# Investigating the Practicality and Cost of Abusing Memory Errors with DNS

Project Bitfl1p by Luke Young

# $ whoami

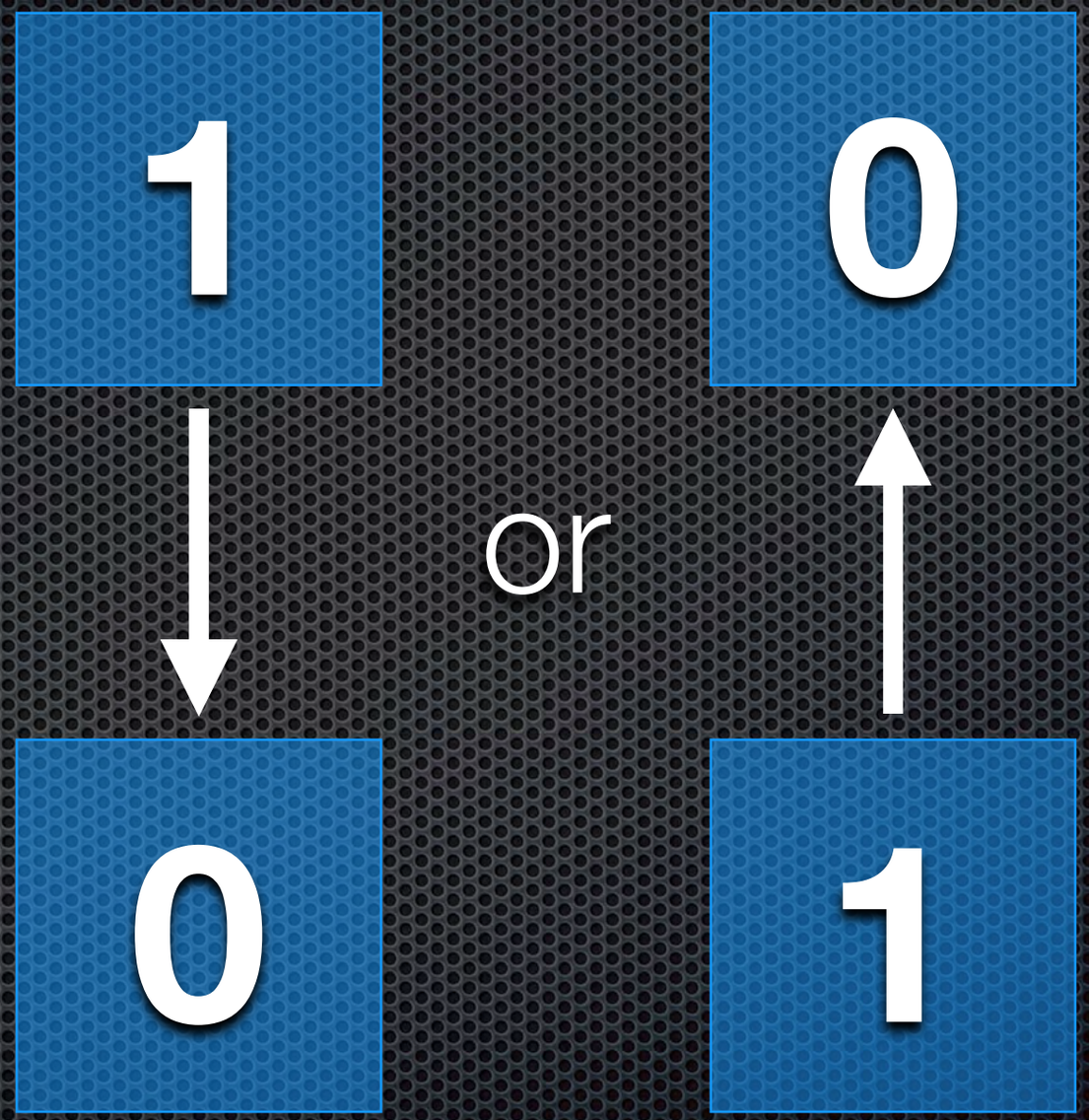
- Undergraduate Student - Sophomore
- Founder of Hydrant Labs LLC
- This presentation is based upon research conducted as a employee of Hydrant Labs LLC and was not supported or authorized by any previous, current, or future employers with the exception of Hydrant Labs LLC.


- Email: luke@hydrantlabs.org
- LinkedIn: https://www.linkedin.com/in/innoying
- Twitter: @innoying

# Agenda

- What is a bitflip and their history
- What is bit-squatting and how it works
- Project Bitfl1p's use of bit-squatting
- Code and partial data release
- Q&A

# What is a bitflip?

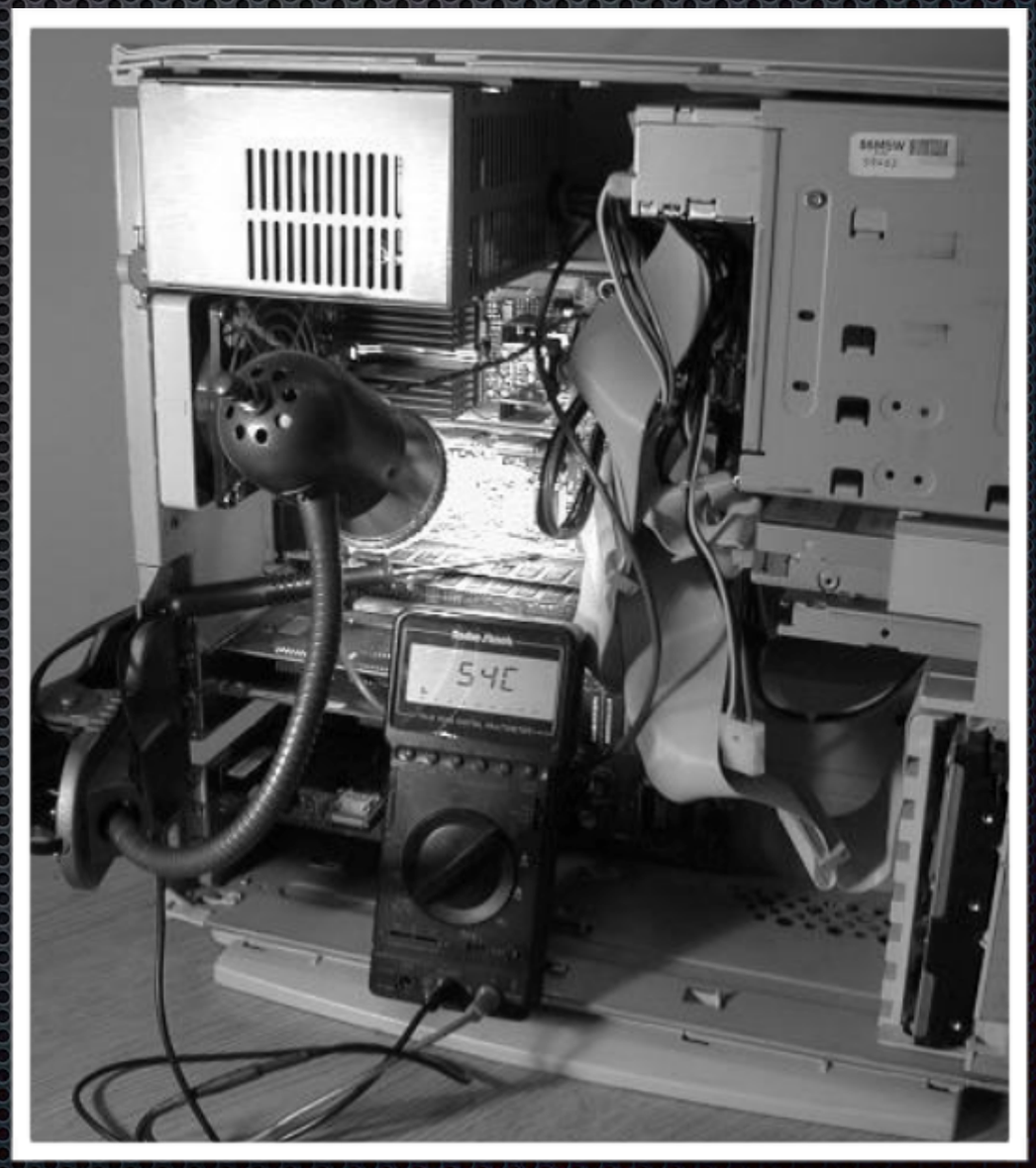


# What causes a bitflip?

- Heat
- Electrical Problems
- Radioactive Contamination
- Cosmic Rays

# History of bitflips

- “Using Memory Errors to Attack a Virtual Machine” - Princeton University in 2003



# Rowhammer

- “Flipping Bits in Memory Without Accessing Them: An Experimental Study of DRAM Disturbance Errors” - Carnegie Mellon University in 2014
- “Exploiting the DRAM rowhammer bug to gain kernel privileges” - Google’s Project Zero

# What is bit-squatting?

- Named by Artem Dinaburg
- Purchasing of domain names that are one bit away from the legitimate name.

# Example of bit-squatting

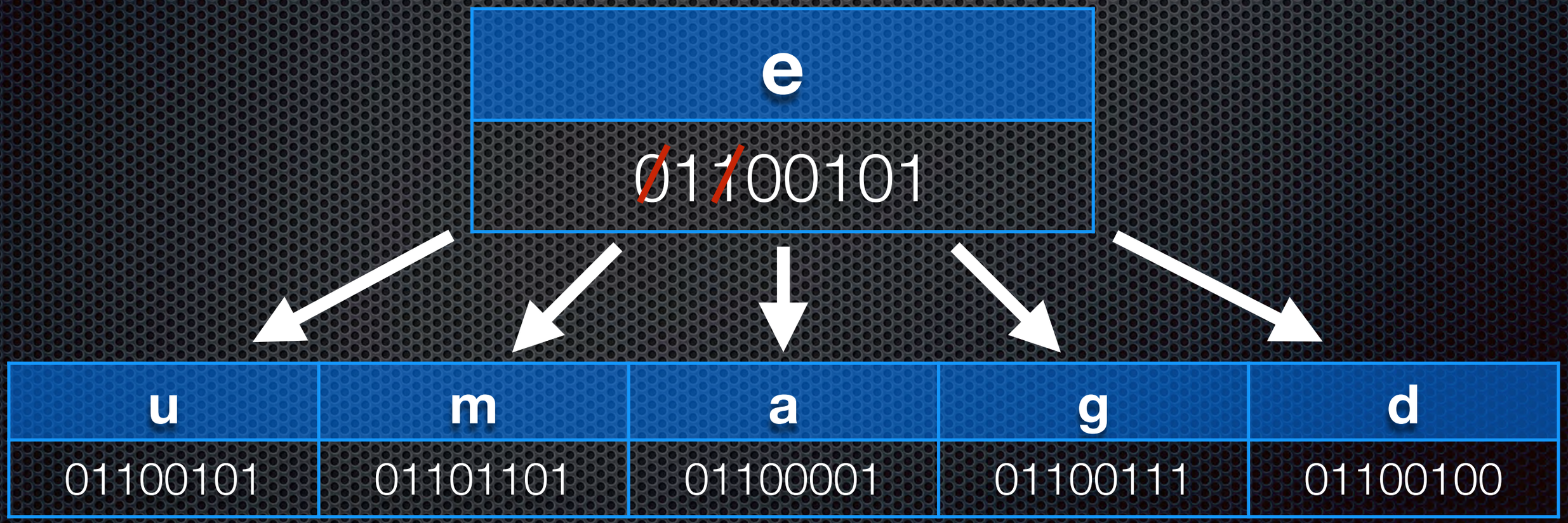
| c | n | n | . | c | o | m |
|---|---|---|---|---|---|---|
| 01100011 | 01101110 | 01101110 | 00101110 | 01100011 | 01101111 | 01101101 |



| c | o | n | . | c | o | m |
|---|---|---|---|---|---|---|
| 01100011 | 01101111 | 01101110 | 00101110 | 01100011 | 01101111 | 01101101 |

# Generating valid bit-squats

**www.defcon.org**



# Generating valid bit-squats

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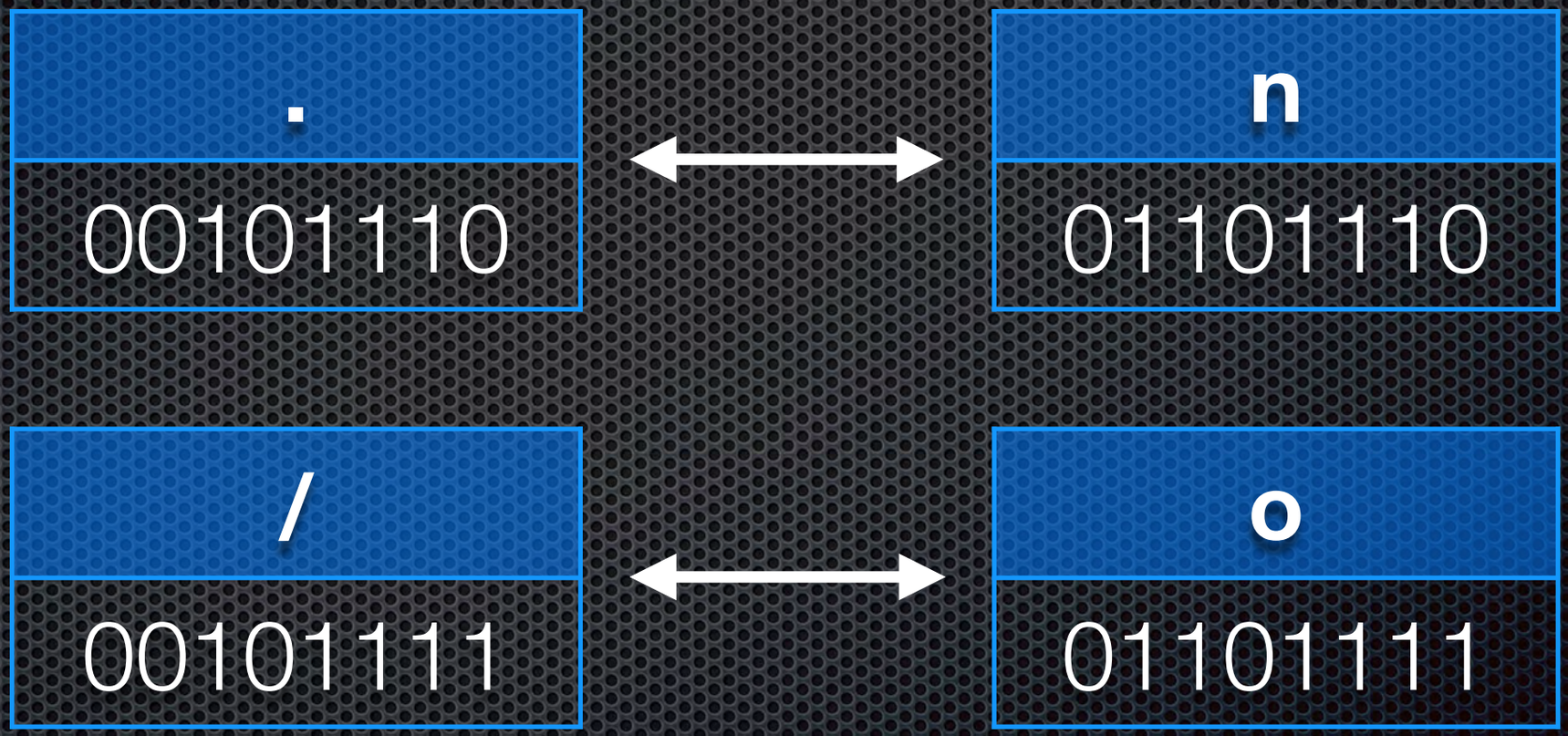

