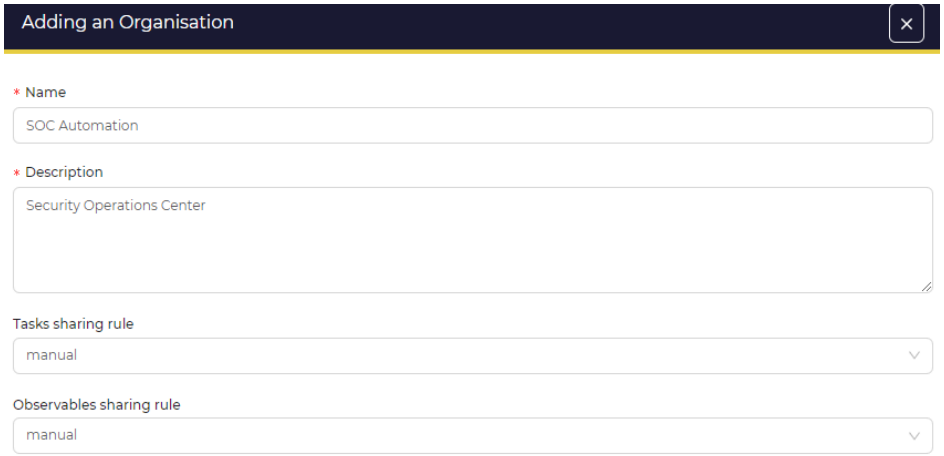
Also, TheHive web interface was active and running.

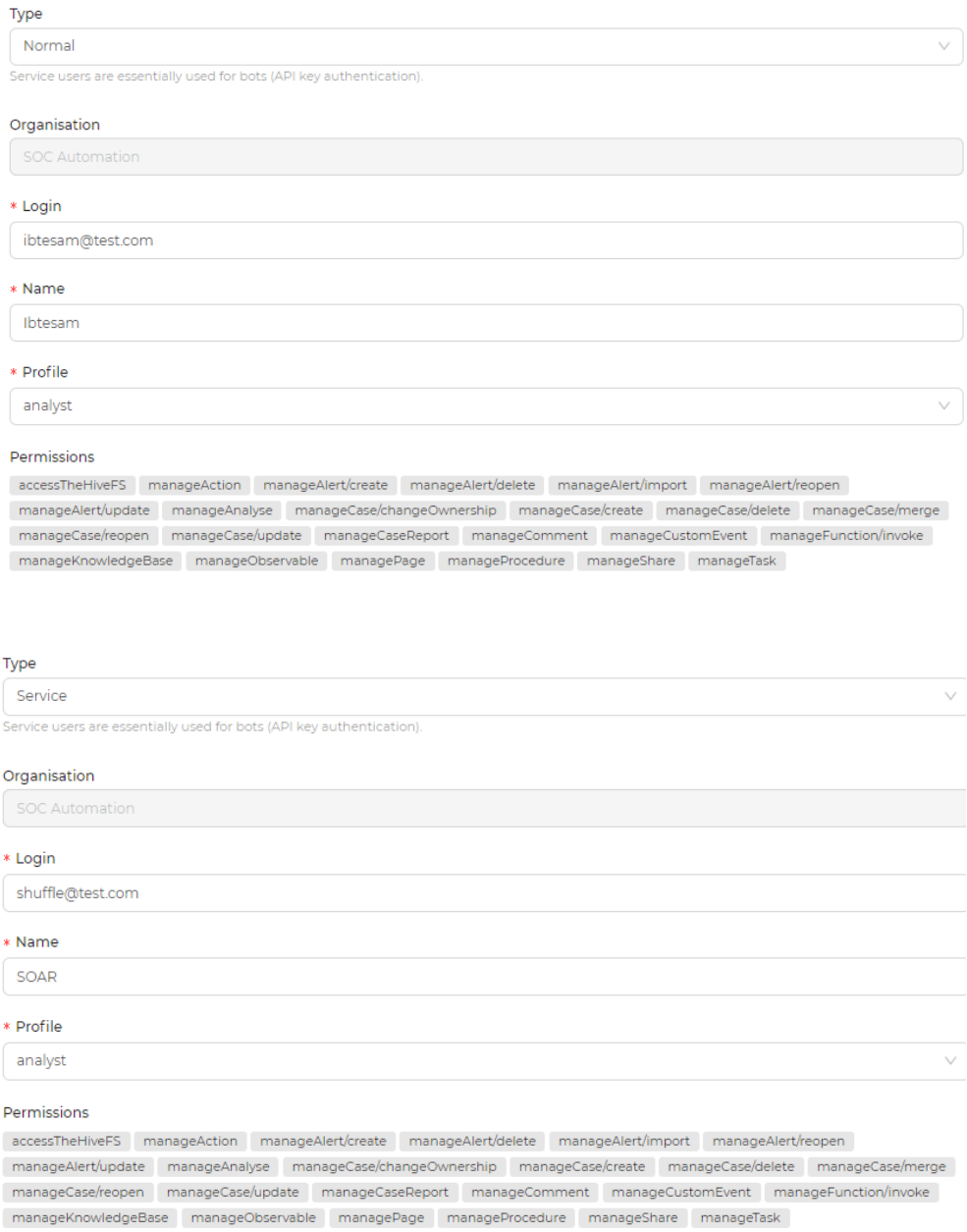


After logged-in as the provided credential in the documentation, an admin is seen on the console



Inside shuffle as admin user, added a new organization “SOC Automation” and included two new accounts. One user account is “Ibtesam” which acts as an analyst and the other is a service account named “SOAR” which will be used to integrate with Shuffle. TheHive has a predefined permission set for the **analyst** type but no template for the **service** account. It is best practice to allow Least Privilege options.

