Penetration Testing: Introduction and Reconnaissance

CSA - September 2023

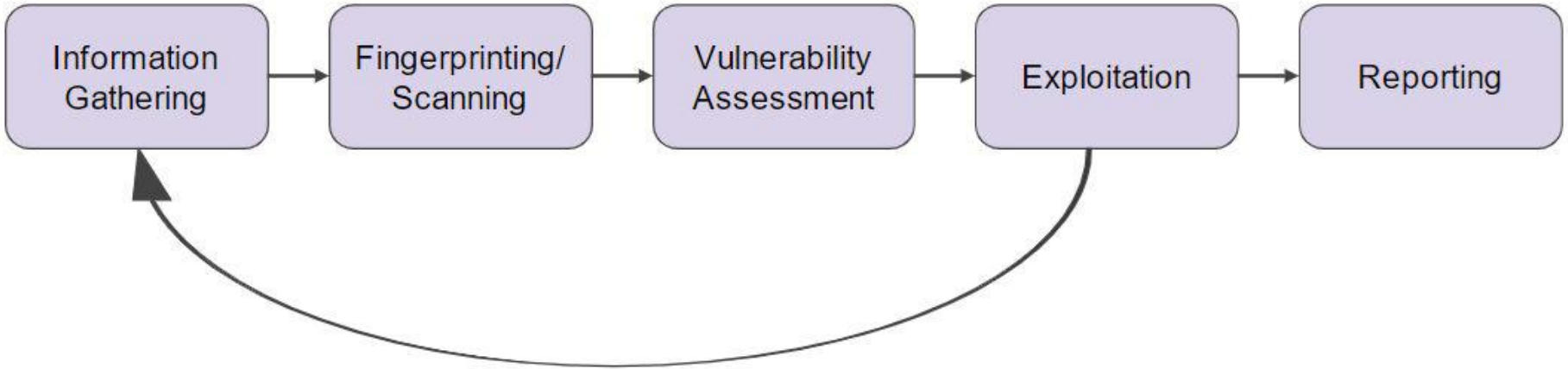
Introduction to Penetration Testing

Penetration Testing Overview

- What?
  - Good guys hack you to tell you how they did it so you know what to improve
- Who?
  - Either 3rd party hired or in-house red team
- How?
  - Black box - no insight into systems, white box - full visibility into environment
- When?
  - Some laws/compliance frameworks require organizations have it done annually or even more often
- Why?
  - You need a fresh set of eyes to pull out vulnerabilities that you hadn’t noticed before

Steps of Penetration Testing

Penetration Testing Steps



There is a step 0, but we won't focus on it here

Information Gathering

- What specific assets are in scope?
  - If given an IP range, which are active?
  - If given a wildcard subdomain scope (like *.byu.edu), what are subdomains?
- OSINT
  - How is the company set up?
  - Do they have a dedicated IT department?
  - What do their emails look like?
  - What do they do/what service(s)/product(s) do they provide?
- This helps you enumerate your attack surface and give first insight into the security of the company

Fingerprinting/Scanning

- What Operating System does it use?
  - Not just “Windows” or “Linux”, but exact OS and kernel/release versions
- What ports are open? What’s running on those ports?
- What type of web/SSH/FTP/SMTP/etc server does it use?
  - Again, exact versions are much more helpful because it can point you to specific CVEs to look for
- **Custom? Say no more**
  - It’s typically much easier to hack custom applications than widely-used ones
- Passive vs Active

Vulnerability Assessment

- Once you know what services are running, what attacks can you perform?
  - If web, think SQLi/XSS/file uploads/etc.
  - If network, think null sessions/anonymous access
- Are there any known CVEs for the known version numbers?
- Can you brute force credentials?
- What are the default credentials?
- Run vulnerability scanners, which can automate a lot of this process for you
  - All results from these scanners need triaging, and only about half of the results are actionable
  - Nessus and Nikto are some examples
- Create a comprehensive list of ***possible vulnerabilities*** based on what you've found - exploitation is next phase. Don't rush it!

Exploitation

- Once possible vulnerabilities are listed, choose the most likely option and pursue it!
- If exploitation is successful, you travel back to the reconnaissance phase
  - What else can you see now? What user accounts are there? Interesting files? Credentials?
- Privilege Escalation
  - Can you become admin/root? Can you pivot to other accounts?
- Network pivoting
  - What networks does the machine have on it? What increased access do you have to other systems?
- Establish persistence - what changes can you make to ensure you have access even if the machine is rebooted/web shell discovered/connection broken?