# $ bf-lookup www.defcon.org

- vww.defcon.org
- uww.defcon.org
- sww.defcon.org
- gww.defcon.org
- 7ww.defcon.org
- wvw.defcon.org
- wuw.defcon.org
- wsw.defcon.org
- wgw.defcon.org
- w7w.defcon.org
- wwv.defcon.org
- wwu.defcon.org
- wws.defcon.org
- wwg.defcon.org
- ww7.defcon.org
- wwwndefcon.org
- www.eefcon.org
- www.fefcon.org
- www.lefcon.org
- www.tefcon.org
- www.ddfcon.org
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- www.defaon.org
- www.defgon.org
- www.defkon.org
- www.defson.org
- www.defcnn.org
- www.defcmn.org
- www.defckn.org
- www.defcgn.org
- www.defcoo.org
- www.defcol.org
- www.defcoj.org
- www.defcof.org

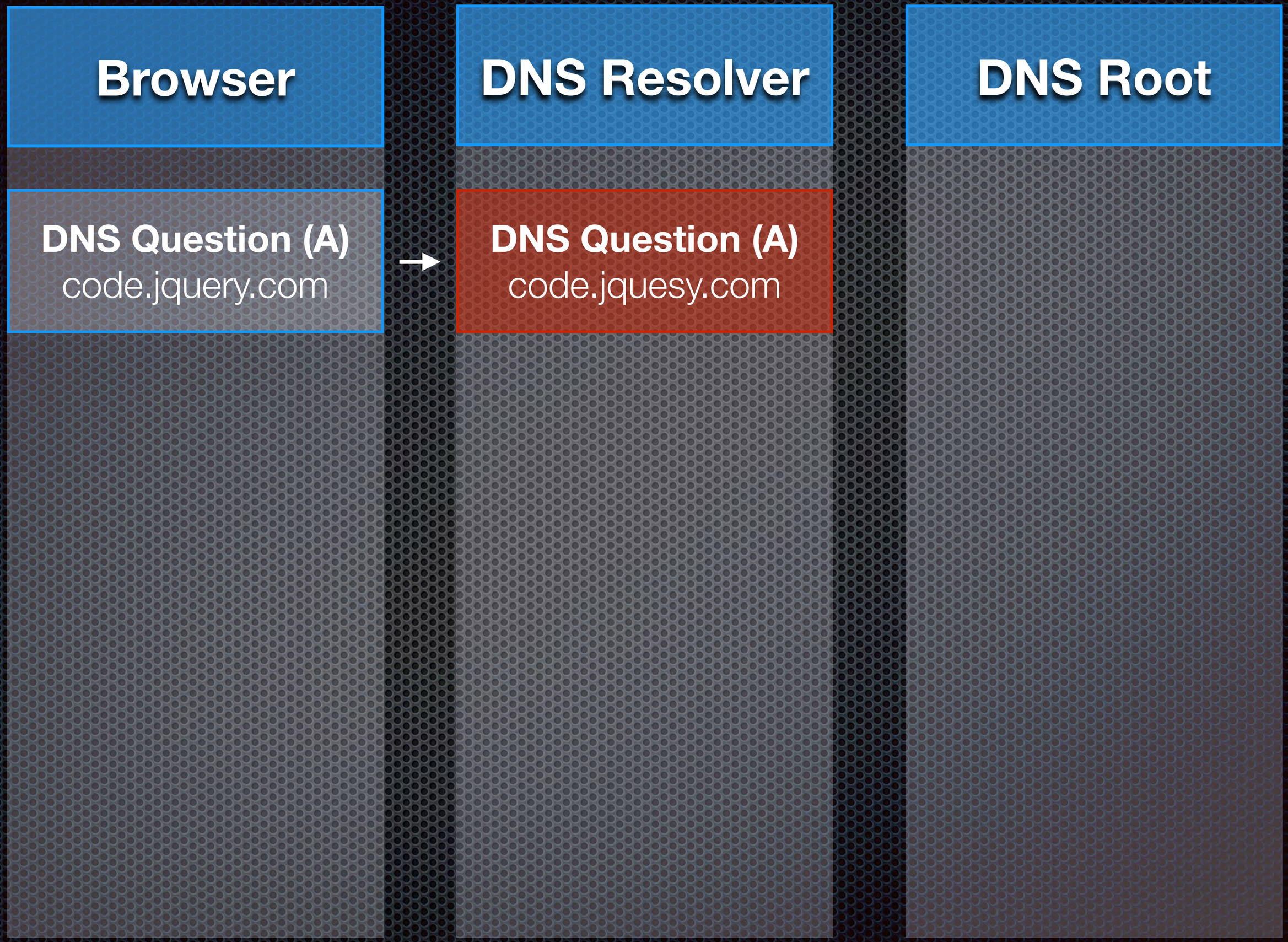
# Previous bit-squatting

- Artem Dinaburg - DEF CON 19
- Jaeson Schultz - DEF CON 21
- Robert Stucke - DEF CON 21

# Project Bitfl1p

Detect and analyze the frequency of bit flips for an average internet user through the use of bit-squatting

