

Duale Hochschule Baden-Württemberg  
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## **Pentest Report**

**Pentesting Project X**

### **Studiengang Cyber Security**

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Unterschrift: \_\_\_\_\_

# **Abstract**

Deutsche Version

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## Englische Version

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# Abkürzungsverzeichnis

<b>DUT</b>	Device Under Testing
<b>AJP</b>	Apache JServ Protocol
<b>CVE</b>	Common Vulnerabilities and Exposures
<b>RCE</b>	Remote Code Execution
<b>CA</b>	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 takeaways 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**

#### 4.1.1 Finding Description

A nmap port scan reveals 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.

#### 4.1.2 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.

#### 4.1.3 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.

### 4.1.4 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)
```

### 4.1.5 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

### 4.2.1 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.

### 4.2.2 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 privilege escalation is possible. (Check configuration)

### 4.2.3 Evaluation of Results

**Effort to Fix:** **Low**

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

```
1 $ sudo apt update
2 $ 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.





### 4.3.1 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.

### 4.3.2 Finding Details

CHECK FOR OTHER PICTURE

## Index of /home

<u>Name</u>	<u>Last modified</u>	<u>Size</u>	<u>Description</u>
 <a href="#">Parent Directory</a>		-	
 <a href="#">bingo/</a>	2023-02-12 20:48	-	
 <a href="#">bluey/</a>	2023-02-12 20:48	-	
 <a href="#">root/</a>	2023-02-12 20:48	-	

**Apache/2.4.54 (Debian) Server at 172.16.0.30 Port 80**

Abbildung 4.1: Apache Version

### 4.3.3 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:

```
1 ServerTokens Prod
2 ServerSignature Off
```

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

```
1 $ 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.



### 4.4.1 Finding Impact

**CVE-2023-25690:** When the `mod_proxy` configuration is enabled a HHTTP 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 inconsistent 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.

### 4.4.2 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))
```

### 4.4.3 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:

```
1 $ 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.

### 4.5.1 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.

### 4.5.2 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
3 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>	<u>Last modified</u>	<u>Size</u>	<u>Description</u>
 <a href="#">Parent Directory</a>		-	
 <a href="#">bingo/</a>	2023-02-12 20:48	-	
 <a href="#">bluey/</a>	2023-02-12 20:48	-	
 <a href="#">root/</a>	2023-02-12 20:48	-	

*Apache/2.4.54 (Debian) Server at 172.16.0.30 Port 80*

Abbildung 4.2: Path Traversal

### 4.5.3 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.

### 4.6.1 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 privilege escalation (horizontal or vertical).

### 4.6.2 Finding Details

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

```
1 $ hydra -l 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:



```
~# ssh bluey@172.16.0.29
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.

plunder bluey [~]:
```

Abbildung 4.3: Login as User Bluey

### 4.6.3 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.

### 4.7.1 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:

```
1 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:

```
1 Error opening ''
2 548660451168:error:02001002:system library:fopen:
3 No such file or directory:bss_file.c:169:fopen('','r')
4 548660451168:error:2006D080:BIIO routines:BIIO_new_file:
5 no such file:bss_file.c:172:
```

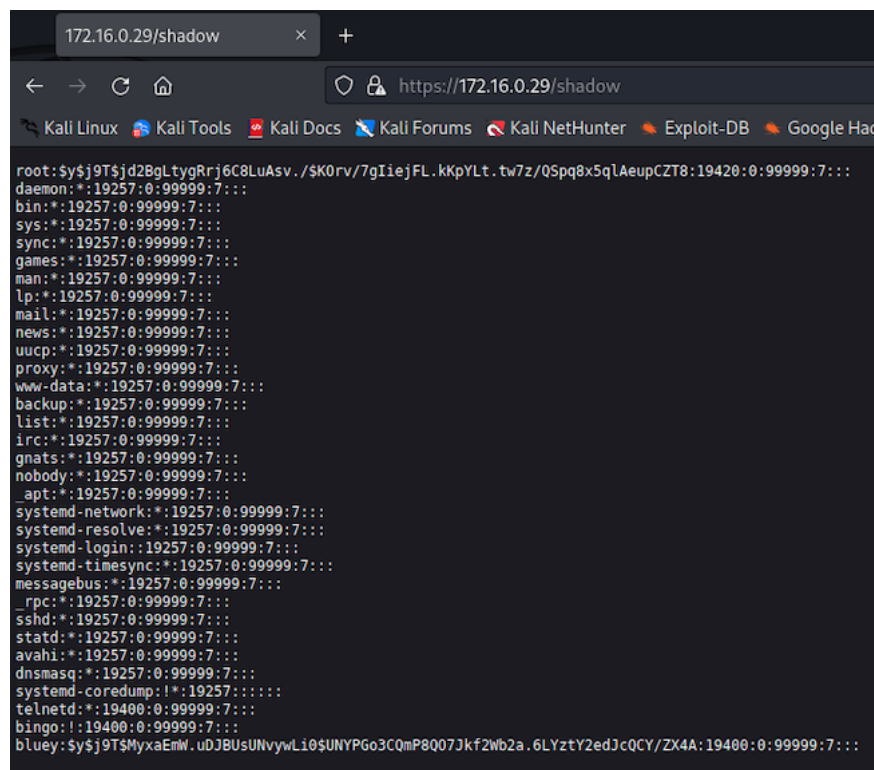
This indicates that the SSL-Server is trying to open a file but the filename is missing in the bss\_file.c file.

### 4.8.1 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.

### 4.8.2 Finding Details

To access the shadow file the following URL was used:



