

Penetration Testing Project (Part 1): Lab Setup, Reconnaissance, and Enumeration

Prepared by: Saboor Ali

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Overview

To simulate a real-world penetration testing environment by setting up a local lab, conducting network and service discovery, and performing vulnerability assessments using open-source tools.

Phase 1: Lab Environment Setup & Fundamentals

Objective: Set up a safe lab environment and get familiar with Kali Linux and essential commands.

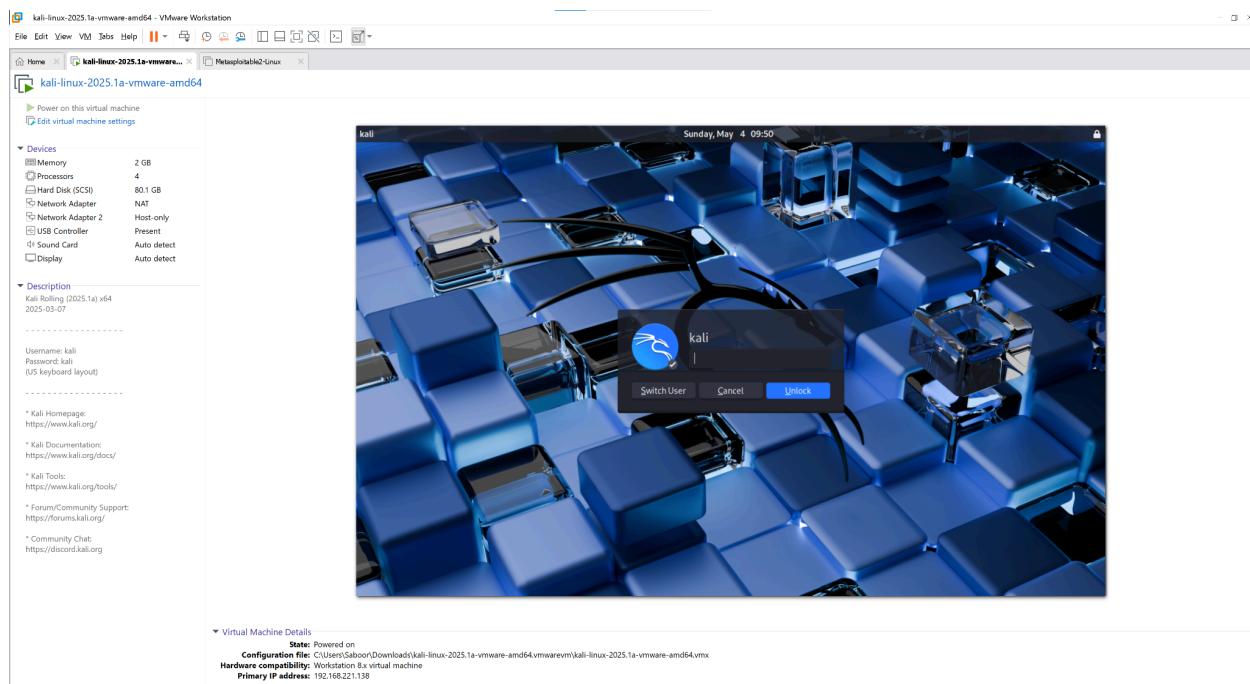
- **Tools Used:** Kali Linux, VMware Workstation, Metasploitable 2, OWASP BWA
 - **Key Concepts:**
 - Virtualization
 - Linux terminal basics
 - Networking setup (bridged adapters, static IPs)
-

1. Setting up Kali Linux (Prebuilt Image)

- **VM Used:** Kali Linux prebuilt VM (kali-linux-2025.1a-vmware-amd64)
<https://cdimage.kali.org/kali-2025.1c/kali-linux-2025.1c-vmware-amd64.7z>
- **Virtualization Platform:** VMware Workstation / VMware Player
- **VM Configuration:**
 - RAM: 8GB
 - CPU: 2 Cores
 - Storage: 80GB
 - Network Adapter: NAT:
 - Network Adapter 2: Host-only

Steps Followed:

1. Downloaded the Kali Linux VMware image from the official Kali Linux website.
2. Unzip the .7z file and open VM into VMware using the .vmx file.
3. Adjusted the system configuration (RAM, CPU, and storage) based on the available system resources.
4. Launched the VM and verified that it booted successfully into Kali Linux.



