

ASSIGNMENT 5

Web Application Vulnerability Assessment Using OWASP ZAP and OWASP Juice Shop

1. Objective

The objective of this assignment was to gain hands-on experience in web application security by performing a full vulnerability scan using **OWASP ZAP**, documenting findings and remediation steps on **GitHub**, and reflecting on lessons learned from the exercise.

2. Lab Environment

- Operating System: Kali Linux
- Target Application: OWASP Juice Shop
- Security Tool: OWASP ZAP
- Browser: Firefox ESR
- Target URL:<http://127.0.0.1:42000>

3. Step-by-Step Procedure

Step 1: Install and Run OWASP Juice Shop

OWASP Juice Shop was used as the target because it is an intentionally vulnerable web application designed for security training.

Juice Shop was launched locally and confirmed accessible via browser at:

<http://127.0.0.1:42000>

Step 2: Install OWASP ZAP

OWASP ZAP was installed using the APT package manager to avoid snap-related issues.

```
sudo apt update  
sudo apt install zaproxy -y
```

ZAP was launched using:

```
zaproxy
```

Step 3: Configure Browser Proxy

To allow ZAP to intercept web traffic:

1. Open Firefox

2. Navigate to **Settings** → **Network Settings** → **Settings**
3. Select **Manual proxy configuration**
4. Configure:
 - HTTP Proxy: **127.0.0.1**
 - Port: **8080**
 - Use this proxy for all protocols
5. Save settings

Step 4: Verify Traffic Interception

With the proxy configured, Juice Shop was accessed via:

`http://127.0.0.1:42000`

OWASP ZAP successfully captured HTTP requests, confirmed by the appearance of the target under the **Sites** tree.

Step 5: Add Target to OWASP ZAP

1. In ZAP, navigate to **Quick Start**
2. Select **Manual Explore**
3. Enter the target URL:
`http://127.0.0.1:42000`
4. Launch browser

Step 6: Spider (Crawl) the Application

To discover application endpoints:

1. Right-click on the target in the **Sites** tree
2. Select **Attack** → **Spider**
3. Start the scan

Since OWASP Juice Shop is a **single-page Angular application**, manual interaction (clicking links, logging in, browsing products) was performed to ensure complete coverage.

Step 7: Passive Scanning

While browsing the application:

- ZAP performed **passive scanning**
- Identified security misconfigurations such as missing headers and information disclosure
- No intrusive attacks were executed at this stage

Step 8: Active Scanning

To identify exploitable vulnerabilities:

1. Right-click the target URL
2. Select **Attack → Active Scan**
3. Use default scan policy
4. Start scan

ZAP tested for:

- Cross-Site Scripting (XSS)
- Security misconfigurations
- Vulnerable libraries
- Session management weaknesses

Step 9: Review Scan Alerts

After the scan completed:

- Navigate to the **Alerts** tab
- A total of **13 alerts** were identified
- Findings were categorized as:
 - Medium Risk
 - Low Risk
 - Informational

Examples included:

- Missing Content Security Policy
- Vulnerable JavaScript Libraries
- Session ID exposed in URLs
- Missing anti-clickjacking headers

4. Exporting the OWASP ZAP Report

Step-by-Step: Export ZAP Scan Report

1. In OWASP ZAP, click **Report** (top menu)
2. Select **Generate Report**
3. Choose:
 - Report Type: **HTML** (recommended for GitHub)

4. Select:
 - Title: *OWASP ZAP Juice Shop Scan*
5. Choose destination folder
6. Click **Generate Report**

The report was saved as:

`zap-report.html`

PS: VIEW APPENDIX FOR ALL PROCEDURAL SCREENSHOTS

Findings and Remediation Notes

Target Application: OWASP Juice Shop

Scanning Tool: OWASP ZAP

Scan Type: Automated Active Scan

Target URL: <http://127.0.0.1:42000>

1. CSP: Failure to Define Content Security Policy

Description

The application does not define a **Content Security Policy (CSP)** header. CSP is a critical security control that helps prevent Cross-Site Scripting (XSS), data injection, and other code execution attacks by restricting the sources from which content can be loaded.

Risk

Without CSP, attackers can inject and execute malicious scripts, leading to:

- Session hijacking
- Credential theft
- Defacement or malware injection

Evidence

OWASP ZAP detected missing or improperly configured CSP headers in HTTP responses.

Remediation

- Define a strict **Content-Security-Policy** HTTP header.
- Restrict script, style, image, and frame sources to trusted domains only.

Example:

```
Content-Security-Policy: default-src 'self'; script-src 'self';
```

2. Missing Anti-Clickjacking Header

Description

The application does not include the `X-Frame-Options` or `frame-ancestors` directive, making it vulnerable to **clickjacking attacks**.