```
172.16.0.29/shadow x +
https://172.16.0.29/shadow
Kali Linux Kali Tools Kali Docs Kali Forums Kali NetHunter Exploit-DB Google Hacking
root:$y$j9T$jD2BgLtygRrj6C8LuAsv./$K0rv/7gIiejFL.kKpYlt.tw7z/QSpq8x5qLAeupCZT8:19420:0:99999:7:::
daemon:*:19257:0:99999:7:::
bin:*:19257:0:99999:7:::
sys:*:19257:0:99999:7:::
sync:*:19257:0:99999:7:::
games:*:19257:0:99999:7:::
man:*:19257:0:99999:7:::
lp:*:19257:0:99999:7:::
mail:*:19257:0:99999:7:::
news:*:19257:0:99999:7:::
uucp:*:19257:0:99999:7:::
proxy:*:19257:0:99999:7:::
www-data:*:19257:0:99999:7:::
backup:*:19257:0:99999:7:::
list:*:19257:0:99999:7:::
irc:*:19257:0:99999:7:::
gnats:*:19257:0:99999:7:::
nobody:*:19257:0:99999:7:::
_apt:*:19257:0:99999:7:::
systemd-network:*:19257:0:99999:7:::
systemd-resolve:*:19257:0:99999:7:::
systemd-login:*:19257:0:99999:7:::
systemd-timesync:*:19257:0:99999:7:::
messagebus:*:19257:0:99999:7:::
_rpc:*:19257:0:99999:7:::
sshd:*:19257:0:99999:7:::
statd:*:19257:0:99999:7:::
avahi:*:19257:0:99999:7:::
dnsmasq:*:19257:0:99999:7:::
systemd-coredump:*:19257:0:99999:7:::
telnetd:*:19400:0:99999:7:::
bingo:*:19400:0:99999:7:::
bluey:$y$j9T$MyxaEmW.uD3BU$UNvYwLi0$UNYPGo3CQmP8Q07Jkf2Wb2a.6LYztY2edJcQCY/ZX4A:19400:0:99999:7:::
```

Abbildung 4.4: Access to shadow file

### 4.8.3 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**

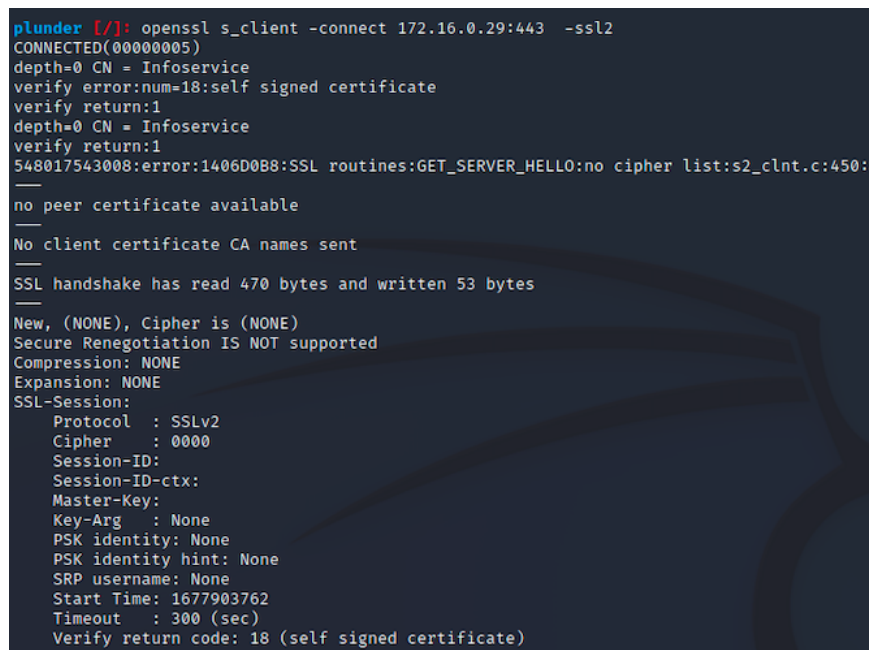
The Webserver running on port 443 of the DUT has ssl2, ssl3 and tls1 enabled. This allows accessing the Webserver with outdated protocols which are vulnerable to attacks.

### 4.9.1 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.

### 4.9.2 Finding Details

This is the proof for the possible usage of SSLv2 to connect to the Webserver:



```
plunder [7]: 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
SSL-Session:
    Protocol  : SSLv2
    Cipher    : 0000
    Session-ID:
    Session-ID-ctx:
    Master-Key:
    Key-Arg   : 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

### 4.9.3 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 - Privilege 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.



