

## Duale Hochschule Baden-Württemberg Mannheim

## **Pentest Report**

Pentesting Project X

## **Studiengang Cyber Security**

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## Abkürzungsverzeichnis

DUT Device Under TestingAJP Apache JServ Protocol

**CVE** Common Vulnerabilities and Exposures

RCE Remote Code Execution
CA Certification Authority

# 1 Introduction CHECKS NOCH ENTFERNEN

## 1.1 Scope

Who gave the assignment? What is the Device under Test (DUT)? What have you received for the test (hardware, information, etc.)? Add email with hash sum of the mail to the report.

## 1.2 Severities

For each vulnerability you uncover in your testing, you typically provide: The likelihood of exploitation, taking into account how easy it is to discover and exploit The impact on the control you get once exploited Suggested remediation Suggested validation of remediation effectiveness

Low Moderate High Severe Critical

## 1.3 Classification

## 1.4 Effort to Fix

Low Moderate High

## 2 Management Summary

Short Summary for non technical people. what are key takeeaways and recommendations? how urgent is acting necessary?

## 3 Technical Summary

summery for technical people

## 3.1 Findings Overview

table that contains the findings you'll describe later, sorted by severity Helps quickly triage results

## 3.2 Used Tools

## 4 Findings

# 4.1 Finding 1 - Exact OpenSSH-Version can be determined

Classification: Information Disclosure CVE: Severity: Low

### **Finding Description**

A nmap port scan reveils the exact version of the running OpenSSH-Server on the DUT. The version used on the DUT is "OpenSSH 8.4p1 Debian 5+deb11u1" and can be accessed via port 22.

## **Finding Impact**

This information can be used by an attacker to find known vulnerabilities in this specific OpenSSH-Version to exploit the DUT. Possible exploitations can be found in Finding 2.

## Finding Cause

This finding is caused by OpenSSH itself. There is no configuration option to hide the version of the SSH-Server. The version-banner can be found in the sshd binary.

## **Finding Details**

```
1  $ nmap -A 172.16.0.29
2  Starting Nmap 7.91 ( https://nmap.org ) at 2023-03-06 09:30 CEST
3  Nmap scan report for 172.16.0.29
4  Host is up (0.00051s latency).
5  PORT STATE SERVICE VERSION
6  22/tcp open ssh OpenSSH 8.4p1 Debian 5+deb11u1 (protocol 2.0)
```

#### **Evaluation of Results**

Effort to Fix: Medium

To fix this finding the OpenSSH Binary has to be changed. By default the binary can be found at '/usr/sbin/sshd'. Change the binary with hexedit and search for the version banner. After removing the version banner restart the ssh service wit 'systemctl restart sshd.service'. Due to the fact of the risk of working on the binary itself, this finding is rated as medium effort to fix.

## 4.2 Finding 2 - Vulnerable OpenSSH Version

Classification: Vulnerable Software Version Severity: Medium

**CVE:** CVE-2021-28041, CVE-2021-41617

### **Finding Description**

The DUT is running a vulnerable OpenSSH version (8.4p1). This version is vulnerable to the following CVEs: CVE-2021-28041, CVE-2021-41617.

## **Finding Impact**

Following exploits can be used to gain access to the DUT:

CVE-2021-28041: This vulnerability enables an attacker to carry out unauthorized code execution on a target system remotely. The vulnerability stems from an error in the ssh-agent, where a remote attacker can lure the victim to connect to a server where the attacker has root access.

CVE-2021-41617: When OpenSSH is used with non default configurations privilige escalation is possible. (Check configuration)

#### **Evaluation of Results**

Effort to Fix: Low

Update to newer OpenSSH version. This can be done by running the following command:

```
sudo apt update
sudo apt install openssh-server
```

# 4.3 Finding 3 - Exact Apache Version can be determined

Classification: Misconfiguration Severity: Low

CVE: Null

Visiting port 80 of the DUT in a web browser with the path "/home" reveals the exact version of Apache that is running on the DUT. The version of Apache that is running on the DUT is "Apache/2.4.54 (Debian)". This Finding has a low severity, because it should be more important to use a newer version of Apache to prevent exploits of known vulnerabilities.

