SIGPwny

Purple Team FA2025 • 2025-09-16

Network Security & Active Recon

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sigpwny{SYN;SYN_ACK;ACK;}

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- Networking intro
- Active Recon
    - Port scanning
    - Service-specific recon techniques
    - Edge cases (proxies & UDP services)
- Gaining Access
    - Services & misconfigurations
    - Exploit a known vulnerability (n-day)
        - Exploitdb, searchsploit, GitHub, Metasploit
    - User Enumeration, Password Brute Force & Password Spray
- Live Demo (Infra-dependent)
    - Port scan, service recon, password attack & exploit!

Infrastructure Update

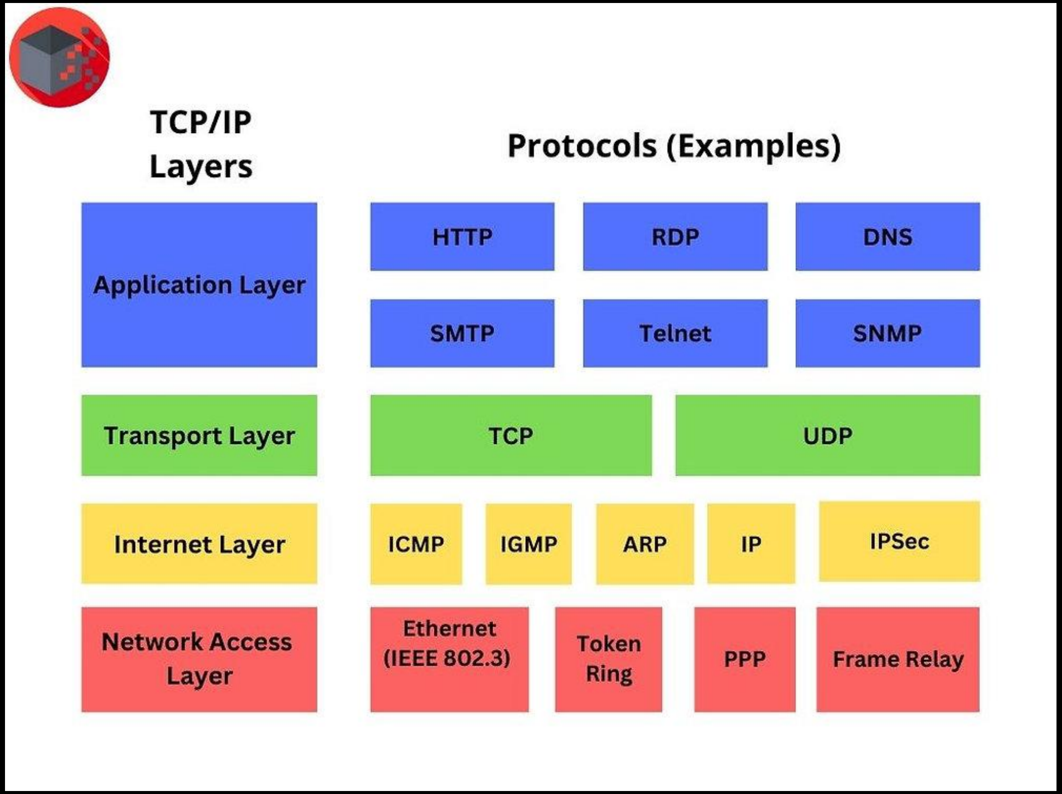
Infraaaahhh

- Servers physically moved to ACM rack (3 floors up!)
- New pwnyos site is: https://pwnyos.purple.sigpwny.com:443
- Cyber range no longer accessible outside of **IllinoisNet**
  - Quirk of Illinois IP space
  - We may change this later with tunneling
- You should be able to access PwnyOS anywhere

Network Security Overview

TCP/IP model

- TCP/IP model offers a very simplified view of networking
- It consists of 4 layers of network, encapsulating one above.
- In purple team, we are only concerned with Application and Transport Layer



TCP/IP Layers	Protocols (Examples)
Application Layer	HTTP RDP DNS SMTP Telnet SNMP
Transport Layer	TCP UDP
Internet Layer	ICMP IGMP ARP IP IPSec
Network Access Layer	Ethernet (IEEE 802.3) Token Ring PPP Frame Relay

Services

- Services serve content with specific Application protocols
- For example, an HTTP server is a service that serves web content with HTTP protocol
- Network Security concerns the security of **services** & **trust relationships** that occur in networked environments
- Common exploitable services include HTTP/S servers, SMB, SSH, NFS, **SQL, WinRM, and many more

How to network 101

- Internet layer offers a way to address machines (IPv4 and IPv6)
- Transport layer offers end-to-end communications (TCP and UDP) between computers, with 65536 different ports each to run different connections on
- Application layer offers client-server communication without worrying about underlying implementation
- To fully understand a service, we must know the address, TCP/UDP and port, as well as application layer protocol
- e.g. https://sigpwny.com -> 172.66.x.x, TCP, port 443, HTTPS

TCP vs UDP

- TCP has a state machine to ensure reliability and speed.
- We will talk about the hand-shake process to initiate a connection, but during the connection it uses sequence number and acknowledgement number to make sure data is received reliably
- UDP is “best-effort”, data reliability is not guaranteed but has very low data overhead.
- Ideal for cases where speed matters over data integrity, like video streaming

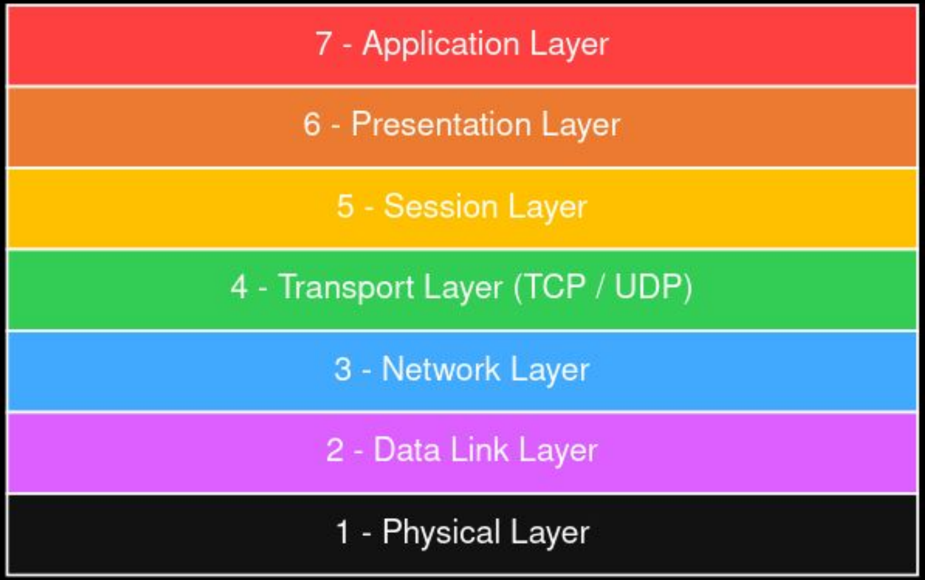
Most services you will see are going to be TCP!

Transmission Control Protocol

Client

How do these sync?

Server



7 - Application Layer

6 - Presentation Layer

5 - Session Layer

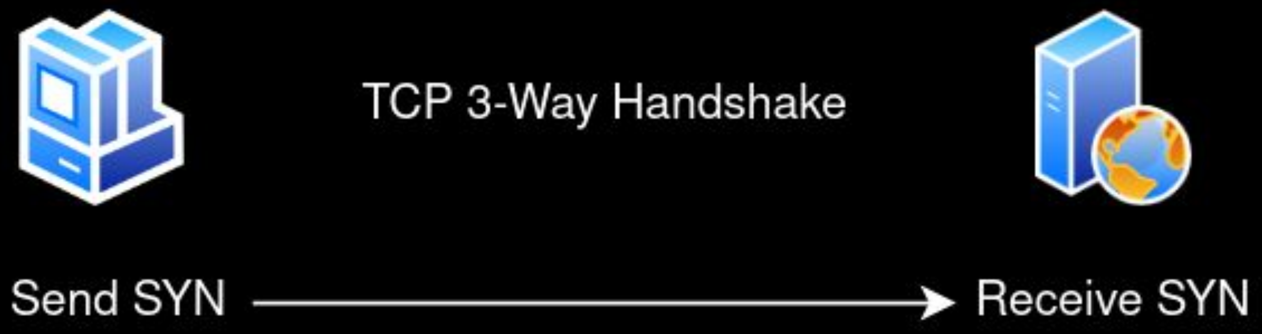
4 - Transport Layer (TCP / UDP)