Risk

Attackers can embed the application inside an invisible iframe to trick users into performing unintended actions.

Remediation

- Add the `X-Frame-Options` header or CSP `frame-ancestors`.

Example:

```
X-Frame-Options: DENY
```

or

```
Content-Security-Policy: frame-ancestors 'none';
```

3. Session ID in URL Rewrite

Description

Session identifiers were observed in URLs. This practice exposes session tokens through browser history, logs, and referrer headers.

Risk

- Session hijacking
- Replay attacks
- Information leakage

Remediation

- Store session identifiers in **secure cookies**, not URLs.
- Ensure cookies use:
 - `HttpOnly`
 - `Secure`
 - `SameSite` attributes

4. Vulnerable JavaScript Library

Description

OWASP ZAP identified JavaScript libraries with known vulnerabilities.

Risk

Known vulnerable libraries can be exploited to:

- Bypass security controls
- Execute malicious scripts
- Perform client-side attacks

Remediation

- Identify outdated libraries.
- Upgrade to the latest secure versions.
- Regularly audit dependencies using tools like:
 - `npm audit`
 - OWASP Dependency-Check

5. Cross-Domain JavaScript Source Inclusion

Description

The application loads JavaScript resources from external or cross-domain sources without sufficient validation.

Risk

If a third-party domain is compromised, malicious scripts may be served to users.

Remediation

- Avoid unnecessary third-party scripts.
- Use Subresource Integrity (SRI).

Example:

```
<script src="example.js" integrity="sha384-..."  
crossorigin="anonymous"></script>
```

6. Application Error Disclosure

Description

Detailed error messages are exposed to users.

Risk

Error messages may reveal:

- Stack traces
- File paths
- Framework versions

This information can help attackers plan targeted attacks.

Remediation

- Disable detailed error messages in production.
- Log errors server-side only.
- Display generic error messages to users.

7. Information Disclosure Issues

Description

Multiple informational alerts were detected, including:

- Private IP address disclosure
- Timestamp disclosure
- Server or framework information exposure

Risk

While low risk individually, combined disclosures can help attackers fingerprint the system.

Remediation

- Remove unnecessary debug information.
- Mask internal IP addresses.
- Minimize response headers.

8. X-Content-Type-Options Header Missing

Description

The X-Content-Type-Options header is not set.

Risk

Browsers may perform MIME-type sniffing, which can lead to XSS attacks.

Remediation

Add the following header:

X-Content-Type-Options: nosniff

9. Modern Web Application Observation

Description

ZAP identified the target as a modern JavaScript-based web application (SPA).

Notes

This is informational and not a vulnerability. However, it highlights the need for:

- Proper API security
- Token protection
- Strong client-side controls

Overall Risk Summary

Severity	Count
High	0
Medium	Multiple
Low	Several
Informational	Multiple

The application demonstrates common security misconfigurations typical of intentionally vulnerable applications like OWASP Juice Shop.

Conclusion

The OWASP ZAP scan of OWASP Juice Shop revealed multiple security issues primarily related to **missing security headers, information disclosure, and insecure configurations**. While Juice Shop is intentionally vulnerable for learning purposes, this exercise demonstrates how automated scanners identify real-world web application risks and emphasizes the importance of secure defaults, proper configuration, and regular security testing.

Reflection and Lessons Learned

This exercise demonstrated the effectiveness of automated security scanning tools in identifying common web application vulnerabilities. It also highlighted the limitations of automation, especially when scanning modern single-page applications, making manual interaction essential. The assignment strengthened practical skills in vulnerability assessment, risk analysis, and secure configuration.

Disclaimer

All testing was conducted on **OWASP Juice Shop**, an intentionally vulnerable application, within a controlled and authorized lab environment. These techniques must not be used on production systems without permission.

APPENDIX

The screenshot shows a Kali Linux desktop environment with the ZAP (Zed Attack Proxy) application running. The browser window is displaying the OWASP Juice Shop application at <http://127.0.0.1:42000/#/>. The main page shows a list of products:

- Apple Juice (1000ml) - Price: 1.99¤
- Apple Pomace - Price: 0.89¤
- Banana Juice (1000ml) - Price: 1.99¤

A tooltip for the Banana Juice item contains the following text:
This website uses fruit cookies to ensure you
get the juiciest tracking experience.
But me wait!

The ZAP interface includes a sidebar with various links such as Standard Mode, Sites, OffSec, Kali Linux, Kali Tools, Kali Docs, Kali Forums, Kali NetHunter, Exploit-DB, and Google Hacking DB. The bottom left of the screen features a cartoon character from the OWASP Juice Shop.