2. System Updates

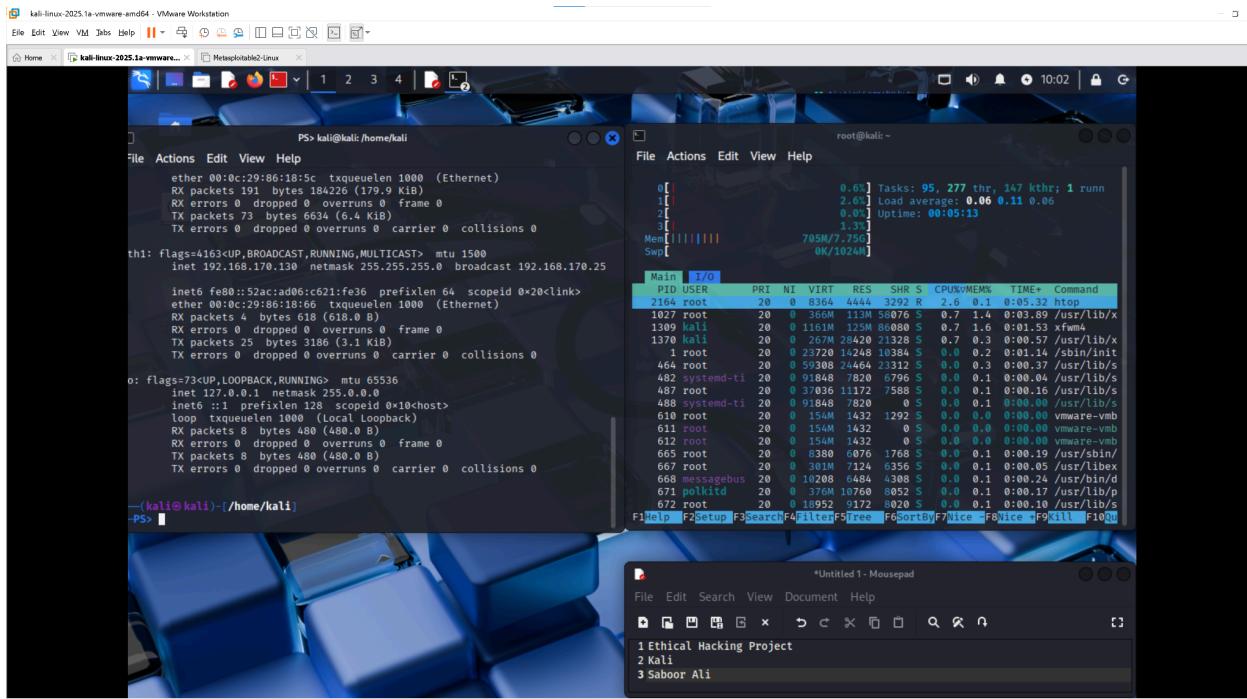
Ran the following command to ensure the Kali system was up-to-date:

```
sudo apt update && sudo apt upgrade
```

This ensured all the software packages and repositories in Kali Linux were up-to-date for security and functionality.

3. Tools Explored

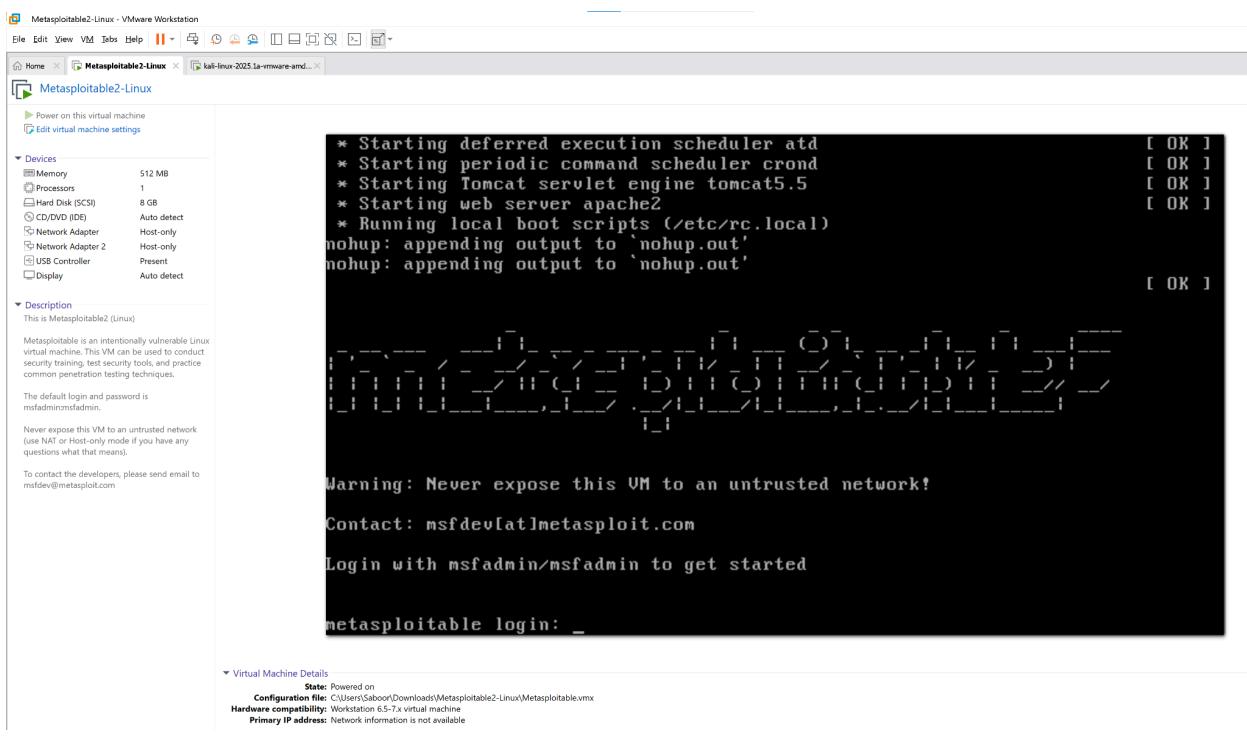
- **gnome-terminal**: Default terminal interface in Kali Linux.
- **htop**: Tool for system resource monitoring.
- **ifconfig / ip a**: Used to check network interface configurations.



4. Setting Up Metasploitable 2

Metasploitable 2 was set up as a vulnerable target system in VMware with the following configuration:

- IP Address:** 192.168.170.128
- Network Configuration:** Host-only, so all lab VMs are on the same network.