## **Finding Impact**

This can be used to find known vulnerabilities in the version of Apache that is running on the DUT. These vulnerabilities can be found in chapter 4.

## **Finding Details**

CHECK FOR OTHER PICTURE

## Index of /home

1	<u>Name</u>	Last modif	<u>fied</u>	Size Description
Paren	t Directory			-
<u>bingo</u>	L	2023-02-12 2	20:48	-
<u>bluey</u>	<u>L</u>	2023-02-12 2	20:48	-
root/		2023-02-12 2	20:48	-

Apache/2.4.54 (Debian) Server at 172.16.0.30 Port 80

Abbildung 4.1: Apache Version

#### **Evaluation of Results**

Effort to Fix: Low

To fix this finding the Apache configuration has to be changed. By default the configuration can be found at '/etc/apache2/conf-enabled/security.conf' (CHECK). In this configuration the following lines have to be added or updated:

- ServerTokens Prod
- 2 ServerSignature Off

After changing the configuration file the apache service has to be restarted with:

sudo service apache2 restart

After restarting the Version of the Apache Server shouldn't be visible anymore.

## 4.4 Finding 4 - Vulnerable Apache Version

Classification: Vulnerable Software Version Severity: Medium

CVE: CVE-2023-25690, CVE-2023-27522, CVE-2006-20001, CVE-2022-36760, CVE-2022-37436

On port 80 the DUT is running a vulnerable Apache version ("Apache 2.4.54"). This version has multiple vulnerabilities and shouldn't be used in production. The following vulnerabilities are known from Common Vulnerabilities and Exposures (CVE) but haven't been exploited on the DUT. Some of these vulnerabilities may only be exploitable with specific configurations. Nevertheless, all of these vulnerabilities are shown to provide transparency and to show the possible impact of the vulnerabilities.

### **Finding Impact**

CVE-2023-25690: When the mod\_proxy configuration is enabled a HHTP smuggling attack is possible, which could bypass the access controls.

CVE-2023-27522: This vulnerability allows an attacker to send a origin header which contains special characters to the server. This could be used truncate/split the response forwarded to the client.

CVE-2006-20001: This vulnerability allows an attacker to send a specific if request to the server, which could be used to crash the process.

CVE-2022-36760: Due to an incosistent interpretation of HTTP requests of the server it could be possible for attackers to smuggle HTTP requests to the Apache JServ Protocol (AJP) server.

CVE-2022-37436: A malicious backend has the ability to terminate the response headers prematurely, leading to certain headers being integrated into the response body. Following headers which serve a security function, they will not be comprehended by the client.

## **Finding Details**

```
1  $ nmap -A 172.16.0.29
2
3  Starting Nmap 7.93 ( https: //nmap.org ) at 2023-03-06 09:30 CET
4  Nmap scan report for 172.16.0.29
5  Host is up (0.00051s latency).
6
7  PORT STATE SERVICE VERSION
8  80/tcp open http Apache httpd 2.4.54 ((Debian))
```

#### **Evaluation of Results**

Effort to Fix: Low

To fix this vulnerability the Apache Server has to be updated to a newer version. This could be done with the following command:

```
ı $ apt update && apt install apache2
```

## 4.5 Finding 5 - Path Traversal on Apache Server

Classification: Information Disclosure Severity: High

CVE:

On the Apache Server of the DUT (port 80) it is possible to access directories via path traversal. By adding the path "/home/..." to the URL it is possible to see directories which seem to be users of the DUT. The directories are empty.

### **Finding Impact**

The Impact of this finding is an severe Information Disclosure. Attackers could try to guess passwords for the found users and eventually gain access to the DUT.