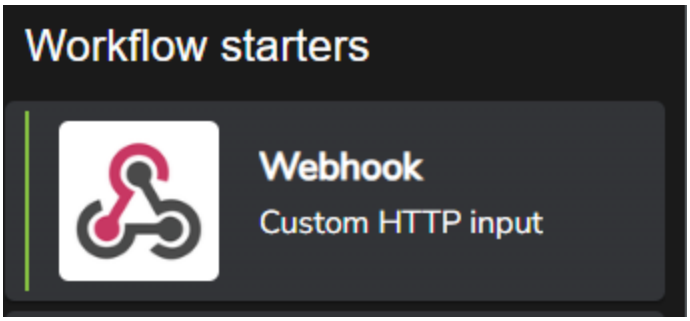




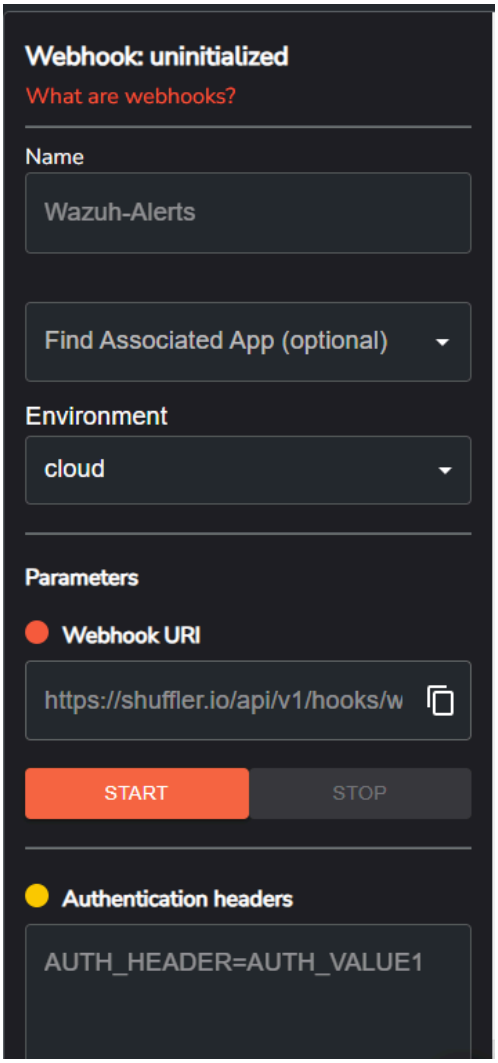
Created a new password for the analyst account and logged in to start receiving alerts. From the service account, an API key can be found and copied to later integrate with shuffle.

3.6. Configuring Shuffle

Shuffle can be used by going to their website shuffler.io and after logging an workflow tab can be found. All the automation actions are then configured using the workflow section. To configure shuffle first a webhook was selected from the triggers section.



By dragging to add it in the workflow and clicking on it opens further settings.



The Webhook URI is copied and added to Wazuh to create a connection between both of them. Config shown below was added into the ossec.conf file inside the Wazuh Manager server.

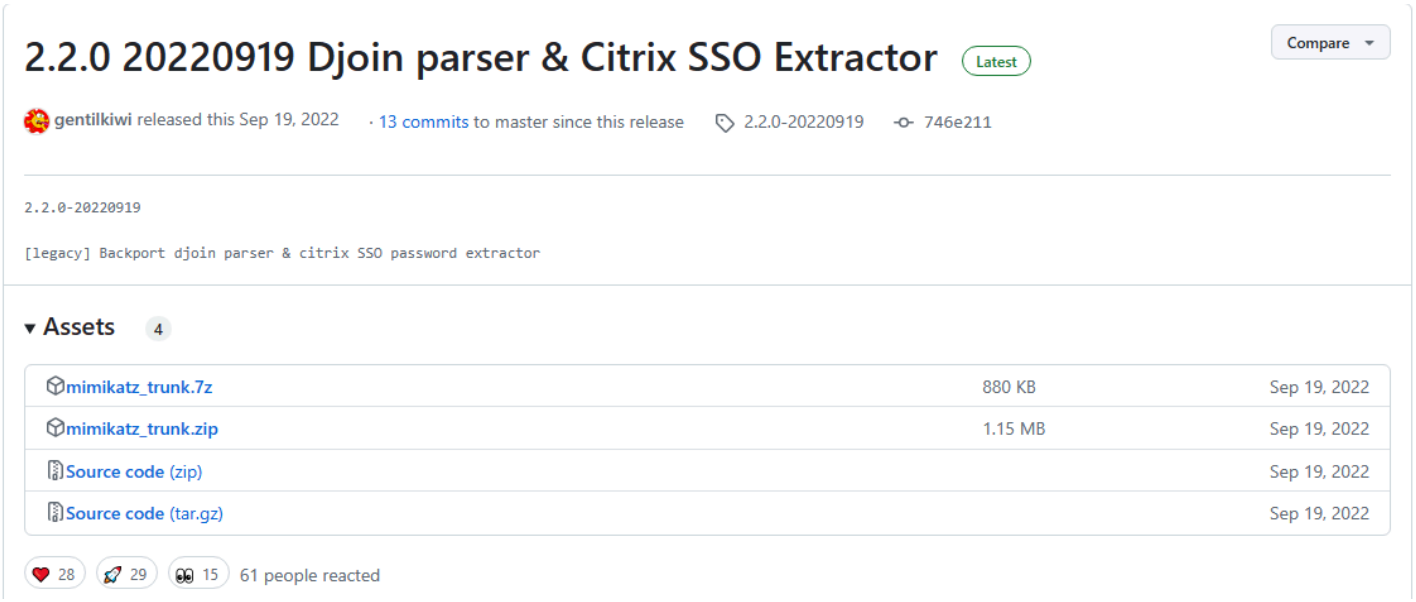
```
<integration>
  <name>shuffle</name>
  <hook_url>https://shuffler.io/api/v1/hooks/webhook_74155535-f145-42ca-8019-be574dd10d8b </hook_url>
  <rule_id>100002</rule_id>
  <alert_format>json</alert_format>
</integration>
```

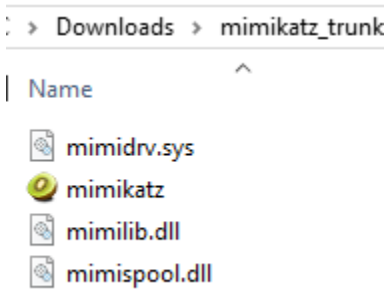
Restarted the service as the config file was modified and confirmed the status running.