| Browser | DNS Resolver | DNS Root |
| --- | --- | --- |
| **DNS Question (A)**<br>code.jquery.com | → **DNS Question (A)**<br>code.jquery.com | |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DNS Resolver
DNS Root
DNS Question (A)
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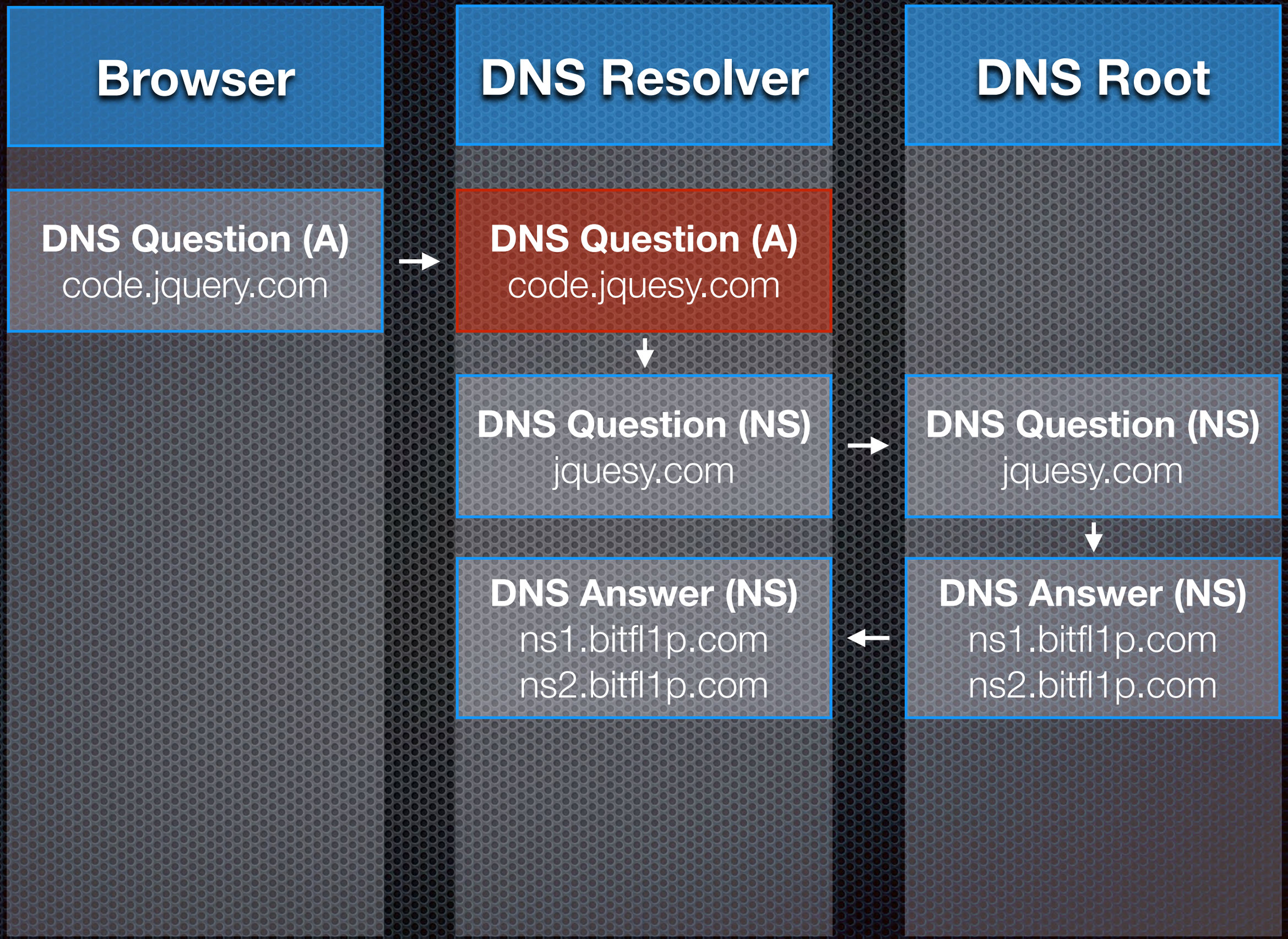
DNS Question (A)
code.jquesy.com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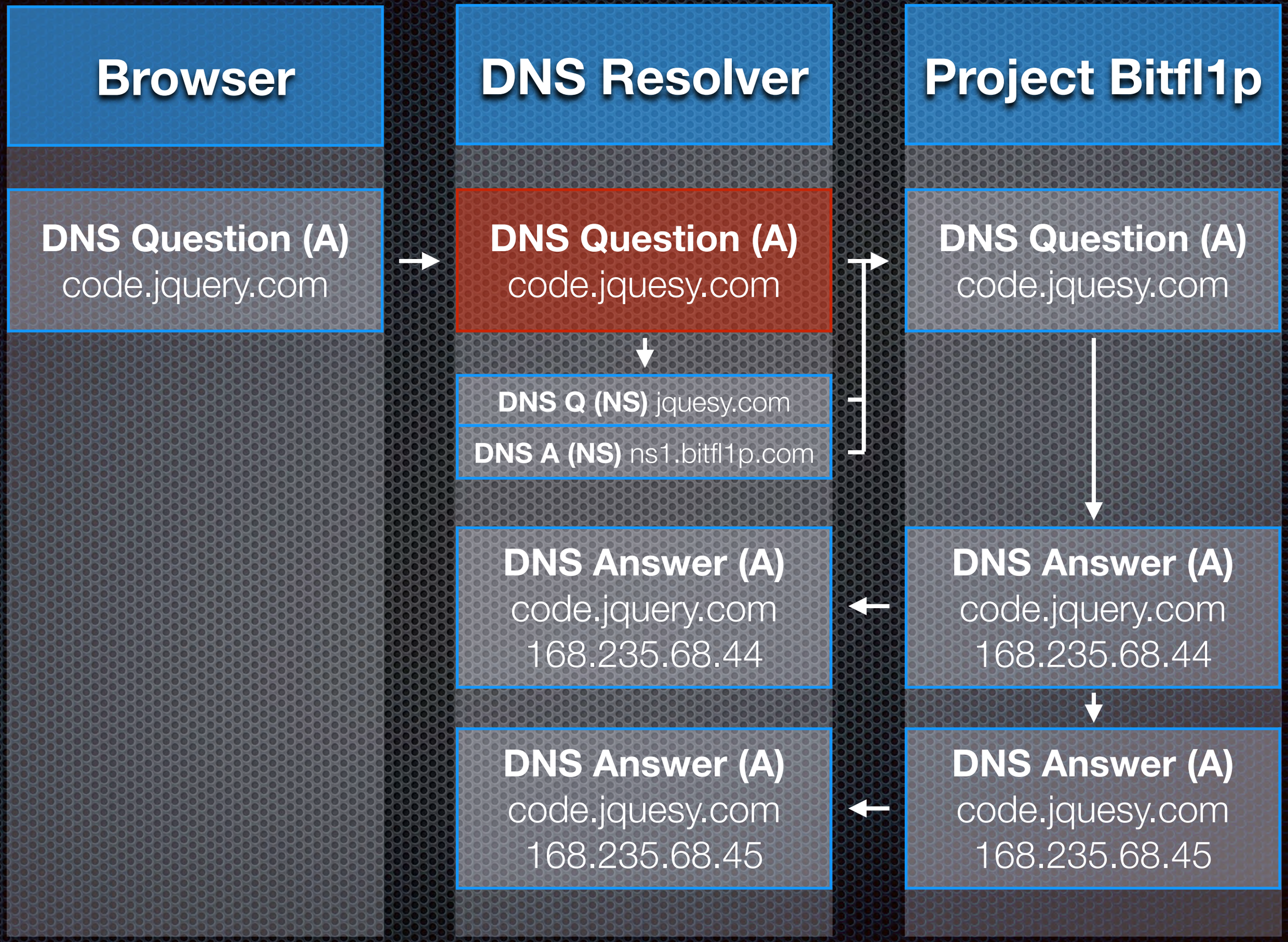
ns1.bitfl1p.com
ns2.bitfl1p.com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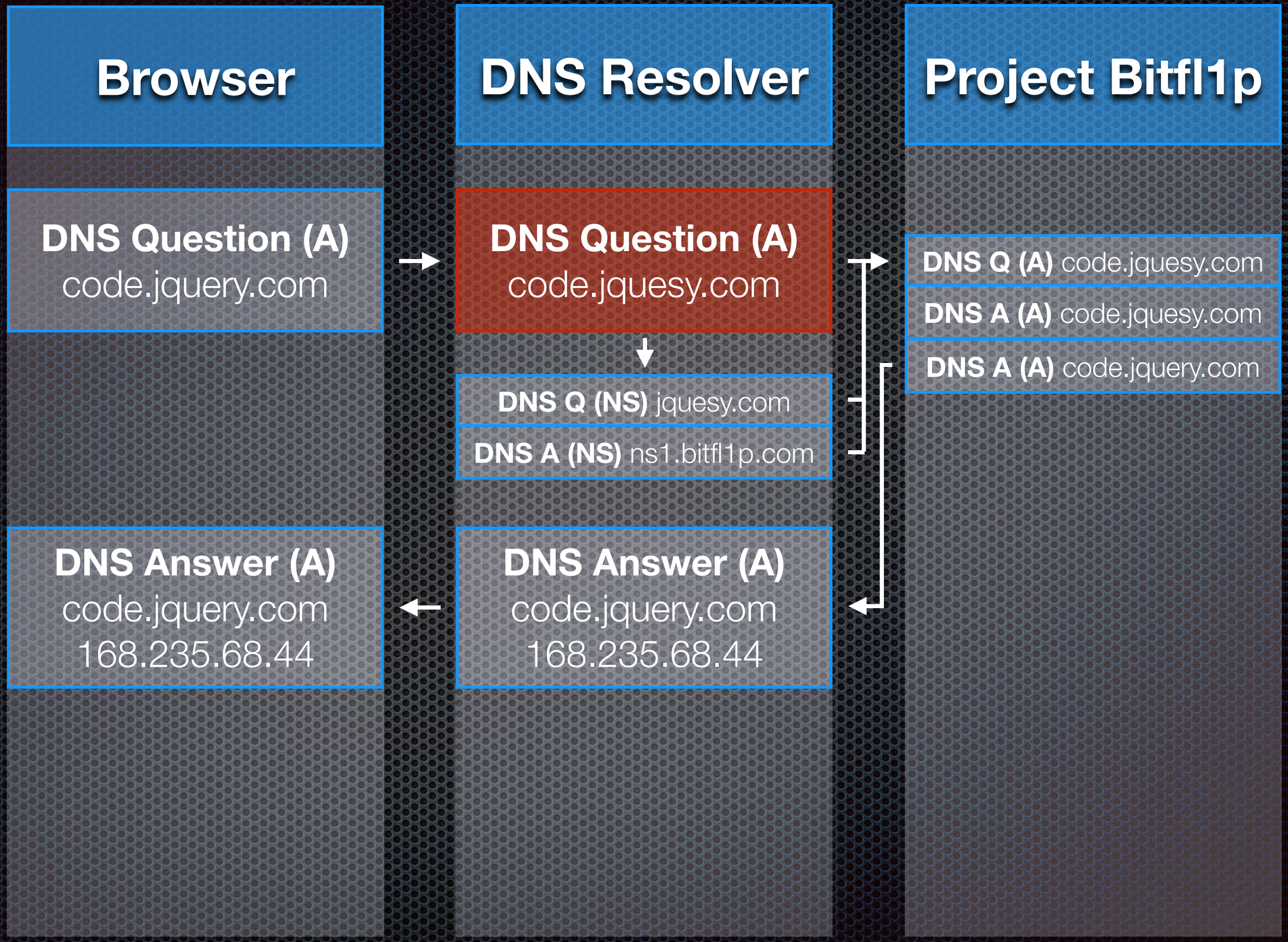
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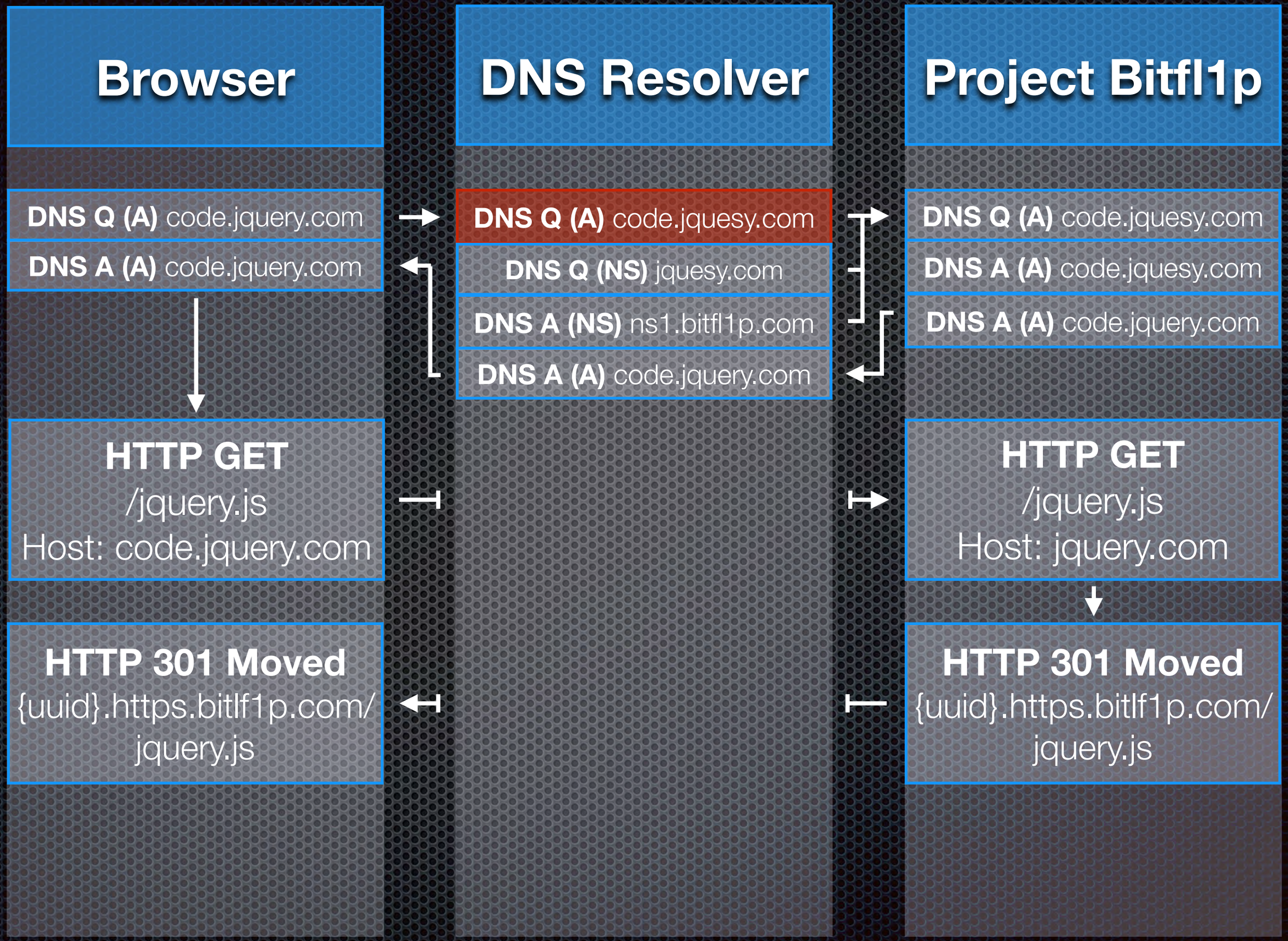
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HTTP GET
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Host: jquery.com
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HTTP 301 Moved
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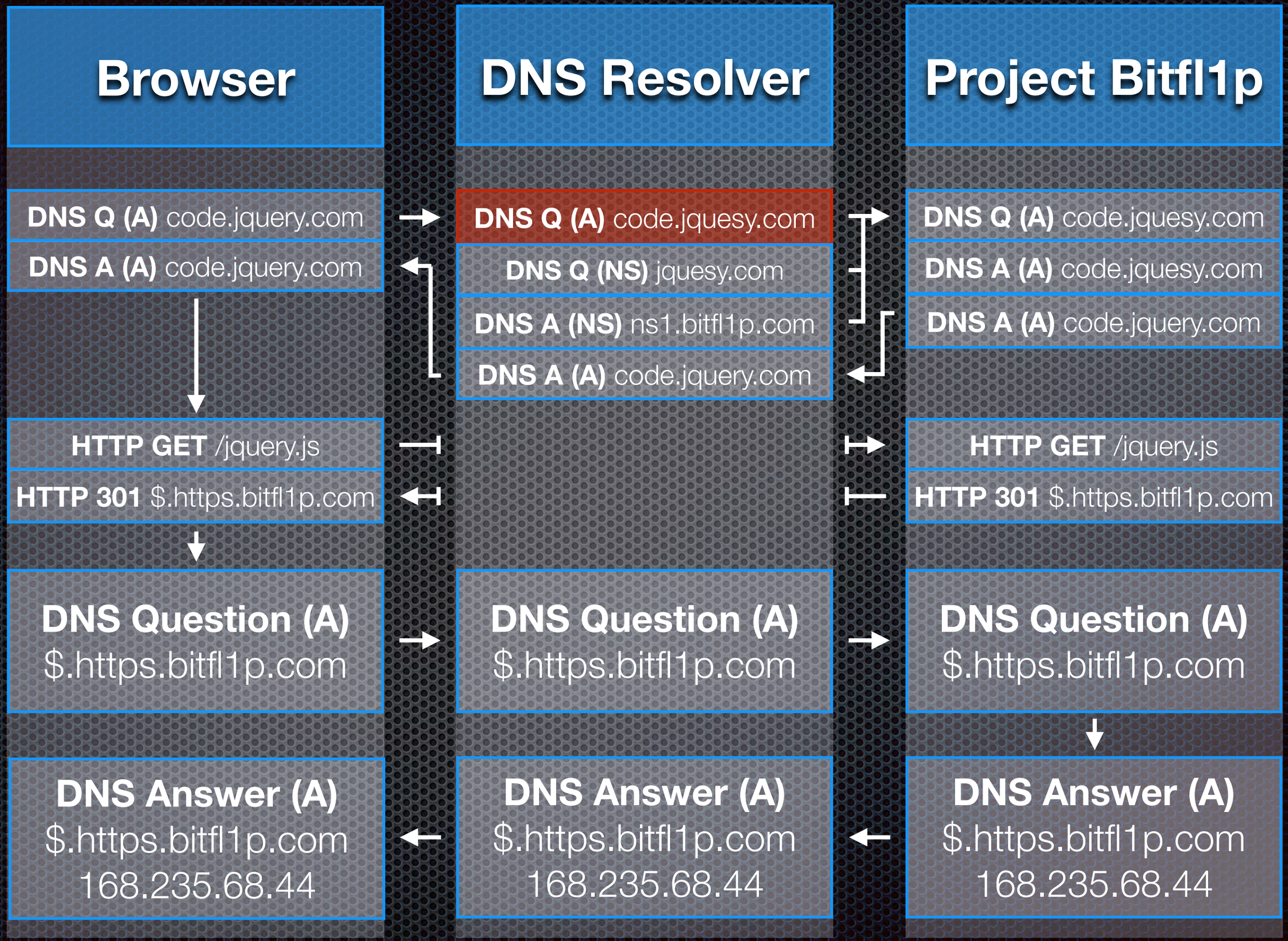
jquery.js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| **DNS A (A)** code.jquery.com | ← | **DNS A (A)** code.jquery.com | ← | |
| ↓ | | | | |
| **HTTP GET** /jquery.js | → | | → | **HTTP GET** /jquery.js |
| **HTTP 301** $.https.bitfl1p.com | ← | | ← | **HTTP 301** $.https.bitfl1p.com |
| ↓ | | | | |
| **DNS Q (A)** $.https.bitfl1p.com | → | **DNS Q (A)** $.https.bitfl1p.com | → | **DNS Q (A)** $.https.bitfl1p.com |
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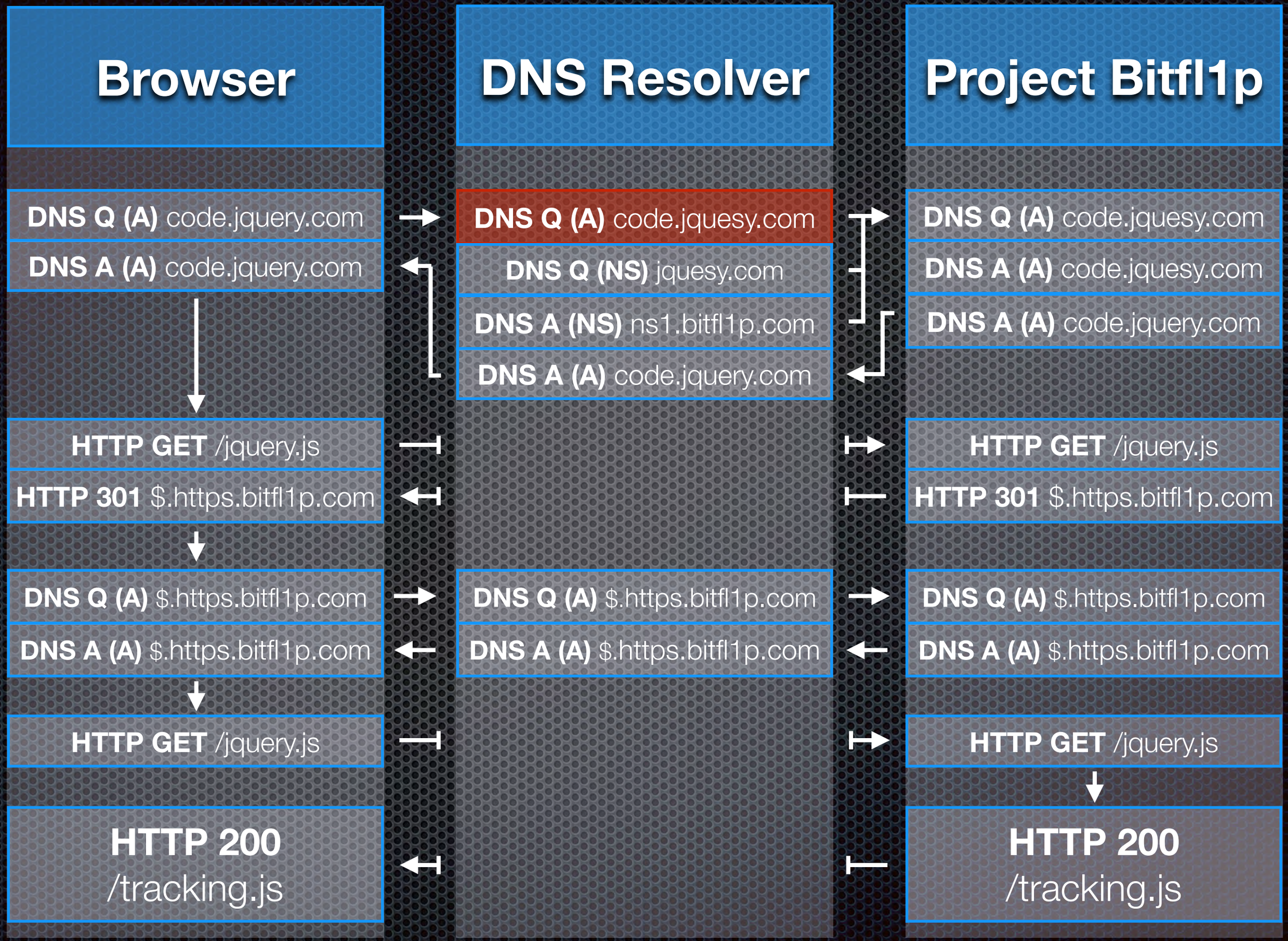
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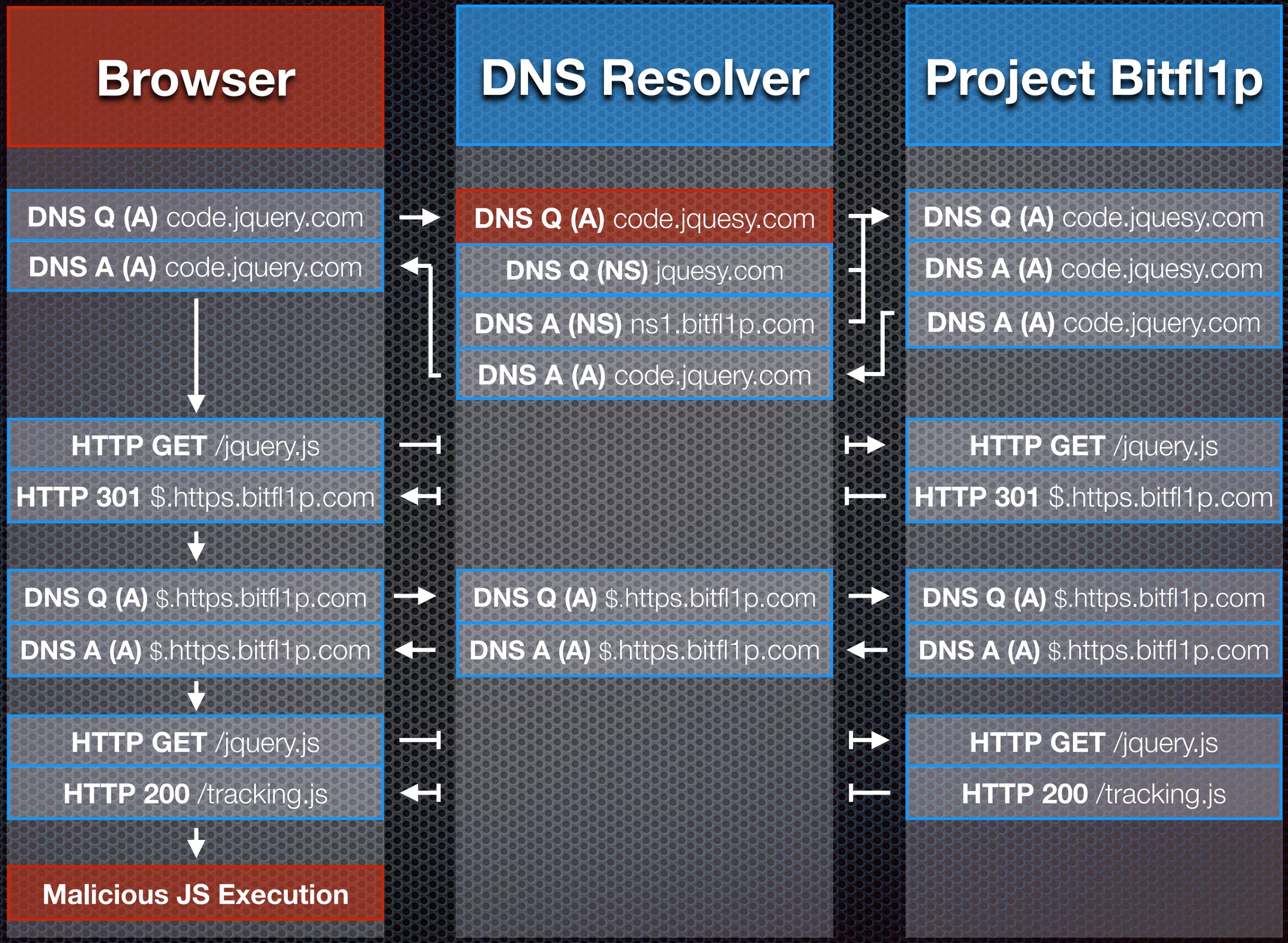
HTTP GET /jquery.js
HTTP GET /jquery.js
HTTP 200
/tracking.js
HTTP 200
/tracking.js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DNS A (A) $.https.bitfl1p.com
DNS A (A) $.https.bitfl1p.com
DNS A (A) $.https.bitfl1p.com
HTTP GET /jquery.js
HTTP GET /jquery.js
HTTP 200 /tracking.js
HTTP 200 /tracking.js
Malicious JS Execution