3 - Network Layer

2 - Data Link Layer

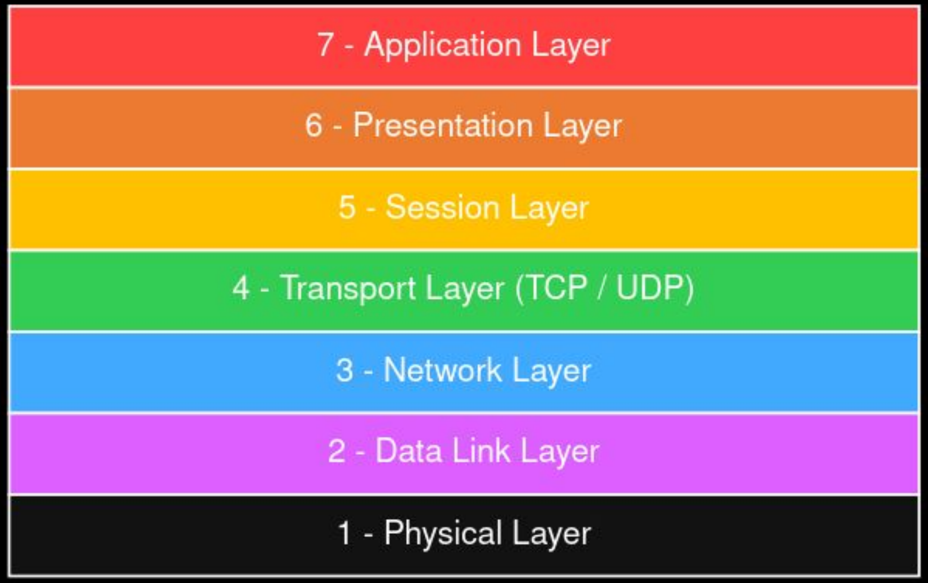
1 - Physical Layer

Transmission Control Protocol



TCP 3-Way Handshake

Send SYN → Receive SYN



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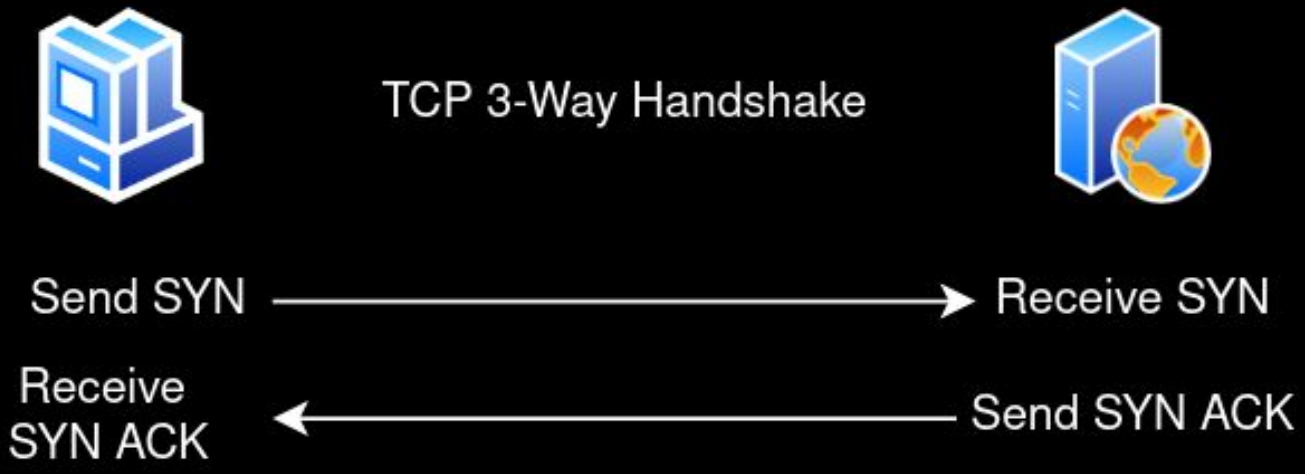

TCP 3-Way Handshake

Send SYN → Receive SYN

Receive SYN ACK ← Send SYN ACK

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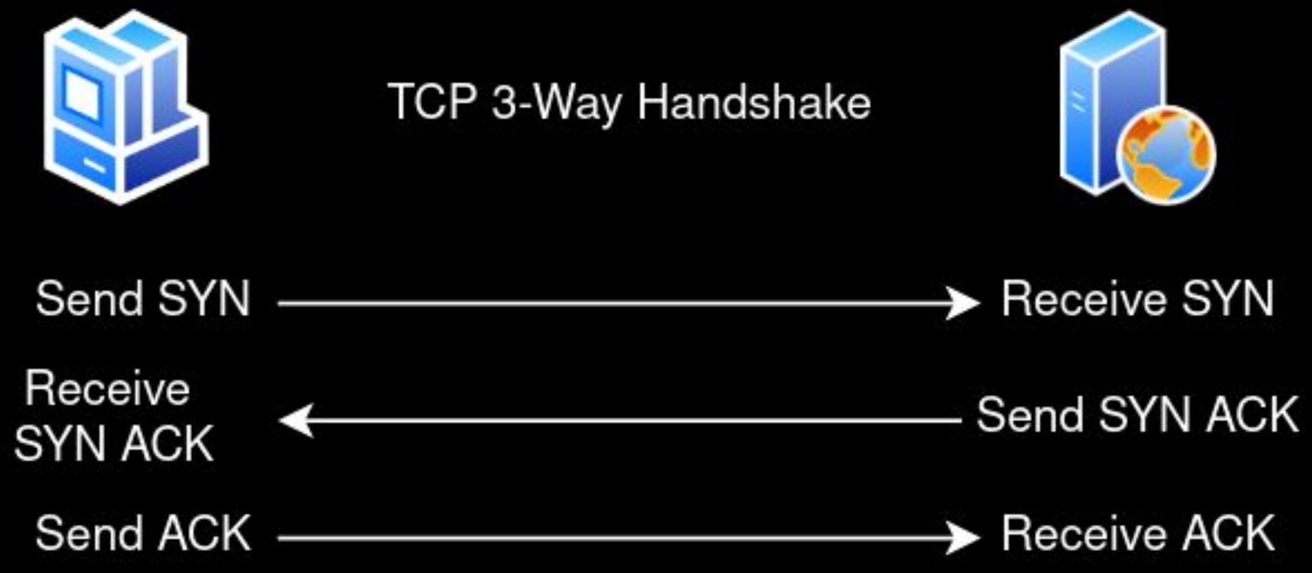
Transmission Control Protocol



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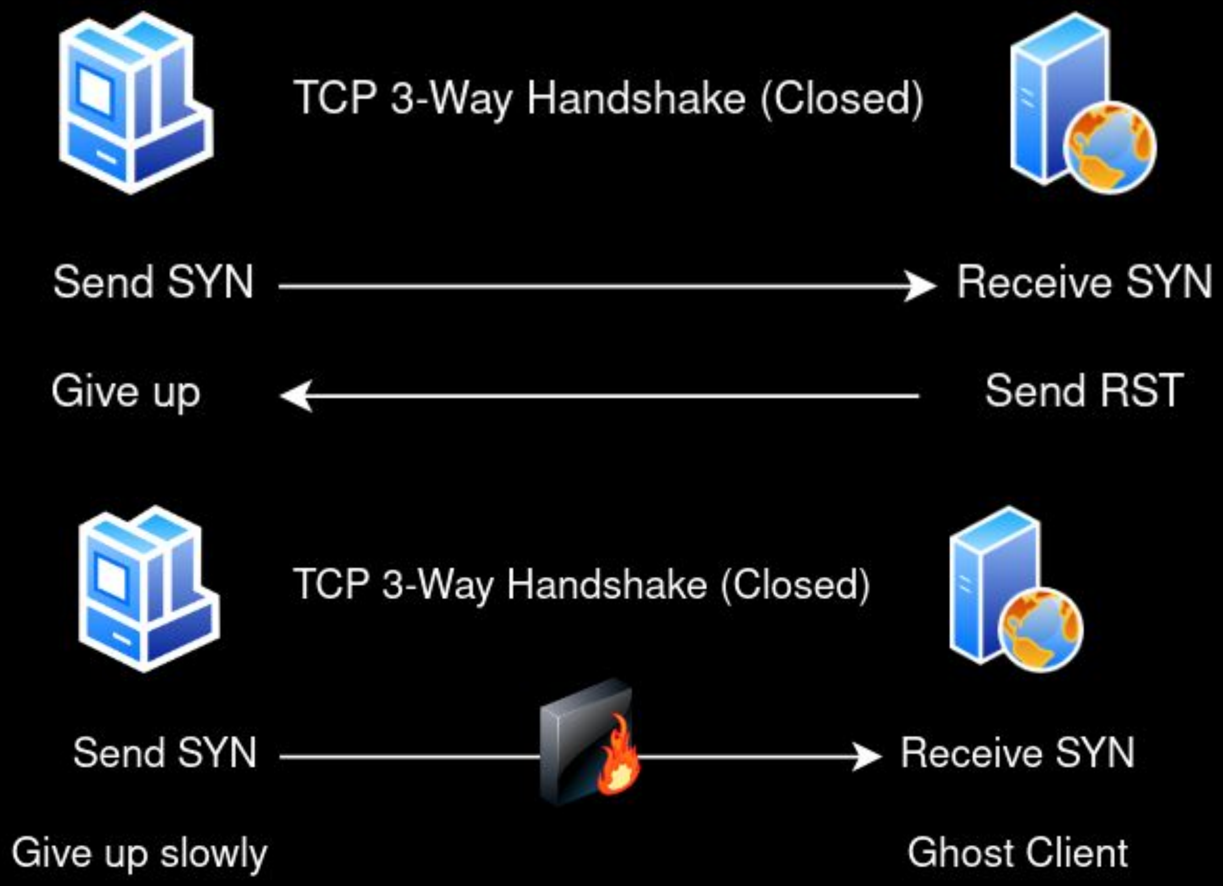
Sorry, We're Closed



