Web (In)Security: Remediation Efforts - Status and Outlook

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Overall Agenda

The Current Web Has Some Holes

Help is On The Way (Some Anyway)

Solving Real World Problems

Still A Ways To Go

The Current Web Has Some Holes

Sort of Like This:

It Is Hard To Do Even Simple Things Safely

- Include an ad on your site
- Use third-party Site-Analytics
- Allow user input (“Rich” or otherwise)
- Uniform use of HTTPS

What Are Some of the Holes?

- Cross Site Request Forgery (CSRF)
- Cross Site Scripting (XSS)
- Clickjacking
- Malvertising
- TLS/SSL Man In The Middle (MITM)
- For example - sslstrip

Why Do These Attacks Exist

- Core protocol/technology weaknesses
- Too much required of each and every developer
- Lack of Security Policy Mechanisms

Core Protocols/Technologies Have Weaknesses

- Cookies are broken:
  - Their scope rules are broken
  - “Secure” Flag doesn’t really mean the same thing everywhere
  - “HTTPonly” and “Secure” only partially effective
  - Network MiTM attacker can overwrite cookies by spoofing..

    http://www.example.com

    ..to overwrite real “secure cookies” for..

    httpS://www.example.com
- **Practically anything** can be interpreted as JavaScript
- Browsers default to HTTP first (Not HTTPS)

<u>Too Much Required of Each and Every Developer</u>

- To Implement a “Strong” Security Policy……
- Every Cookie has to have HTTPonly and Secure Flag
- Every link generated has to have the right scheme (HTTP vs. HTTPS)
- Every page must have the right content encoding

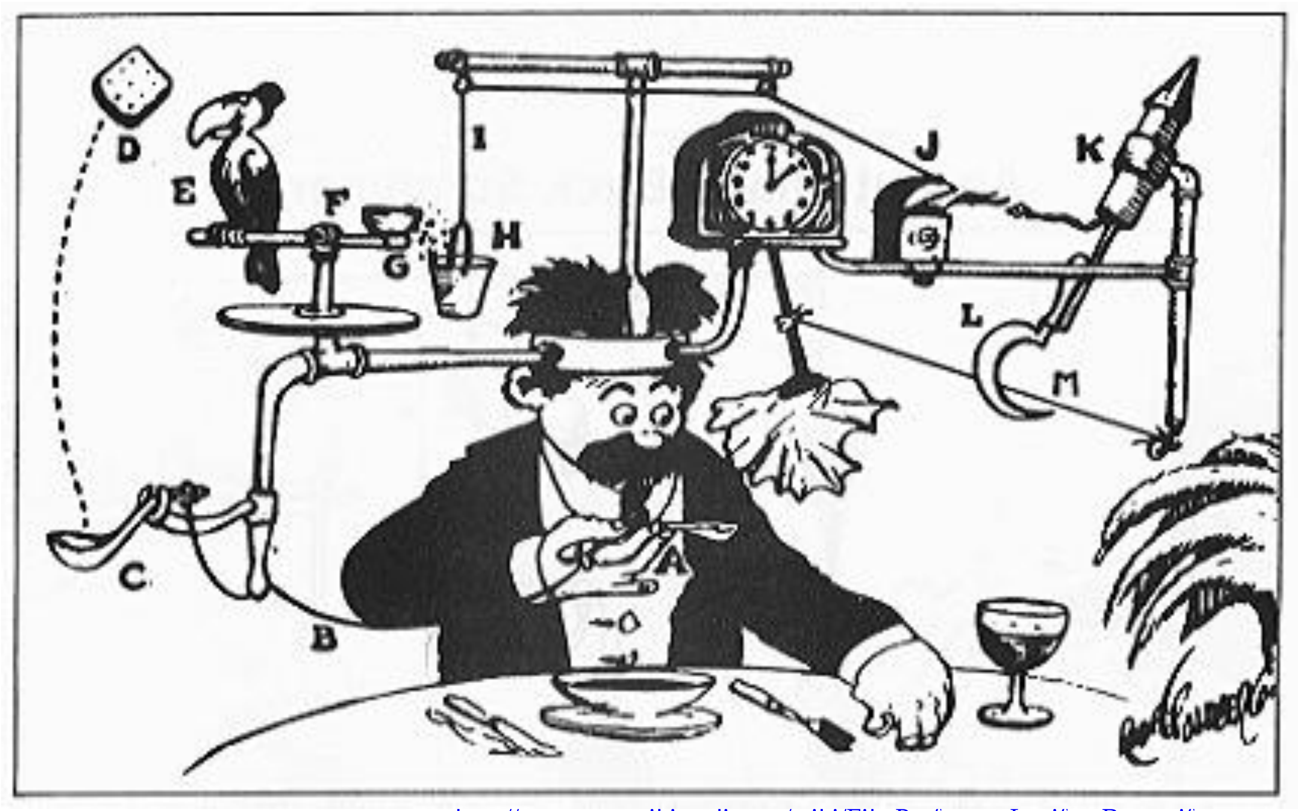
- This is TOO HARD

Lack of “Site” Security Policy Mechanisms

- A Developer or WebSite Administrator has *no coherent way* to say, for example:
  - Treat all my cookies “Securely”,
  - Only load HTTPS Content,
  - And don’t frame my site.