The screenshot shows the ZAP interface during a scan of a local host at port 142000. The left sidebar displays the site structure with various endpoints like /, /api, /assets, and /main.js. The main pane shows a list of captured requests, mostly GET requests for static files and API endpoints. The status bar indicates the scan is at 30% completion.

The screenshot shows the ZAP interface with the following details:

- Header Text:** X-Frame-Options: SAMEORIGIN
Feature-Policy: payment 'self'
X-Recruiting: /#jobs
Content-Type: text/html; charset=UTF-8
Content-Length: 156
Content-Security-Policy: default-src 'none'
- Output:** CSP: Failure to Define Directive with No Fallback
- Alerts (13):**
 - CSP: Failure to Define Risk:** URL: http://127.0.0.1:42000/assets, Confidence: Medium, High, Content-Security-Policy: default-src 'none'
 - Content Security Policy Miscon Parameter:** CWE ID: 693
 - Cross-Domain Miscon Parameter:** CWE ID: 15
 - Missing Anti-clickjacking Attack:**
 - Session ID at URL Rew. Evidence:**
 - Vulnerable JS Library:** CWE ID: 693
 - Application Error Discl WASC ID:**
 - Cross-Domain JavaScript Source:** Passive (10055 - CSP)
 - Private IP Disclosure:** Alert Reference: 10055-13
 - Timestamp Disclosure Input Vector:**
 - X-Content-Type-Option Description:**
 - Information Disclosure:** The Content Security Policy fails to define one of the directives that has no fallback. Missing/excluding them is the same as allowing anything.
 - Modern Web Application:**
- Other Info:** The directive(s): frame-ancestors, form-action is/are among the directives that do not fallback to default-src.

The screenshot shows the OWASpwarm interface. At the top, there's a navigation bar with File, Edit, View, Analyse, Report, Tools, Import, Export, Online, Help, and a Standard Mode dropdown. A 'Screen Capture' window is open, displaying the message 'Screenshot captured' and 'You can paste the image from the clipboard'. The main pane shows a tree view of network requests under 'Sites'. One request to 'http://127.0.0.1:42000' is expanded, showing headers like 'Content-Type: application/javascript' and 'Content-Security-Policy: none'. Below the tree, a 'History' tab is selected, showing a list of alerts. The first alert is 'Content Security Policy (CSP) Header Not Set' under the 'Alerts (13)' section. It details the URL as 'http://127.0.0.1:42000', Risk as 'Medium', Confidence as 'High', and provides a detailed description of CSP and its purpose.

Header: Text Body: Text

HTTP/1.1 200 OK
Access-Control-Allow-Origin: *
X-Content-Type-Options: nosniff
X-Frame-Options: SAMEORIGIN
Feature-Policy: payment 'self'
X-Recruiting: /#iobs
<!--
~ Copyright (c) 2014-2026 Bjoern Kimmich & the OWASP Juice Shop contributors.
~ SPDX-License-Identifier: MIT
-->

Content Modified

Content Security Policy (CSP) Header Not Set

URL: http://127.0.0.1:42000/
Risk: Medium
Confidence: High
Parameter:

Cross-Domain Miscon

Missing Anti-clickjacking Attack

Session ID in URL Rev

Vulnerable JS Library

Application Error Disc

Cross-Domain JavaScr

Private IP Disclosure

Timestamp Disclosure

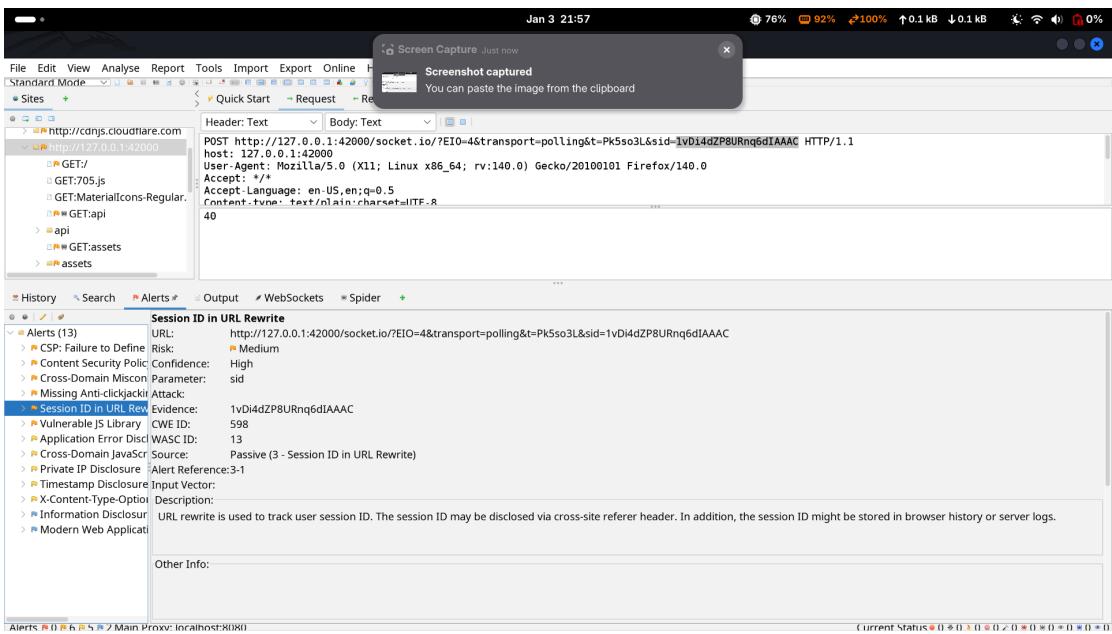
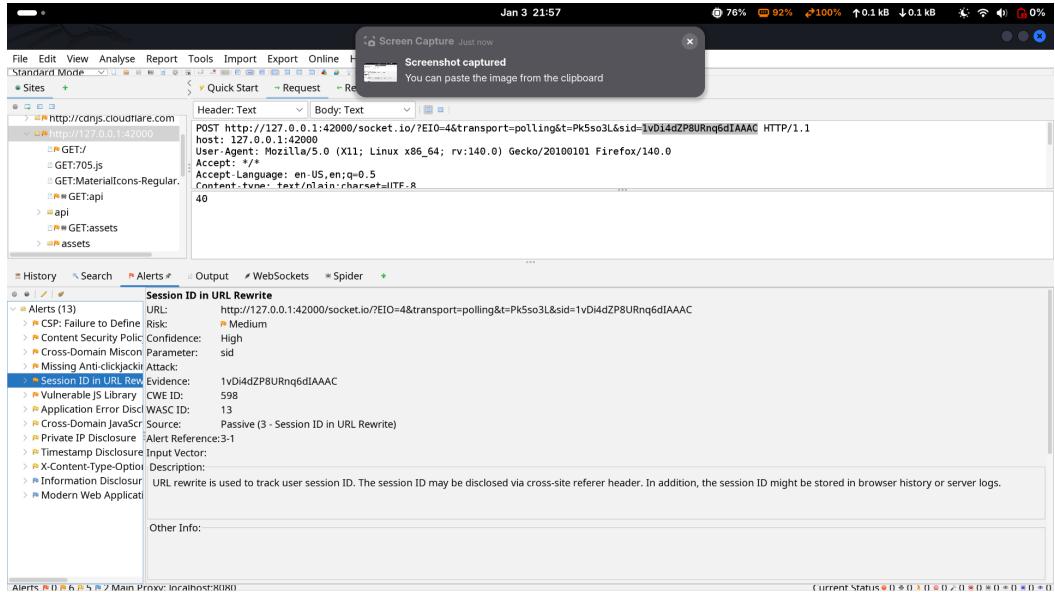
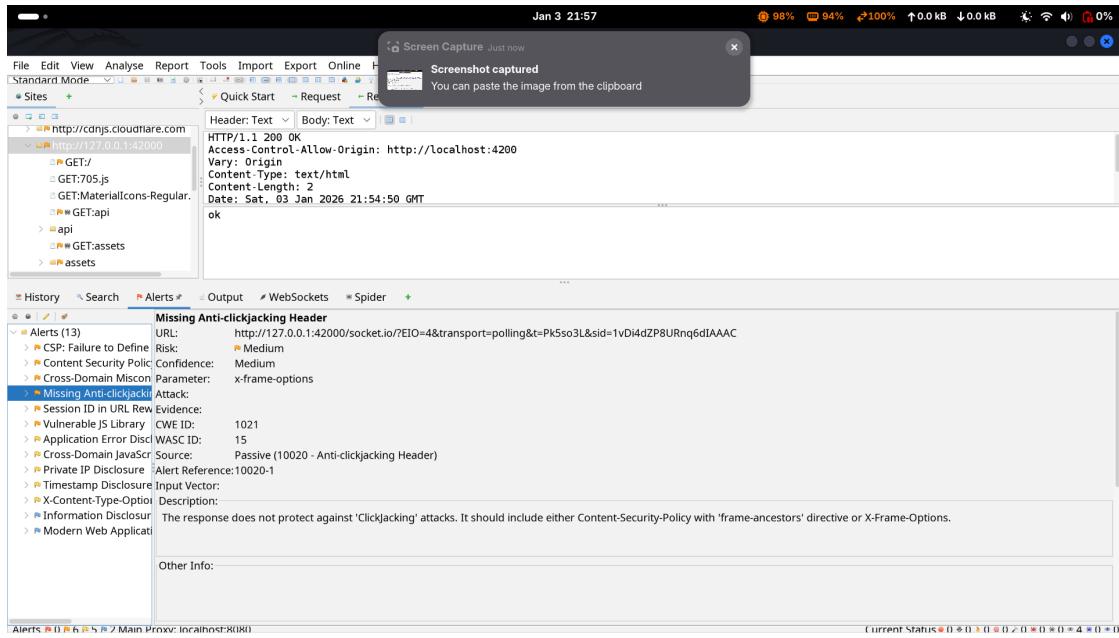
X-Content-Type-Optio

