Web Security: Loose Ends

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OWASP Top 10 Web Vulnerabilities

1. Injection
2. Broken Authentication & Session Management
3. Cross-Site Scripting
4. Insecure Direct Object References
5. Security Misconfiguration
6. Sensitive Data Exposure
7. Missing Function Level Access Control
8. Cross-Site Request Forgery
9. Using Known Vulnerable Components
10. Unvalidated Redirects and Forwards

http://www.owasp.org
Web Session Management
Primitive Browser Session

View catalog

Select item

Check out

Store session information in URL; easily read on network
Bad Idea: Encoding State in URL

• Unstable, frequently changing URLs
• Vulnerable to eavesdropping and modification
• There is no guarantee that URL is private
FatBrain.com circa 1999

• User logs into website with his password, authenticator is generated, user is given special URL containing the authenticator
  
  https://www.fatbrain.com/HelpAccount.asp?t=0&p1=me@me.com&p2=540555758
  
  – With special URL, user doesn’t need to re-authenticate
  
  • Reasoning: user could not have not known the special URL without authenticating first. That’s true, BUT...

• Authenticators are global sequence numbers
  
  – It’s easy to guess sequence number for another user
    
    https://www.fatbrain.com/HelpAccount.asp?t=0&p1=SomeoneElse&p2=540555752
  
  – **Partial fix**: use random authenticators
Typical Solution: Web Authentication via Cookies

- Servers can use cookies to store state on client
  - When session starts, server computes an authenticator and gives it back to browser in the form of a cookie
    - Authenticators must be unforgeable and tamper-proof
      - Malicious client shouldn’t be able to compute his own or modify an existing authenticator
    - Example: MAC(server’s secret key, session id)
      - With each request, browser presents the cookie
      - Server recomputes and verifies the authenticator
        - Server does not need to remember the authenticator
Storing State in Hidden Forms

• Dansie Shopping Cart (2006)
  – “A premium, comprehensive, Perl shopping cart. Increase your web sales by making it easier for your web store customers to order.”

```html
<FORM METHOD=POST
ACTION="http://www.dansie.net/cgi-bin/scripts/cart.pl">
  Black Leather purse with leather straps<br>
  <INPUT TYPE=HIDDEN NAME=name VALUE="Black leather purse">
  <INPUT TYPE=HIDDEN NAME=price VALUE="20.00">
  <INPUT TYPE=HIDDEN NAME=sh VALUE="1">
  <INPUT TYPE=HIDDEN NAME=img VALUE="purse.jpg">
  <INPUT TYPE=HIDDEN NAME=custom1 VALUE="Black leather purse with leather straps">
  <INPUT TYPE=SUBMIT NAME="add" VALUE="Put in Shopping Cart">
</FORM>

Change this to 2.00
Bargain shopping!

Fix: MAC client-side data, or, more likely, keep on server.
Top Web Vulnerabilities: Summary

• XSS (CSS) – cross-site scripting
  – Malicious code injected into a trusted context (e.g., malicious data presented by an honest website interpreted as code by the user’s browser)

• SQL injection
  – Malicious data sent to a website is interpreted as code in a query to the website’s back-end database

• XSRF (CSRF) – cross-site request forgery
  – Bad website forces the user’s browser to send a request to a good website

• Broken authentication and session management
Cross-Origin Communication?

• Websites can embed scripts, images, etc. from other origins.

• **But**: AJAX requests (aka XMLHttpRequests) are not allowed across origins.

On example.com:

```html
<script>
var xhr = new XMLHttpRequest();
xhr.onreadystatechange = handleStateChange; // Elsewhere
xhr.open("GET", "https://bank.com/account_info", true);
xhr.send();
</script>
```
Cross-Origin Communication?

• Websites can embed scripts, images, etc. from other origins.
• **But:** AJAX requests (aka XMLHttpRequests) are not allowed across origins.

• Why not?
  • Browser automatically includes cookies with requests (i.e., user credentials are sent)
  • Caller can read returned data (clear SOP violation)
Allowing Cross-Origin Communication

• Domain relaxation
  – If two frames each set document.domain to the same value, then they can communicate
    • E.g. www.facebook.com, facebook.com, and chat.facebook.com
    • Must be a suffix of the actual domain

• Access-Control-Allow-Origin: <list of domains>
  – Specifies one or more domains that may access DOM
  – Typical usage: Access-Control-Allow-Origin: *

• HTML5 postMessage
  – Lets frames send messages to each other in controlled fashion
  – Unfortunately, many bugs in how frames check sender’s origin
What about Browser Plugins?

• **Examples:** Flash, Silverlight, Java, PDF reader
• **Goal:** enable functionality that requires transcending the browser sandbox
• Increases browser’s attack surface

Java and Flash both vulnerable—again—to new 0-day attacks
Java bug is actively exploited. Flash flaws will likely be targeted soon.

by Dan Goodin (US) - Jul 13, 2015 9:11am PDT

• **Good news:** plugin sandboxing improving, and need for plugins decreasing (due to HTML5 and extensions)
News: Goodbye Flash

Get ready to finally say goodbye to Flash — in 2020

Posted Jul 25, 2017 by Frederic Lardinois (@fredericl)
What about Browser Extensions?

• Most things you use today are probably extensions
• **Examples:** AdBlock, Ghostery, Mailvelope
• **Goal:** Extend the functionality of the browser

• (Chrome:) Carefully designed security model to protect from malicious websites
  – **Privilege separation:** extensions consist of multiple components with well-defined communication
  – **Least privilege:** extensions request permissions
What about Browser Extensions?

- But be wary of malicious extensions: not subject to the same-origin policy – can inject code into any webpage!