## **Finding Details**

A way to find the path is to use a nmap scan with the "http-enum" script:

```
1  $ nmap -A --script -http-enum 172.16.0.29
2    PORT STATE SERVICE VERSION
4  80/top open http Apache httpd 2.4.54 ((Debian))
5  | http-server-header: Apache/2.4.54 (Debian)
6  | http-enum:
7  | /home/:
8  Potentially interesting directory w/ listing on
9  'apache/2.4.54 (debian)'
```

To see the directory it is possible to visit the URL in a web browser:

## **Index of /home**

<u>Name</u>	Last modified	Size Description
Parent Director	cy.	-
<u>bingo/</u>	2023-02-12 20:48	-
<u>bluey/</u>	2023-02-12 20:48	-
root/	2023-02-12 20:48	-

Apache/2.4.54 (Debian) Server at 172.16.0.30 Port 80

Abbildung 4.2: Path Traversal

#### **Evaluation of Results**

Effort to Fix: Medium

The Server should validate the path before accessing it. A possible solution could be to whitelist the allowed paths, which should be accessible. This would prevent accessing directories of the DUT which are not intended to be accessed by the user.

## 4.6 Finding 6 - Weak password for User Bluey

Classification: Weak Password Severity: High

**CVE:** CVE-2022-1039

Using the Tool "Hydra" the Password for the User "bluey" was found in a very short amount of time with Brute Force. The Password is "phoenix". As a passwordlist the file "rockyou.txt" was used which contains about 14 million common passwords. This file can be found online and is accessible for everyone.

### **Finding Impact**

With the password it is possible to login to the DUT as the User "bluey" via ssh. This allows attackers to gain access to the DUT and to execute commands as the User "bluey". This could lead for example to a Remote Code Execution (RCE) or to a privlige escaltion (horizontal or vertical).

### **Finding Details**

The Password was found using the Tool "Hydra" with the following command:

```
s hydra -1 bluey -P rockyou.txt 172.16.0.29 ssh -t 4 -V -I
```

After the password was found it was possible to login to the DUT as the User "bluey" via ssh:

```
The authenticity of host '172.16.0.29 (172.16.0.29)' can't be established. ED25519 key fingerprint is SHA256:6Ha71kTRiSiyuQbUB1+LVlB71pL8t5cVtI+ZNn1sDI4. This key is not known by any other names Are you sure you want to continue connecting (yes/no/[fingerprint])? y Please type 'yes', 'no' or the fingerprint: yes Warning: Permanently added '172.16.0.29' (ED25519) to the list of known hosts. bluey@172.16.0.29's password: Permission denied, please try again. bluey@172.16.0.29's password: Linux plunder 5.15.61-v8+ #1579 SMP PREEMPT Fri Aug 26 11:16:44 BST 2022 aarch64 Wi-Fi is currently blocked by rfkill. Use raspi-config to set the country before use.
```

Abbildung 4.3: Login as User Bluey

#### **Evaluation of Results**

Effort to Fix: Low

The password should be changed immediately. Notice that passwordlength is the most important aspect. Don't use common passwords.

# 4.7 Finding 7 - No Brute-Force Protection for SSH

Classification: Misconfiguration Severity: High CVE:

As seen in Finding 6 the password of the user "bluey" can be brute-forced. Even though the weak password is a finding on its own, there should be also a protection against brute-force attacks. This could have stopped the attack in Finding 6.

#### **Evaluation of Results**

Effort to Fix: Low

To protect against brute-force attacks the following configuration should be updated/added to the sshd\_config file:

MaxTries 3

Also a multifactor authentication could be used for the ssh service.

# 4.8 Finding 8 - Accesss to the DUT via SSL-Server

Classification: Misconfiguration Severity: High

On port 443 of the DUT a SSL-Server is running. Trying to access this SSL-Server with an Internet Browser results in an error page. The following error message is shown:

```
Error opening ''
548660451168:error:02001002:system library:fopen:
No such file or directory:bss_file.c:169:fopen('','r')
4548660451168:error:2006D080:BIO routines:BIO_new_file:
no such file:bss_file.c:172:
```

This indicates that the SSL-Server is trying to open a file but the filename is missing in the bss\_file.c file.