4. TESTING DEPLOYMENTS

4.1. Mimikatz

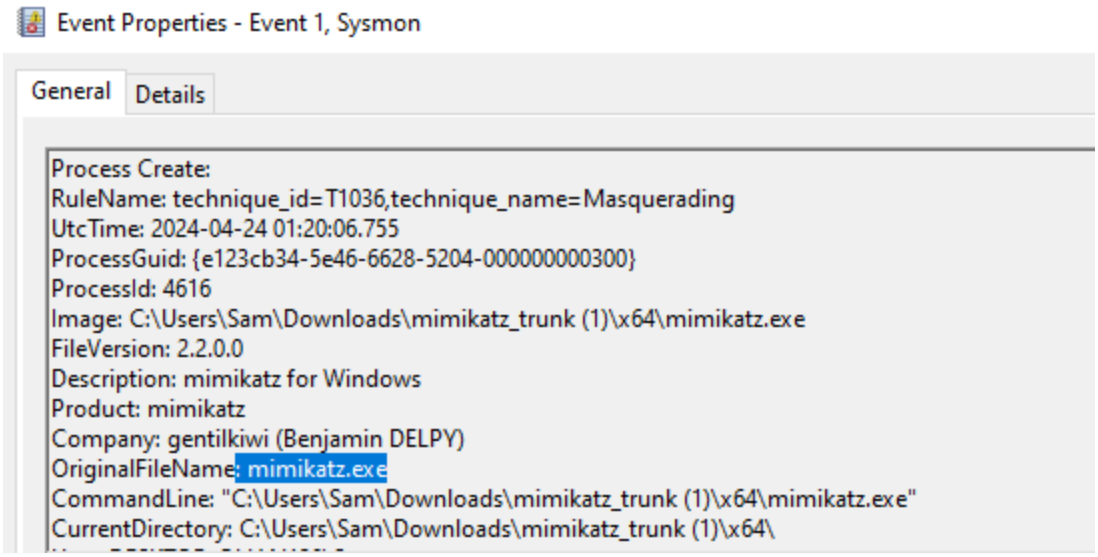
The Windows client was sending Sysmon logs to Wazuh and it was successfully showing up in the security events tab. To simulate an attack to the windows pc, mimikatz was used. Mimikatz is a malicious tool known for its credential dumping capabilities. Mimikatz was downloaded from GitHub and extracted.



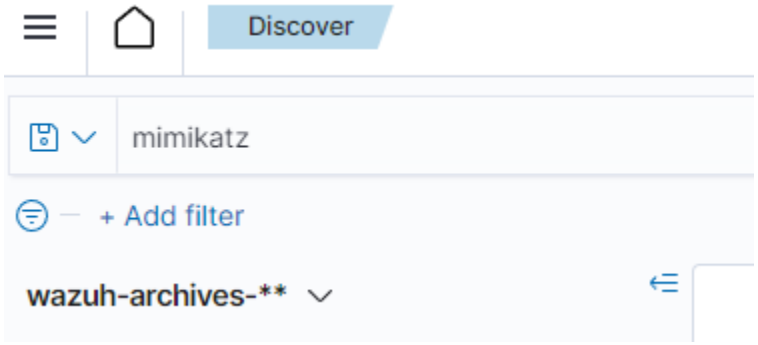


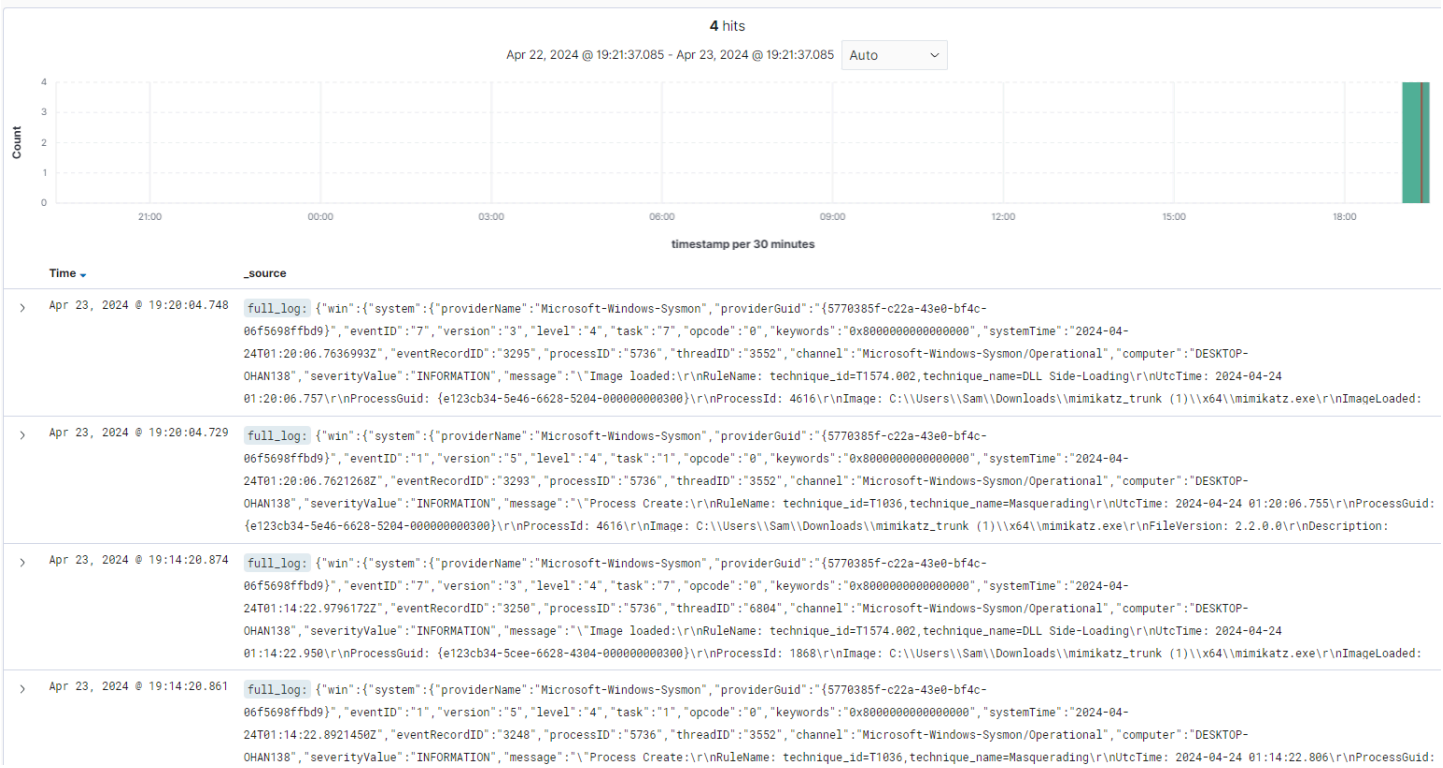
After that, ran powershell in the administrator mode and executed mimikatz.