Reporting

- **MOST IMPORTANT PART OF THE JOB**
  - If you can hack them but can't effectively convey how you did it or what to do to stop it, you are of no use to them. Effective reports are your job security.
- Include an overview of how their infrastructure withstood your pentests, major takeaways, etc.
- A large part of the pentest report afterwards includes detailing how to reproduce vulnerabilities, why the vulnerability is so important, and how to mitigate it
- Not a huge part of what we focus on because it's probably best if you learn from your company how they make the reports

Installing Kali Linux

What is a Virtual Machine?

A virtual machine is the virtualization or emulation of a computer system on your own host. This allows you to run another OS on your system, including other OS's that aren't native to your computer. For example, a Windows machine could run MacOS or any flavor of Linux, or another Windows OS computer on their system. And it stays completely virtualized, meaning (generally), that anything that happens on that VM won't affect the host computer. Malware, files, changes, and activity all stay within the VM.

Step One – Installing VMware

- Go to software.byu.edu and click 'Student'
- For Windows and Linux, find 'VMware Workstation' and follow the link
- For Mac, find 'VMware Fusion' and follow the link
- Scroll down and Download for your OS, for Mac choose VMware Fusion Pro
- Once downloaded and opened, click 'Add key'
- Copy and paste the key to get full access to VMware

Step Two - Installing Kali

- Go to kali.org/get-kali
- Click on 'Virtual Machines'
- Hit the arrow on VMware
- Install 7zip if needed for windows only at https://7zip.org
- Extract the 7z file
- Once extracted, find the .vmx file in the folder that was extracted and double click.
- When setting up, give the VM at least 4GB of Ram, set it to 1 processor with 2 cpu cores, and 80 GB of storage.
- Boot it up, and the username and password will be kali

Reconnaissance

Information Gathering

- Enumerating subdomains
  - **Depends on scope** - use tools like sublist3r, DNSDumpster, and crt.sh to find
  - theHarvester is a common choice also
  - Can brute force with a wordlist
- Enumerating IP addresses
  - Ping scan - which machines in the given IP range are up and responding?
- OSINT
  - What email format does the organization use?
  - Who are some employees? Do they have any secrets on their social media?
  - Who are the executives?
  - What is the layout of the company? Do they have a dedicated IT department?

Passive vs Active Scanning

- Active - more effective, faster, more noisy
- Passive - slower, less effective, more stealthy
- Which do I choose?
  - How likely are you to be caught?
  - Do they have an IDS that will detect you?
  - ***Custom == More Stealthy***
- Passive techniques/tools
  - Capturing WiFi traffic w/ wifi pineapple
  - Using Wireshark/p0f to capture & analyze network traffic not intended for you
  - Google dorks

Ping Scan

- “Ping” is a layer 3 protocol that sends an ICMP Echo packet to an IP and expects a response from machines that are running
  - Ping can be disabled on machines, but not very likely
- ARP packets can also be sent - these operate on layer 2 and try to resolve IP addresses into MAC addresses
  - If ping is disabled, ARP may work
  - ARP resolution is done by default when nmap is run with sudo
- Nmap
  - -sn -> ping/ARP only
  - -Pn -> no ping

https://nmap.org/book/host-discovery.html

```
└─$ sudo nmap -sn 192.168.126.0/24
[sudo] password for justin:
Starting Nmap 7.92 ( https://nmap.org ) at 2022-08-26 19:13 MDT
Stats: 0:00:17 elapsed; 0 hosts completed (0 up), 256 undergoing Ping Scan
Ping Scan Timing: About 8.30% done; ETC: 19:16 (0:03:08 remaining)
Nmap scan report for 192.168.126.128
Host is up (0.0013s latency).
Nmap done: 256 IP addresses (1 host up) scanned in 21.12 seconds
```

Somewhat quick

REALLY quick

```
└─$ fping -g 192.168.126.0/24 2> /dev/null
192.168.126.128 is alive
192.168.126.1 is unreachable
192.168.126.2 is unreachable
192.168.126.3 is unreachable
192.168.126.4 is unreachable
192.168.126.5 is unreachable
192.168.126.6 is unreachable
192.168.126.7 is unreachable
192.168.126.8 is unreachable
192.168.126.9 is unreachable
```

Fingerprinting - Operating Systems

- Nmap has a -O option that will guess an operating system based on minutiae in the network packets
  - Use the --osscan-guess option afterwards so it will tell you which OSes are likely even if it's not 100% certain
  - Somewhat aggressive, but also effective
- Presence of running services may indicate which OS is running
  - Ports 135-139, 445, 3389 -> Windows
  - Port 22 -> Linux
  - IIS web server -> Windows
- Web servers and SSH servers may include the OS name in their banner
- Knowing exact OS versions can help later on in exploitation phase