Help is On The Way
(Some Anyway)

Web Security Today



http://commons.wikimedia.org/wiki/File:Professor_Lucifer_Butts.gif

However, help is on the way...

Help is on the Way

Though, it might not be *quite* what you want….

“Emerging” Web Security Standards

- X-Frame-Options
- HTTP Strict-Transport-Security (HSTS)
- Mozilla Content Security Policy (CSP)
- NoScript Application Boundary Enforcer (ABE)
- Cross Origin Resource Sharing (CORS)
- X-Content-Type-Options: nosniff

Some Details On...

X-Frame-Options

HTTP Strict Transport Security

Content Security Policy (CSP)

Control Who Can Frame Your Site (X-Frame-Options)

- Doing this in JavaScript is an exercise in futility
- X-Frame-Options (Invented by Microsoft In 2009)
- HTTP header that tells a browser whether to allow framing (and by whom)
    - Now widely implemented
    - Not very flexible
    - Doesn't solve all use cases

```
HTTP/1.1 200 OK
Content-Type: text/xml; charset=UTF-8
Date: Fri, 07 Jan 2011 17:38:01 GMT
X-Frame-Options: SAMEORIGIN
```

Force Your Entire Site to HTTPS (HTTP Strict Transport Security)

- *ForceHTTPS* conceived by Jackson and Barth in 2007
  - In response to others' approaches (e.g. Locked-Same-Origin)
- Presented at WWW 2008 (April) [1]
- General notion discussed sporadically since publication
- Initially spec was known as *ForceTLS*
- Presently a draft specification at the IETF

[1] https://crypto.stanford.edu/forcehttps/

Force Your Entire Site to HTTPS (HTTP Strict Transport Security)

- Ostensibly simple high-level use case:
  - *Web browser users* wish use sites securely
  - *Web site deployer* wishes to offer site securely

- STS Server declares STS policy by returning STS response header:

```
HTTP/1.1 200 OK
Cache-Control: private
Pragma: no-cache
Strict-Transport-Security: max-age=31536000
```

- Helps mitigate attacks such as sslstrip and malicious network operators

Content Security Policy (CSP)

- Mozilla developed CSP to help prevent common web attacks such as XSS
- Side Benefit - Clickjacking Protection
- Allows a site to specific how and from where content (scripts, images, css, etc) will load/execute.

What Can You Do With CSP?

- Force all JavaScript to load from include file, not inline
- Eliminate certain JavaScript usage (e.g. “eval()”)
- Whitelist where JS can be loaded from (eliminate injections)
- Detect violations of your defined web security policy
- Control who can frame your content
- And much more…
  - https://wiki.mozilla.org/Security/CSP/Specification

```
HTTP/1.1 200 OK
Content-Type: text/xml; charset=UTF-8
X-Content-Security-Policy: allow 'self'; img-src *;
object-src media1.com media2.com *.cdn.com; script-
src trustedscripts.example.com
```

Solving Real World Problems

Solving Real World Problems: Agenda

Prevent Framing of Your Site

Make All Your Cookies “Secure”

Make Your Entire Website HTTPS Only

Prevent Framing of Your Site

- Harder than it looks – should do ALL of these:
- Deploy “Framebusting” JavaScript
  - Though, most are relatively easily defeated (see [2])
- Deploy X-Frame-Options Headers

```
HTTP/1.1 200 OK
Content-Type: text/xml; charset=UTF-8
Date: Fri, 07 Jan 2011 17:38:01 GMT
X-Frame-Options: DENY
```

  - Note: Not supported in older browsers!

- For Clients running Firefox-4
  - Use CSP to control frame-ancestors
- [2] http://seclab.stanford.edu/websec/framebusting/index.php

Make All Your Cookies "Secure"

```
HTTP/1.1 200 OK
Date: Fri, 07 Jan 2011 17:52:34 GMT
Server: Apache
Set-Cookie: Name=Value; domain=paypal.com; path=/;
```

- Lacking "HTTPOnly" and "Secure" flags

Make All Your Cookies "Secure"

```
HTTP/1.1 200 OK
Date: Fri, 07 Jan 2011 17:52:34 GMT
Server: Apache
Set-Cookie: Name=Value; domain=paypal.com; path=/;Secure;HttpOnly
```

- No "standard approach" that makes this easy for you
- Web Application Firewalls or Servlet Filters can help
- E.g. if using Apache server, then use ModSecurity to...
  - Craft ruleset that checks for cookies lacking either/both flags and adds them if needed [3]
- [3] http://blog.spiderlabs.com/2008/12/fixing-both-missing-httponly-and-secure-cookie-flags.html