# > bf-dns

- Golang
- DNS server designed to answer bit squatted domain queries

# > bf-www

- Lighttpd
- HTTP configuration and PHP scripts

# Tracking JavaScript

- Installed plugins, user agent, timezone, langauge, referer, document title, screen size/resolution, current URL, doNotTrack value
- Installed fonts via flash
- Local IPs via WebRTC sdp
- Cookie names and SHA256 hashed value

# Selecting a host (Ramnode)

- Multiple IPv4 addresses
- IPv6 support
- Smaller
- High and cheap bandwidth
- Hosted on 2GB RAM, 2 IPv4, a /64 IPv6 addresses, 80GB SSD cached, 3TB bandwidth a month
- Price/Month: $15.50 USD

# Selecting domains

- Captured traffic for a day
- Purchased flips of top (interesting) domains

# googleusercontent.com

- Chosen because it serves images for Google
- Long name, increases probability of a flip

# googleusercontent.com

- coogleusercontent.com
- eoogleusercontent.com
- ggogleusercontent.com
- gkogleusercontent.com
- gmogleusercontent.com
- gnogleusercontent.com
- goggleusercontent.com
- gokgleusercontent.com
- gomgleusercontent.com
- gongleusercontent.com
- goocleusercontent.com
- gooeleusercontent.com
- googdeusercontent.com
- googheusercontent.com
- googlausercontent.com
- googldusercontent.com
- google5sercontent.com
- googleqsercontent.com
- googletsercontent.com
- googleu3ercontent.com
- googleucercontent.com
- googleuqercontent.com
- googleurercontent.com
- googleusdrcontent.com
- googleuse2content.com
- googleusepcontent.com
- googleuseraontent.com
- googleuserbontent.com
- googleusercgntent.com
- googleuserckntent.com
- googleusercmntent.com
- googleusercnntent.com
- googleusercoftent.com
- googleusercojtent.com
- googleusercoltent.com
- googleusercon4ent.com
- googleusercondent.com
- googleuserconpent.com
- googleusercontdnt.com
- googleuserconteft.com
- googleusercontejt.com
- googleusercontelt.com
- googleuserconten4.com
- googleusercontend.com
- googleusercontenp.com
- googleusercontenu.com
- googleusercontenv.com
- googleuserconteot.com
- googleusercontgnt.com
- googleusercontmnt.com
- googleusercontunt.com
- googleuserconuent.com
- googleuserconvent.com
- googleusergontent.com
- googleuserkontent.com
- googleusersontent.com
- googleusescontent.com
- googleusevcontent.com
- googleusezcontent.com
- googleusgrcontent.com
- googleusmrcontent.com
- googleusurcontent.com
- googleuwercontent.com
- googlewsercontent.com
- googlgusercontent.com
- googlmusercontent.com
- googluusercontent.com
- googmeusercontent.com
- googneusercontent.com
- goooleusercontent.com
- goowleusercontent.com
- woogleusercontent.com

# Panic...

```
➜ ~  sudo nc -l 80
GET /attachment/u/0/?ui=2&ik=5c6a36c81d&view=att&th=14b764c34894e1cd&attid=0.1.1&disp=sa
fe&zw&saduie=AG9B_P_1fvIEcxFQKdB_mG4pfaVs&sadet=1424920930164&sads=S1v5A3uDsew-PyFHZd-2J
BxpvEI HTTP/1.1
Host: mail-attachment.googleusercontent.com
Connection: keep-alive
Cache-Control: max-age=0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q=0.8
User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10_10_2) AppleWebKit/537.36 (KHTML, l
ike Gecko) Chrome/40.0.2214.111 Safari/537.36
Accept-Encoding: gzip, deflate, sdch
Accept-Language: en-US,en;q=0.8

➜ ~
```

# More panic...

- mail-attachment.googleusercontent.com - Mail Attachments
- oauth.googleusercontent.com - OAuth authentication
- themes.googleusercontent.com - Google fonts
- webcache.googleusercontent.com - Google cached pages
- translate.googleusercontent.com - Google translated webpages

# cloudfront.net

- CDN for Amazon CloudFront
- Commonly used to serve JS, CSS, and media
- 43 possible bit-squats, 4 already registered
- Registered 39 of them

# cloudfront.net

- aloudfront.net
- bloudfront.net
- cdoudfront.net
- clgudfront.net
- clkudfront.net
- clmudfront.net
- clnudfront.net
- clo5dfront.net
- cloqdfront.net
- choudfront.net
- clotdfront.net
- cloudbront.net
- cloudf2ont.net
- cloudfbont.net
- cloudfpont.net
- cloudfrgnt.net
- cloudfrknt.net
- cloudfrmnt.net
- cloudfrnnt.net
- cloudfroft.net
- cloudfrojt.net
- cloudfrolt.net
- cloudfron4.net
- cloudfrond.net
- cloudfronp.net
- cloudfronu.net
- cloudfronv.net
- cloudfroot.net
- cloudfsont.net
- cloudfvont.net
- cloudfzont.net
- cloudnront.net
- cloudvront.net
- clouefront.net
- cloulfront.net
- cmoudfront.net
- cnoudfront.net
- kloudfront.net
- sloudfront.net

# amazonaws.com

- Serves pretty much all AWS services as subdomains excluding CloudFront.
- Includes Amazon S3, ELB, and EC2
- 38 possible bit-squats, 37 were registered
- 33 were already registered by Amazon!