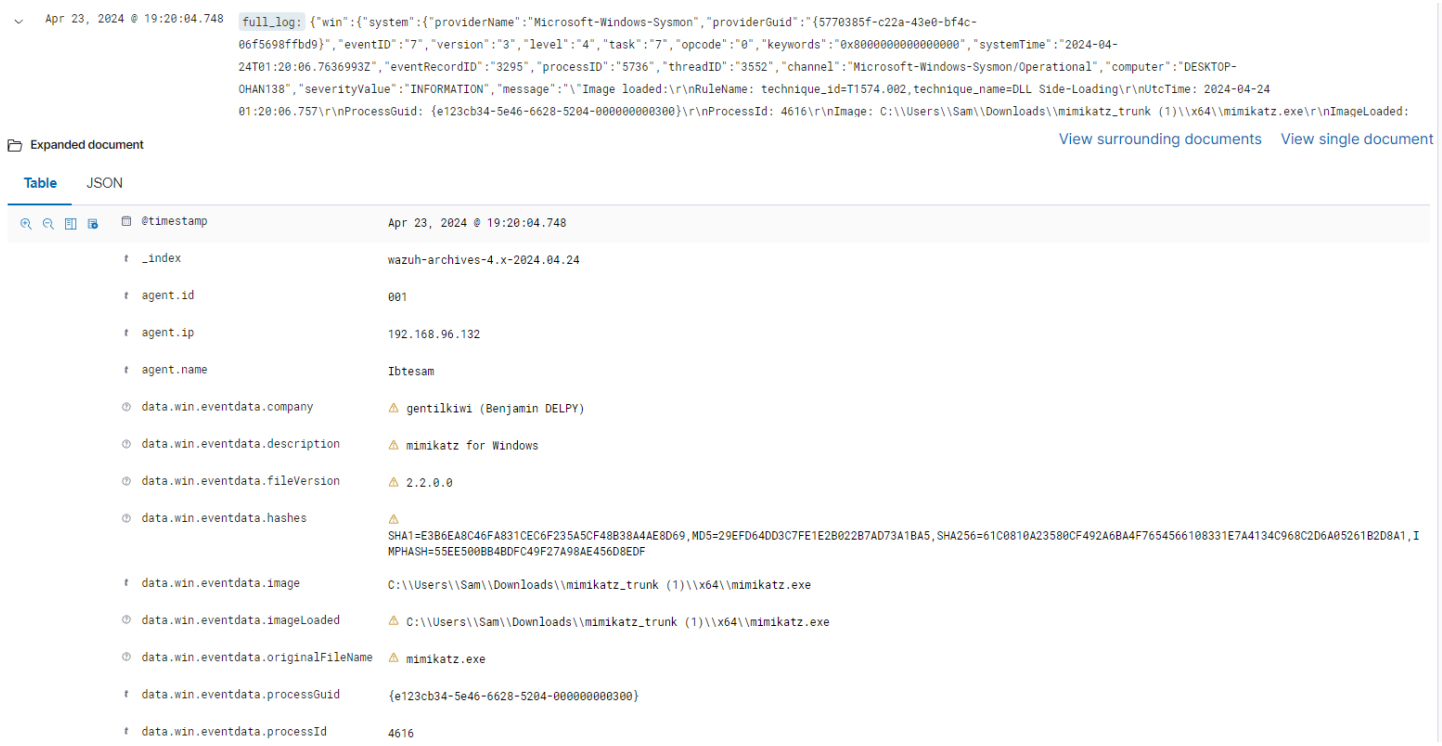
Identified that mimikatz was successfully logged in the windows event viewer with the mimikatz.exe as the OriginalFileName field.



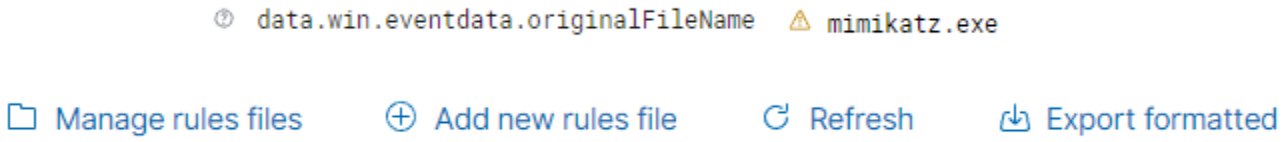
Heading back into Wazuh under the newly created index wazuh-archives-*, it was seen that wazuh logged mimikatz.







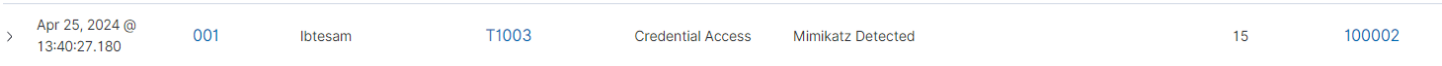
In addition, a similar field named win.eventdata.originalFileName also picked mimikatz.exe. This provided the pathway for creating a custom rule that can detect mimikatz even if the filename is modified by the adversaries as the original file name will always stay the same.



Accessing add new rules functionality, added a new rule that will detect any original file name matched to mimikatz.exe. Additionally, MITRE id of T1003 was selected which is designated as Credential Dumping.

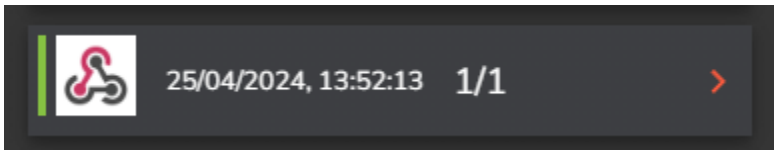
```
<rule id="100002" level="15">
  <if_group>sysmon_event1</if_group>
  <field name="win.eventdata.originalFileName" type="pcre2">(?i)mimikatz\.exe</field>
  <description>Mimikatz Detected</description>
  <mitre>
    <id>T1003</id>
  </mitre>
</rule>
```

Executing mimikatz once more from the Windows client showed that the rule is correctly detecting mimikatz.