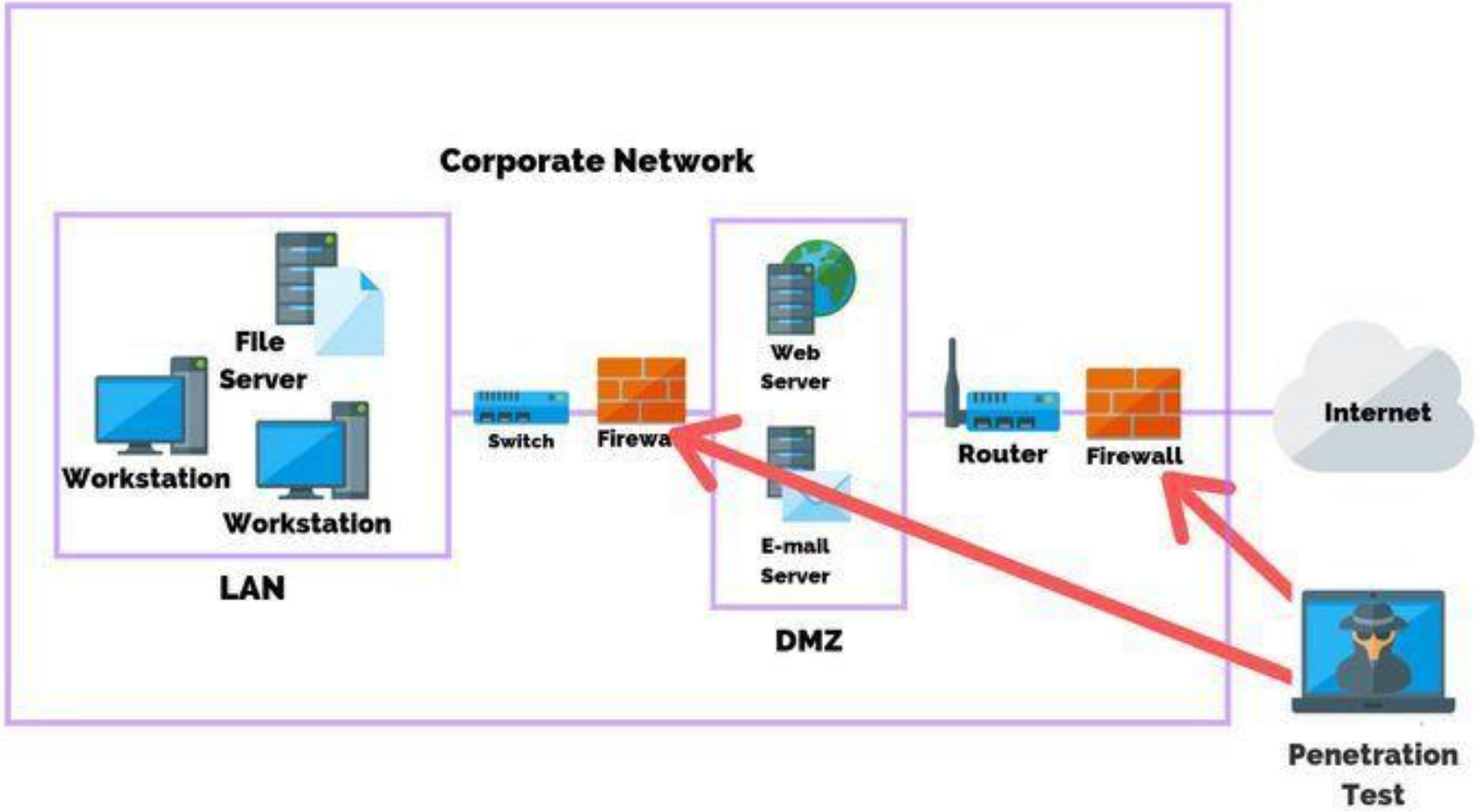
Port Scanning

- Understand TCP handshake (difference between SYN scan and TCP scan)
- Which port numbers
  - Nmap does top 1000 by default
  - -p used to specify port number
    - -p 80
    - -p 22,80,440-443
    - -p- (for all 65535)
- UDP ports
  - Not done by default, -sU enables this
- Fingerprint services -> -sV (grabs banners)
  - Netcat can do the same thing for some services

https://nmap.org/book/scan-methods.html

Network Diagram

- After discovering which machines are available at what IP addresses with which OSes and services running, make a diagram!
- Perfect at this point in time (and not afterwards) because it ensures that you don’t forget any assets as you get into the fun part of exploiting
- Use online tools like draw.io or LucidChart


Corporate Network
File
Server
Workstation
Workstation
LAN
Switch
Firewa
Web
Server
E-mail
Server
DMZ
Router
Firewall
Internet
Penetration
Test

Activity

Reconnaissance

Now, let's walk through doing your own NMAP scan!

Questions? Just ask!