TCP 3-Way Handshake (Closed)

Send SYN → Receive SYN

Give up ← Send RST

TCP 3-Way Handshake (Closed)

Send SYN → Receive SYN

Give up slowly

Ghost Client

7 - Application Layer

6 - Presentation Layer

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1 - Physical Layer

Example Services

- FTP (port 21)
- SSH (port 22)
- Telnet (port 23)
- DNS (port 53)
- HTTP (port 80)
- HTTPS (port 443)
- SMB (port 445)
- MSSQL (port 1433)
- NFS (port 2049)
- RDP (port 3389)

All the ports above are the default ports, assigned by IANA!

Example Services

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- RDP (port 3389)
- **Non-Default HTTP** (31337)

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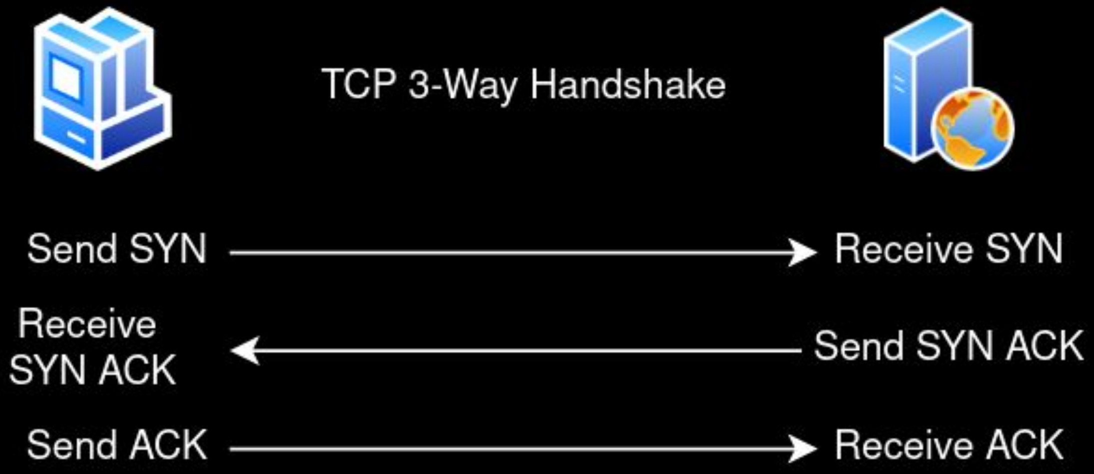
How do we tell **which services** are running on **which ports** for a given IP?

Transmission Control Protocol



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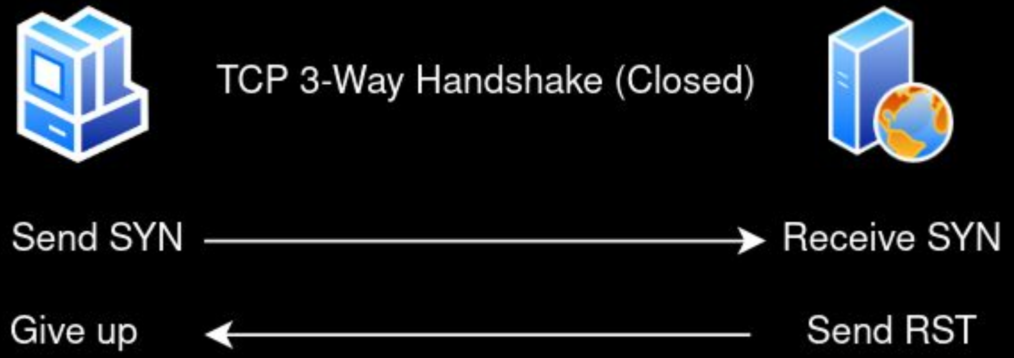
Receive SYN ACK ← Send SYN ACK

Send ACK → Receive ACK



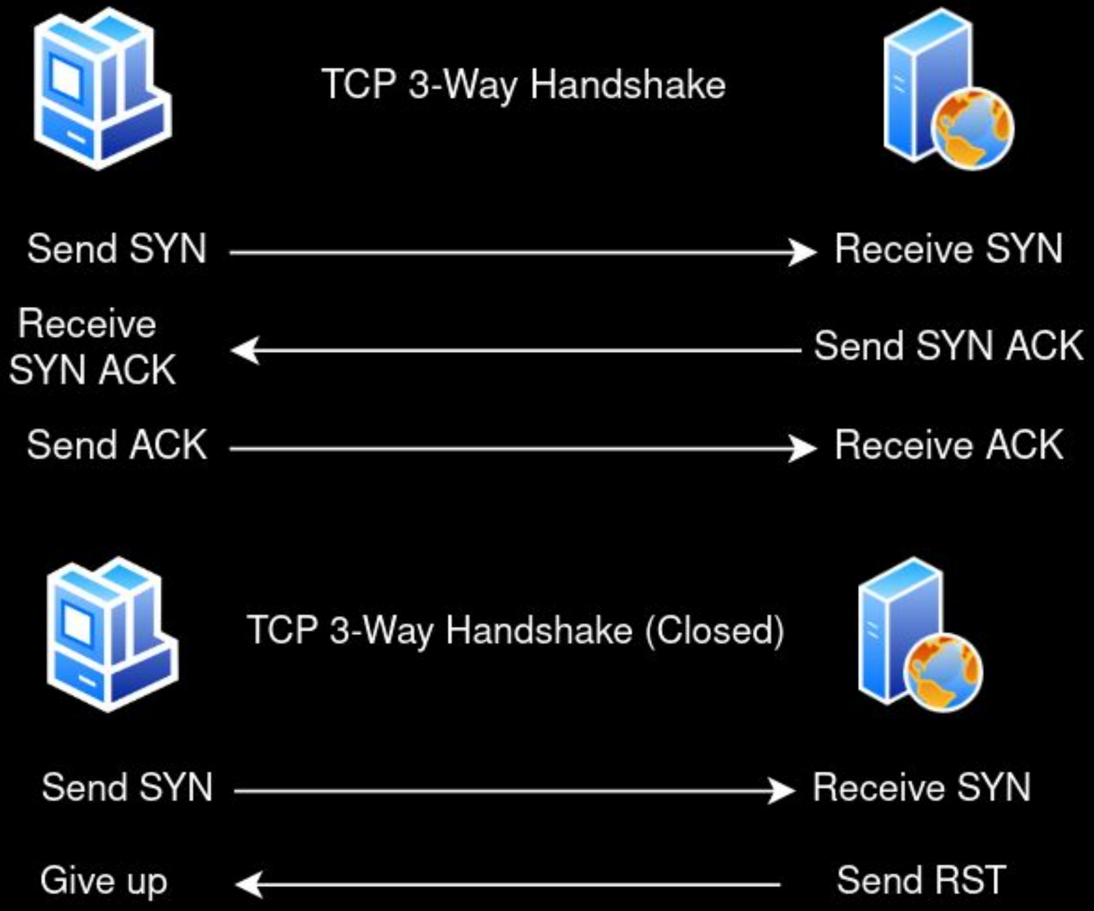
TCP 3-Way Handshake (Closed)

Send SYN → Receive SYN

Give up ← Send RST

- 65536 TCP ports
- What if we do this handshake on port 0, 1, 2, up to 65535?

