

Web App Security

Browser Isolation

Mendel Rosenblum

What could go wrong with our web app?

- Our app could allow an attacker to view and/or modify any information or perform any operations we provide
 - Leak information provided
 - Perform actions on behalf of the user
- Our app could be used to attack anything on our user's machine and or anything our user machine can talk to
 - If the user trusts us we can allow damage far beyond what the user believes they give to us
- Security concept: **Threat Model**
 - What attacks are we trying to deal with?

Security is an hard problem

- Many opportunities for attackers
 - Full stack means there are many interface that an attacker can use
- Hard to identify all the vulnerabilities
 - Complexity of system make it impossible guarantee no vulnerabilities
- Even a small mistake can compromise entire application
 - Only as strongest as the weakest link

Modes of attacks on web applications

- Attack the connection between browser and web server
 - Steal password
 - Hijack existing connection
- Attack the server
 - Inject code that does bad things
- Attack the browser
 - Inject code that does bad things
- Breach the browser, attack the client machine
- Fool the user (phishing)

Security Defences

- Isolation in browsers
 - Web app run in isolated sandbox
- Cryptography
 - Protect information from unauthorized viewing
 - Detect changes
 - Determine origin of information
- Web development frameworks
 - Use patterns that help, avoid dangerous ones

Challenge of isolation in the browser

- Web content comes from many sources, not all equally trusted
 - Example: Your bank and the web site your friend sent you
- Trusted and untrusted content are in close proximity
 - Frames, tabs, sequential visits
- Must separate various forms of content so that untrusted content cannot corrupt/misuse trusted content

Example: a "good" page displays a sponsored ad

- Attackers can buy advertisements, use them to attack good pages.
- Advertiser gets to supply content for ad
 - "good" page links to advertiser site in `<iframe>`
- Ad can contain `<script>` elements that access DOM, submit forms, etc.
 - `parent.frames[0].forms[0].submit;`

Same-Origin Policy

- General idea: separate content with different trust levels into different frames, restrict communication between frames
- One frame can access content in another frame only if they both came from the same origin
- Origin is
 - Protocol
 - Domain name
 - Port
- Access applies to DOM resource, cookies, XMLHttpRequest requests

same-origin policy is too restrictive

- There are times when it is useful for frames with different origins to communicate
 - Example: Sub-domains of same organization
 - Web fonts
 - Content distribution network

- Browsers allows page to set its domain with `document.domain`

```
document.domain = "company.com";
```

- Limited to sub-domain sharing

HTML5 feature: Access-Control-Allow-Origin

- Access-Control-Allow-Origin header in HTTP response:

Access-Control-Allow-Origin: http://foo.com

Access-Control-Allow-Methods: PUT, DELETE

- Specifies one or more domains that may access this object's DOM.

Can use "*" to allow universal access.

HTML5 postMessage - safe messaging

- Sender (from domain a.com) to an embedded frame of different domain

```
frames[0].postMessage("Hello world", "http://b.com/");
```

- Receiver (domain b.com) can check origin:

```
window.addEventListener("message", doEvent);  
function doEvent(e) {  
    if (e.origin === "http://a.com") {  
        ... e.data ...  
    }  
}
```

Cookie Security

- Cookies can be read and written from Javascript:

```
alert(document.cookie);  
document.cookie = "name=value; expires=1/1/2011"
```

- Browsers use the same-origin policy to restrict access to cookies.