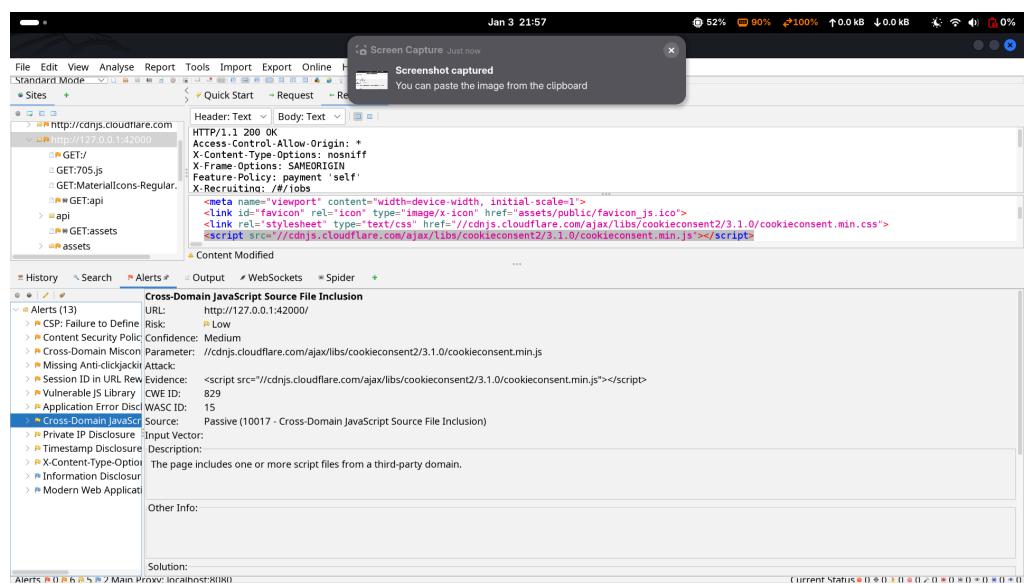
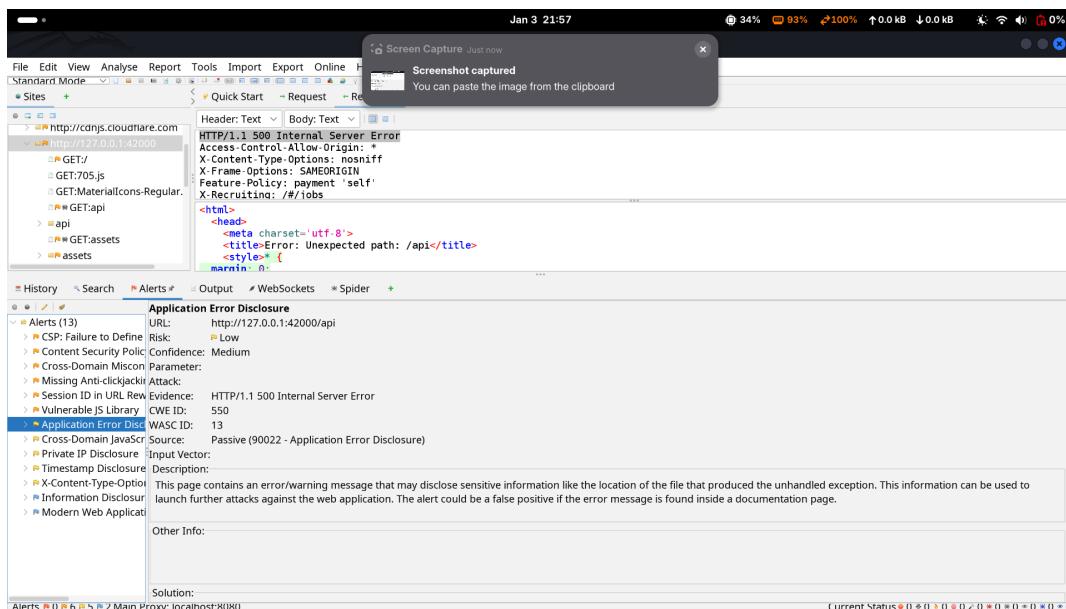
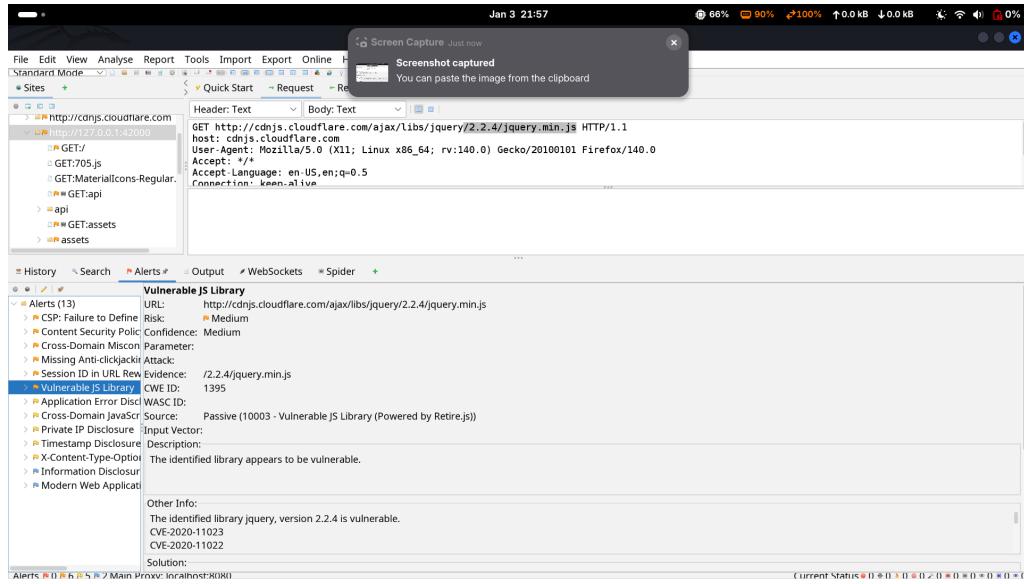
Information Disclosur