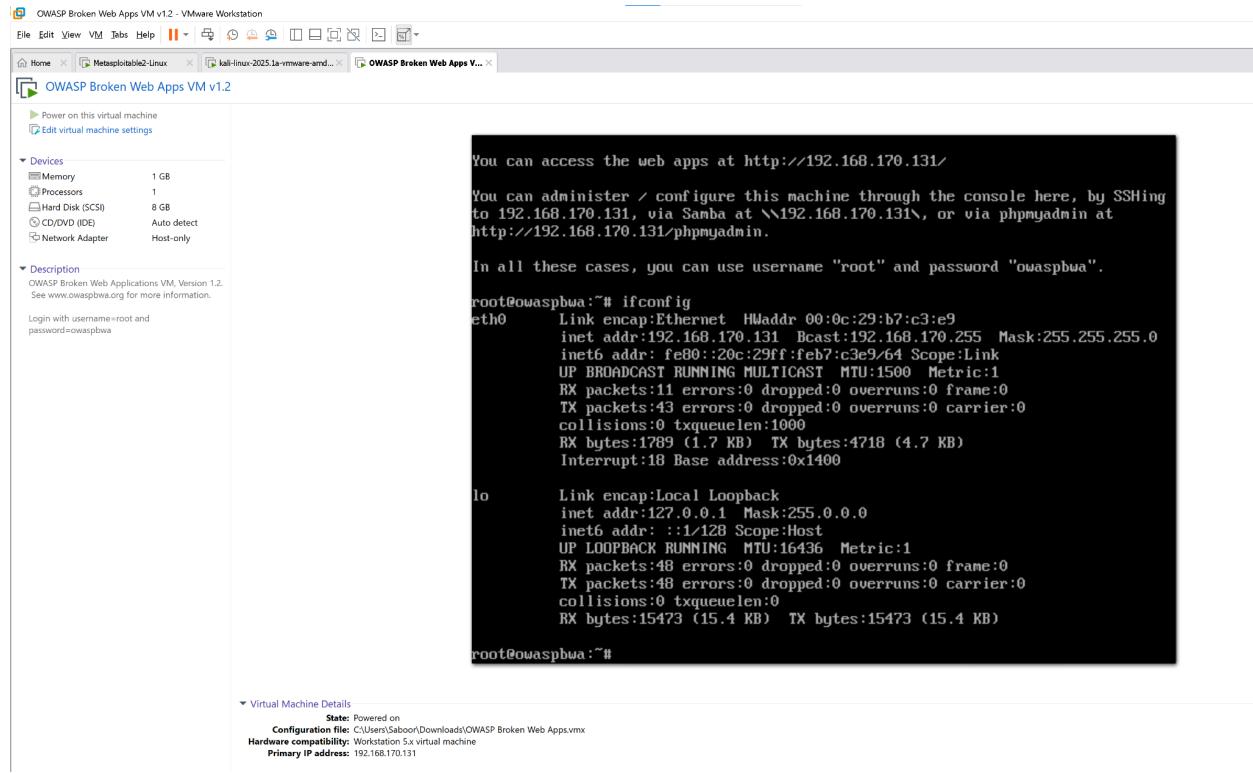


5. Setting Up OWASP BWA (DVWA)

OWASP BWA (Broken Web Applications) was imported into VMware as a prebuilt virtual machine. It contains intentionally vulnerable web applications such as **DVWA** (Damn Vulnerable Web Application), **Mutillidae**, and more.

- **VM Settings:**

- **Network Adapter:** Host-only (same network as Kali)
- **IP Address:** Static (e.g., **192.168.170.131**)
- **OS:** Ubuntu-based with LAMP stack preconfigured



Phase 2: Network Scanning & Enumeration

Objective:

Discover devices and gather information from the network using active and passive reconnaissance techniques.

Tools Used:

- Netdiscover
- Nmap
- Greenbone Vulnerability Management (GVM)

1. Discover Devices on Local Area Network (LAN)

Tool Used: `netdiscover`

This tool was used to discover active devices on the local network.

Command:

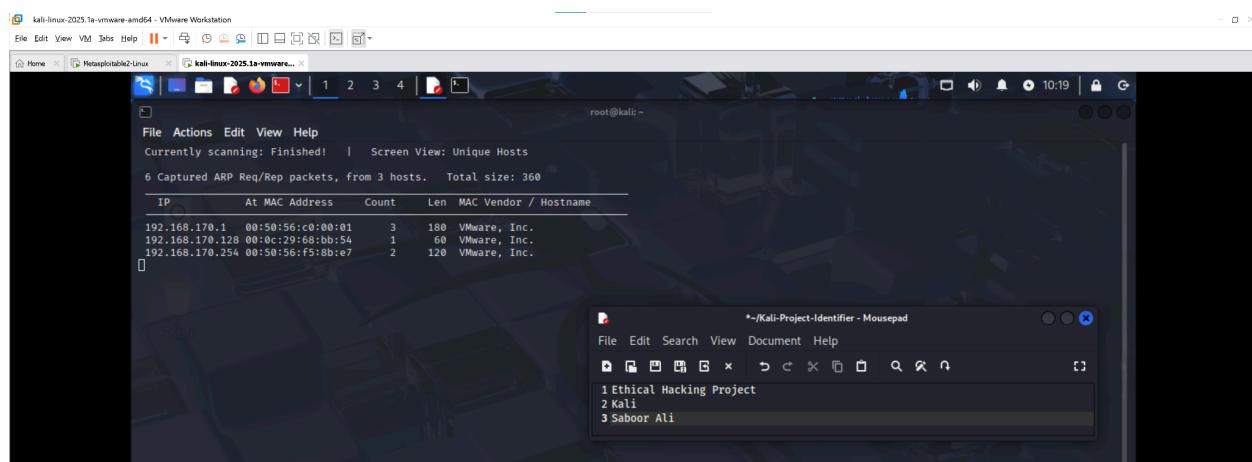
```
netdiscover -r 192.168.170.0/24
```

Explanation:

This command scans the `192.168.170.0/24` network range and lists all devices on the network, including IP and MAC addresses.

