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How Mozilla Does Web Security

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OWASP AppSec 2010 - DC

Agenda

- Declarative Web Security
  - Content Security Policy
  - HTTP Strict Transport Security
- Addressing the Web's top threats (spoiler: these aren't solved problems)
  - Outdated plugins
  - CSRF
  - Clickjacking
  - Better privacy support

Landscape of Threats

- The web faces a host of well-known but persistent threats
  - XSS
  - CSRF
  - MITM
  - Phishing
  - Overlay (“clickjacking”)
- Developers are aware of threats and mitigation strategies
- Rates of regression and bug discovery remain stable
- **Declarative security** mechanisms hold promise for reliable attack mitigation

Content Security Policy

- Addresses the threat of **content injection**, e.g. XSS:
- Fundamental problem:
  - Web client treats all content in server response with equal privilege
  - No way to differentiate legitimate content from injected content
- CSP provides a mechanism for sites to explicitly state which content is legitimate
  - Everything else can be dropped on the floor

A Line in the Sand...

- Script must come from external files served from white-listed hosts
  - No inline JavaScript, e.g. internal `<script>` nodes, `javascript:` URIs, event handling attributes
- No code from strings, a.k.a. `eval` is evil
  - Strings easily tainted by attacker-controlled data
- Only explicitly allowed content will load
  - Policies can be separately defined for other types of content too: images, audio/video, plugin content, stylesheets, etc.

Content Security Policy Directives

- allow
  - catch-all for unspecified content types
- img-src
- media-src
- script-src
- object-src
- frame-src
  - "what can be embedded here?"
- frame-ancestors
  - "what sites may embed me?"
- style-src
- report-uri
- policy-uri

Content Sources:

- Host expression
  - Hostname plus optional scheme and port
  - Wildcards are valid, e.g. *.example.com
- Keywords: 'self', 'none'

Example:

- X-Content-Security-Policy: allow 'self' my-cdn.com; frame-src ads.net; frame-ancestors 'self'

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Content Security Policy – Side Benefits

- Clickjacking Protection
  - `frame-ancestors` policy allows site to specify where a resource may be embedded
  - Frame-busting not as effective as once thought http://w2spconf.com/2010/papers/p27.pdf
- Violation Reporting
  - `report-uri` – "Canary in the coal mine" – get notified when policy violations occur
  - Report-only mode also available

Content Security Policy Demo

- WebGoat protected by CSP

More information on Content Security Policy

- Getting started
  - http://mzl.la/csp-info
- New in Firefox 4 (Early 2011)
  - Grab a beta: http://mzl.la/csp-demo
- W3C standard planned
  - http://www.w3.org/2010/07/appsecwg-charter
  - Proposed spec: http://mzl.la/csp-spec
- Mozilla looking for launch partners
  - We're willing to help! (bsterne@mozilla.com, @bsterne)

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HTTP Strict-Transport-Security

- Addresses the threat of **Man-in-the-middle** attacks
  - Packet sniffing, session hijacking
  - See also: recent Firesheep controversy
- Fundamental problem:
  - Web sites don't fully implement SSL/TLS
  - Session tokens are passed insecurely
- HTTP Strict Transport Security allows sites to force all connections to be made over SSL/TLS
  - Insecure requests are automatically rewritten