### 4.10.1 Finding Impact

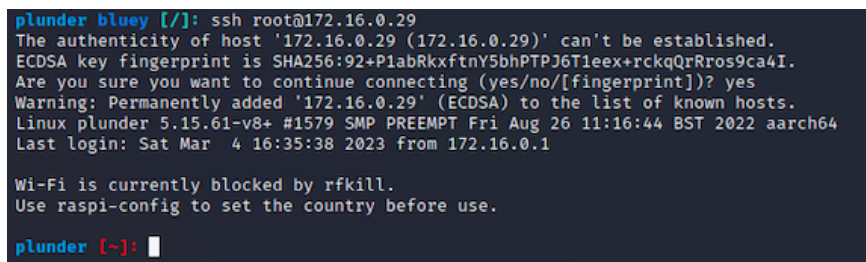
Doing a simple ssh login the "bluey" user can login as root without a password.

### 4.10.2 Finding Details

The following snippet shows the content of the `authorized_keys` file for the root user:

```
1 $ cat authorized_keys
2 ssh-ed25519 AAAAC3NzaC11ZDI1NTE5AAAAIMOEHQP4e3BVrq0R9nPQzf
3 olf9349W/UDXSAbQIj6RDM joe@reliant
4 ssh-ed25519 AAAAC3NzaC11ZDI1NTE5AAAAINV2RR0AIF7+9Cm7U2PWV
5 TmJ0hjvTQeYF04Lo7Et1qk 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

### 4.10.3 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.

### 4.11.1 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.

### 4.11.2 Finding Details

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

5752	2461.5760032...	172.16.0.29	172.16.0.1	HTTP	780 HTTP/1.1 200 OK (text/html)
5754	2461.6318539...	172.16.0.1	172.16.0.29	HTTP	361 GET /icons/blank.gif HTTP/1.1
5759	2461.6360850...	172.16.0.1	172.16.0.29	HTTP	360 GET /icons/back.gif HTTP/1.1
5762	2461.6362667...	172.16.0.1	172.16.0.29	HTTP	362 GET /icons/folder.gif HTTP/1.1
5765	2461.6373246...	172.16.0.29	172.16.0.1	HTTP	497 HTTP/1.1 200 OK (GIF89a)
5767	2461.6396720...	172.16.0.29	172.16.0.1	HTTP	575 HTTP/1.1 200 OK (GIF89a)
5769	2461.6402824...	172.16.0.29	172.16.0.1	HTTP	566 HTTP/1.1 200 OK (GIF89a)
5771	2465.3315776...	172.16.0.1	172.16.0.29	HTTP	446 GET /home/root/ HTTP/1.1
5772	2465.3364309...	172.16.0.1	172.16.0.1	HTTP	722 HTTP/1.1 200 OK (text/html)
5774	2466.5602741...	172.16.0.1	172.16.0.29	HTTP	446 GET /home/ HTTP/1.1
5775	2466.5678092...	172.16.0.29	172.16.0.1	HTTP	780 HTTP/1.1 200 OK (text/html)
5789	2474.0826163...	172.16.0.1	172.16.0.29	HTTP	447 GET /home/bingo/ HTTP/1.1
5791	2474.0874516...	172.16.0.29	172.16.0.1	HTTP	725 HTTP/1.1 200 OK (text/html)
5793	2475.1406308...	172.16.0.1	172.16.0.29	HTTP	447 GET /home/ HTTP/1.1
5794	2475.1402204...	172.16.0.29	172.16.0.1	HTTP	780 HTTP/1.1 200 OK (text/html)
5796	2475.6931353...	172.16.0.1	172.16.0.29	HTTP	447 GET /home/bluey/ HTTP/1.1
5797	2475.6978385...	172.16.0.29	172.16.0.1	HTTP	724 HTTP/1.1 200 OK (text/html)
5799	2476.5149085...	172.16.0.1	172.16.0.29	HTTP	447 GET /home/ HTTP/1.1
5800	2476.5223083...	172.16.0.29	172.16.0.1	HTTP	780 HTTP/1.1 200 OK (text/html)
5808	2581.0607812...	172.16.0.1	172.16.0.29	HTTP	447 GET /home/bingo/ HTTP/1.1
5810	2581.0654091...	172.16.0.29	172.16.0.1	HTTP	725 HTTP/1.1 200 OK (text/html)

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

```

```
5 Host is up (0.00051s latency).  
6  
7 PORT STATE SERVICE VERSION  
8 80/tcp open http Apache httpd 2.4.54 ((Debian))
```

### 4.11.3 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:

### 4.12.1 Finding Impact

### 4.12.2 Finding Details

### 4.12.3 Evaluation of Results

Effort to Fix: **Medium**

## 4.13 Finding 13 - Possible SYN Flood Attack

Classification: Missing Protection Severity: **High**

CVE:

### **4.13.1 Finding Impact**

### **4.13.2 Finding Details**

### **4.13.3 Evaluation of Results**

Effort to Fix: **High**

## 5 Results