Observations:

- Discovered multiple devices on the LAN.
- Successfully identified **Metasploitable 2** at IP `192.168.170.128`.



2. Nmap Scans

2.1 Basic Nmap Scan

Used Nmap to perform a basic service version scan on Metasploitable 2 (IP: 192.168.170.128).

Command:

```
nmap -sS -sV -T4 192.168.170.128
```

Explanation:

- **-sS:** Performs a TCP SYN scan
- **-sV:** Attempts to determine service versions
- **-T4:** Speeds up the scan (aggressive timing)

Output Observations:

Identified the following open ports on Metasploitable 2:

- **21/tcp – FTP**
- **22/tcp – SSH**
- **23/tcp – Telnet**
- **80/tcp – HTTP**

Other services were also detected, indicating a vulnerable system.

```
root@kali:~# nmap -sS -sV -T4 192.168.170.128
Starting Nmap 7.95 ( https://nmap.org ) at 2025-05-04 10:21 EDT
Nmap scan report for 192.168.170.128
Host is up (0.00028s 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)
513/tcp   open  exec        netkit-rsh reexec
513/tcp   open  login?      Netkit rshd
514/tcp   open  shell        Netkit rshd
1099/tcp  open  java-remi   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 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
MAC Address: 00:0C:29:68:BB:54 (VMware)

Service Info: Hosts: metasploitable.localdomain, irc.Metasploitable.LAN; OSs: Unix, 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 65.58 seconds
```

2.2 Aggressive Nmap Scan

Command:

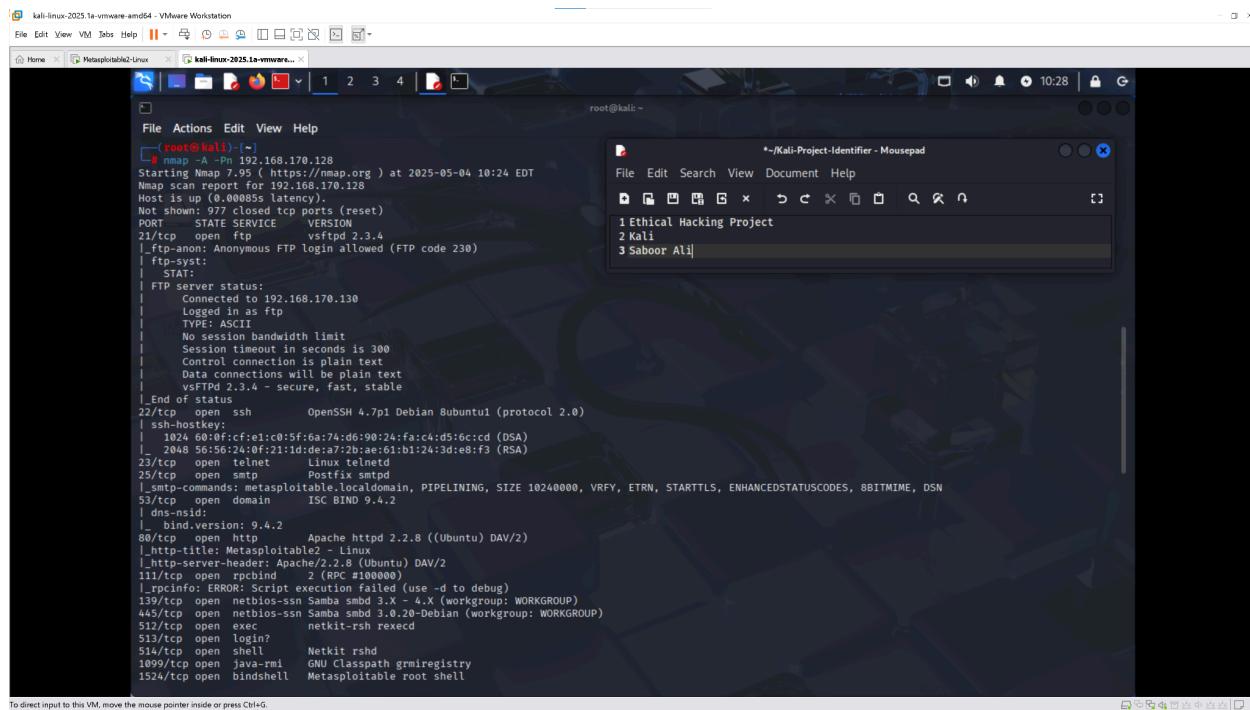
```
nmap -A -Pn 192.168.170.128
```

Explanation:

- **-A**: Enables OS detection, version detection, script scanning, and traceroute.
- **-Pn**: Skips host discovery; assumes the host is up.