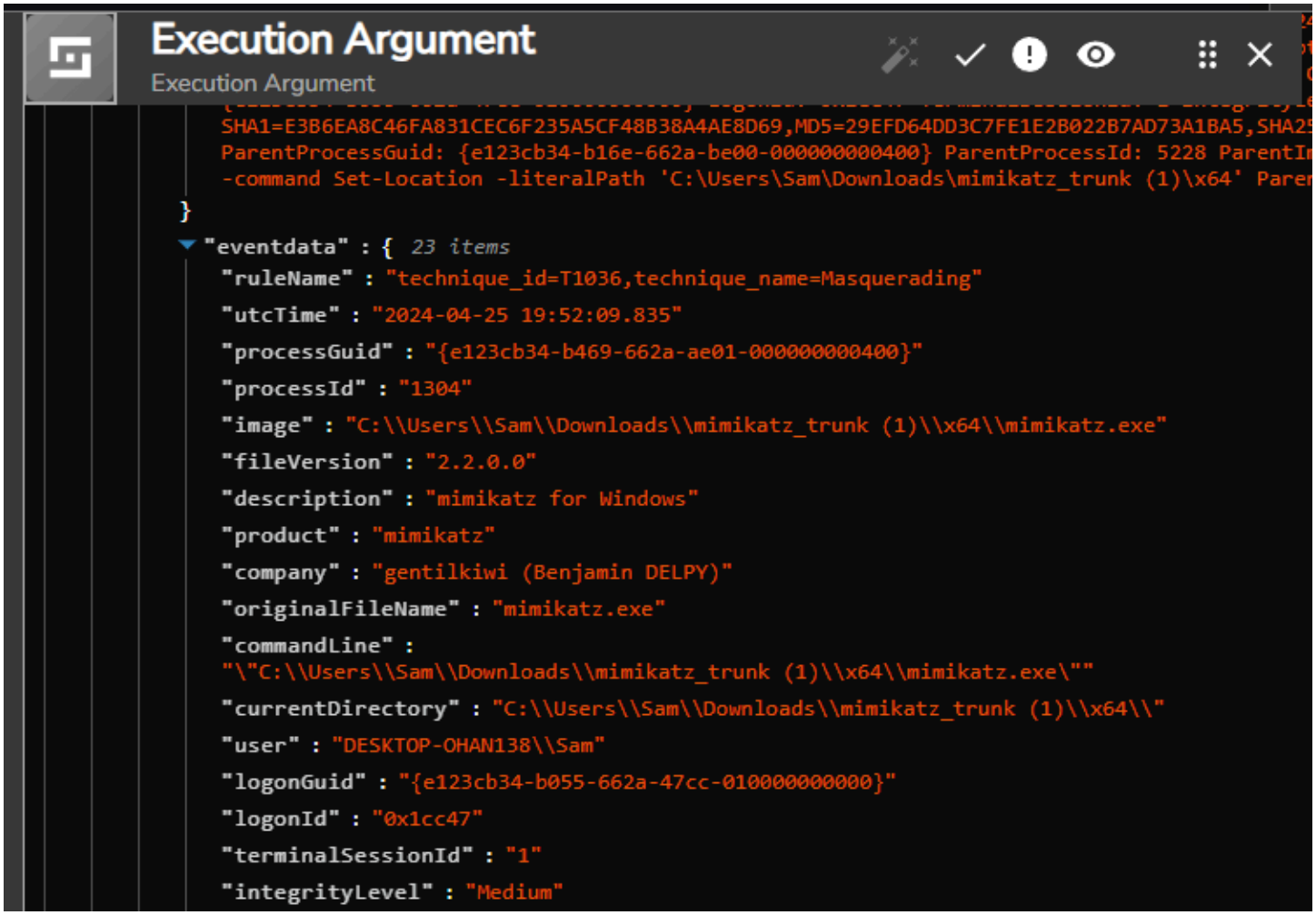


4.2. Testing Shuffle

Under Shuffle's execution tab, it was seen that the webhook was successfully generated.



And the execution argument showed mimikatz.exe with the originalFileName parameter.

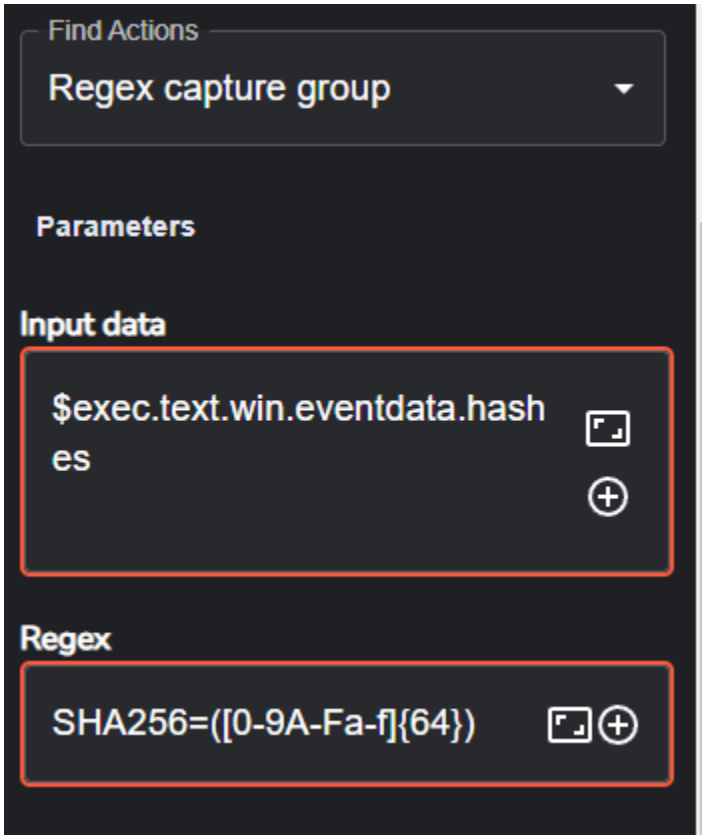


5. AUTOMATION and RESPONSE

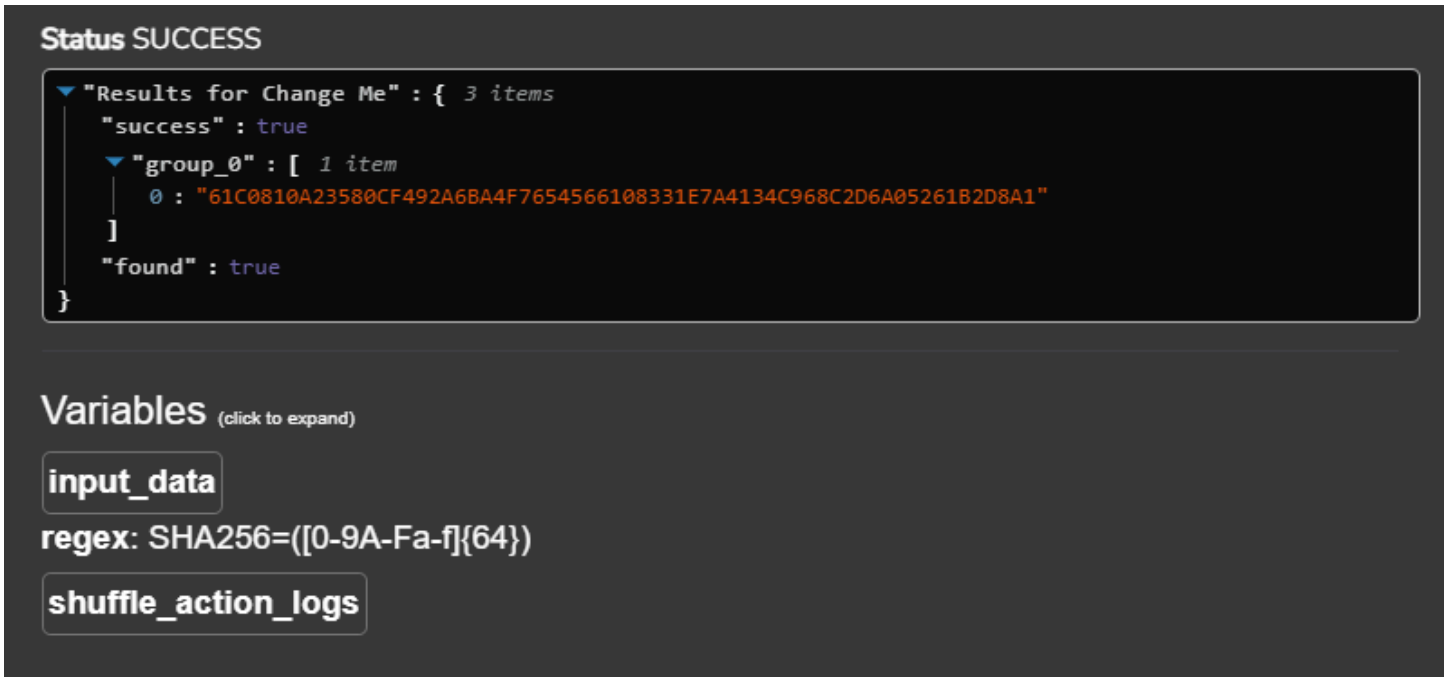
With all the components including Wazuh, Shuffle, and TheHIve properly configured and tested, it was time for automation workflows. As previously stated this project's goal was to enhance the effectiveness and efficiency of security operations, VirusTotal was used as a threat intelligence medium to enrich IOCs and provide a detailed alert to the analyst inside TheHive console.