- **amazonass.com**
- s3namazonaws.com
- compute-1namazonaws.com
- compute-2namazonaws.com
- elbnamazonaws.com

# doubleclick.net

- Serves Google Ads
- Mainly via JavaScript
- 45 possible bit-squats, 19 already registered

# doubleclick.net

- dgubleclick.net
- dkubleclick.net
- dnubleclick.net
- dmubleclick.net
- doqbleclick.net
- dotbleclick.net
- doublecliak.net
- doubleblick.net
- doubleclibk.net
- doublecligk.net
- doubleclicc.net
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- doubluclick.net
- doubmeclick.net
- doubneclick.net
- doucleclick.net
- doufleclick.net
- doujleclick.net
- dowbleclick.net
- dourleclick.net

# apple.com

- Most apple services are served via subdomains
- 21 possible bit-squats, 1 available: applg.com

# icloud.com

- iOS/OSX devices check-in regularly
- Receives emails for icloud.com accounts
- 25 possible bit-squats, 17 registered already
- icdoud.com, iclgud.com, iclkud.com, iclmud.com, iclnud.com, icloqd.com, iclotd.com, icnoud.com

# jquery.com

- JavaScript compatibility script
- Used by over 70% of the top 10,000 sites
- 26 possible bit-squats, 9 already registered

# jquery.com

- jauery.com
- jqqery.com
- jpuery.com
- jqtery.com
- jqueby.com
- jquepy.com
- jquerq.com
- jquerx.com
- jquesy.com
- jquevy.com
- jqugry.com
- jquezy.com
- jqumry.com
- jsuery.com
- juuery.com

# disqus.com

- Blog comment hosting service
- Roughly 750,000 thousand blogs/web-sites use it
- 27 possible bit-squats, 3 already registered

# disqus.com

- dhsqus.com
- di3qus.com
- diqqus.com
- dirqus.com
- dis1us.com
- disaus.com
- disqqs.com
- disq5s.com
- disqts.com
- disqu3.com
- disquc.com
- disquq.com
- disqur.com
- disquw.com
- disqws.com
- disuus.com
- diwqus.com
- disyus.com
- dksqus.com
- dmsqus.com
- eisqus.com
- dysqus.com
- tisqus.com
- lisqus.com

# google-analytics.com

- The most widely used website statistics service
- 63 possible bit-squats, 53 already registered
- googlm-analytics.com, googlg-analytics.com, googne-analytics.com, gooole-analytics.com, ggogle-analytics.com, gmogle-analytics.com, gomgle-analytics.com, gooele-analytics.com, googde-analytics.com, google-alalytics.com

# sfdcstatic.com

- CDN for SalesForce
- SalesForce is one of the largest cloud computing companies in the world
- 42 possible bit-squats

# sfdcstatic.com

- 3fdcstatic.com
- cfdcstatic.com
- qfdcstatic.com
- rfdcstatic.com
- sbdcstatic.com
- sfdbstatic.com
- sfdcrtatic.com
- sfdcqtatic.com
- sfdastatic.com
- sfdcctatic.com
- sfdc3tatic.com
- sfdcsdatic.com
- sfdcs4atic.com
- sfdcsta4ic.com
- sfdcstadic.com
- sfdcstatia.com
- sfdcspatic.com
- sfdcstathc.com
- sfdcstapic.com
- sfdcstatib.com
- sfdcstatis.com
- sfdcstavic.com
- sfdcstatyc.com
- sfdcstauic.com
- sfdcstatik.com
- sfdcstatig.com
- sfdcstatkc.com
- sfdcstatmc.com
- sfdcstctic.com
- sfdcstqtic.com
- sfdcsvatic.com
- sfdcsuatic.com
- sfdcwtatic.com
- sfdkstatic.com
- sfdgstatic.com
- sfecstatic.com
- sfdsstatic.com
- sflcstatic.com
- sftcstatic.com
- sndcstatic.com
- svdcstatic.com
- wfdcstatic.com

# aspnetcdn.com

- Microsoft's Ajax Content Delivery Network
- Serves Microsoft sites, and many jQuery plugins
- 39 possible bit-squats, 1 already registered

# aspnetcdn.com

- a3pnetcdn.com
- acpnetcdn.com
- arpnetcdn.com
- aqpnetcdn.com
- as0netcdn.com
- aspfetcdn.com
- aspjetcdn.com
- aspndtcdn.com
- aspletcdn.com
- aspne4cdn.com
- aspnedcdn.com
- aspnepcdn.com
- aspnetadn.com
- aspnetbdn.com
- aspnetcdf.com
- aspnetcdj.com
- aspnetcdl.com
- aspnetcdo.com
- aspnetcen.com
- aspnetcln.com
- aspnetctn.com
- aspnetgdn.com
- aspnetkdn.com
- aspnetsdn.com
- aspneucdn.com
- aspnevcdn.com
- aspngtcdn.com
- aspoetcdn.com
- aspnmtcdn.com
- asqnetcdn.com
- asrnetcdn.com
- astnetcdn.com
- awpnetcdn.com
- asxnetcdn.com
- espnetcdn.com
- cspnetcdn.com
- qspnetcdn.com
- ispnetcdn.com

# googleapis.com

- Google's JS Content Delivery Network
- Serves Angular JS, Prototype, etc
- 39 possible bit-squats, 27 registered

# googleapis.com

- coogleapis.com
- eoogleapis.com
- ggogleapis.com
- gkogleapis.com
- gmogleapis.com
- gnogleapis.com
- goggleapis.com
- gokgleapis.com
- gomgleapis.com
- goocleapis.com
- gooeleapis.com
- googdeapis.com
- googheapis.com
- googldapis.com
- googlgapis.com
- googlmapis.com
- googmeapis.com
- googneapis.com
- goowleapis.com
- gooooleapis.com
- ooogleapis.com
- woogleapis.com

# gstatic.com

- Google static content hosting
- Serves pages like Chrome’s connectivity test
- Also purchased by Artem Dinaburg and Robert Stucke
- 30 possible bit-squats, 11 registered

# gstatic.com

- gs4atic.com
- gsdatic.com
- gspatic.com
- gsta4ic.com
- gstadic.com
- gstapic.com
- gstathc.com
- gstatia.com
- gstatib.com
- gstatig.com
- gstatkc.com
- gstatmc.com
- gstatyc.com
- gstavic.com
- gstauic.com
- gstctic.com
- gstqtic.com
- gsuatic.com
- gsvatic.com

# fbcdn.net

- Facebook's CDN
- 19 possible bit-squats, 3 available
- fbadn.net, fbcdj.net, frcdn.net

# ytimg.com

- YouTube's CDN
- 22 possible bit-squats, 3 available
- ytieg.com, yti-g.com, y4img.com

# twimg.com

- Twitter's CDN
- 23 possible bit-squats, 9 available
- 4wimg.com, t7img.com, twhmg.com, twi-g.com, twimw.com, twilg.com, twkmg.com, twmmg.com, uwimg.com

# Purchasing 337 Domains

on a college budget

# Coupons!

# 1&1


Sales: 1 (877) 461-2631
Para español por favor haz clic aquí
US
Partner programs
Help & Contact
Login
1&1
Domain Names
Websites
Web Hosting
Servers
E-Mail & Office
eCommerce
Your search term
.nyc
Starting at
$0.99
first year*
Order now!
1&1 DOMAINS
AT UNBEATABLE PRICES!
Enter your desired web address
MyWebsite
Create your own successful website
Hosting
For developers and professionals
Online Store
Sell successfully online
Virtual Servers
Speed and convenience at a great price

**1&1 Internet - Account Authentication** <auth@1and1.com>

to me

Dear Luke Young, (Customer ID: [redacted])

You have exceeded the limit of our current special offer.

Further orders placed under this offer will be canceled.

--
Sincerely,
Security Team
1&1 Internet, Inc.

# Final statistics

- 89 from GoDaddy
- 255 from 1&1
- Average cost per domain: $1.62
- Total: $545.44

# Purchasing SSL Certificates

# Wildcard SSL Certificates

- $595 per wildcard certificate from DigiCert
- $595 * 337 domains = $200,000+

# StartSSL

- 60$ for Class 2 Identity/Organization verification
- Issued 103 wildcard certificates
- 17 flagged for manual review, all approved

# Certificates Issued

- *.aloudfront.net
- *.amazonass.com
- *.applg.com
- *.bloudfront.net
- *.cdoudfront.net
- *.choudfront.net
- *.clgudfront.net
- *.clkudfront.net
- *.clmudfront.net
- *.clnudfront.net
- *.clo5dfront.net
- *.cloqdfront.net
- *.clotdfront.net
- *.cloudbront.net
- *.cloudf2ont.net
- *.cloudfbont.net
- *.cloudfpont.net
- *.cloudfrgnt.net
- *.cloudfrknt.net
- *.cloudfrmnt.net
- *.cloudfrnnt.net
- *.cloudfroft.net
- *.cloudfrojt.net
- *.cloudfrolt.net
- *.cloudfron4.net
- *.cloudfrond.net
- *.cloudfronp.net
- *.cloudfronu.net
- *.cloudfronv.net
- *.cloudfroot.net
- *.cloudfsont.net
- *.cloudfvont.net
- *.cloudfzont.net
- *.cloudnront.net
- *.cloudvront.net
- *.clouefront.net
- *.cloulfront.net
- *.cmoudfront.net
- *.cnoudfront.net
- *.coogleapis.com
- *.dgubleclick.net
- *.dhsqus.com
- *.dkubleclick.net
- *.doubleblick.net
- *.doublecliak.net
- *.doubleclibk.net
- *.doubleclicc.net
- *.doublecligk.net
- *.doubleclikk.net
- *.doubleclisk.net
- *.doubleclmck.net
- *.doublecmick.net
- *.doublecnick.net
- *.doubleglick.net
- *.eoogleapis.com
- *.ggogle-analytics.com
- *.ggogleapis.com
- *.gkogleapis.com
- *.gmogle-analytics.com
- *.gmogleapis.com
- *.goggleapis.com
- *.gokgleapis.com
- *.gomgle-analytics.com
- *.gomgleapis.com
- *.goocleapis.com
- *.gooele-analytics.com
- *.gooeleapis.com
- *.googde-analytics.com
- *.googlm-analytics.com
- *.googne-analytics.com
- *.gooole-analytics.com
- *.goooleapis.com
- *.goowleapis.com
- *.gs4atic.com
- *.gsdatic.com
- *.gspatic.com
- *.gsta4ic.com
- *.gstadic.com
- *.gstapic.com
- *.gstathc.com
- *.gstatia.com
- *.gstatib.com
- *.gstatig.com
- *.gstatkc.com
- *.gstatmc.com
- *.gstatyc.com
- *.gstauic.com
- *.gstavic.com
- *.gstctic.com
- *.gstqtic.com
- *.gsuatic.com
- *.gsvatic.com
- *.icdoud.com
- *.iclgud.com
- *.iclkud.com
- *.iclmud.com
- *.iclnud.com
- *.icloqd.com
- *.iclotd.com
- *.icnoud.com
- *.jsuery.com
- *.kloudfront.net
- *.sloudfront.net

# Login Revoked!

**StartCom CertMaster (Eddy Nigg)** <certmaster@startcom.org> 8/25/14

to me

To Luke Young,

Your certificate with serial number (686611) has been revoked for the following reason(s):

- no reason / see comment below.

The following comment has been added by StartCom's Administration Personnel:

Abuse! Please contact us.

** If you feel, that the reasons above are not correct,
please contact us, by replying to this message, with
your explanation!

StartCom Ltd.
StartSSL™ Certification Authority

# StartCom Response

- “I'm sorry, but for high-profile names only the name owner should be able to get certificates for it and those resembling them closely never issued.”
- “Most certificates really shouldn't have been issued to start with.”

# Excerpt from StartCom Certificate Policy

- “The StartCom Certification Authority performs additional sanity and fraud prevention checks in order to limit accidental issuing of certificates whose domain names might be misleading and/or might be used to perform an act of fraud, identity theft or infringement of trademarks. For example domain names resembling well known brands and names like PAYPA1.COM and MICR0S0FT.COM, or when well known brands are part of the requested hostnames like FACEBOOK.DOMAIN.COM or WWW.GOOGLEME.COM.”

# Potential problem domains

- *.eoogleapis.com
- *.ggogleapis.com
- *.gkogleapis.com
- *.gmogleapis.com
- *.goggleapis.com
- *.gokgleapis.com
- *.gomgleapis.com
- *.goocleapis.com
- *.gooeleapis.com
- *.goooleapis.com
- *.goowleapis.com
- *.ggogle-analytics.com
- *.gmogle-analytics.com
- *.gomgle-analytics.com
- *.gooele-analytics.com
- *.googde-analytics.com
- *.googlm-analytics.com
- *.googne-analytics.com
- *.gooole-analytics.com

# Timeline

- 7/29/14 - Identity/Organization verification completed
- 8/14/14 - Certificate requests started
- 8/25/14 - Login certificate revoked
- 10/16/14 - Certificates revoked

# Mass revocation

| | | |
|---|---|---|
| Inbox | StartSSL Certificate revoked, 17 Oct 2014 03:26 - has been revoked for the following re | 10/16/14 |
| Inbox | StartSSL Certificate revoked, 17 Oct 2014 03:25 - has been revoked for the following re | 10/16/14 |
| Inbox | StartSSL Certificate revoked, 17 Oct 2014 02:58 - has been revoked for the following re | 10/16/14 |
| Inbox | StartSSL Certificate revoked, 17 Oct 2014 02:57 - has been revoked for the following re | 10/16/14 |
| Inbox | StartSSL Certificate revoked, 17 Oct 2014 02:56 - has been revoked for the following re | 10/16/14 |
| Inbox | StartSSL Certificate revoked, 17 Oct 2014 02:55 - has been revoked for the following re | 10/16/14 |
| Inbox | StartSSL Certificate revoked, 17 Oct 2014 02:54 - has been revoked for the following re | 10/16/14 |
| Inbox | StartSSL Certificate revoked, 17 Oct 2014 02:53 - has been revoked for the following re | 10/16/14 |
| Inbox | StartSSL Certificate revoked, 17 Oct 2014 02:52 - has been revoked for the following re | 10/16/14 |
| Inbox | StartSSL Certificate revoked, 17 Oct 2014 02:39 - has been revoked for the following re | 10/16/14 |
| Inbox | StartSSL Certificate revoked, 17 Oct 2014 02:38 - has been revoked for the following re | 10/16/14 |
| Inbox | StartSSL Certificate revoked, 17 Oct 2014 02:37 - has been revoked for the following re | 10/16/14 |
| Inbox | StartSSL Certificate revoked, 17 Oct 2014 02:36 - has been revoked for the following re | 10/16/14 |
| Inbox | StartSSL Certificate revoked, 17 Oct 2014 02:35 - has been revoked for the following re | 10/16/14 |
| Inbox | StartSSL Certificate revoked, 17 Oct 2014 02:34 - has been revoked for the following re | 10/16/14 |

# Remaining certificates

- *.applg.com
- *.jsuery.com
- *.dhsqus.com
- *.gsta4ic.com
- *.gstatig.com
- *.gs4atic.com
- *.gsdatic.com
- *.gstatib.com
- *.gspatic.com
- *.gstavic.com
- *.gsvatic.com
- *.gstctic.com
- *.gstauic.com
- *.gstatyc.com
- *.gstathc.com
- *.gsuatic.com
- *.gstqtic.com
- *.gstapic.com
- *.gstadic.com
- *.gstatmc.com
- *.gstatkc.com
- *.gstatia.com

“Everything we haven't revoked so far was considered not so problematic and hence we left them to expire naturally.”

# The Future

- EFF's Let's Encrypt CA
- Large vendors

Did anybody else even notice?

