Clickjacking Protection Under Non-trivial Circumstances

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- **What is Clickjacking?**
- **Current Defenses**
- **Open Issues and Limitations**
- **Protection Approach**

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Technical Background
What is Clickjacking?

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> *Clickjacking* (also called *UI redressing*) is an attack that lures an unsuspicious user into clicking on an element that is different to what the user perceives to click on.

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Technical Background
What is Clickjacking?

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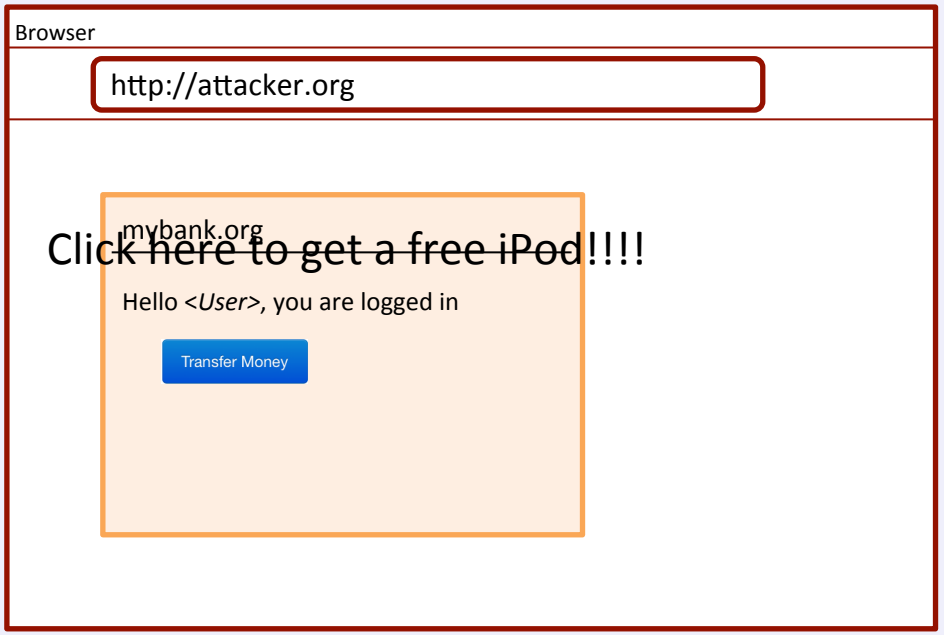
Controllable Container

- Frames
- Object, Embed
- Popup windows

Disguising the UI

- Covering it with other elements
- Reducing its size
- Displaying it only for a very short amount of time
- Making it transparent



mybank.org

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Current Defense Techniques

Overview

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Client-side approaches:

- Protect a single user against attacks on all web applications
  - E.g.: NoScript Clearclick
  - Alternative browser designs: Gazelle, OP, Secure Web Browser

Server-side approaches:

- Protect all users of single web application against attacks
- Deployed on the server-side, but enforcement happens on the client-side
  - Frame Busting
  - X-Frame-Options Header

Current Defense Techniques

Server-Side

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Frame Busting

- Basic Idea: Avoid unauthorized framing of a web page
- Implementation: A small snippet of JavaScript code checks if page is framed. If so, it navigates the top frame towards the framed page

```
<script>
  if (parent!= self)
    parent.location = self.location;
</script>
```

Several ways exist to circumvent this protection:

- Prevent JavaScript execution
  - Misusing modern XSS filters
  - Using sandboxed iframes
- Prevent redirect
  - 204 flushing
  - Double framing
  - By asking the user nicely (onbeforeunload event)

It is possible to build secure frame busters. However, the knowledge about it is not widely spread

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X-Frame-Options Header

- Approach introduced by Microsoft to counter Clickjacking attacks
- Idea is similar to frame busting: Avoid unauthorized framing of a page
- Implementation:
  - Non-JavaScript solution
  - Based on an HTTP Response header
  - Browser enforces the Web server's desired behavior

The X-Frame-Options header takes one of two values:

- SAMEORIGIN: Only same-origin pages are allowed to frame the marked page
- DENY: Framing is forbidden
- (IE only: FROMORIGIN: Allows one specific origin to frame the marked page)