Transmission Control Protocol



TCP 3-Way Handshake

Send SYN → Receive SYN

Receive SYN ACK ← Send SYN ACK

Send ACK → Receive ACK

TCP 3-Way Handshake (Closed)

Send SYN → Receive SYN

Give up ← Send RST

- 65536 total TCP ports
- What if we do this handshake on port 0, 1, 2, up to 65535?
- **Easy to detect**, but we can randomize the order
- SYN scan: just send the SYN and see if we get anything back (bypasses firewalls!)

Port Scanning

- This process is **port scanning**, the most important active recon technique
- Port scanning tells us which **ports** are open for a given **IP**
- Once we know this, we can then check each port to see what **protocol** they are talking
- Once we know that, we can check them by protocol to see what **service** they are offering
- Optionally, we can check each **service** by cross-referencing its version with a large database of all known vulnerabilities

Disclaimer: Passive Recon

- When engaging a real target, there is a lengthy **passive recon** phase before this
- You would scope out owned IPs, domains, employees, and tech stack
- Advanced adversaries would also do their covert infrastructure and malware preparation here
- None of these are relevant for this point in the year

Active Recon

Port Scanning

- Port range: 0-65535, TCP & UDP
- sudo nmap -Pn -F -sV -vv $IP -oN fast.txt
- sudo nmap -Pn -A -sV -p- -vv $IP -oN full.txt
- -Pn skips the ping check (Windows does not respond)
- -A means that nmap will run scripts and OS fingerprinting (Aggressive)
- -sV will have the scan perform version checking
- -p- will scan every single port from 1-65535
- -vv will enable very verbose output
- -oN saves the result to a text file so you don't re-scan

Port Scanning - Edge Cases

- Don't forget UDP services like SNMP!
- `sudo nmap -Pn -F -sU -vv $IP -oN udp.txt`
- `-sU` will have the scan check UDP ports
- `-F` will scan top 1000 ports (UDP scanning is **SLOW**)
- If you're scanning through a SOCKS proxy, you can only scan TCP ports, and should use the **-sT** flag
  - This does a TCP scan rather than SYN scan
- If you're in a network, do a very fast scan using IP range
- General workflow tip: make a directory for each target

Port Scanning Alternative - Rustscan

- `rustscan` is a modern, insanely fast alternative to **nmap**
- Can scan all 65535 TCP ports in **as fast as 3 seconds**
- **Not stealthy AT ALL**, does not bypass firewalls
- Great for situations where the only thing that matters is speed
- Integrates with nmap for service scanning and script execution
- Generally fewer features

We recommend rustscan for practice like hackthebox!

Service Scanning: SMB

- Server Message Block runs by default on all Windows computers
- If you know the password, you can view remote file shares
- If the target is running Windows Server or is AD joined, and you have Administrator credentials, **remote code execution is a feature**
- Windows computers prior to Windows 7 SP 6.1 are vulnerable to MS17-010 (**SYSTEM** Remote Code Execution)
- Depending on the target configuration, you can potentially read/write files

Service Scanning: Other services

- FTP: can be used to upload files or download sensitive files if left unsecured
  - This is especially potent if chained with a web server w/LFI vuln
- SSH: if you have a password or key, you can login and get a shell
- Telnet: like SSH, but without the secure part (yikes)
- SNMP: Simple Network Management Protocol, allows viewing all of the running processes, usernames, and software versions, including command-line arguments (UDP port 161)
- SMTP: Simple Mail Transfer Protocol, runs email server
- MSSQL: Microsoft SQL server, can sometimes **run commands**
- Redis: Database, can **gain RCE as a feature**

Service Scanning

- You won't know every service
- Get in the flow of understanding unfamiliar services quickly and think in terms of primitives (what does the service let me do)
- https://book.hacktricks.xyz/ has some good preliminary steps for interacting with and attacking unfamiliar network services
- Other really important or common services (like web servers & active directory) will be covered individually
- It is very common to see new and unfamiliar services when attacking a network

When you don’t know something, Google it!

Gaining Access

Gaining Access: Exploitation

- Sometimes, when attacking vulnerable software, it's as easy as running searchsploit or the relevant metasploit module
- Other times, custom exploit development is necessary
  - This is where time spend doing traditional CTF is helpful
- Example workflow:
  - nmap -> port 80 is open -> feroxbuster -> find gitlab instance
  - searchsploit gitlab
  - run exploit, hopefully get shell
- **ALWAYS** read exploit code before running it!

Gaining Access: Misconfiguration

- Sometimes, services are set up with really stupid permissions
- For example, an file server that lets you write to anything in a web server or a user's home directory would be a huge problem
- Example Workflow:
  - nmap -> port 21 & 80 -> unauthenticated FTP server with access to /var/www/html -> put webshell -> browse to port 80 -> get shell
- There are way too many possible misconfigurations to cover here
- Get in the habit of thinking about what access is appropriate

Gaining Access: Password Attack

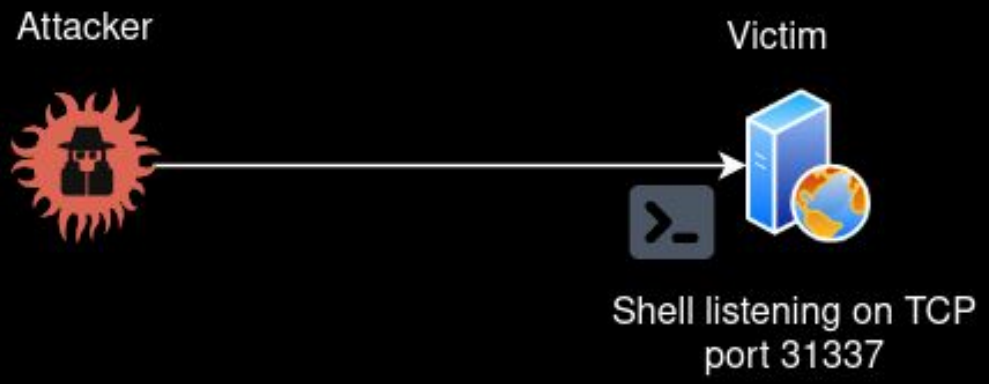
- Lots of common software, like WordPress, doesn't rate-limit authentication, so you can go through an obscene amount of login attempts
- Hydra is a fantastic general-purpose password attack tool
- Example workflow:
    - nmap -> port 443 -> feroxbuster -> /wp-admin

    -
      ```
      hydra -l Admin -P /usr/share/wordlists/rockyou.txt 10.10.230.209 http-post-form "/wp-login.php:log=^USER^&pwd=^PWD^:The password you entered for the username" -t 30
      ```
- Use admin login to upload PHP reverse shell (feature)
- Hydra can be used to attack many other services as well

Welcome to Shell

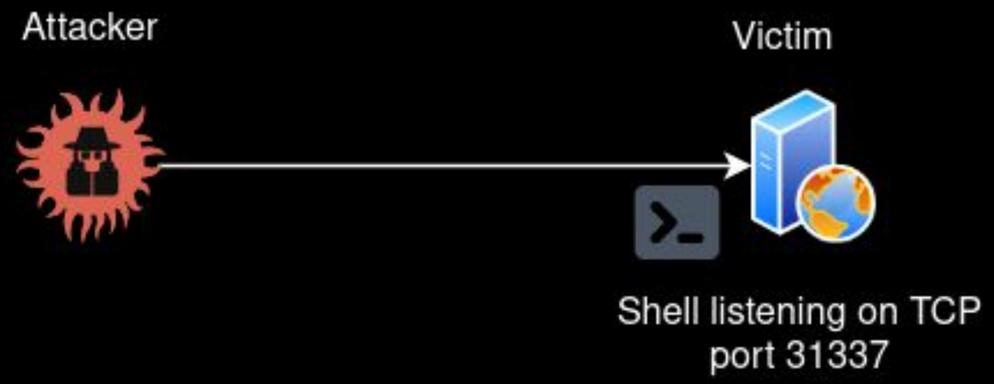
Bind Shells

- Run a command or program to run a shell as a service
  - Binds to a port on the victim
- Connect **forward** into the shell
- Generally uncommon. Why?