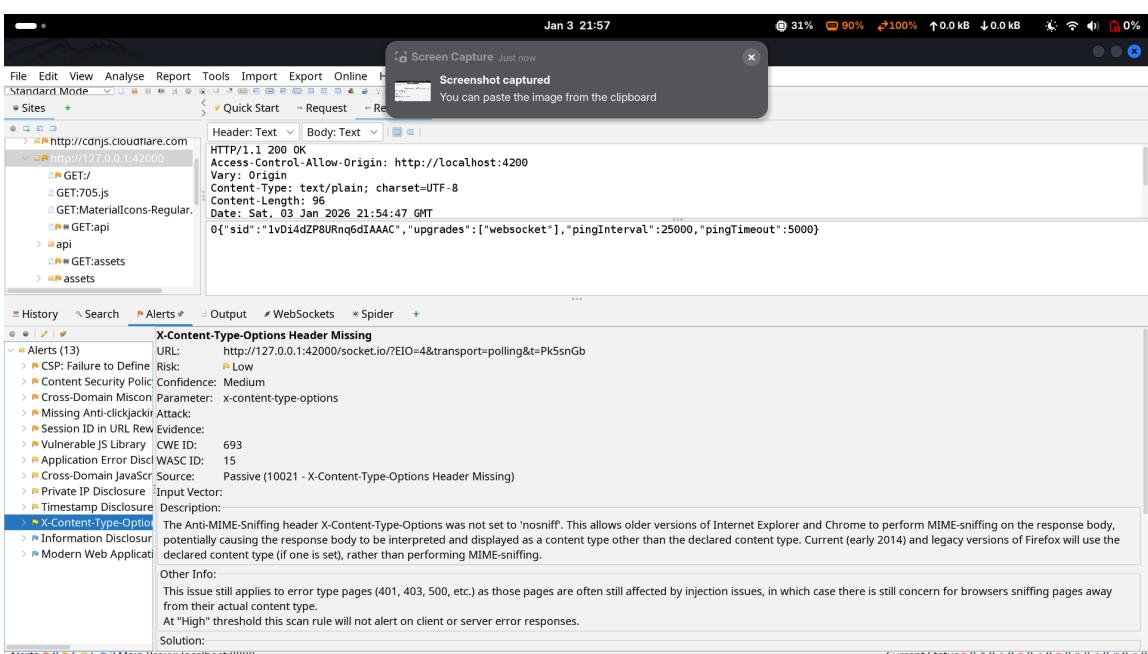
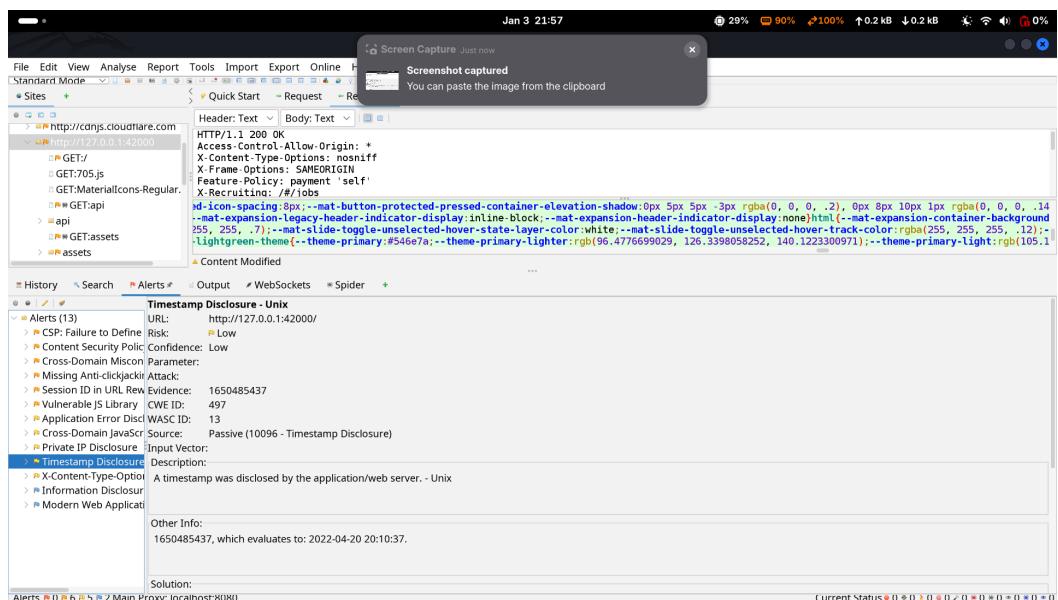
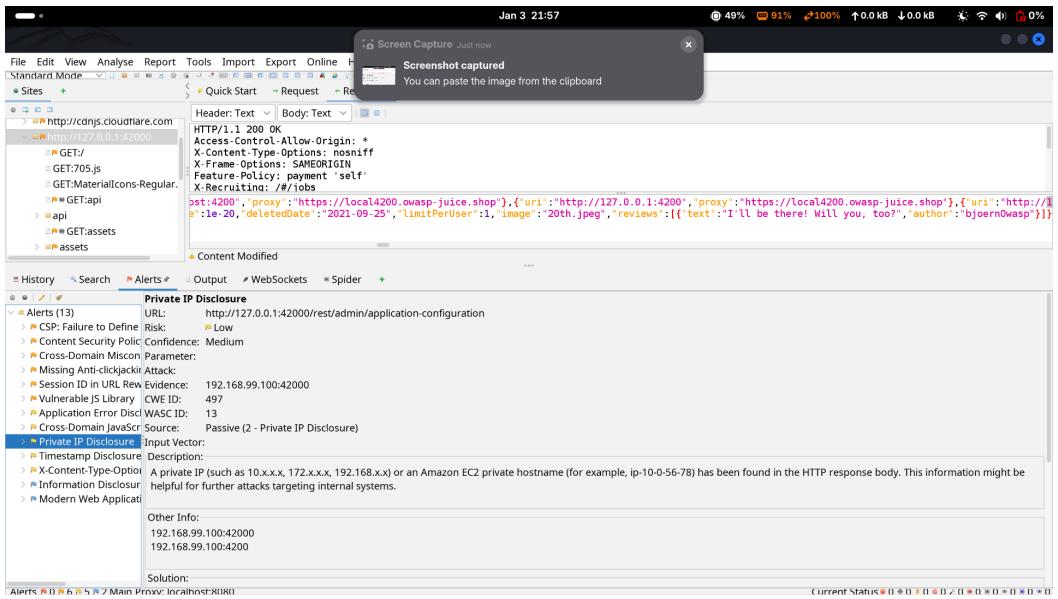
Modern Web Applicat