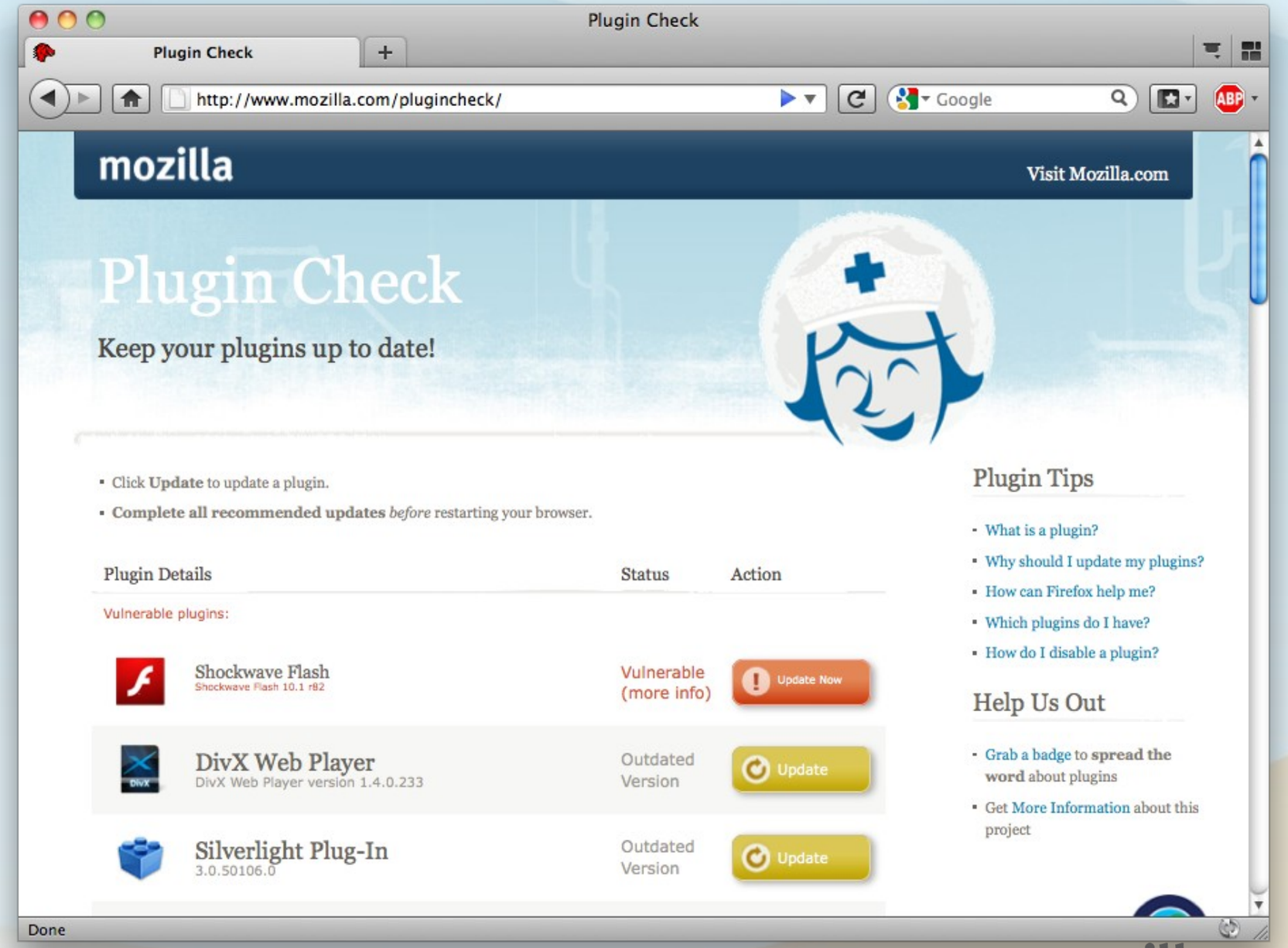
HTTP Strict Transport Security

- Specification:
  - http://tools.ietf.org/html/draft-hodges-strict-transport-sec
- Examples:
  - `Strict-Transport-Security: max-age=60000`
  - `Strict-Transport-Security: max-age=60000; includeSubdomains`
- Firefox 4
  - Fully implements the spec
  - Add-on for better UI: STS UI
- Firefox 3.6
  - Implemented by Force-TLS and NoScript add-ons

Plugin Checking Service

- Addresses the threat of **outdated plugins**

- **Major** source of security and stability risk for users
- Provides a way for users to see if their plugins are up to date



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Plugin Checking Service

- Top 24 plugins currently checked – more being added
- Plugin check webpage also works in Safari 4, Chrome 4, and Opera 10.5
- Longer term the service will be integrated into Firefox
  - Updating process varies widely between plugins → confusing to users
  - Plugin vendors will have “self-service” panel for updating new versions as they are released