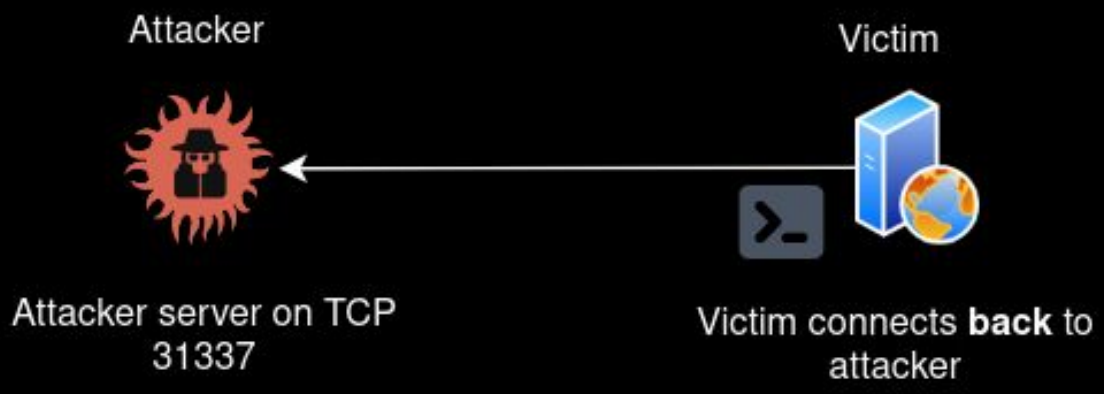
Bind Shells

- Run a command or program to run a shell as a service
  - Binds to a port on the victim
- Connect **forward** into the shell
- Generally uncommon due to **poor security and stealth**
- Anyone can connect to this!



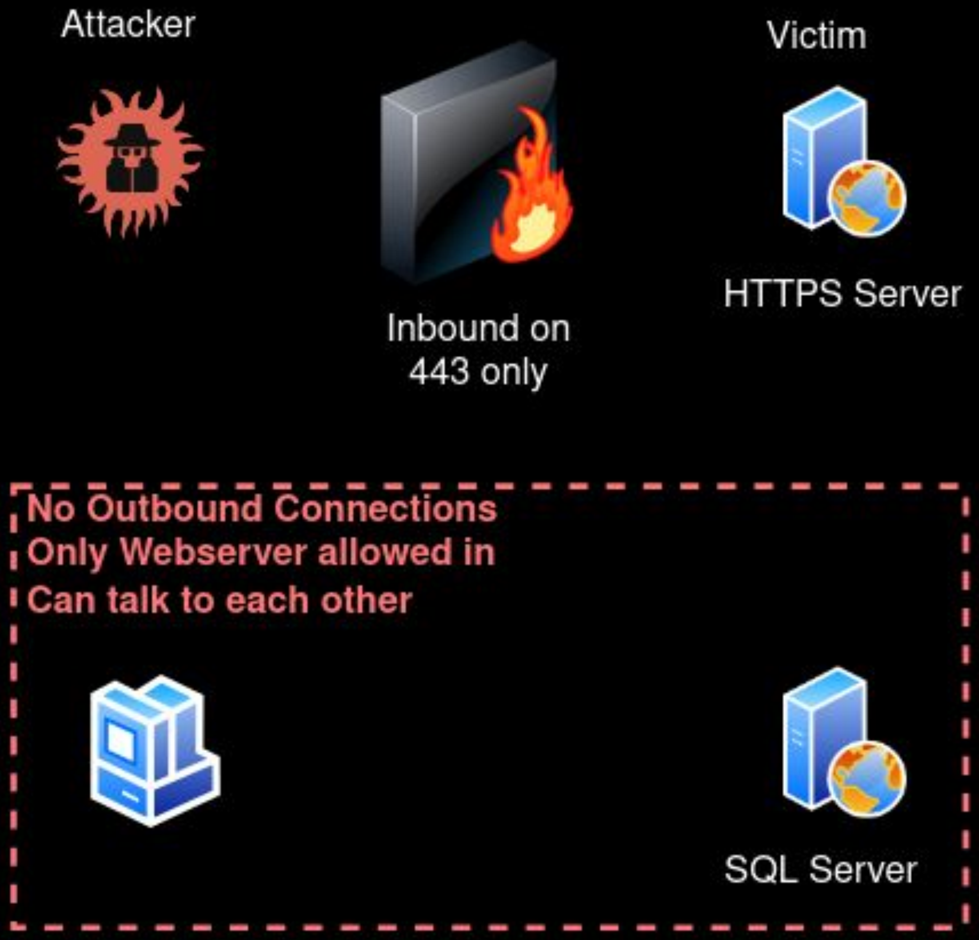
Reverse Shells

- Shell connects **back** to an attacker server
  - In this case, the attacker runs the "service" to accept the connection
- Harder to detect (most software clients generate EGRESS TCP traffic)
- More secure - only the attacker gets access


Attacker
Victim
Attacker server on TCP 31337
Victim connects **back** to attacker

Food for thought

- What happens here?
- The answer will be revealed in about a month…



Assembling the Pieces

Network Recon & Attacks

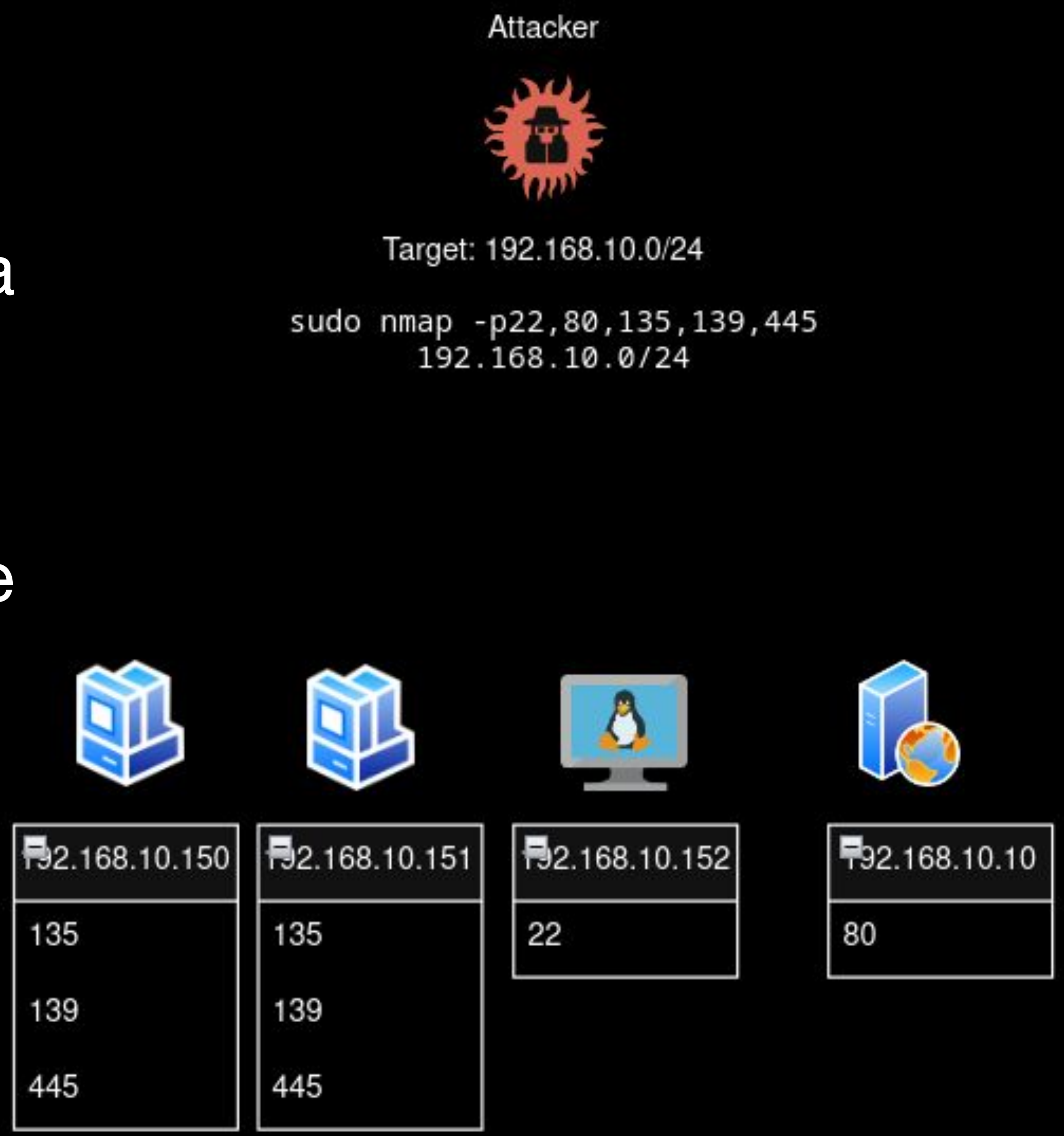
- Begin with a quick sweep of all in-scope IPs to see which ones you can reach
- Continue to port scan each of them, preferably including a version scan and maybe even vulnerability scan
- Recon each service with further tools
  - SMB? NetExec, enum4linux, smbclient
  - FTP? FTPclient
- Figure out any weaknesses (insecure credentials) or vulnerabilities
- **Recon phase ends here**
- Exploit the vulnerability
- Control the computer via a bind or reverse shell