CWE ID: 693
WASC ID: 15
Source: Passive (10038 - Content Security Policy (CSP) Header Not Set)
Alert Reference: 10038-1
Input Vector:
Description:
Content Security Policy (CSP) is an added layer of security that helps to detect and mitigate certain types of attacks, including Cross Site Scripting (XSS) and data injection attacks. These attacks are used for everything from data theft to site defacement or distribution of malware. CSP provides a set of standard HTTP headers that allow website owners to declare approved sources of content that browsers should be allowed to load on that page — covered types are JavaScript, CSS, HTML frames, fonts, images and embeddable objects such as Java applets, Flash movies, PDF files and Silverlight controls.

Other Info:







Jan 3 21:58

Screen Capture Just now

Screenshot captured
You can paste the image from the clipboard

Header: Text **Body: Text**

```
HTTP/1.1 200 OK
Access-Control-Allow-Origin: *
X-Content-Type-Options: nosniff
X-Frame-Options: SAMEORIGIN
Feature-Policy: payment 'self'
X-Recruiting: #/jobs
```

Content Modified

Information Disclosure - Suspicious Comments

- Alerts (13)
 - CSP: Failure to Define
 - Content Security Policy
 - Cross-Domain Miscon Parameter:
 - Missing Anti-clickjacking Attack:
 - Session ID in URL Rewrite
 - Vulnerable JS Library
 - Application Error Disclosure
 - Cross-Domain JavaScript
 - Private IP Disclosure
 - Timestamp Disclosure
 - X-Content-Type-Option
 - Information Disclosure
 - Modern Web Application

The response appears to contain suspicious comments which may help an attacker.

Other Info:
The following pattern was used: `\bQUERY\b` and was detected in likely comment: `"/owasp.org' target='_blank">Open Worldwide Application Security Project (OWASP)` and is developed and maintained by `volunteer`, see evidence field for the suspicious comment/snippet.

Solution:

Current Status: 0.0% 1.0% 2.0% 3.0% 4.0% 5.0% 6.0% 7.0% 8.0% 9.0% 10.0%

File Edit View Analyse Report Tools Import Export Online Help

Sites +

http://cdnjs.cloudflare.com

http://127.0.0.1:42000

GET/

GET:705.js

GET:MaterialIcons-Regular.

GET:api

GET:assets

Content Modified

History Search Alerts Output WebSockets Spider

Alerts (13)

URL: http://127.0.0.1:42000/main.js

Risk: Informational

Confidence: Low

Cross-Domain Miscon Parameter:

Missing Anti-clickjacking Attack:

Session ID in URL Rewrite

Evidence: query

Vulnerable JS Library

CWE ID: 615

Application Error Disclosure

WASC ID: 13

Cross-Domain JavaScript

Source: Passive (10027 - Information Disclosure - Suspicious Comments)

Private IP Disclosure

Input Vector:

Timestamp Disclosure

X-Content-Type-Option

Information Disclosure

Modern Web Application

Other Info:
The following pattern was used: `\bQUERY\b` and was detected in likely comment: `"/owasp.org' target='_blank">Open Worldwide Application Security Project (OWASP)` and is developed and maintained by `volunteer`, see evidence field for the suspicious comment/snippet.

Solution:

Current Status: 0.0% 1.0% 2.0% 3.0% 4.0% 5.0% 6.0% 7.0% 8.0% 9.0% 10.0%

File Edit View Analyse Report Tools Import Export Online Help

Sites +

http://cdnjs.cloudflare.com

http://127.0.0.1:42000

GET/

GET:705.js

GET:MaterialIcons-Regular.

GET:api

GET:assets

Content Modified

History Search Alerts Output WebSockets Spider

Alerts (13)

URL: http://127.0.0.1:42000/main.js

Risk: Informational

Confidence: Low

Cross-Domain Miscon Parameter:

Missing Anti-clickjacking Attack:

Session ID in URL Rewrite

Evidence: query

Vulnerable JS Library

CWE ID: 615

Application Error Disclosure

WASC ID: 13

Cross-Domain JavaScript

Source: Passive (10027 - Information Disclosure - Suspicious Comments)

Private IP Disclosure

Input Vector:

Timestamp Disclosure

X-Content-Type-Option

Information Disclosure

Modern Web Application

Other Info:
The following pattern was used: `\bQUERY\b` and was detected in likely comment: `"/owasp.org' target='_blank">Open Worldwide Application Security Project (OWASP)` and is developed and maintained by `volunteer`, see evidence field for the suspicious comment/snippet.

Solution:

Current Status: 0.0% 1.0% 2.0% 3.0% 4.0% 5.0% 6.0% 7.0% 8.0% 9.0% 10.0%

- ## Alerts (13)
- > **CSP: Failure to Define**
 - > **Content Security Policy**
 - > **Cross-Domain Miscon**
 - > **Missing Anti-clickjakin**
 - > **Session ID in URL Rew**
 - > **Vulnerable JS Library**
 - > **Application Error Disc**
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 - > **Information Disclosur**
 - > **Modern Web Applicati**