5.1. Parsing Hash and Calling VirusTotal API

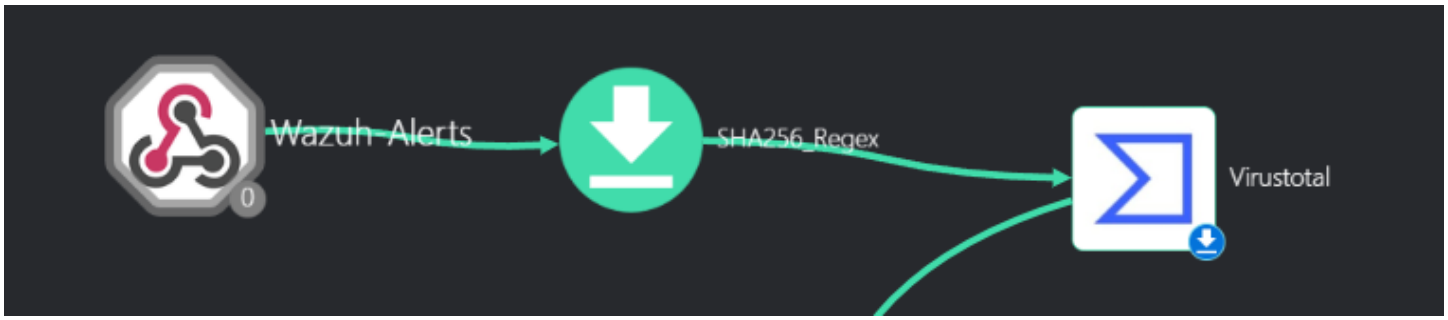
To use this workflow, created an account with VirusTotal and utilized their API to integrate with Shuffle. From the available applications inside Shuffle searched for VirusTotal. However, the workflow cannot send a full execution argument to the VirusTotal. Using the documentation provided by the VirusTotal, it was found that it accepts file hash as an input. Using Shuffle's tool a "Regex capture group" action was selected to parse the SHA256 Hash from the generated webhook execution argument. This step was necessary as the execution argument provided results in this format "**SHA256Hash=hash**" whereas VirusTotal takes only the hash portion of the result.

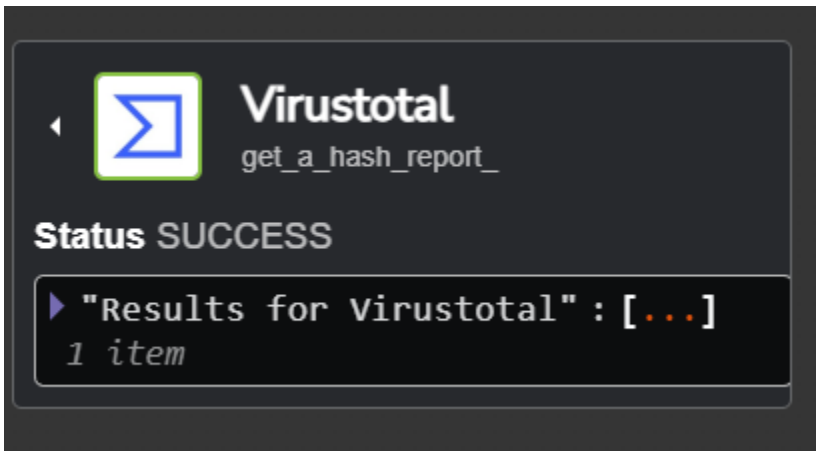


Ran the execution of the workflow one more time and Shuffle tool successfully parsed the hash.

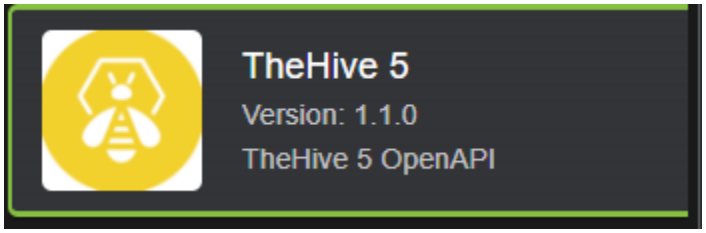


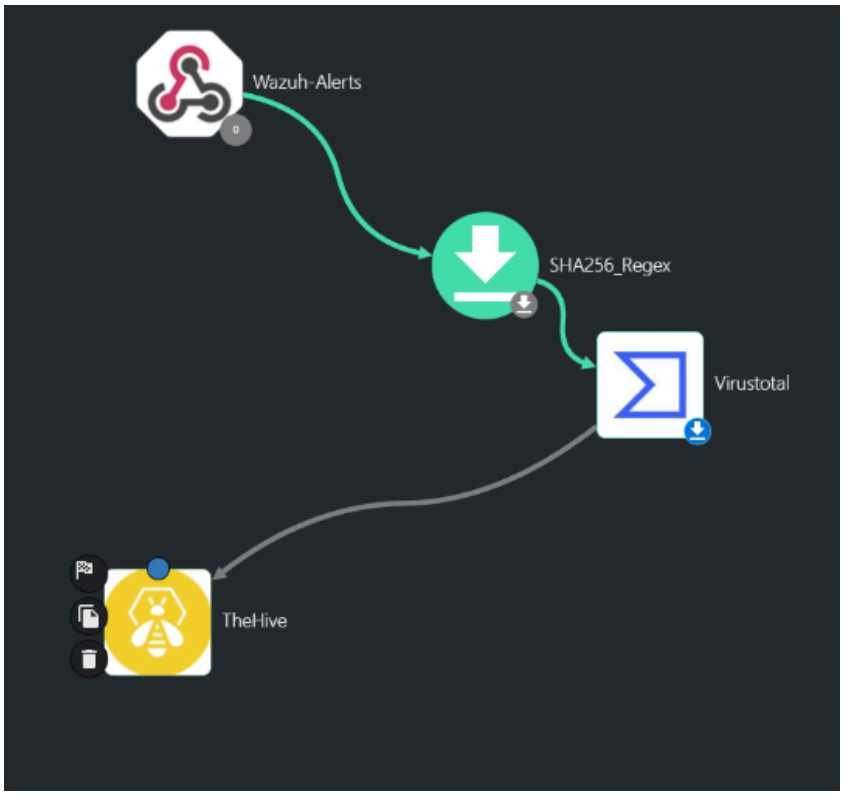
This hash can now be used with the VirusTotal API using the "**Get A Hash Report"** endpoint. The workflow so far and the execution and response is given below.