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Open Issues

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Clickjacking is not limited to frames

- Double Clickjacking
- Clickjacking via History navigation

Open Issues

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Double Clickjacking

Technique developed by Huang and Jackson

- Based on popups instead of frames

- **Procedure**

1. Open target page as a popup window behind the current browser window
   - The opening page receives a window handle = navigational control
2. Lure the victim into double clicking on the current browser window
   - First click: hits current window + triggers focus to the popup
   - Second click: hits the popup + triggers state changing action
3. Close the popup shortly after the first click

E.g. Google OAuth authentication popup was attacked with this method

Open Issues

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Clickjacking via History Navigation (Caching)

Technique developed by Michal Zalewski

- Also based on popups instead of frames

- **Procedure**

1. Open target page as a popup window
   - Page is cached by the browser
2. Immediately navigate the popup to an attacker controlled site
3. Lure user into clicking on the page
4. Shortly before the click: call history.back()
   - Target page is loaded from cache: It is immediately rendered
   - Click hits the target page: Navigate away or close the window afterwards

Open Issues
Vulnerabilities

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Removing HTTP response headers in Safari

- Vulnerability within the HTML5 Offline Application Cache
- Offline App Cache allows to store HTML documents for offline usage
- Websites are always retrieved from Cache first (even if a connection is available)
- The App Cache does not store HTTP response headers
  - Hence web pages stored/read from cache cannot be protected via X-Frame-Options

Risk Assessment

- HTML5 Offline Applications are often used in mobile environments
  - Mobile version of GMAIL
  - Mobile version of Hotmail
- Given Apple's (and therewith Safari's) market leadership this is a serious vulnerability for iOS users

Open Issues
Vulnerabilities

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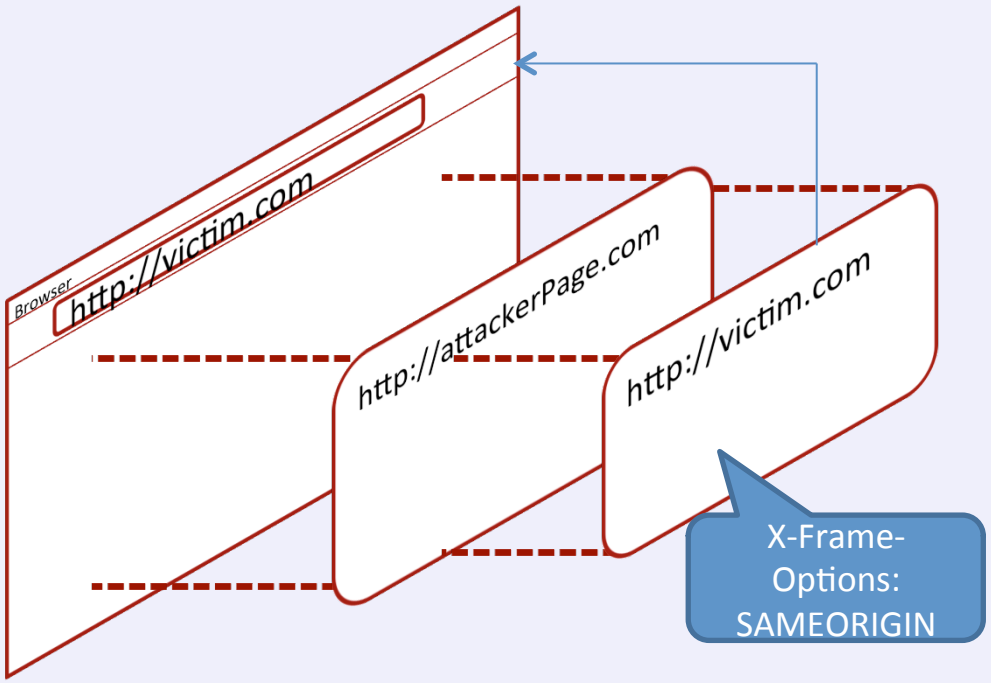
Nested Clickjacking



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Open Issues
Vulnerabilities

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Nested Clickjacking

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The current defense mechanisms have one thing in common

- Prevent unauthorized framing to protect against Clickjacking
- Authorized framing = same-domain framing
- Unauthorized framing = cross-domain framing

How to protect against Clickjacking if cross-domain framing is required?