## **Finding Impact**

While trying to use pathtraversal on the SSL-Server it was found that the filename isn't missing but using the path appended to the URL. This can be exploited to access files on the DUT which are not intended to be accessed by the user. By changing the path for example the shadow file can be accessed. This could be used to gain access to the DUT by hashcracking the passwords. Also other exploits could be possible.

## **Finding Details**

To access the shadow file the following URL was used:

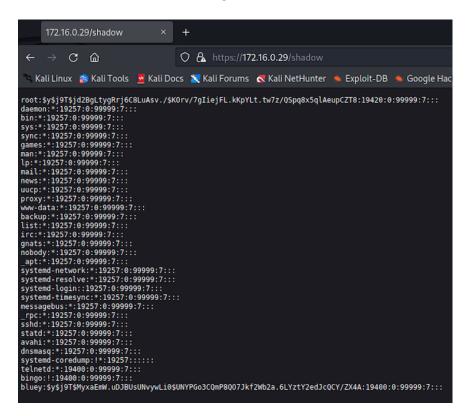


Abbildung 4.4: Access to shadow file

#### **Evaluation of Results**

Effort to Fix: Low

Fix the file which sets the filename that should be opened. This should prevent the SSL-Server from opening files which are not intended to be opened. Also whitelisting the allowed paths could be a solution to prevent path traversal.

# 4.9 Finding 9 - Webserver allows vulnerable Protocols

Classification: Misconfiguration Severity: High

The Webserver running on port 443 of the DUT has ssl2, ssl3 and tls1 enabled. This allows accessing the Webserver with outsided protocols which are vulnerable to attacks.

## **Finding Impact**

Using lower versions than TLS 1.2, can pose security risks to the webserver and your users' data. This is because these older versions have known vulnerabilities and weaknesses that can be exploited by attackers.

## **Finding Details**

This is the proof for the possible usage of SSlv2 to connect to the Webserver:

```
plunder E/1: openssl s_client -connect 172.16.0.29:443 -ssl2
CONNECTED(00000005)
depth=0 CN = Infoservice
verify error:num=18:self signed certificate
verify return:1
depth=0 CN = Infoservice
verify return:1
548017543008:error:1406D0B8:SSL routines:GET_SERVER_HELLO:no cipher list:s2_clnt.c:450:

no peer certificate available

No client certificate CA names sent

SSL handshake has read 470 bytes and written 53 bytes

New, (NONE), Cipher is (NONE)
Secure Renegotiation IS NOT supported
Compression: NONE
Expansion: NONE
Expansion: NONE
SSL-Session:
Protocol : SSLV2
Cipher : 0000
Session-ID:
Session-ID:
Session-ID-ctx:
Master-Key:
Key-Arg : None
PSK identity: None
PSK identity: None
PSK identity hint: None
SRP username: None
Start Time: 1677903762
Timeout : 300 (sec)
Verify return code: 18 (self signed certificate)
```

Abbildung 4.5: Screenshot of the Webserver

#### **Evaluation of Results**

Effort to Fix: Medium

Disable the usage of ssl2, ssl3 and tls1. This should prevent the usage of outdated protocols which are vulnerable to attacks.

## 4.10 Finding 10 - Privilige Escalation via SSH

Classification: Misconfiguration Severity: High

Within the roots authorized\_keys file in the ".ssh" directory a public key for the user "bluey" is stored.

### **Finding Impact**

Doing a simple ssh login the "bluey" user can login as root without a password.