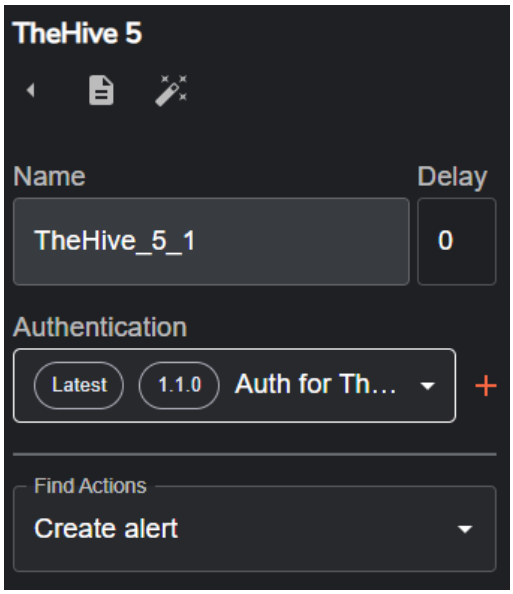


Adding TheHive into the workflow to streamline the whole process. Similar to the VirusTotal, TheHive can aslo be found by searching for apps inside Shuffle.





Used TheHive's service account API to connect Shuffle with TheHive. Selected "Create Alert" as the intended action.



Edited Alert fields as below:
Title:

```
Mimikatz Alert on host $exec.text.win.system.computer
```

```
Mimikatz Alert on host DESKTOP-OHAN138
```

Summary:

```
VirusTotal Suggested Threat Label: $virustotal.#.body.data.attributes.popular_threat_classification
  .suggested_threat_label Malicious labeled by $virustotal.#.body.data.attributes.last_analysis_stats
  .malicious
```

```
VirusTotal Suggested Threat Label: hacktool.mimikatz/hacktoolx Malicious labeled by 63
```

Description:

```
Mimikatz Detected on host DESKTOP-OHAN138
```

Tags: T1003

Status: New

Date and time:

```
$exec.text.win.eventdata.utcTime
```

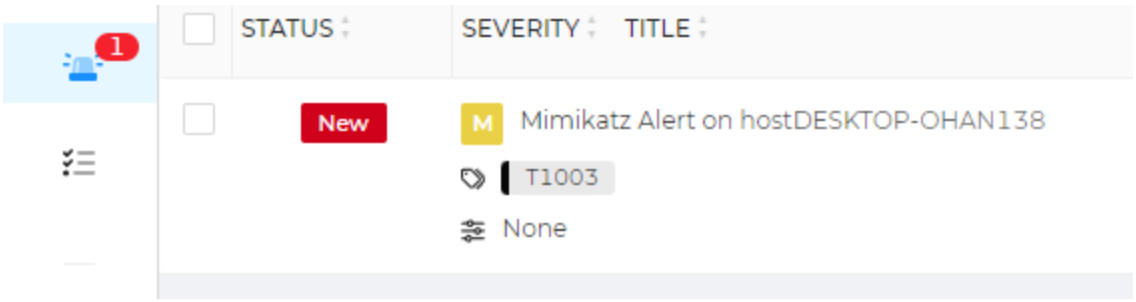
```
2024-04-25 19:52:09.835
```

Source: Wazuh

Sourceref: Rule:100002

Finally Shuffle executed the workflow successfully.

Logged-in as the analyst user Ibtesam, an alert was seen in the case management section.

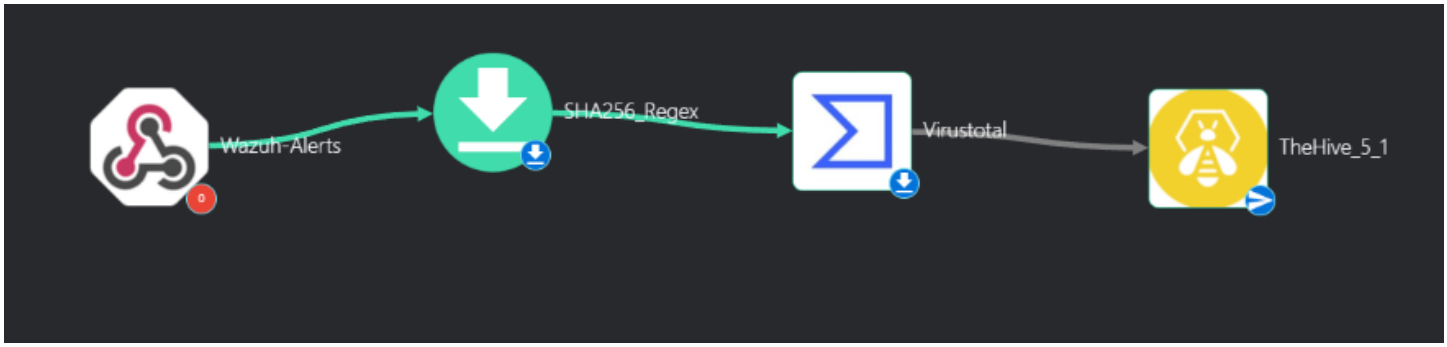


5.2. Workflow Scenarios

Depending on the organization's needs, this SIEM SOAR platform can be customized for hundreds of possible scenarios. With Shuffle's vast application connectors sky is really the limit. Below some possible automation scenarios are listed.

5.2.1. Scenario 1

As demonstrated above, our Windows client sent security events through Sysmon logs which generated a security event inside Wazuh (SIEM) which then triggered Shuffle (SOAR) to create an alert in TheHive (Case Management) while also performing threat intelligence on the event.