Hypothetical

- Attacker needs to discover vulnerable devices on this network to attack them

Hypothetical

- The attacker will first discover computers on the network with a quick scan
- No need to scan all ports when most computers will not be up



Attacker

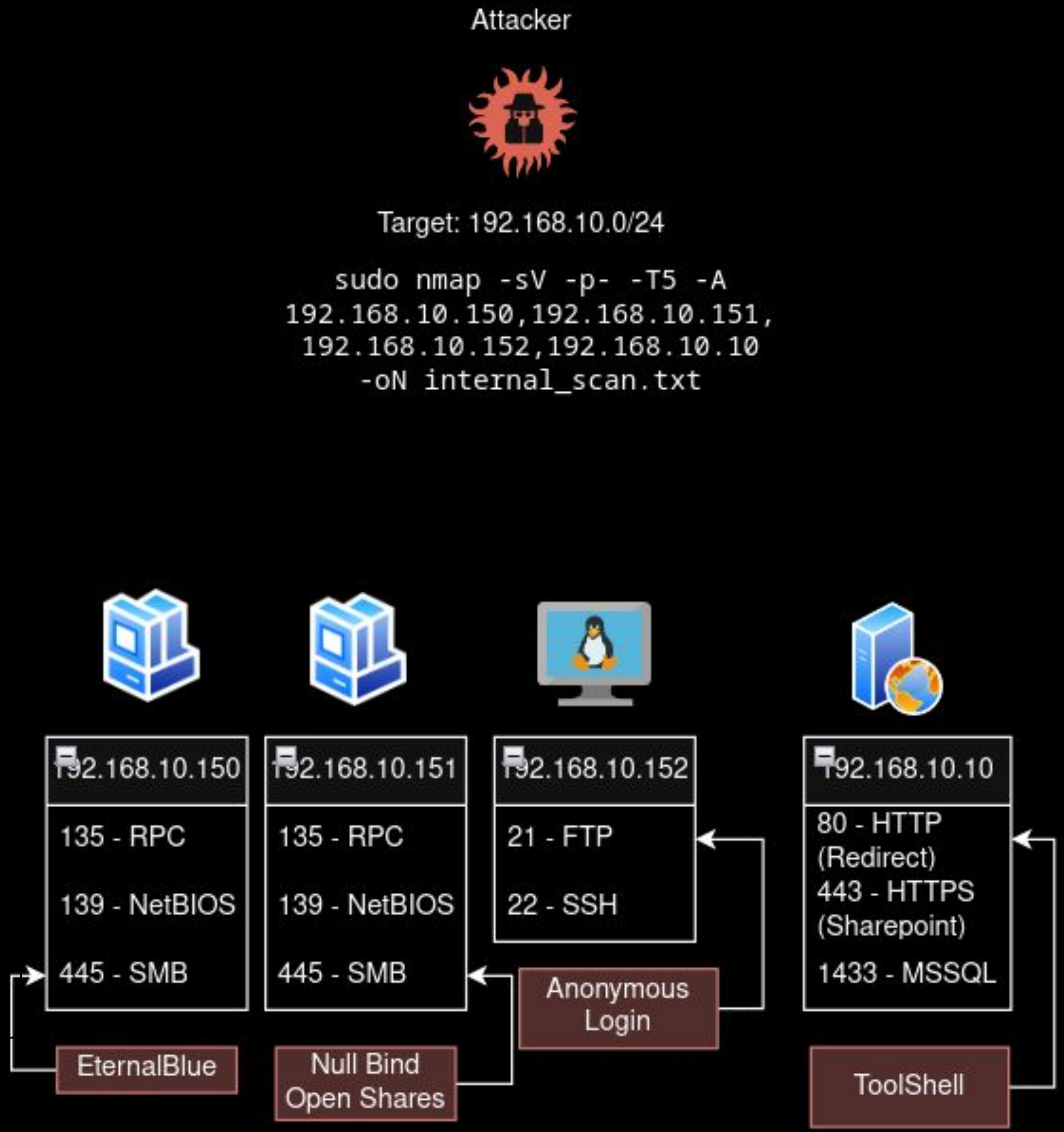
Target: 192.168.10.0/24

```
sudo nmap -p22,80,135,139,445
192.168.10.0/24
```

192.168.10.150	192.168.10.151	192.168.10.152	192.168.10.10
135	135	22	80
139	139		
445	445		

Hypothetical

- The attacker will now map out specific services, hunting for information and vulnerabilities



Target: 192.168.10.0/24

```
sudo nmap -sV -p- -T5 -A
192.168.10.150,192.168.10.151,
192.168.10.152,192.168.10.10
-oN internal_scan.txt
```

192.168.10.150
135 - RPC
139 - NetBIOS
445 - SMB

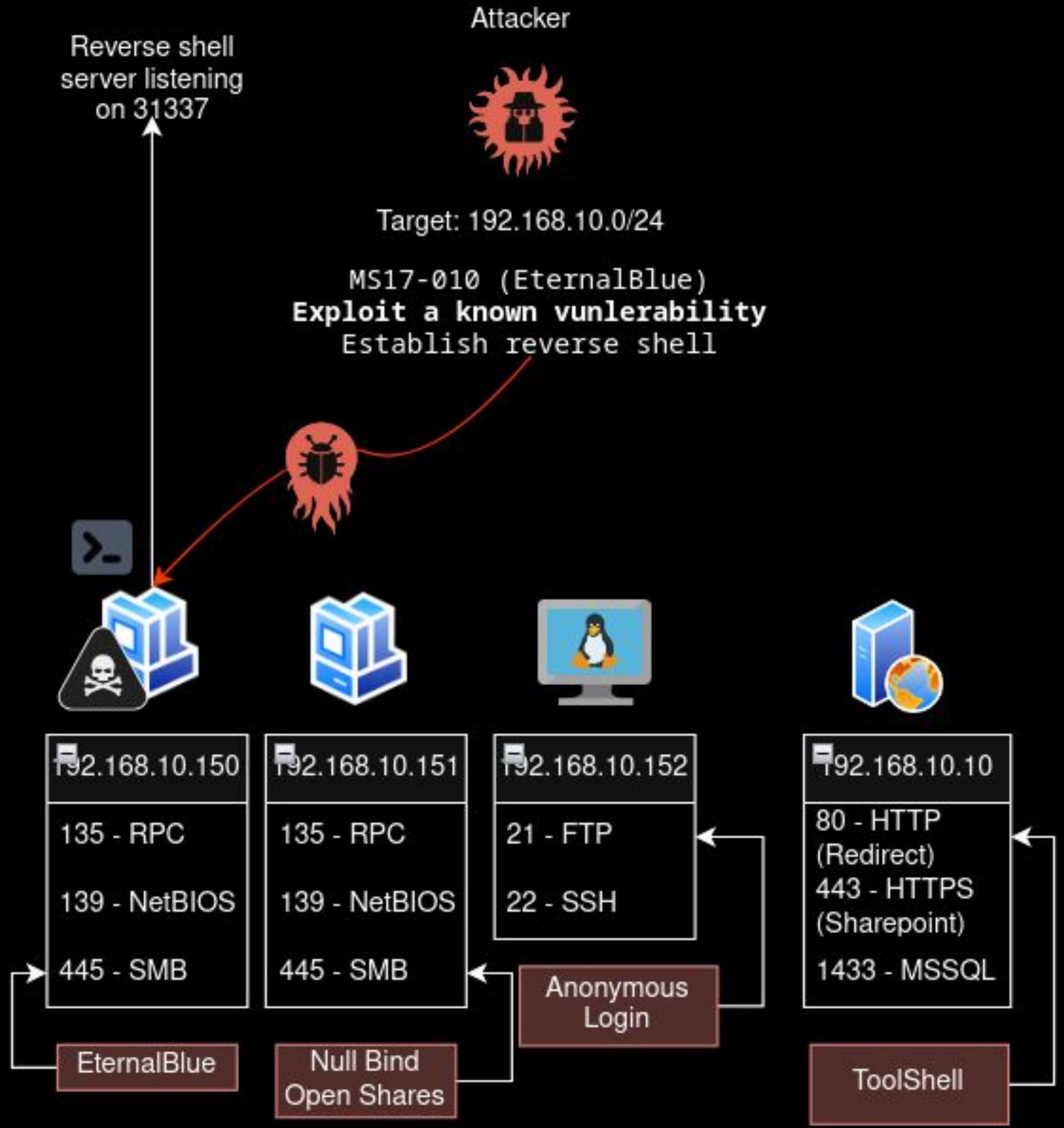
192.168.10.151
135 - RPC
139 - NetBIOS
445 - SMB