Observations:

- Revealed detailed service information and OS fingerprinting.
- Detected potentially exploitable services such as outdated versions of FTP, HTTP, and SMB.



```
# nmap -A -Pn 192.168.170.128
Starting Nmap 7.95 ( https://nmap.org ) at 2025-05-04 10:24 EDT
Nmap scan report for 192.168.170.128
Host is up (0.00085s latency).
Not shown: 977 closed tcp ports (reset)
PORT      STATE SERVICE VERSION
21/tcp    open  ftp     vsftpd 2.3.4
|_s-anon  Anonymous FTP login allowed (FTP code 230)
|_ftp-syst
|_STAT:
FTP server status:
Connected to 192.168.170.130
Logged in as ftp
TYPE: ASCII
No session bandwidth limit
Session timeout in seconds is 300
Control connection is plain text
Data connections will be plain text
vsFTPD 2.3.4 - secure, fast, stable
|_End of status
22/tcp    open  ssh     OpenSSH 4.7p1 Debian 8ubuntu1 (protocol 2.0)
| ssh-hostkey:
|   1024 60:0f:cfe1:c0:5f:6a:74:d6:98:24:fa:c4:d5:6c:cd (DSA)
|   2048 56:56:24:0f:21:1d:de:a7:2b:ae:61:b1:24:3d:e8:f3 (RSA)
23/tcp    open  telnet  Linux telnetd
25/tcp    open  smtp   Postfix smtpd
|_smtp-commands: metasploitable.localdomain, PIPELINING, SIZE 10240000, VRFY, ETRN, STARTTLS, ENHANCEDSTATUSCODES, 8BITMIME, DSN
53/tcp    open  domain  ISC BIND 9.4.2
| dns-nsid:
|   bind-version: 9.4.2
80/tcp    open  http   Apache httpd 2.2.8 ((Ubuntu) DAV/2)
|_http-title: Metasploitable2 - Linux
|_http-server-header: Apache/2.2.8 (Ubuntu) DAV/2
111/tcp   open  rpcbind 2 (RPC #100000)
|_rpcinfo: ERROR: Script execution failed (use -d to debug)
139/tcp   open  netbios-ssn Samba smbd 3.X - 4.X (workgroup: WORKGROUP)
445/tcp   open  netbios-ssn Samba smbd 3.0.20-Debian (workgroup: WORKGROUP)
512/tcp   open  exec    netkit-rsh rexecd
513/tcp   open  login?
514/tcp   open  shell   Netkit rshd
1099/tcp  open  java-vmi GNU Classpath grmiregistry
1524/tcp  open  bindshell Metasploitable root shell

To direct input to this VM, move the mouse pointer inside or press Ctrl-Q.
```

3. Vulnerability Assessment with GVM (Greenbone Vulnerability Management)

GVM (formerly known as OpenVAS) is an open-source framework used for scanning systems and identifying known vulnerabilities. It integrates vulnerability scanning, result management, and reporting in a centralized interface.

3.1 Installing GVM on Kali Linux

Command used:

```
sudo apt install gvm
```

```
sudo gvm-setup
```

```
sudo gvm-check-setup
```

Explanation:

- Installed the GVM framework.
- Initialized feed downloads (Network Vulnerability Tests).
- Ensured scanner and services were correctly configured.

3.2 Starting GVM and Logging In

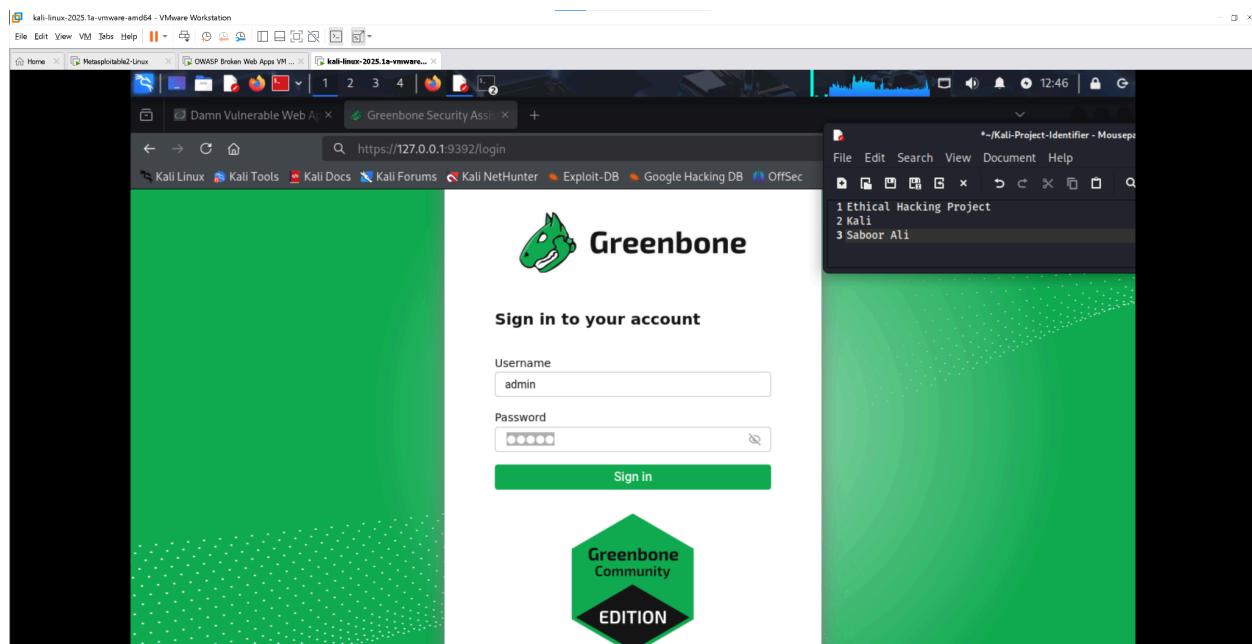
Command:

```
sudo gvm-start
```

Access:

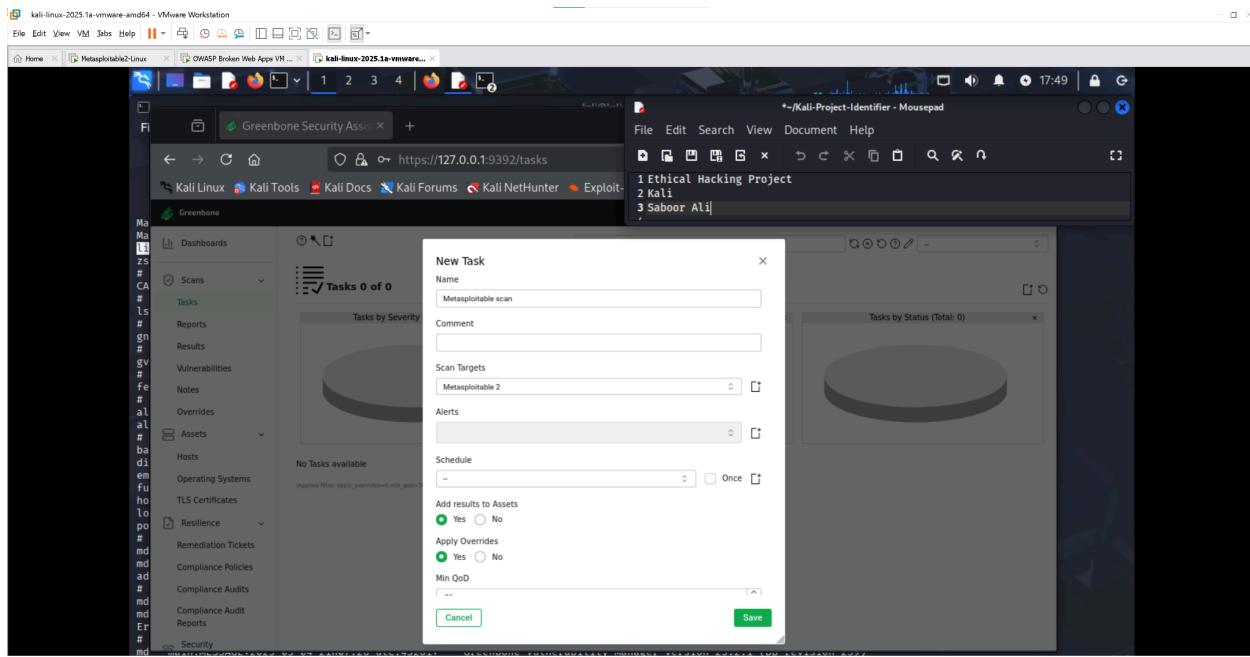
Opened browser and navigated to: <https://127.0.0.1:9392>

Logged in using credentials generated during setup.



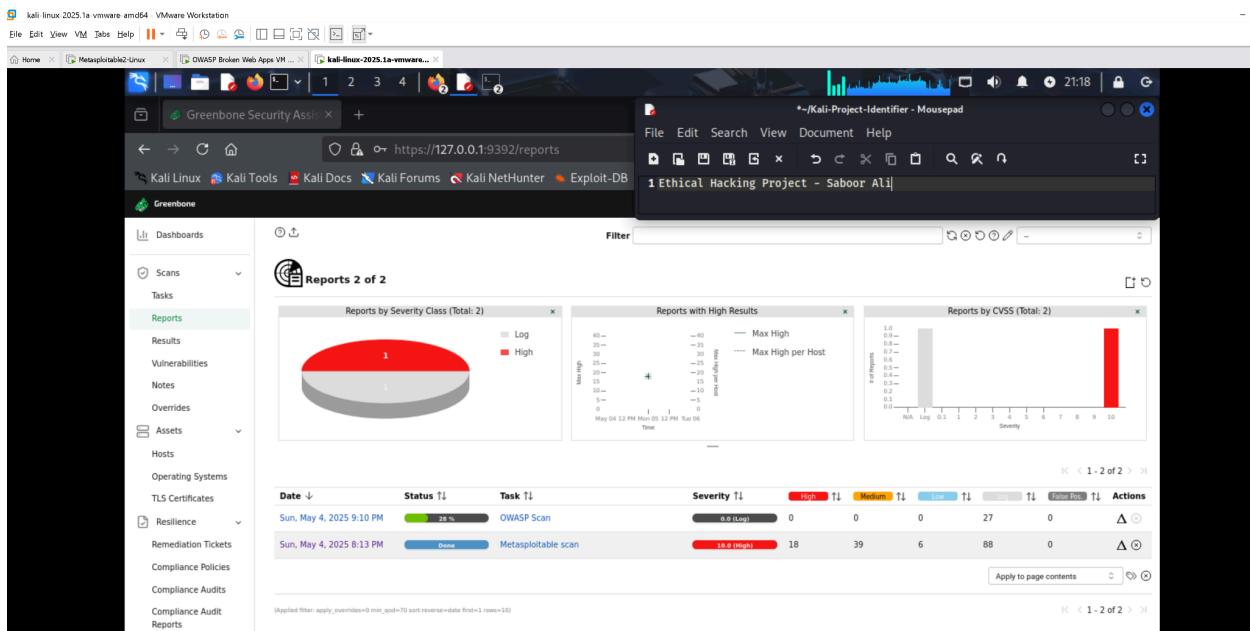
3.3 Scanning Metasploitable 2 with GVM

- Created a new target with IP: 192.168.170.128
- Launched a full and fast scan
- Waited for the scan to complete and reviewed the results