Fixed: CSS History Sniffing Attack

- Addresses the threat of **browser history leakage** via CSS
- Long and well-understood issue
  - http://jeremiahgrossman.blogspot.com/2006/08/i-know-where-youve-been.html
  - http://ha.ckers.org/weird/CSS-history-hack.html
- Fixed in bug 147777
  - Limited which properties can be styled using :visited
  - `GetComputedStyle()` "lies" to the webpage

Fixed: CSS History Sniffing Attack

Firefox 3.6

File Edit View History Bookmarks Tools Help

http://ha.ckers.org/weird/CSS-history-hack.html

CSS History Hack

CSS History Hack

Originally found here but permanantly hosted on ha.ckers.org with Jeremiah's permission.

Ha.ckers.org home || Jeremiah's blog

Firefox Only! (1.5 - 2.0) tested on WinXP.

Visited

- http://mail.google.com/
- http://mail.yahoo.com/
- http://www.amazon.com/
- http://www.bankofamerica.com/
- http://www.cgisecurity.com/
- http://www.chase.com/
- http://www.cnn.com/
- http://www.ebay.com/
- http://www.etrade.com/
- http://www.flickr.com/
- http://www.google.com/
- http://www.yahoo.com/

Not Visited

- http://ha.ckers.org/blog/
- http://login.yahoo.com/
- http://my.yahoo.com/
- http://sla.ckers.org/forum/
- http://slashdot.org/
- http://www.aol.com/
- http://www.apple.com/
- http://www.bankone.com/
- http://www.blackhat.com/
- http://www.blogger.com/
- http://www.bofa.com/
- http://www.capitalone.com/
- http://www.citibank.com/
- http://www.comerica.com/
- http://www.e-gold.com/
- http://www.hsbc.com/
- http://www.icq.com/
- http://www.live.com/
- http://www.microsoft.com/
- http://www.microsoft.com/en/us/default.aspx

Done Connect

Firefox 4

File Edit View History Bookmarks Tools Help

CSS History Hack

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Google

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Visited

Not Visited

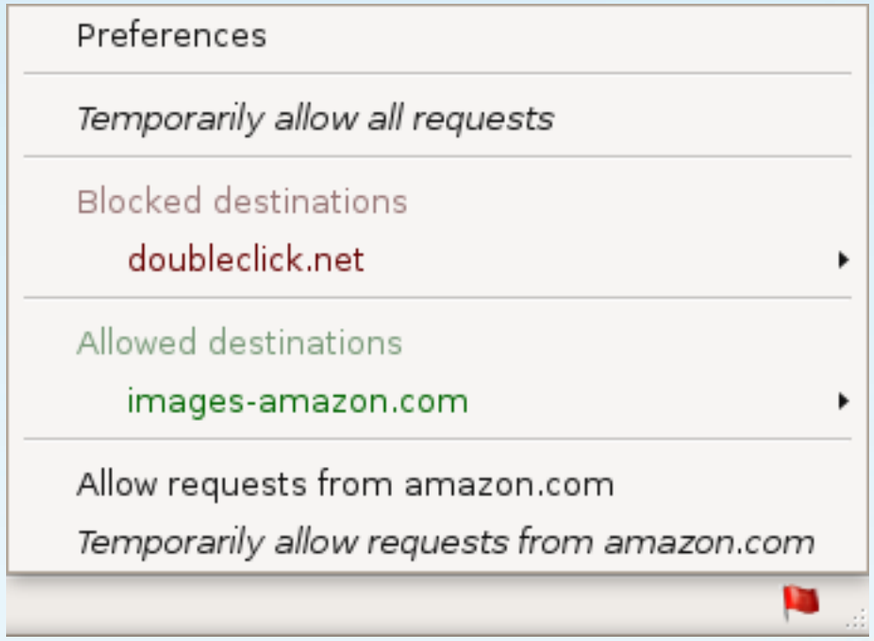
- http://ha.ckers.org/blog/
- http://login.yahoo.com/
- http://mail.google.com/
- http://mail.yahoo.com/
- http://my.yahoo.com/
- http://sla.ckers.org/forum/
- http://slashdot.org/
- http://www.amazon.com/
- http://www.aol.com/
- http://www.apple.com/
- http://www.bankofamerica.com/
- http://www.bankone.com/
- http://www.blackhat.com/
- http://www.blogger.com/
- http://www.bofa.com/
- http://www.capitalone.com/
- http://www.cgisecurity.com/
- http://www.chase.com/
- http://www.citibank.com/
- http://www.cnn.com/
- http://www.comerica.com/
- http://www.e-gold.com/
- http://www.ebay.com/
- http://www.etrade.com/
- http://www.flickr.com/
- http://www.google.com/
- http://www.hsbc.com/
- http://www.icq.com/
- http://www.live.com/
- http://www.microsoft.com/
- http://www.microsoft.com/en/us/default.aspx
- http://www.msn.com/
- http://www.myspace.com/
- http://www.passport.net/