192.168.10.152
21 - FTP
22 - SSH

192.168.10.10
80 - HTTP (Redirect)
443 - HTTPS (Sharepoint)
1433 - MSSQL

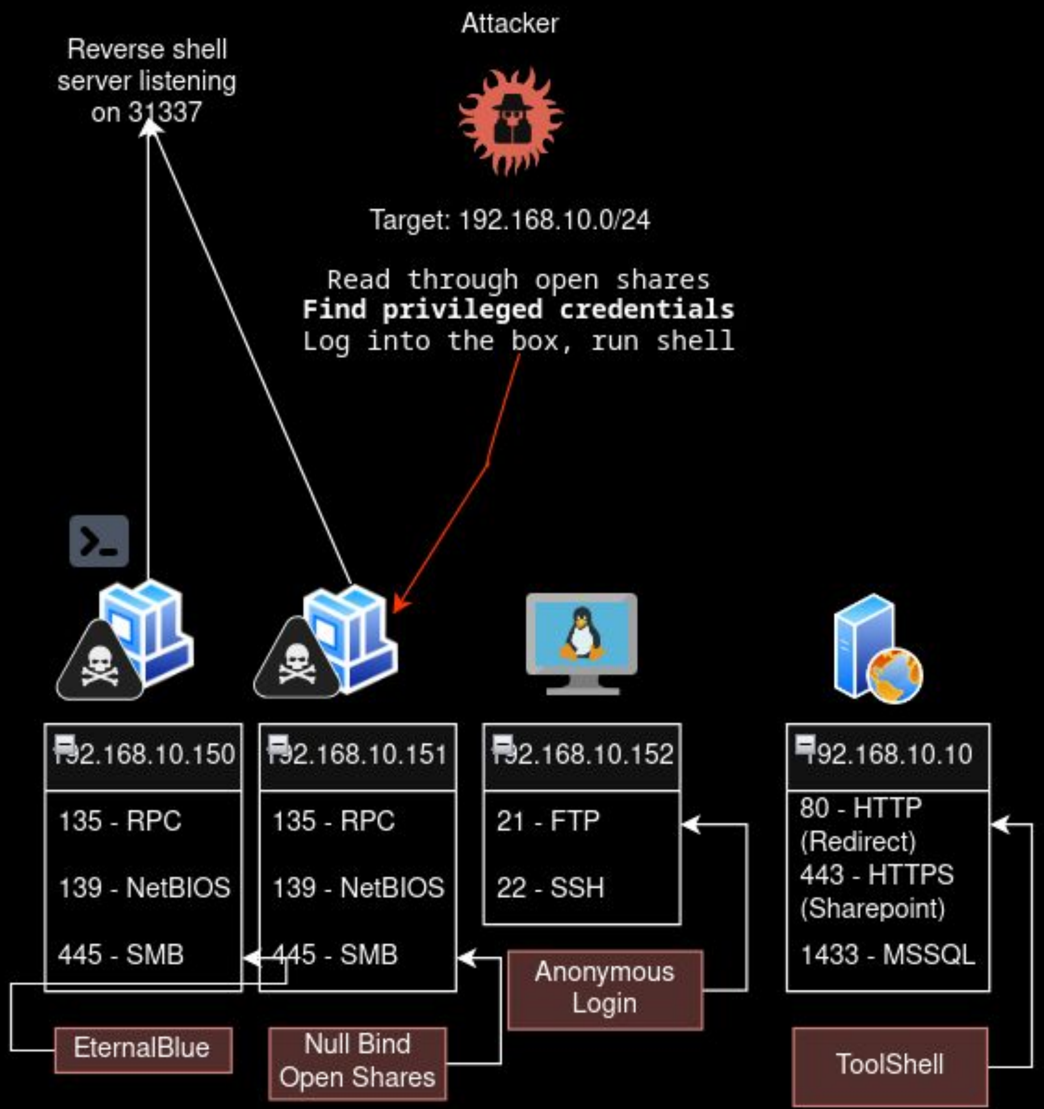
Hypothetical

- Exploiting known vulnerabilities will often net an easy compromise
- A common method is to run a command to gain a reverse shell
- This is the simplest and most ubiquitous type of compromise



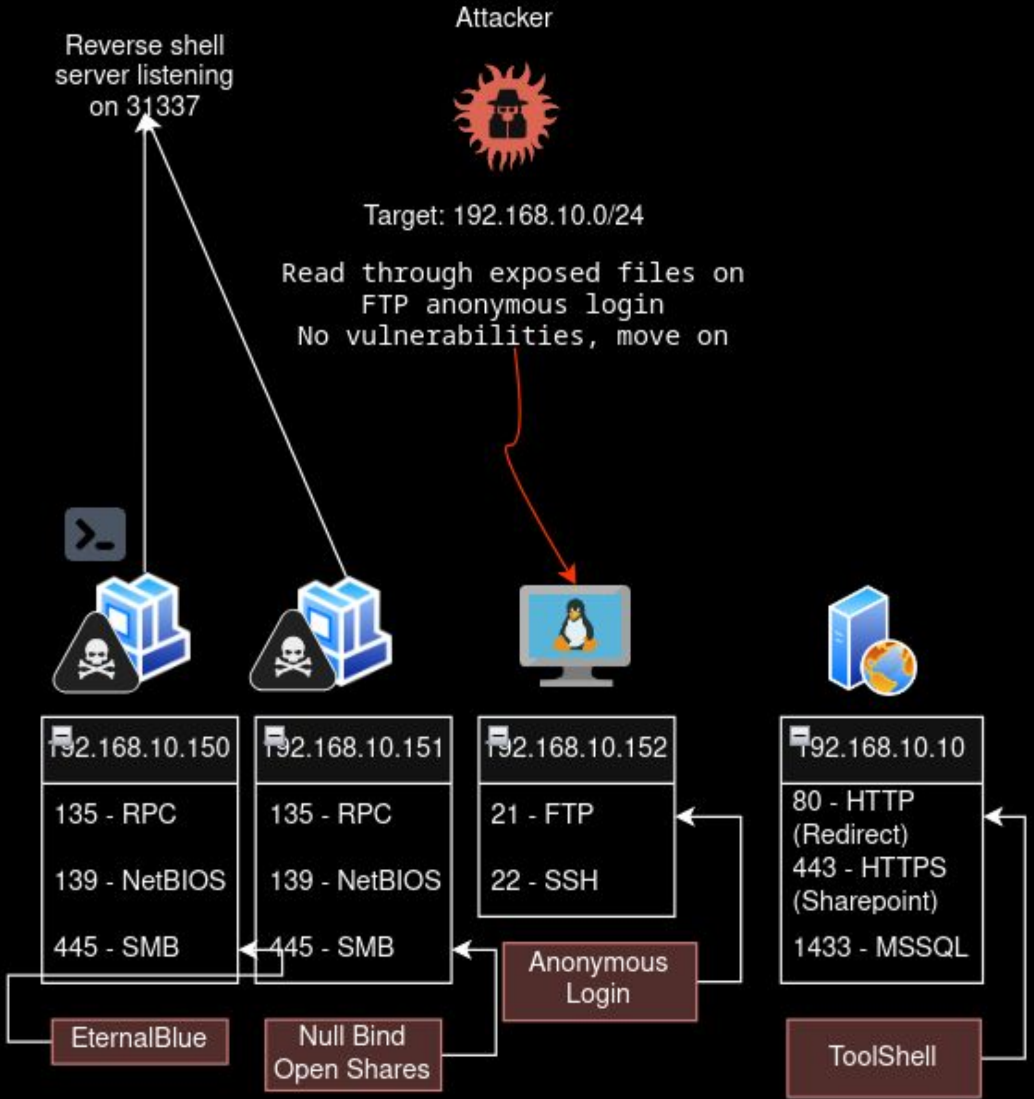
Hypothetical

- Sometimes, we will find **valuable information** exposed
- What may not be a vulnerability in theory can lead to compromise in practice
- Especially if an admin leaves their password in the open…