3.4 Vulnerability Assessment Results

The vulnerability assessment conducted using Greenbone Vulnerability Management (GVM) on host 192.168.170.128 revealed 63 vulnerabilities, with 16 vulnerabilities scoring a CVSS v3 base score of 9.0 or higher, indicating a critical security risk to the system. The affected services span multiple open ports and protocols, and include both remote code execution (RCE) vulnerabilities and misconfigurations exposing the host to potential compromise.



3.5 Targeting Vulnerable Services on Metasploitable 2

The screenshot shows a Kali Linux desktop environment within a VMware Workstation window. On the left, the OWASP Broken Web Apps application is open, displaying a report for a target at 127.0.0.1:9392. The report includes sections for Information, Results, Hosts, Ports, Applications, Operating Systems, CVEs, Closed CVEs, TLS Certificates, Error Messages, and User Tags. A detailed table of vulnerabilities is shown, such as 'CVE-2008-5304 CVE-2008-5305' and 'CVE-1999-0618'. On the right, a Mousepad window titled 'Ethical Hacking Project - Saboor Ali' lists various vulnerabilities with their severity levels (e.g., Critical, High, Medium, Low) and host counts.

3.6 Vulnerability Scanning with Nikto

Nikto is a web vulnerability scanner that detects common misconfigurations and outdated software.

Command Used:

```
nikto -h http://192.168.170.131
```

The screenshot shows a terminal window on a Kali Linux VM. The user has run the command 'nikto -h http://192.168.170.131'. The output of the scan is displayed, detailing various findings on the target server. Key findings include:

- Target IP: 192.168.170.131
- Target Hostname: 192.168.170.131
- Target Port: 80
- Start Time: 2025-05-04 10:55:32 (GMT+4)
- Server: Apache/2.2.14 (Ubuntu) mod_mono/2.4.3 PHP/5.3.2-1ubuntu4.30 with Suhosin-Patch proxy_html/3.0.1 mod_python/3.3.1 Python/2.6.5 mod_ssl/2.2.14 OpenSSL/0.9.8k Phusion_Passenger/4.0.38 mod_perl/2.0.4 Perl/v5.10.1
- Notes: Server may leak inodes via ETags, header found with file /, inode: 2866483, size: 28067, mtime: Thu Jul 30 22:55:52 2015. See: <http://cve.mitre.org/cgi-bin/cvename.cgi?name=CVE-2003-1418>
- Notes: The anti-clickjacking X-Frame-Options header is not present. See: <https://developer.mozilla.org/en-US/docs/Web/HTTP/Headers/X-Frame-Options>
- Notes: The X-Content-Type-Options header is not set. This could allow the user agent to render the content of the site in a different fashion to the MIME type. See: <https://www.netsparker.com/web-vulnerability-scanner/vulnerabilities/missing-content-type-header/>
- Notes: /cgi-bin directory index.html found.
- Notes: /crossdomain.xml found, contains a wildcard entry. See: <http://jeremiahgrossman.blogspot.com/2008/05/crossdomainxml-invites-cross-site.html>
- Notes: Uncommon header 'tcm' found, with contents: list
- Notes: /index: Apache mod_negotiation is enabled with MultiViews, which allows attackers to easily brute force file names. The following alternatives for 'index' were found: index.css, index.html. See: <http://www.wisec.org/id/4698ebdc59d15>, <https://exchange.xforce.ibmcloud.com/vulnerabilities/8275>
- Notes: /images: IP address found in the 'location' header. The IP is "127.0.1.1". See: https://portswigger.net/kb/issues/00600300_private-ip-addresses-disclosed
- Notes: /images: The web server may reveal its internal or real IP in the Location header via a request to with HTTP/1.0. The value is "127.0.1.1". See: <http://cve.mitre.org/cgi-bin/cvename.cgi?name=CVE-2000-0649>
- Notes: /favicon.ico: identified this app/server as: owasp.org. See: <https://en.wikipedia.org/wiki/Favicon>
- Notes: Perl/v5.10.1 appears to be outdated (current is at least v5.32.0), mod_perl/v2.0.4 (current is at least 2.0.11), PHP 7.4.28 for the 7.4 branch.
- Notes: mod_perl/2.0.4 appears to be outdated (current is at least 2.0.11).
- Notes: OpenSSL/0.9.8k appears to be outdated (current is at least 3.0.7). OpenSSL 1.1.15 is current for the 1.x branch and will be supported until Nov 11 2023.
- Notes: proxy_html/3.0.11 appears to be outdated (current is at least 3.1.2).
- Notes: mod_python/3.3.1 appears to be outdated (current is at least 3.5.0).
- Notes: mod_ssl/2.2.14 appears to be outdated (current is at least 2.9.6) (may depend on server version).
- Notes: Phusion_Passenger/4.0.38 appears to be outdated (current is at least 6.0.7).
- Notes: mod_mono/2.4.3 appears to be outdated (current is at least 3.12).
- Notes: Python/2.6.5 appears to be outdated (current is at least 3.9.6).
- Notes: Apache/2.2.14 appears to be outdated (current is at least Apache/2.4.54). Apache 2.2.34 is the EOL for the 2.x branch.
- Notes: mod_ssl/2.2.14 Phusion_Passenger/4.0.38 mod_perl/2.0.4 Perl/v5.10.1 - mod_ssl 2.8.7 and lower are vulnerable to a remote buffer overflow which may allow a remote shell.
- Notes: PHP/5.3 - PHP 3/4/5 and 7.0 are End of Life products without support.
- OPTIONS: Allowed HTTP Methods: GET, HEAD, POST, OPTIONS, TRACE .
- Notes: / HTTP TRACE method is active which suggests the host is vulnerable to XST. See: https://owasp.org/www-community/attacks/Cross_Site_Tracing
- Notes: /phpBB2/search.php?search_id=1\: Retrieved x-powered-by header: PHP/5.3.12-1ubuntu4.30.
- Notes: /phpBB2/search.php?search_id=1\:\Cookie phpbz2owaspwba_data created without the httponly flag. See: <https://developer.mozilla.org/en-US/docs/Web/HTTP/Co>