- E.g. in Corporate-Portal environments
- E.g. Ad providers
- E.g. Web widgets
- No possibility to protect against Clickjacking in this case
  - At least not until allow-from is widely supported

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Protection Approach

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Design Goals

1. Based on standard browser features
   - To ensure immediate availability and cross browser compatibility
2. Protection within different environments
   - Frames
   - Popups
   - Protection against the described vulnerabilities
3. Configurability
   - Allow a whitelisting approach
   - With a potentially unlimited number of entries

Protection Approach

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High-level Overview

- Idea: Whenever a page tries to render(frame/popup) a page outfitted with our countermeasure, force the embedding page to prove it's authenticity to the embedded page. Rendering of the embedded webpage is postponed until a prove is given.
- Challenges:

1. Prevent rendering of the page

```
<style>
  body { display:none; }
</style>
```

2. Detect untrusted view-port constellations (framing/popup)

```
parent !== self || opener !== null
```

3. Prove the authenticity of the embedding page

```
function handlePostMessage(event){
  if(event.origin === 'http://example.net'){
    bodyElement.style.display='block ';
  }
}
```

4. Inform the framing about the registration of the PostMessage handler within the frame

```
parent.postMessage("Anti-Clickjacking ready", "*")
```

Protection Approach

Putting the pieces together

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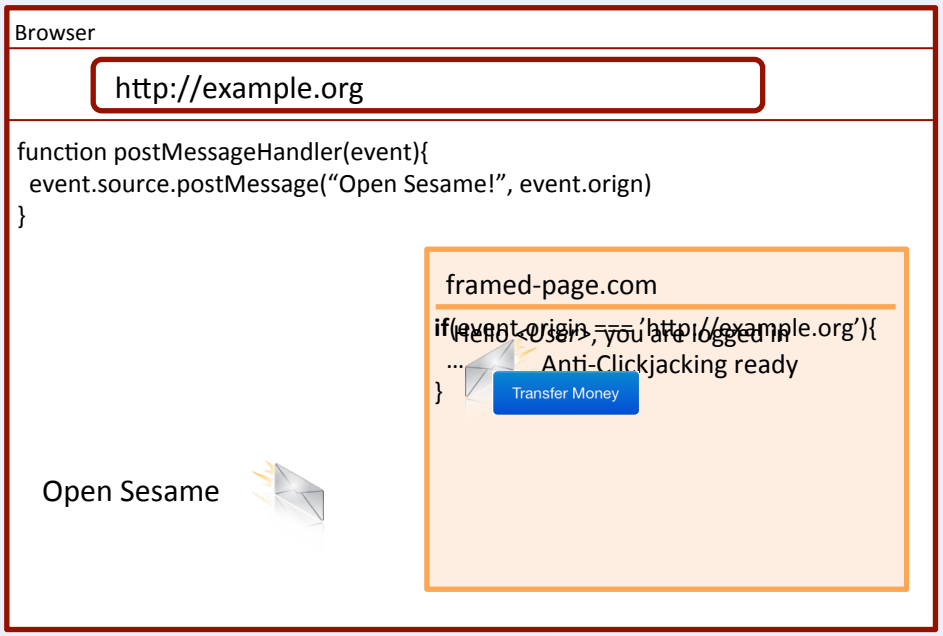

Embeding Page

- Register a PostMessage handler
- Insert the iframe element
- Reply PostMessage

Framed Page

- Load & send PostMessage
- Receive reply
- Check origin of reply
- If origin is appropriate, reveal the content

Conclusion

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Clickjacking

- Attack that hijacks clicks from an unsuspicious user

Protection Approaches

- Client-side: Clearclick or alternative browser designs
- Server-side: X-Frame-Options, Frame busting, CSP
- All techniques focus on preventing framing
- Techniques are not applicable in many cases
- Vulnerabilities: Nested Clickjacking, Clearclick circumvention

New Protection Approach

- Based on standard features: JavaScript (PostMessage API) & CSS
- Protects against all the outlined cases
- Flexible and configurable

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Thank you

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