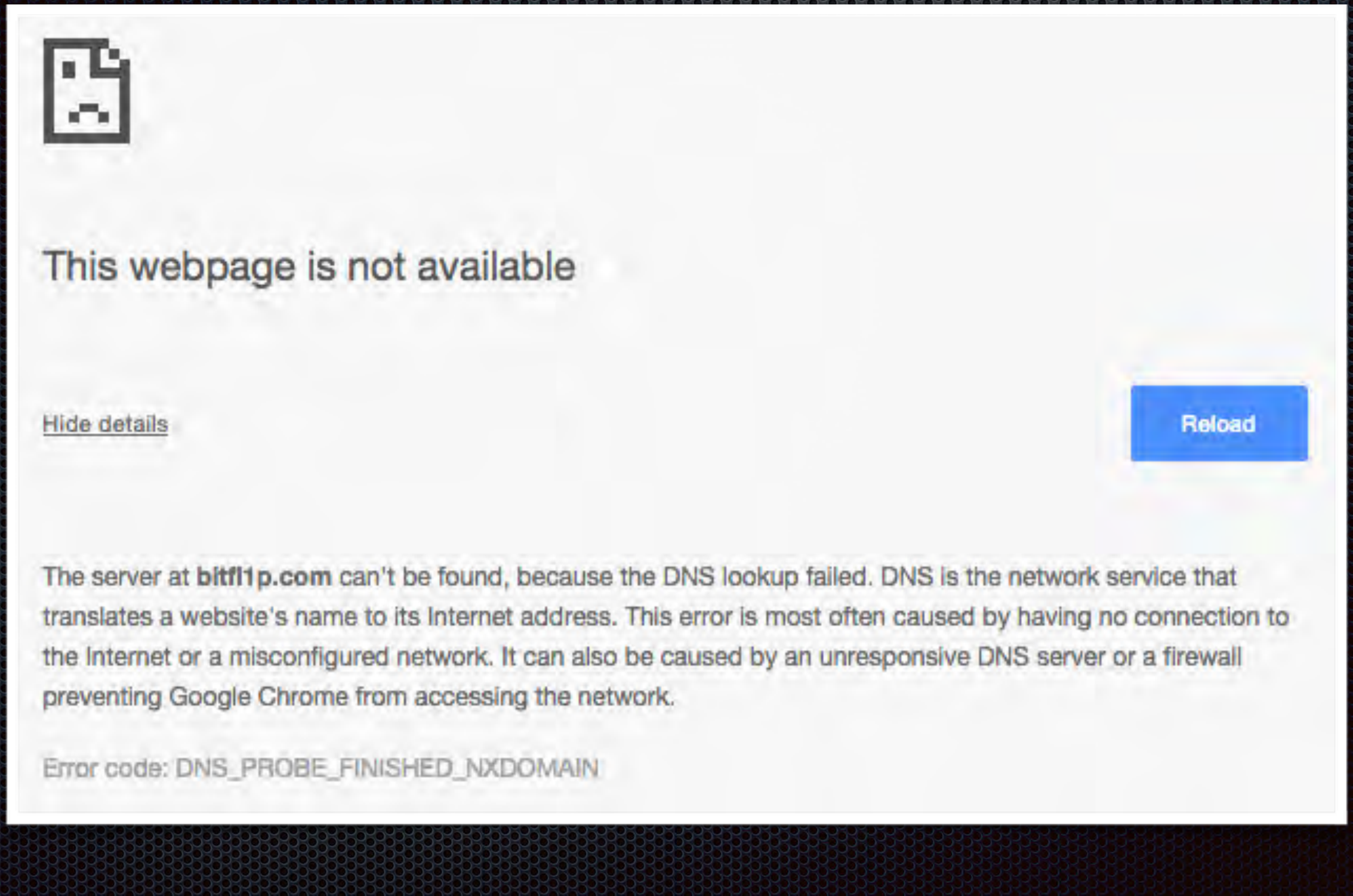
# Getting noticed

- “One example would be in the gstatic.com domain that was used in the demonstrations and presentations:

  gstatic.com – October 2013 – 26 squats unregistered
  gstatic.com – October 2014 – 0 squats unregistered

  This reduction in availability was observed in other domains too, interestingly most of the gstatic squats and some of the other domains appear to have been registered by the same individual with the name servers at bitfl1p.com so at least some one is having fun :)” - x8x.net

# Uh oh...


This webpage is not available
Hide details
Reload
The server at bitfl1p.com can't be found, because the DNS lookup failed. DNS is the network service that translates a website's name to its Internet address. This error is most often caused by having no connection to the Internet or a misconfigured network. It can also be caused by an unresponsive DNS server or a firewall preventing Google Chrome from accessing the network.
Error code: DNS_PROBE_FINISHED_NXDOMAIN

# Uh oh...

```
➜ ~  dig bitfl1p.com @8.8.8.8

; <<>> DiG 9.8.3-P1 <<>> bitfl1p.com @8.8.8.8
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 52382
;; flags: qr rd ra; QUERY: 1, ANSWER: 2, AUTHORITY: 0, ADDITIONAL: 0

;; QUESTION SECTION:
;bitfl1p.com.                   IN      A

;; ANSWER SECTION:
bitfl1p.com.            21440   IN      A       168.235.68.45
bitfl1p.com.            21440   IN      A       168.235.68.44

;; Query time: 43 msec
;; SERVER: 8.8.8.8#53(8.8.8.8)
;; WHEN: Tue Mar 10 18:34:19 2015
;; MSG SIZE  rcvd: 61
```

# Uh oh...

```
➜ ~  dig bitfl1p.com @75.75.75.75

; <<>> DiG 9.8.3-P1 <<>> bitfl1p.com @75.75.75.75
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: SERVFAIL, id: 33561
;; flags: qr rd ra; QUERY: 1, ANSWER: 0, AUTHORITY: 0, ADDITIONAL: 0

;; QUESTION SECTION:
;bitfl1p.com.                   IN      A

;; Query time: 53 msec
;; SERVER: 75.75.75.75#53(75.75.75.75)
;; WHEN: Tue Mar 10 18:36:38 2015
;; MSG SIZE  rcvd: 29
```

# Payment Issues (Stripe)

- Wells Fargo says they're approving the transaction
- "I had a look at that charge and we have reason to believe that that card has been associated with fraudulent activity."
- "We are indeed blocking it on our end due to a level of risk on this card that we're not willing to take. I know this a very vague reason, but for security purposes I'm limited in how much information I am able to give out."

More

Wells Fargo Online access has been suspended

Inbox x

**Wells Fargo Online** <alerts@notify.wellsfargo.com> Aug 6 (2 days ago)

to me

wellsfargo.com

## Please reset your password to restore access

**What is happening**
Account security is a top priority for Wells Fargo. As a safety measure, we have suspended your access to *Wells Fargo Online*® because we detected a possible unauthorized attempt to sign on to your account.

**What this means for you**
To regain access, all you need to do is reset your password, if you have not done so already. Please also consider changing your username for added protection.

**What you can do**
Reset your password now:

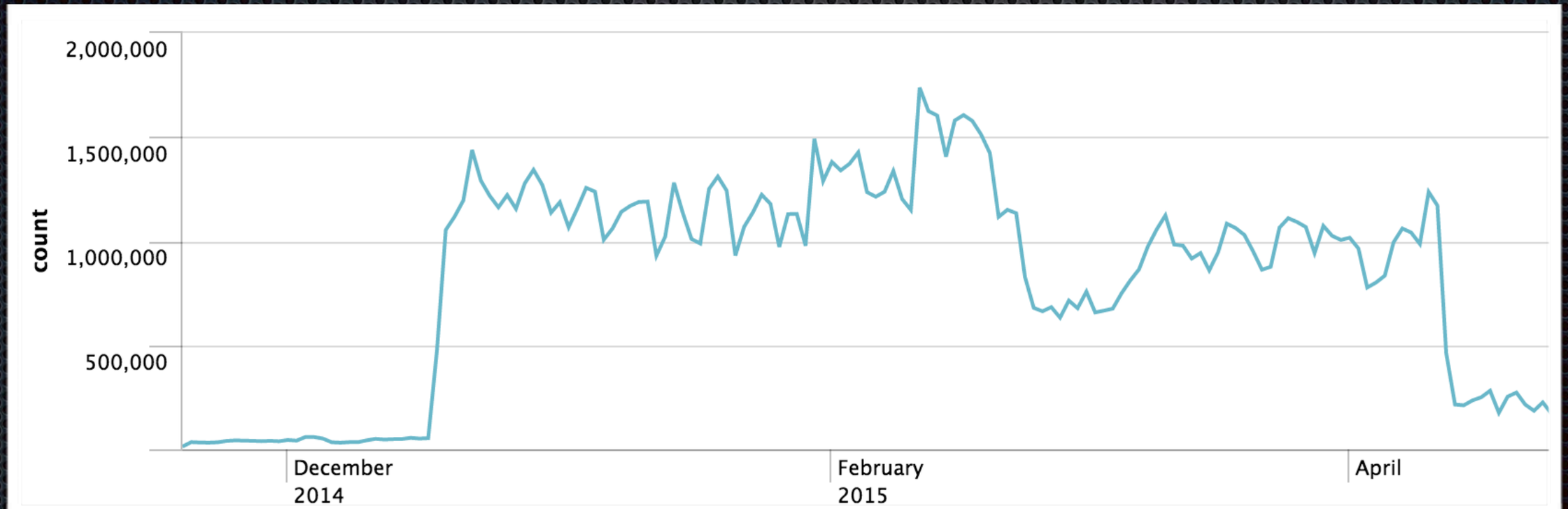
- Go to the wellsfargo.com home page and select **Username/Password Help** below the sign-on box.
- Select **Get Password Help** and follow the instructions to reset your password.

Change your username:

- Sign on from the wellsfargo.com home page and choose the **Account Services** tab.
- Under **My Profile**, select **Change Username** and follow the instructions to make your update.

# The Data

# DNS Queries


2,000,000
1,500,000
1,000,000
500,000
count
December
2014
February
2015
April

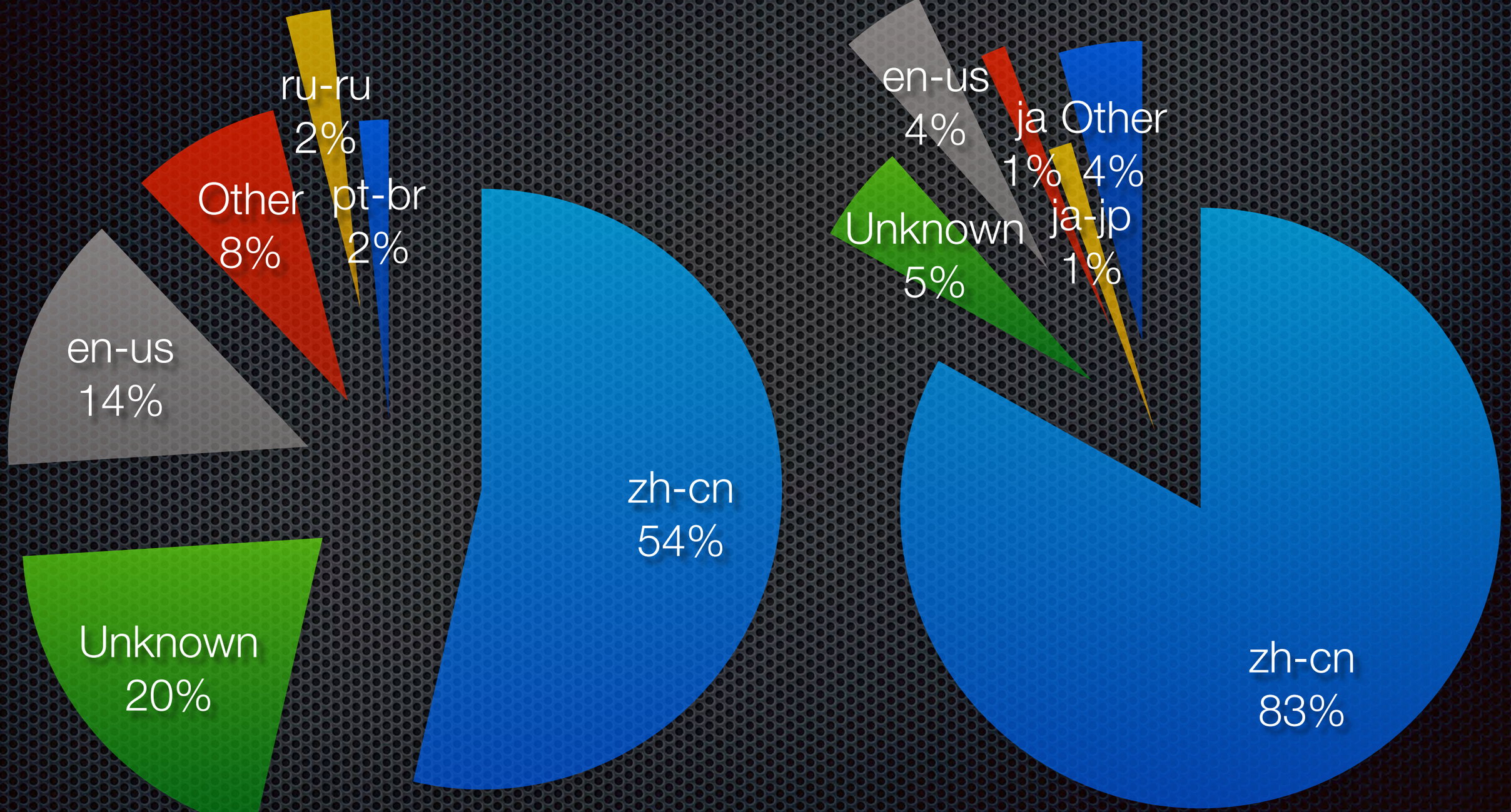
# DNS Queries

- Over 1 million queries every 24 hours
- 4.8% result in TCP connections
- 85% of initiated SSL connections complete the handshake and issue a HTTP request