4. Enumeration Overview

In this section, I performed a detailed enumeration to identify open services, gather system information, and discover potential vulnerabilities on both Metasploitable 2 and OWASP BWA. This phase builds on the information gathered during the initial network scanning.

4.1 Metasploitable 2 Enumeration

Based on Nmap and GVM findings for Metasploitable 2, this is a concise list of the easiest and most commonly exploited vulnerabilities that are often flagged and actively exploitable via Metasploit:

Service	Port	Vulnerability	CVE	Exploit Name in Metasploit
vsftpd	21	Backdoor Command Execution	CVE-2011-2523	<code>exploit/unix/ftp/vsftpd_234_backdoor</code>
Telnet / Linux (root shell)	23	Default Credentials	N/A (misconfig)	<code>auxiliary/scanner/telnet/telnet_login</code>
DistCC	3632	Remote Command Execution	CVE-2004-2687	<code>exploit/unix/misc/distcc_exec</code>
Samba	139, 445	Remote Code Execution	CVE-2007-2447	<code>exploit/multi/samba/usermap_script</code>
MySQL	3306	Auth Bypass with root/no pass	N/A (misconfig)	<code>auxiliary/scanner/mysql/mysql_login</code>
Tomcat Manager	8180	Weak creds → RCE via WAR	CVE-2009-3843	<code>exploit/multi/http/tomcat_mgr_upload</code>
UnrealIRCd	6667	Backdoored version RCE	CVE-2010-2075	<code>exploit/unix/irc/unreal ircd_3281_backdoor</code>
PhpMyAdmin	80	Exposed login page, common creds	Various	<code>auxiliary/scanner/http/phpmyadmin_login</code>
PHP CGI Argument Injection	80	Remote Code Execution	CVE-2012-1823	<code>exploit/multi/http/php_cgi_arg_injection</code>
Apache 2.2.8	80	Multiple known exploits	e.g. CVE-2009-1891	Varies by module (mod_negotiation, mod_ssl, etc.)

4.2 OWASP BWA Enumeration

Based on Nikto findings for the OWASP BWA (Broken Web Applications) VM, this is a concise list of the easiest and most commonly exploited vulnerabilities identified during the assessment. These vulnerabilities are frequently targeted in penetration testing and can be actively exploited to gain unauthorized access or execute malicious actions.

Finding	Risk Level	CVE / Reference	Description / Exploitability	Recommended Fix
Outdated Apache/2.2.8 (Ubuntu)	High	CVE-2017-9798 , CVE-2011-3368	Multiple known vulnerabilities (RCE, DoS, path traversal)	Upgrade to Apache 2.4.54+
Outdated PHP/5.2.4	High	CVE-2014-3515 , CVE-2012-0830	Multiple RCE and info disclosure flaws	Upgrade to PHP 8.x
phpinfo.php exposed	High	CWE-552	Reveals server paths, loaded modules, configs	Remove file or restrict access
phpMyAdmin exposed	High	CVE-2009-1151	Brute-force, XSS, privilege escalation possible	Restrict IP or use auth
Directory Indexing Enabled (/doc/, /icons/, /test/)	High	CVE-1999-0678	Allows file listing and potential download of sensitive files	Disable <code>Indexes</code> in Apache config
TRACE Method Enabled	High	OWASP XST	Can be exploited for Cross Site Tracing (XST) to steal cookies	Set <code>TraceEnable Off</code> in Apache config
wp-config.php# file exposed	High	CWE-538	WordPress DB credentials exposed	Remove file or deny access in <code>.htaccess</code>

5. Analysis of Enumeration Findings

Based on the enumeration results, the most critical and easily exploitable services have been identified:

- **Metasploitable 2:**

- FTP (vsftpd 2.3.4) – Backdoor (CVE-2011-2523)
- Telnet – Default credentials
- Samba (CVE-2007-2447)
- DistCC (CVE-2004-2687)
- UnrealIRCd (CVE-2010-2075)

- **OWASP BWA:**

- Apache (Multiple CVEs)
- phpMyAdmin (Exposed)
- DVWA (SQL Injection, XSS)

These services will be prioritized in the exploitation phase.