## **Finding Details**

The following snippet shows the content of the authorized\_keys file for the root user:

```
1 $ cat authorized_keys
```

- ssh-ed25519 AAAAC3NzaC11ZDIINTE5AAAAIMOEhQP4e3BVrq0R9nPQzf
- 3 olf9349W/UDXSAbQIj6RDM joe@reliant
- 4 ssh-ed25519 AAAAC3NzaC11ZDI1NTE5AAAAINV2RROAIF7+9Cm7U2PWV
- 5 TmJOhjvTQeYFO4Lo7Et1qk bluey@plunder

The following screenshot shows the root login as the "bluey" user:

```
plunder bluey [/]: ssh root@172.16.0.29

The authenticity of host '172.16.0.29 (172.16.0.29)' can't be established.

ECDSA key fingerprint is SHA256:92+P1abRkxftnY5bhPTPJ6T1eex+rckqQrRros9ca4I.

Are you sure you want to continue connecting (yes/no/[fingerprint])? yes

Warning: Permanently added '172.16.0.29' (ECDSA) to the list of known hosts.

Linux plunder 5.15.61-v8+ #1579 SMP PREEMPT Fri Aug 26 11:16:44 BST 2022 aarch64

Last login: Sat Mar 4 16:35:38 2023 from 172.16.0.1

Wi-Fi is currently blocked by rfkill.

Use raspi-config to set the country before use.

plunder [-]:
```

Abbildung 4.6: Screenshot of the portscan

#### **Evaluation of Results**

Effort to Fix: Low

Remove the public key for the user "bluey" from the authorized\_keys file for the root user.

# 4.11 Finding 11 - No Encryption for Webserver on Port 80

Classification: Misconfiguration Severity: High

A portscan of the DUT revealed that the Webserver on port 80 is not encrypted.

## **Finding Impact**

All of the traffic between the client and the Webserver is unencrypted. This allows an attacker to intercept the traffic and read the data.

## **Finding Details**

The following screenshot shows an excerpt of a wireshark capture. This is how an atacker could intercept the traffic:

Abbildung 4.7: Screenshot of Wireshark

Following is the output of the portscan which shows that the Webserver on port 80 uses http:

```
1  $ nmap -A 172.16.0.29
2
3  Starting Nmap 7.93 ( https: //nmap.org ) at 2023-03-06 09:30 CET
4  Nmap scan report for 172.16.0.29
```

```
    Host is up (0.00051s latency).
    PORT STATE SERVICE VERSION
    80/tcp open http Apache httpd 2.4.54 ((Debian))
```

#### **Evaluation of Results**

Effort to Fix: Medium

Traffic between clients and the webserver should be encrypted. This can be done by using a certificate for the webserver. This certificate should be signed by a trusted Certification Authority (CA). This can be done by using a certificate from a CA like Let's Encrypt.

# 4.12 Finding 12 - Weak Cipher Suites for Webserver on Port 443

Classification: Weak Cryptography Severity: High

CVE:

COMMAND NOCHMAL EINGEBEN UND SCREENSHOTS MACHEN

**Finding Impact** 

**Finding Details** 

**Evaluation of Results** 

Effort to Fix: Medium

## 4.13 Finding 13 - Possible SYN Flood Attack

WELCHES TOOL GENUTZT?

Classification: Missing Protection Severity: High
CVE:

**Finding Impact** 

**Finding Details** 

**Evaluation of Results** 

Effort to Fix: High

# 4.14 Finding 14 - Sudo Access on Less for User bluey

Classification: Privilige Escalation Severity: High

The user "bluey" has sudo access to the less command for the file "auth.log".

## **Finding Impact**

This allows the user "bluey" to execute the following command:

plunder bluey [~]: sudo /usr/bin/less /var/log/auth.log

Within less the user can execute the following command:

! /bin/bash

This opens a root shell on the system due to the sudo access without a password.