5.2.2. Scenario 2

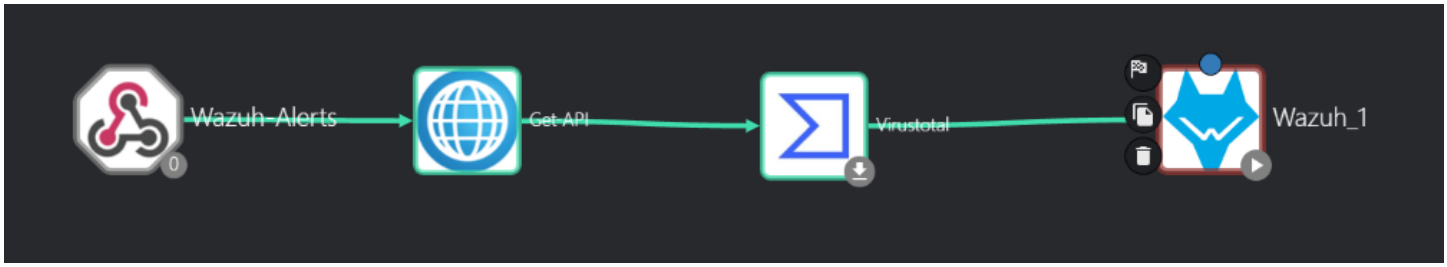
In this scenario, instead of alerting analysts through TheHive, we can use an active response command using the Wazuh application. So, the scenario is, someone scanning or pinging or even trying to SSH into our Windows client and we want to block the IP at the firewall. To add a custom active response command, Wazuh needs to be configured like below.

```
<active-response>
  <command>firewall-drop</command>
  <location>local</location>
  <level>5</level>
  <timeout>no</timeout>
</active-response>
```

And the actual command to be used is: firewall-drop0 as shown below

```
root@Wazuh:/var/ossec/bin# ./agent_control -L

Wazuh agent_control. Available active responses:

   Response name: firewall-drop0, command: firewall-drop
```

In Shuffle, we need to use the Wazuh API to execute the command. The workflow looks like this:

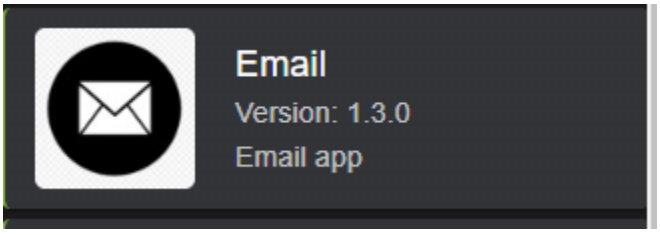


651	Host Blocked by firewall-drop Active Response

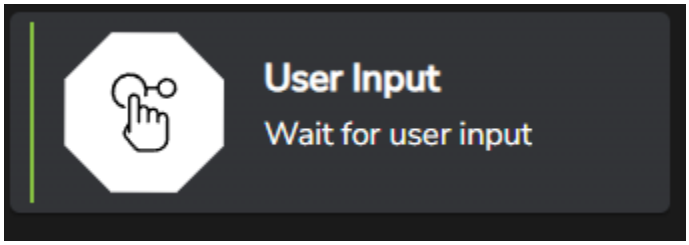
5.2.3. Other App Recommendations

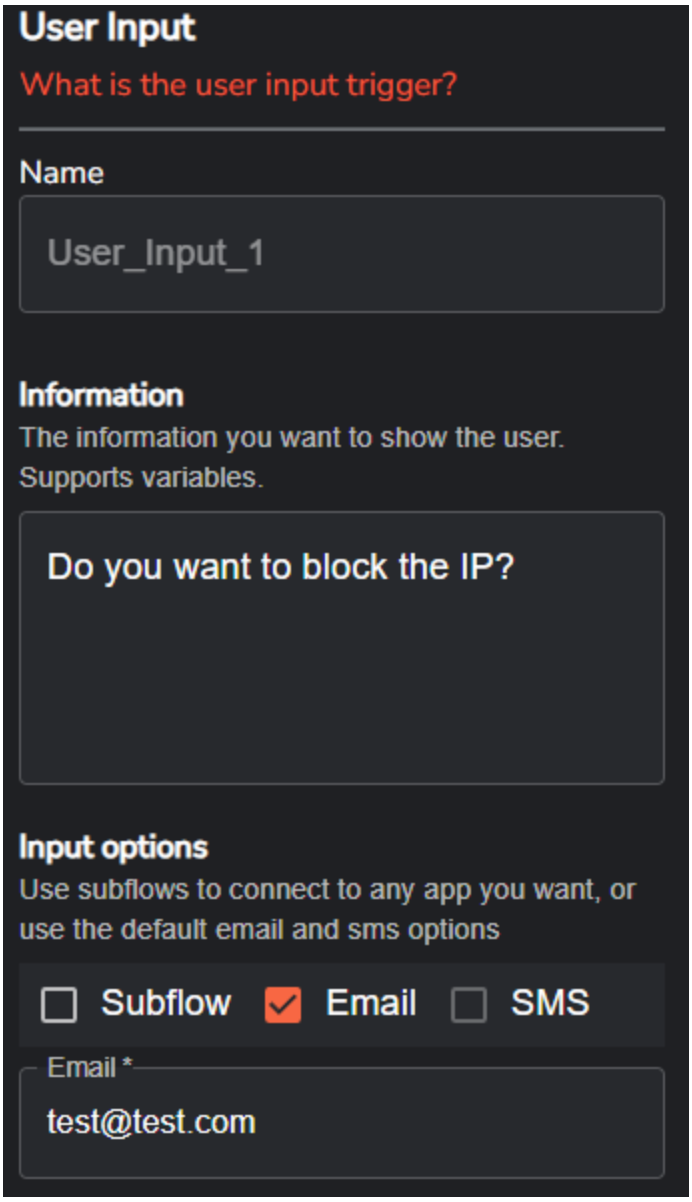
These are some recommended app for SOC Automation workflows other than demonstrated above. These includes:

Email: This allows sending emails.



User Input:
This allows anyone selected through email or text message to take any specified action. For example, an email can be sent out asking the analyst to block an IP and based on the response it can forward the decision to Wazuh to block that IP using the firewall-drop0 command.





6. CONCLUSION

In conclusion, the "SOC Automation with SIEM & SOAR" project has been a resounding success, demonstrating the tangible benefits of implementing advanced security automation solutions. By leveraging SIEM and SOAR technologies, the project has significantly enhanced threat detection capabilities, streamlined incident response processes, and empowered security analysts with enriched contextual information. The project's impact extends beyond the confines of the simulated environment, serving as a testament to the transformative power of automation in modern cybersecurity operations. As organizations continue to face increasingly sophisticated cyber threats, the lessons learned from this project will undoubtedly shape the future of security operations and pave the way for more agile and resilient security frameworks.