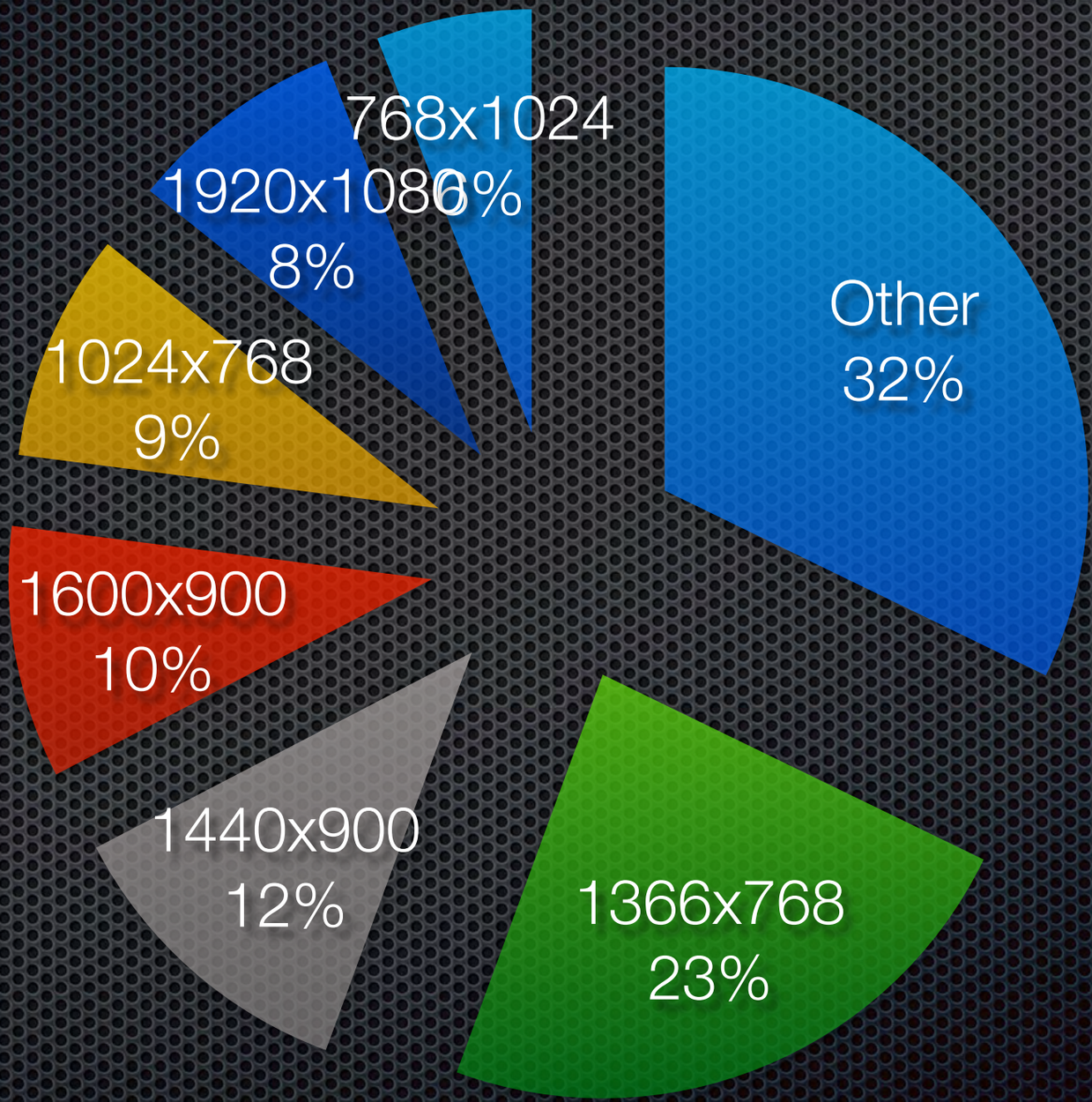
# HTTP Access Logs

- 2.4 million requests
- Repeat users remain cached for an average of 4.33 requests

# Language


ru-ru
2%
Other
8%
pt-br
2%
en-us
14%
Unknown
20%
zh-cn
54%
en-us
4%
ja
1%
Other
4%
Unknown
5%
ja-jp
1%
zh-cn
83%

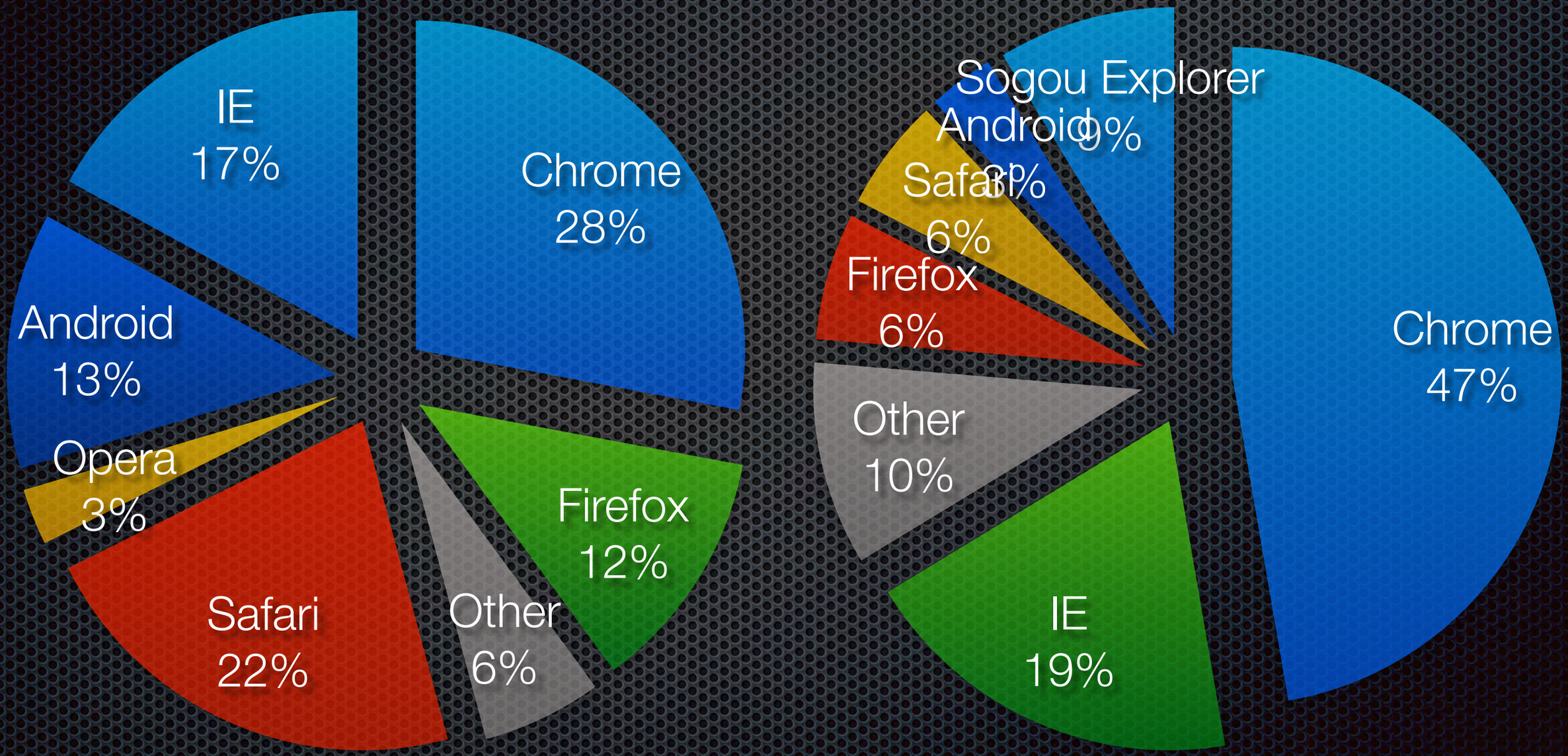
# Screen resolution



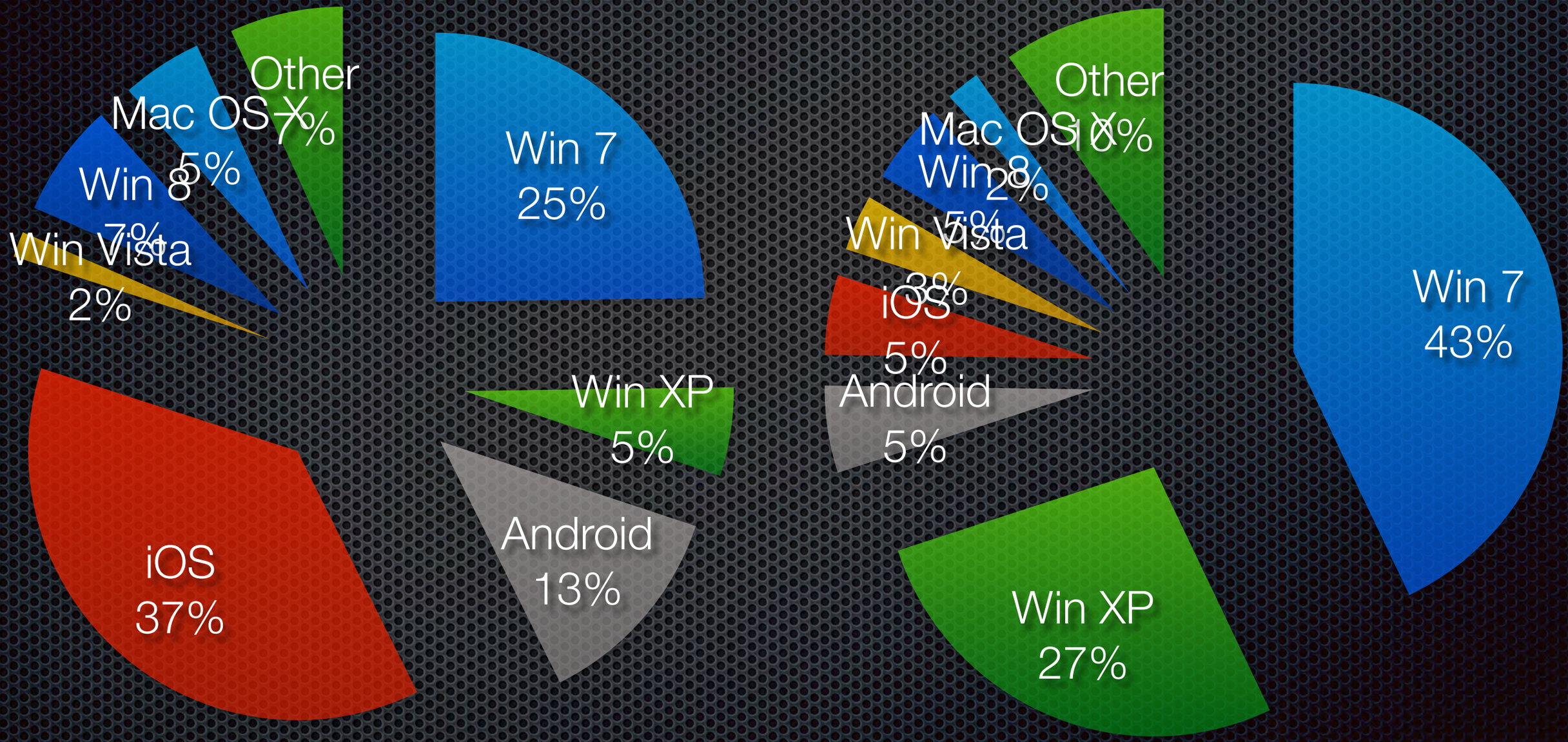
# IPv6 adoption

- 1.67% queries delivered via IPv6
- 1.17% of address record queries for AAAA (IPv6)

# Browser Usage



# OS Usage


Other
7%
Mac OS X
5%
Win 8
7%
Win Vista
2%
Win 7
25%
iOS
37%
Win XP
5%
Android
13%
Other
10%
Mac OS X
8%
Win 8
2%
Win Vista
3%
iOS
5%
Android
5%
Win 7
43%
Win XP
27%

# Cookies

- 240,000 cookie names and hashed value pairs
- Top cookies from:
  - Google analytics
  - Baidu
  - weather.com

```
{ [-]
   _time: 1433816359
   appCodeName: Mozilla
   appName: Netscape
   appVersion: 5.0 (Windows NT 6.3; WOW64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/43.0.2357.81 Safari/537
   browserTime: 1433816366451
   browserTimezoneOffset: 240
   cookieEnabled: true
   doNotTrack: false
   innerHeight: 667
   innerWidth: 1366
   language: en-US
   localAddress: [redacted]
   location: [redacted]
   maxTouchPoints:
   platform: Win32
   plugins: [ [+]
   ]
   product: Gecko
   productSub: 20030107
   referrer: [redacted]
   remoteAddress: [redacted]
   screenHeight: 768
   screenPixelDepth: 24
   screenWidth: 1366
   screenX: 0
   screenY: 0
   title: Amazon.com : Apple iPad Air 2 MH0W2LL/A (16GB, Wi-Fi, Gold) NEWEST VERSION : Computers & Accessories
   track: [redacted]
   userAgent: Mozilla/5.0 (Windows NT 6.3; WOW64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/43.0.2357.81 Saf
   vendor: Google Inc.
   vendorSub:
}
```

```
{ [-]
   _time: 1435143790
   appCodeName: Mozilla
   appName: Netscape
   appVersion: 5.0 (Windows NT 6.1; WOW64; Trident/7.0; SLCC2; .NET CLR 2.0.50727; .NET CLR 3.5.30729; .NET CLR
   browserTime: 1435143791431
   browserTimezoneOffset: -180
   cookieEnabled: true
   doNotTrack: false
   innerHeight: 1
   innerWidth: 1
   language: tr-TR
   localAddress: [redacted]
   location: https://accounts.google.com/o/oauth2/postmessageRelay[redacted]
   maxTouchPoints:
   platform: Win32
   plugins: [ [+]
   ]
   product: Gecko
   productSub:
   referrer: [redacted]
   remoteAddress: [redacted]
   screenHeight: 900
   screenPixelDepth: 24
   screenWidth: 1440
   screenX: -8
   screenY: -8
   title:
   track: [redacted]
   userAgent: Mozilla/5.0 (Windows NT 6.1; WOW64; Trident/7.0; SLCC2; .NET CLR 2.0.50727; .NET CLR 3.5.30729; .
   vendor:
   vendorSub:
}
```