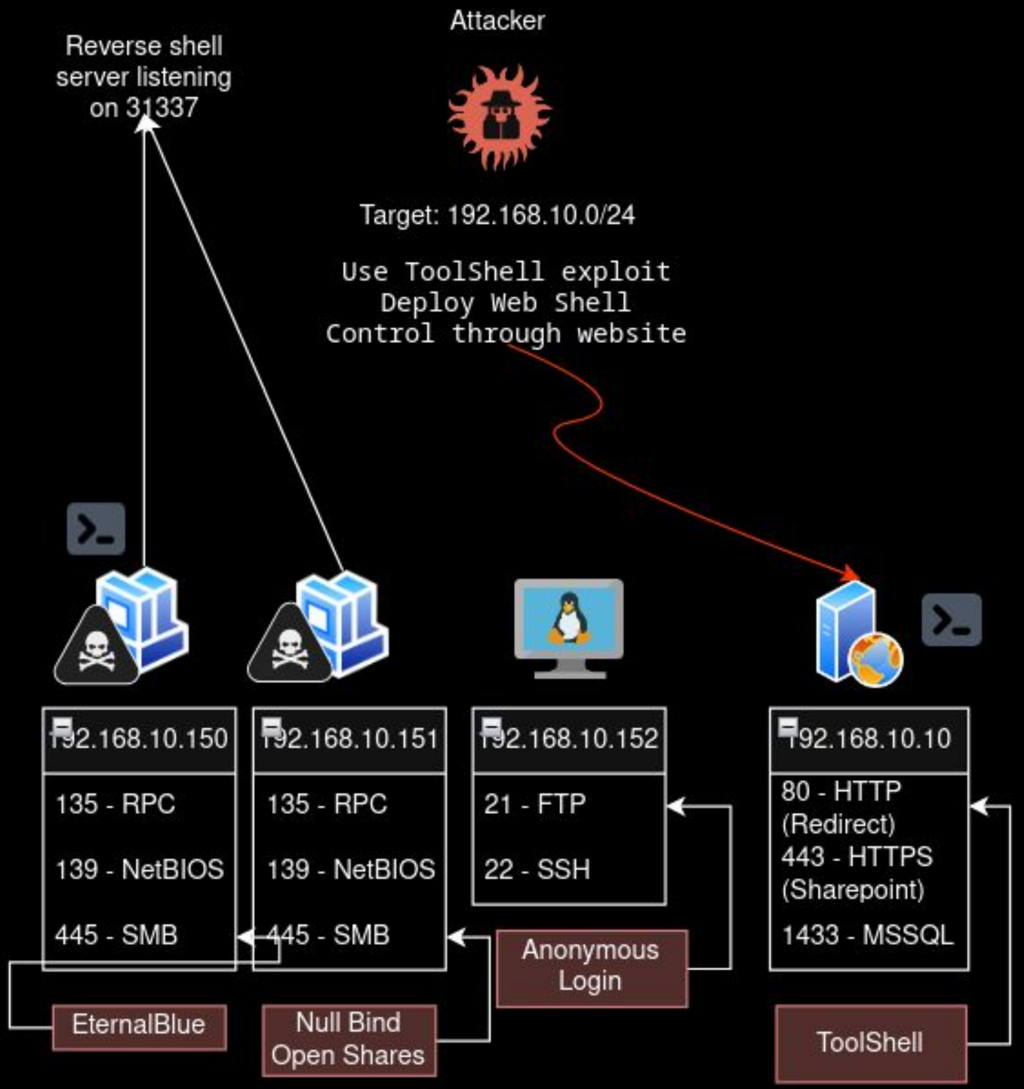
Hypothetical

- Not all boxes will be vulnerable!
- Many times, you will need to compromise one to get to another
- "Six degrees of separation"



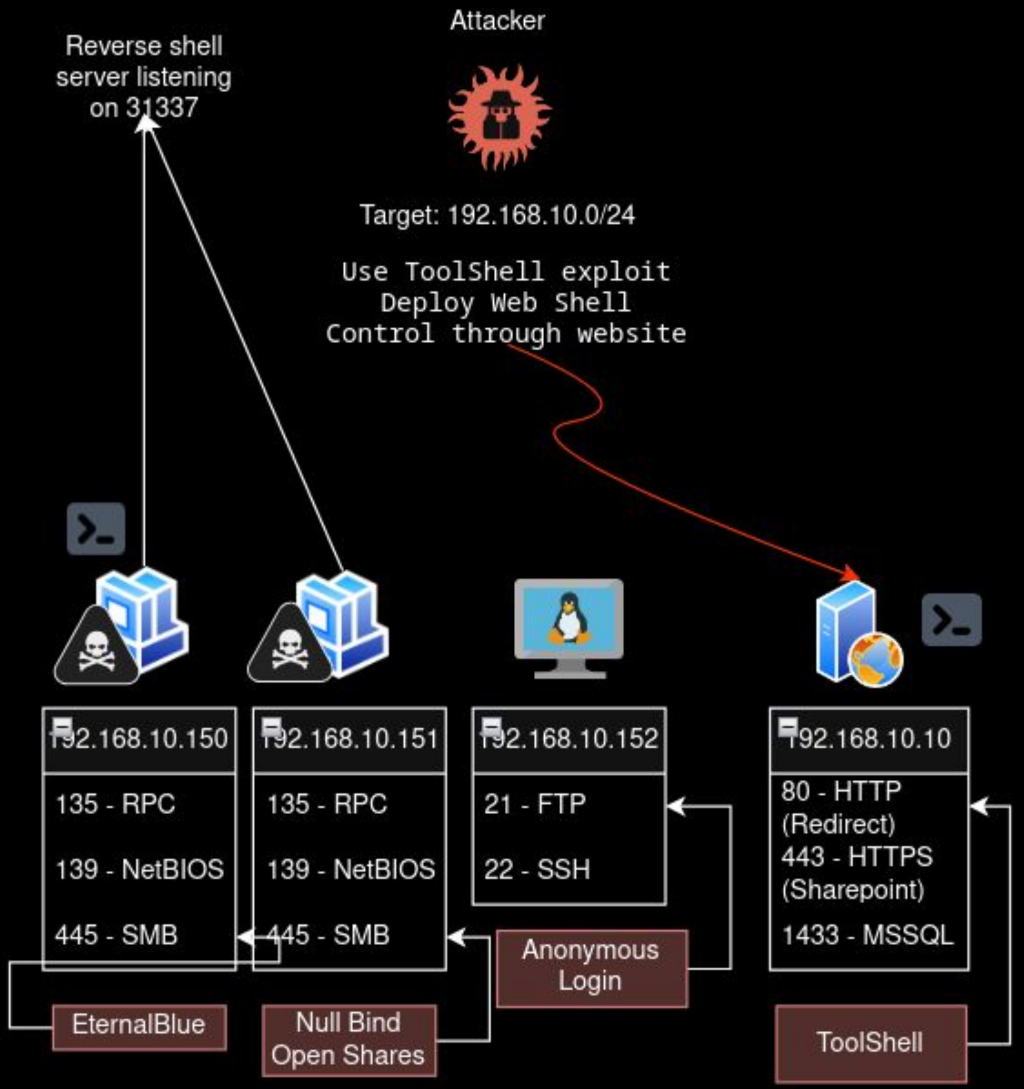
Hypothetical

- Deploy a web shell
  - Special bind shell
  - Lives on a website
  - Access it by visiting the site



Hypothetical

- Deploy a web shell
  - Special bind shell
  - Lives on a website
  - Access it by visiting the site
- Now, we own 75% of the network!
- Realism depends on environments, open shares are common, EternalBlue is not



Next Meetings

2025-09-18 • This Thursday

- Wireshark & Detecting Lateral Movement
- We'll go over the basics of defensive network security

2025-09-23 • Next Tuesday

- Practical Web Hacking
- Learn some different web hacking techniques that we see in the wild!

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Meeting content can be found at sigpwny.com/meetings.

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