Make Your Entire Website HTTPS Only

- Convert your entire website to ***serve all content over*** HTTPS
  - Convert all links you generate to “https:”

  - Beware of content served from other domains!
  - e.g. Images you include, web analytics Javascript
  - Make sure you redirect from HTTP to HTTPS with an HTTP-301 (SEO reasons)
- And, deploy HSTS headers:

```
HTTP/1.1 200 OK
Date: Fri, 07 Jan 2011 17:19:03 GMT
Server: Apache
Cache-Control: private
Pragma: no-cache
Strict-Transport-Security: max-age=31536000
```

Still a Ways To Go

Still a Ways to Go...

- Remember that list of things you couldn’t do safely?
  - Include an ad on your site
  - Use third-party Site-Analytics
  - Allow user input (“Rich” or otherwise)
  - Uniform use of HTTPS
  - etc.
- You still can’t in some cases

Why?   Some Current Constraints...

- Lack of standards for general purpose ***Security Policy mechanisms***
- Can’t safely frame third-party content directly without lots of “attack surface”
- Can’t safely embed third-party script
- Not all deployed browsers implement the new security features/standards
- And also because...
  - You can't “break the Web”

Some Goals for Approaches

- Should not rely on every developer (and user) “getting it right” 100% of the time
- Security mechanisms should be “declarative policy and configuration”
  - separate from “code”
- Reduce the need for new individual HTTP headers for each specific issue
- Overall – create security mechanisms that allow/enforce the concept of **Least Privilege**

How Do We Get Started

- What we need..
  - Commonly agreed to terms and definitions of Web security concepts
    - e.g. “origin”, “site”
  - Web Security Policy Framework
    - and coherent notions of what that *means*
  - Forums in which to have the discussion

Some Work In Progress

- IETF WebSec Working Group
- W3C WebAppSec and WebApps Working Groups
- Related:
  - IETF DANE WG (a.k.a. “Keys in DNS (KIDNS)” and “KeyAssure”)

Some Work In Progress

- IETF WebSec WG
  - Newly-established: 12-Oct-2010
  - Charter: http://tools.ietf.org/wg/websec/charters
  - Initial existing specifications…
  - HSTS – HTTP Strict Transport Security
    - **`draft-ietf-websec-strict-transport-sec`**
  - Origin definition and explicit header
    - **`draft-ietf-websec-origin`**
  - Content Sniffing Rules
    - **`draft-ietf-websec-mime-sniff`**
  - Will develop…
    - HTTP app security "problem statement and requirements" doc

Some Work In Progress

- W3C WebAppSec and WebApps Working Groups
  - WebAppSec WG
    - Nascent
    - Proposed charter: http://www.w3.org/2010/07/appsecwg-charter.html
  - Mission:
    - "…to develop security and policy mechanisms to improve the security of Web Applications, and enable secure cross-site communication."
  - Have security-oriented specs from WebApps move to WebAppSec…
    - Cross-Origin Resource Sharing (CORS)
    - Uniform Messaging Policy (UMP)
    - Content Security Policy (CSP) (from Mozilla, yet to appear as a W3C draft)
    - (Security-oriented portions of HTML5 ?)
  - WebApps working group: http://www.w3.org/2008/webapps/

Some Work In Progress

- IETF DANE WG
  - "DNS-based Authentication of Named Entities"
    - (a.k.a. "Keys in DNS (KIDNS)", nee "KeyAssure")
- Charter: http://tools.ietf.org/wg/dane/charters?item=charter-dane-2010-12-13.txt
- Objective:
  - "Specify mechanisms and techniques that allow Internet applications to establish cryptographically secured communications by using information distributed through DNSSEC for discovering and authenticating public keys which are associated with a service located at a domain name."
- Draft specification:
  - Using Secure DNS to Associate Certificates with Domain Names For TLS
    - **`draft-ietf-dane-protocol`**

Some Work Still Lacking a Home

- Common Security User-Interfaces
  - Browsers presently display security issues differently
  - Also have differing approaches to dealing with issues
- Fixing the Certificate Authority (CA) Situation
  - Multitude of CAs in browser & OS “Trust Anchor Repositories (TARs)”
  - All trusted equally
  - Each can certify any domain name
  - Large attack surface
  - CA/Browser Forum + WebTrust ?

What Can You Do to Help?

- Participate in the IETF and W3C Working Groups
- Deploy your website uniformly via HTTPS
- Deploy HSTS and CSP on your website
- Provide feedback to the working groups

Web Security Tomorrow (our desire)

http://upload.wikimedia.org/wikipedia/commons/3/33/Golden_gate2-2.jpg

Questions?

- For more details:

- The Need for Coherent Web Security Policy Framework(s)
  http://w2spconf.com/2010/papers/p11.pdf

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