#### **Finding Details**

Using the following command as the user "bluey" shows which commands the user can execute with sudo access:

```
plunder bluey [~]: sudo -l

User bluey may run the following commands on plunder:

(root) NOPASSWD: /usr/bin/less /var/log/auth.log
```

The Reason for this is the following line in the sudoers file: SCREENSHOT VON SUDOERS FILE MACHEN

FOTO VON EXPLOIT EINFÜGEN

#### **Evaluation of Results**

Effort to Fix: Low

Remove the sudo access for the user "bluey" in the sudoers file. This can be done by using the following command:

sudo visudo

And then removing the line:

bluey ALL=NOPASSWD: /usr/bin/less /var/log/auth.log

# 4.15 Finding 15 - Encrypted Image can be Decrypted

Classification: Vulnerable Software Severity: Medium

#### WIE WURDE DIE PYTHON DATEI GEFUNDEN?

On the DUT a luke encrypted image named "container.img" was found. The Passphrase for the decryption can be determined by exploiting a vulnerable python file named "fdsetup.pyc" on the DUT.

#### **Finding Impact**

By decompiling the "fdsetup.pyc" file with "pycdc" the source code of the python file can be determined. The usage of this file is to access the encrypted image. It contains a fernet encrypted configuration. This configuration contains a debug option which is set to "false" by default. This configuration can be edited to change the debug option to "true". After encrypting the edited configuration the decompiled python file can be modified to use the new configuration with the vim editor. This modified python file can be executed with:

s python3 /usr/local/bin/fdesetup.pyc

Caused by the modified configuration this will print debug information to the console which contains the passphrase for the decryption of the encrypted "container.img". SCREENSHOT VON DEBUG OUPUT EINFÜGEN WIE WURDE DAS IMAGE ENTSCHLÜSSELT?? SO:?? The image can be decrypted with:

1 \$ sudo cryptsetup luksOpen /srv/container.img container

The image can now be accessed with:

sudo mount /dev/mapper/decrypted\_devicess /media/my\_device

#### **Finding Details**

IN WELCHEN LOGS WURDE DIESE DATERI GEFUNDEN? The service looks like this:

```
1 [Unit]
2 Description=FDE initialization
3 After=network-online.target
4 
5 [Service]
6 Type=oneshot
7 ExecStart=/usr/bin/python3 /usr/local/bin/fdesetup.pyc
8 
9 [Install]
10 WantedBy=multi-user.target
```

This service is always executed when the network of the DUT is online. The description indicates that this service is used for the encryption of the "container.img" (FDE = Full Disk Encryption). The service also leads to the "fdesetup.pyc" file. Trying to view the content of the python file results in mostly nonsense because the file is already compiled. But some buzzwords of the file can be seen like "password" or "luks". The whole compiled "fdesetup.pyc" file can be found in the appendix. Not all decompilers are able to decompile the file due to the used python version. One decompiler that can be used is "pycdc". The whole decompiled "fdesetup.pyc" file can be found in the appendix. To decrypt the configuration the following python scrpit was used:

```
#! /usr/bin/ python
  from cryptography.fernet import Fernet
  key = b'dGH1BR5gJ6wz6rneOkvmW50UsgY_J3kBZ1RIUmsSiYw='
  f = Fernet(key)
5
6
  token =b'gAAAAAB6U1FZADONUKESIJFYDrY8jeRSFL2TqYpqfIiTrTP8ceG
  BoffIZt7XvWS5pXWE9afjswEi_fSq9D-tcEnh8QflWQu2j4158VrbjbD1s8k
  WRqcv665XHDiFSEDPAL1yb2w == '
10
  decrypted f.decrypt(token)
11
  print(decrypted)
  Following is the decrypted default configuration used in the "fdsetup.pyc" file:
  "debug": false,
  "initial_passphrase": "Q99mjPp4xMwnEpgJd4kd5LNe",
  "mapper_name": "fde",
  "source_dev": "/srv/container.img",
  "interface_mac": "eth0",
  "source_files": [
       ["/proc/cpuinfo", "filter_cpuinfo"],
       ["/sys/kernel/debug/bluetooth/hci0/identity", null],
8
       ["/sys/devices/platform/soc/3f980000.usb/usb1/1-1/1-1.1
  /1-1.1:1.0/net/eth0/address", null]
10
  ]
11
```

This configuration also reveils the path to the encrypted image. The path is "/srv/container.img".

## **Evaluation of Results**

Effort to Fix: Medium

## 5 Results