6/24/15
3:22:15.000 AM


{ [-]
  accept: */*
  acceptEncoding: gzip, deflate
  acceptLanguage: zh-cn
  bytesIn: 232
  bytesOut: 284
  cookie: -
  dst: 168.235.68.44
  httpHost: init.ess.apple.com
  method: GET
  port: 80
  protocol: HTTP/1.1
  referer: -
  src: [redacted]
  timestamp: [23/Jun/2015:21:22:15 -0400]
  url: GET /WebObjects/VCInit.woa/wa/getBag?ix=1 HTTP/1.1
  userAgent: server-bag [iPhone OS,8.1.3,12B466,iPhone7,1]
}


Show as raw text

```
{ [-]
   accept: */*
   acceptEncoding: gzip, deflate
   acceptLanguage: zh-cn
   bytesIn: 715
   bytesOut: 350
   cookie: downloadKey=expires=1432580536~access=/us/r1000/129/Purple7/v4/a3/87/44/a3874464-0640-2798-ee65-
f67d2be6b88d/adi83611693489164264 71.D2.pd.ipa*~md5=83e79f24fa2089f2d817542accc1e5e0
   dst: 168.235.68.44
   httpHost: a1648.phobos.apple.com
   method: GET
   port: 80
   protocol: HTTP/1.1
   referer: -
   src: [redacted]
   timestamp: [23/May/2015:09:05:37 -0400]
   url: GET /us/r1000/129/Purple7/v4/a3/87/44/a3874464-0640-2798-ee65-
f67d2be6b88d/adi83611693489164264 71.D2.pd.ipa HTTP/1.1
   userAgent: itunesstored/1.0 iOS/8.1.2 model/iPhone7,2 build/12B440 (6; dt:106)
}
```

```
{ [-]
   accept: */*
   acceptEncoding: gzip
   acceptLanguage: en
   bytesIn: 387
   bytesOut: 312
   cookie: -
   dst: 168.235.68.44
   httpHost: mesu.applg.com
   method: GET
   port: 80
   protocol: HTTP/1.1
   referer: -
   src: [redacted]
   timestamp: [17/Feb/2015:21:05:54 -0500]
   url: GET /assets/com_apple_MobileAsset_Font/com_apple_MobileAsset_Font.xml HTTP/1.1
   userAgent: MobileAsset/1.1
}
```


Show as raw text

# Top Google Searches

- wood birthday gifts for wife
- welding gun mig
- sew in weave
- mariah carey nude
- golf 1.4 tsi
- Clarence porn

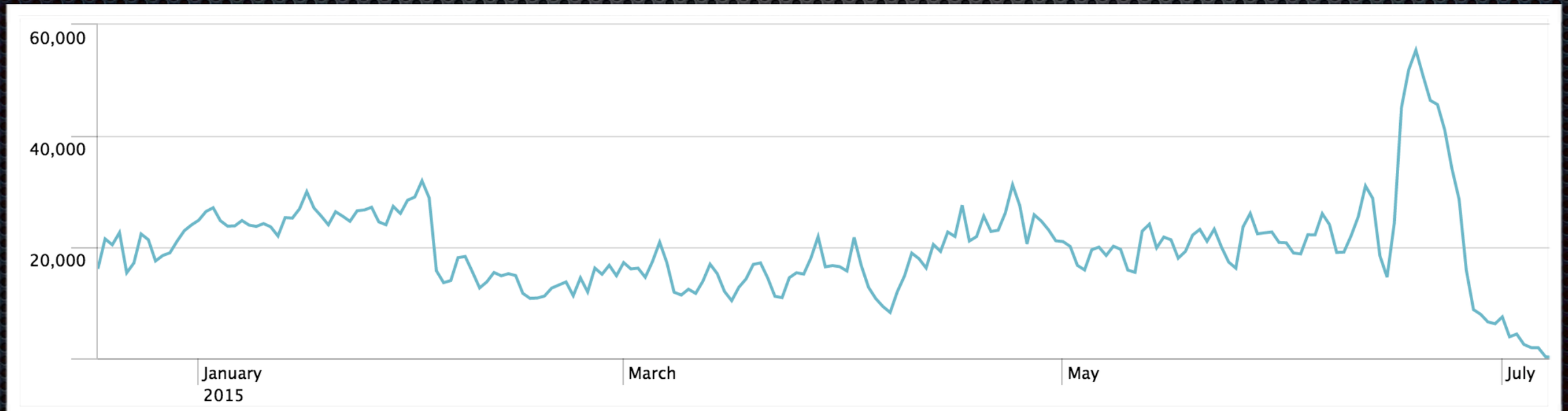
# Local IP Addresses

- 158,834 IP Addresses collected
- 12% have non private IP addresses

# Local IP Addresses

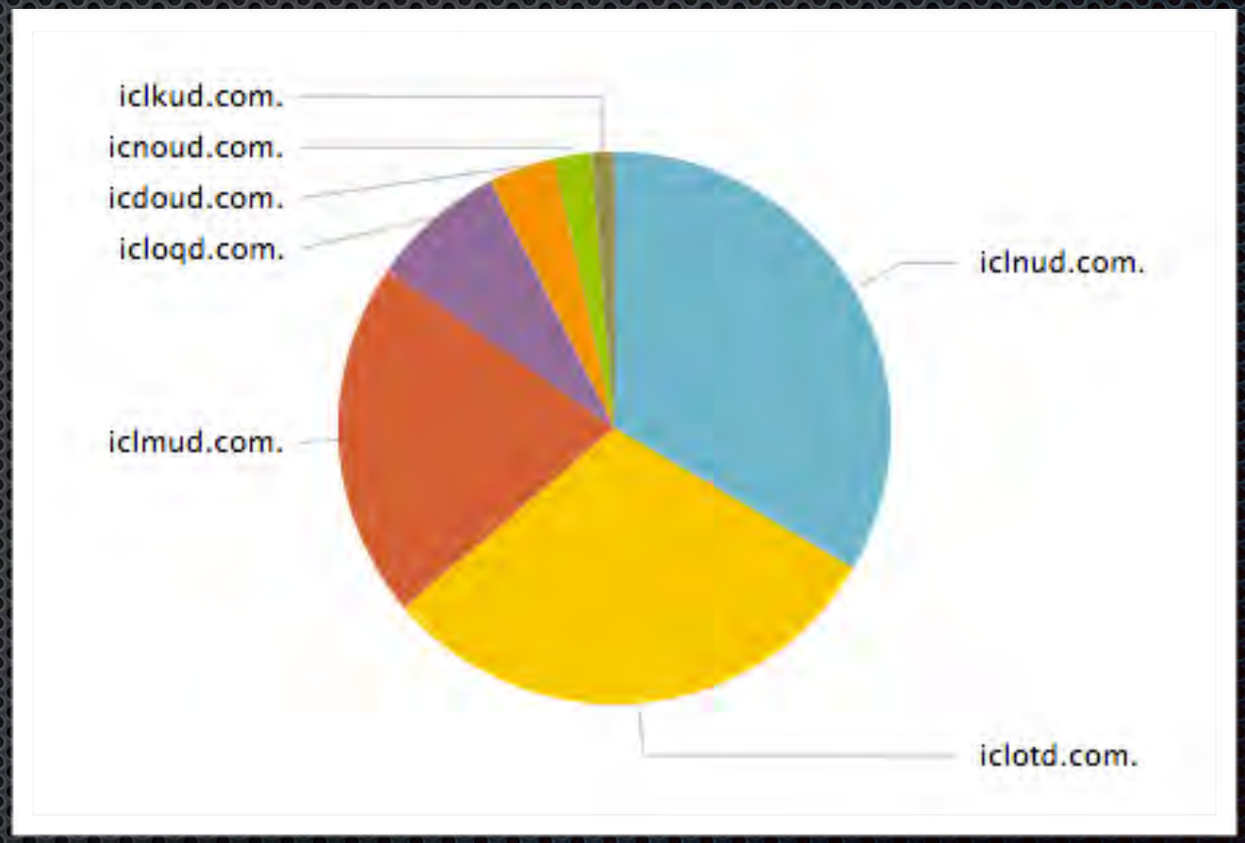


# SMTP Traffic

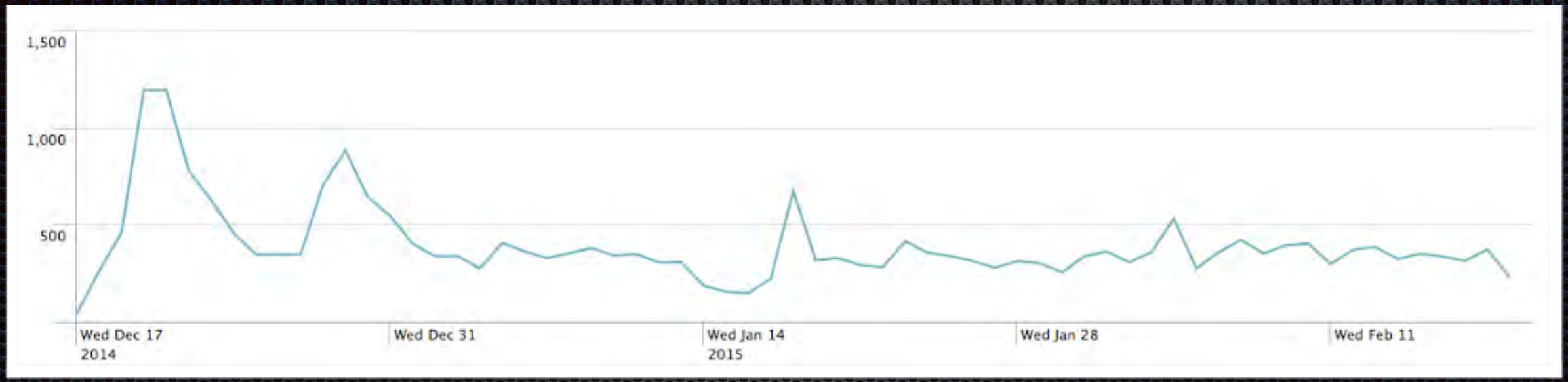


# AS13414 (Twitter Inc.)

- 38.44% of DNS traffic
- 199.16.156.0/22
  199.59.148.0/22



# AS13414 SMTP Traffic




- 2.3% - MX, 93.7% - A record queries
- Roughly 390 SMTP connection attempts per day

# Twitter Response

- “After some discussion, it looks like we're going to try to restrict outbound traffic from our network to bit flipped domains. This should address these specific problems you outlined without having to own the domains or worrying about who does.”

# > bf-splunk

- Sourcetypes for bf-dns, lighttpd output logs
- Tools for analysis
- Various pre-configured indexes, etc

# Remediation

- Buy your bit flips.
- Buy your bit flips.
- Buy your bit flips.
- Use ECC Memory and setup an RPZ for common flips

# Vendor Responses

# Salesforce

- 42 domains
- Response time under 2 hours
- Transfer initiated in under 24

# Apple

- 9 domains
- Timeline:
  - 6/15 - Reported
  - 6/15 - Vendor initial ACK
  - 6/17 - Domains unlocked and transfer process initiated

# Amazon AWS

- 44 domains
- Timeline:
  - 6/15 - Reported
  - 6/15 - Vendor initial ACK
  - 6/18, 6/19, 6/23 - Vendor requests conference call to discuss issue, further correspondence planning
  - 6/25 - Conference Call
  - 6/30 - Domains unlocked and transfer process initiated

# Facebook

- 3 domains
- Timeline:
  - 6/15 - Reported
  - 6/15 - Vendor initial ACK
  - 7/1 - Vendor requests transfer codes
  - 7/6 - Domains unlocked and transfer codes sent

# Microsoft

- 38 domains
- Timeline:
  - 6/15 - Reported
  - 6/15 - Vendor initial ACK
  - 6/29 - Attempted vendor contact
  - 7/6 - Attempted vendor contact
  - 7/16 - Attempted vendor contact
  - 7/26 - Attempted vendor contact
  - 7/30 - Attempted vendor contact
  - 8/4 - Domains unlocked and transfer process initiated

# Twitter

- 9 domains
- Timeline:
  - 6/15 - Reported
  - 6/17 - Vendor declines domain transfer

# Twitter Response

- “We don't actively try to prevent bit flipping attacks by registering all the nearby domain names due to the fact these attacks are relatively rare and that we own a lot of domains and so this would be quite an undertaking. So we are not interested in acquiring the domains you have, please just maintain possession of them until they expire.”

# Google

- 152 domains
- Timeline:
  - 6/15 - Reported
  - 6/15 - Vendor initial ACK
  - 6/29 - Attempted vendor contact
  - 7/4 - Attempted vendor contact
  - 7/6 - Vendor declines domain transfer

# Google Response

- “Our domains team let us know they won't be trying to grab these, so you can just let them expire.... The sheer number of bit-flipping possibilities makes this an unbounded game of whack-a-mole.”

```
➜  ~  whois [redacted] | grep "^Name Server"
Name Server: ns2.bitfl1p.com
Name Server: ns1.bitfl1p.com
➜  ~  whois [redacted] | grep "^Name Server"
Name Server: ns1.bitfl1p.com
Name Server: ns2.bitfl1p.com
➜  ~
```

# Data Release

- **Complete JSON DNS logs**
  - src, dst, port, qName, qType, qClass, type
- **Anonymized Webserver logs**
  - hashedSrc, dst, accept, acceptEncoding, acceptLanguage, httpHost, method, userAgent, protocol, bytesIn, bytesOut
- **Anonymized SSL**
  - hashedSrc, dst, port, version, cipher, curve, server_name, session_id
- **Anonymized SMTP logs**
  - hashedSrc, dst, port, helo

# Project Bitfl1p - Luke Young


- Email: luke@hydrantlabs.org
- LinkedIn: https://www.linkedin.com/in/innoying

- Website (with Code & Data Dumps): www.bitfl1p.com