Looking Forward

- Prioritize list of biggest security threats to Web
  - **Your** input is invaluable
  - mozilla.dev.security, security@mozilla.org
- Always a spectrum of solutions
  - Compatibility/Usability ↔ Security
- How much can we reasonably break?

Top Threat: CSRF*

- Huge percentage of sites are vulnerable
  - Conservatively 21% per WhiteHat Fall 2010 report
- Mitigation strategies are apparently hard to implement
- One complete solution: RequestPolicy add-on
  - Breaks the Web for most users
  - Workaround: ship with known-good policy configurations and crowd source the rest



*** author's humble opinion**

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CSRF – Another solution

- Origin header
  - Privacy improvements over Referer header
  - http://tools.ietf.org/html/draft-abarth-origin-00
    - "The user agent MAY include an Origin header in any HTTP request."
    - Implemented in Chrome, only sent with POST
    - Browsers will send null from "privacy-sensitive contexts"
  - Web is fraught with state-changing GETs
  - Still requires servers to do the right thing with Origin data

CSRF – Fixing part of the problem

- Intranet hacking
  - Yes, an old and well-understood issue
    - "Hacking Intranet Websites…" - Grossman, Black Hat 2006
  - Not a trivial fix
    - Security context not always available (a common theme)
    - Web proxies
  - 95% fixed in bug 354493
    - Ironing out testing infrastructure

Clickjacking

- Browsers have started to provide solutions
  - X-Frame-Options
  - CSP frame-ancestors
- Incomplete Solutions
  - Does prevent framing, does not prevent stolen mouse clicks
  - Sites want to be framed across domains, they just don't want to be clickjacked

Clickjacking – Potential Solution

- Prevent obfuscated elements from being clicked
- Heuristics are hard
  - Can't force an iframe to be unconditionally on top, could break the embedding site's layout
  - A strong definition of “clickable” would be a good start; force such elements to be 100% opaque and on top
  - Obscured by small size, similar background, etc.
- NoScript attempts to implement these heuristics
  - “Partially obstructed, transparent or otherwise disguised” elements are revealed before interaction

Privacy Improvements

- Anonymous Browsing Mode
  - Different from Private Browsing (protect against local attacker)
  - Minimize amount of identifying data sent to servers
    - Prevent tracking and fingerprinting (see Panopticlick)
  - Do everything Torbutton add-on does natively in the browser
  - Exploratory work: https://wiki.mozilla.org/Security/Anonymous_Browsing

Privacy Improvements

- Double-keyed cookies
  - Third party cookies are only sent from the same embedding context
    - The Doubleclick cookie you got on example.com only gets sent when you're on example.com
  - Work in progress
    - https://wiki.mozilla.org/Thirdparty
    - 3rd party cookies downgraded to session \o/ (bug 565475) but pref'd-off (bug 570630) ಠ_ಠ
    - Key cookies by embedding context (bug 565965)
    - Political groundwork needed

Thank You