Passive Detection of Misbehaving Name Servers

Based on CMU/SEI-2013-TR-010

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Flocon 2014, Charleston SC

This material is based upon work funded and supported by the Department of Defense under Contract No. FA8721-05-C-0003 with Carnegie Mellon University for the operation of the Software Engineering Institute, a federally funded research and development center.

DM-0000866

Agenda

- Background on Fast Flux
- Motivation – shortcomings
- Data sources and method
- Results – NS that do IP flux.
- So what?
- Future questions
- What to do about it – flow analysis

About me

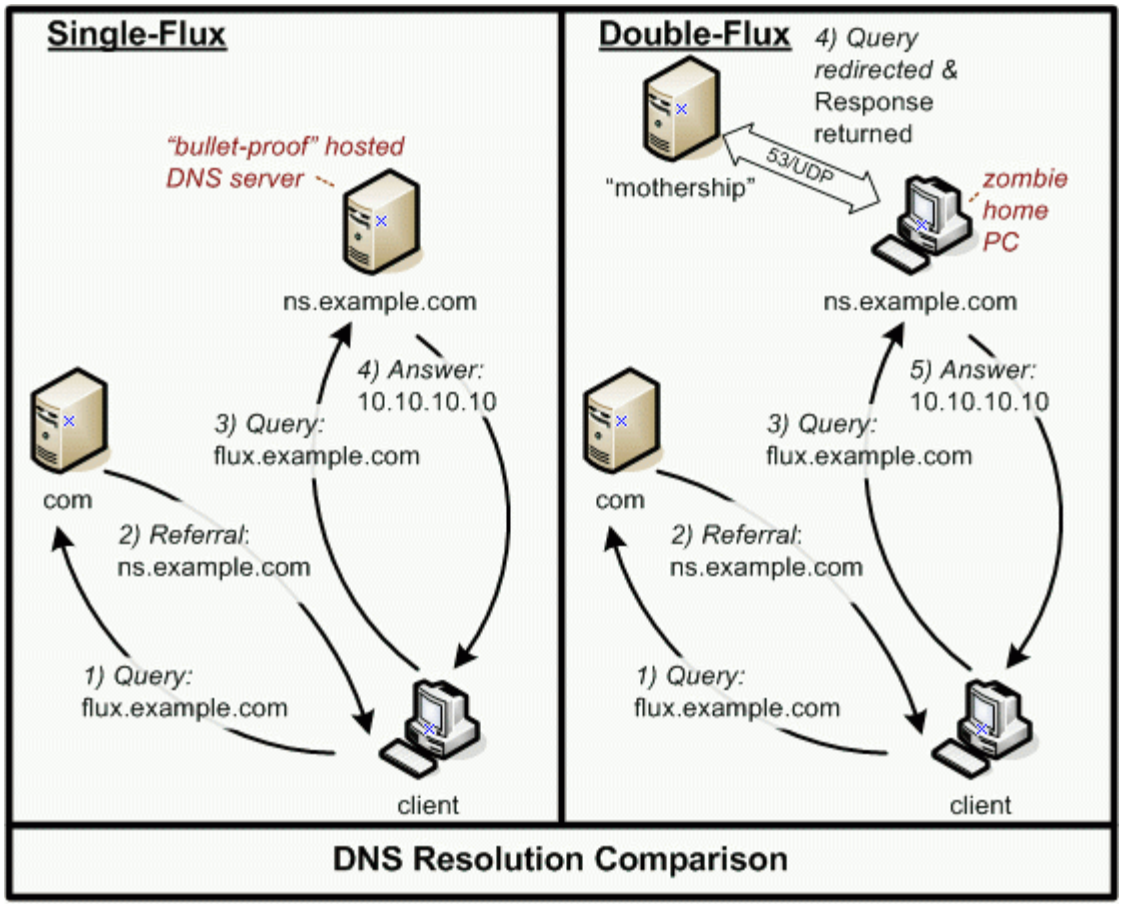
- pDNS analysis since May 2009
- netFlow analysis since Nov 2010
- My work in both of these got a lot better when Leigh and I started collaborating because she does a lot of hard stuff I can't do.
- I also teach Network Security at U of Pittsburgh
- I also co-authored a textbook (Introduction to Information Security: A Strategic-based Approach)
- So….I think this means you should listen to me
- Besides that the work is decent

Fast Flux – so last decade

- In early 2008, the ICANN SSAC detailed fast flux networks†
- In case you've forgotten:
  - One domain uses multiple IPs
  - Optionally, one IP hosts multiple related domains
  - If both, we have a malicious CDN

† "SSAC Advisory on Fast Flux Hosting and DNS." ICANN TR# SAC-025.

Fast Flux – so last decade (II)



http://www.honeynet.org/book/export/html/130

Special thanks to William Salusky & Robert Danford

So why am I talking about this now?

A bunch of people talked about fast flux domains for delivering malicious software and add redirection

Standard approach: find and block the domains

Realization: Whack-a-mole is tiring.

Second realization: Whack-a-mole is actually impossible to win

- If you want more about this, ask about my APWG eCRS paper *Modeling Malicious Domain Name Take-down Dynamics: Why eCrime Pays*

How can we jump out ahead?

Domains need two things:

- Location (A, AAAA, or CNAME)
- NS

IP works fine reactively, and reputation for some AS

But it’s hard to jump out ahead

Name servers, then!

Two sources

Zone files

Pro:

- Complete for the zones we have

Con:

- Only have gTLDs (by policy), updated daily

Passive DNS

Pro:

- Visibility across TLDs, finer time resolution

Con:

- Incomplete; no data until someone issues the query

Process

1. Look for name servers that move IP addresses.
2. Map IPs to ASNs, and look at IP changes that also change ASN.
3. Since NS are more stable, the parameters for “fast” flux need to be adjusted.

- This is the key point – NS are by definition stable. In a CDN, Akamai e.g., each *NS* does *not* change IP.
- They may change what NS you point to, but the NS is stable.

Surprise!

There are suspicious name servers

In Zone Files (2011)

# Changes	# NS change IP	% of total	# NS change ASN	% of total
0	2734327	97.8%	2754332	98.5%
1	52741	1.9%	36645	1.3%
2	4855	0.2%	1846	0.1%
3	551	0.0197%	635	0.0227%
4	198	0.0071%	838	0.0300%
5	233	0.0083%	531	0.0190%
6	482	0.0172%	500	0.0179%
7	660	0.0236%	401	0.0143%
8	706	0.0252%	224	0.0080%
9	607	0.0217%	30	0.0011%
10	478	0.0171%	19	0.0007%
11	138	0.0049%	9	0.0003%
more	152	0.0053%	118	0.0041%

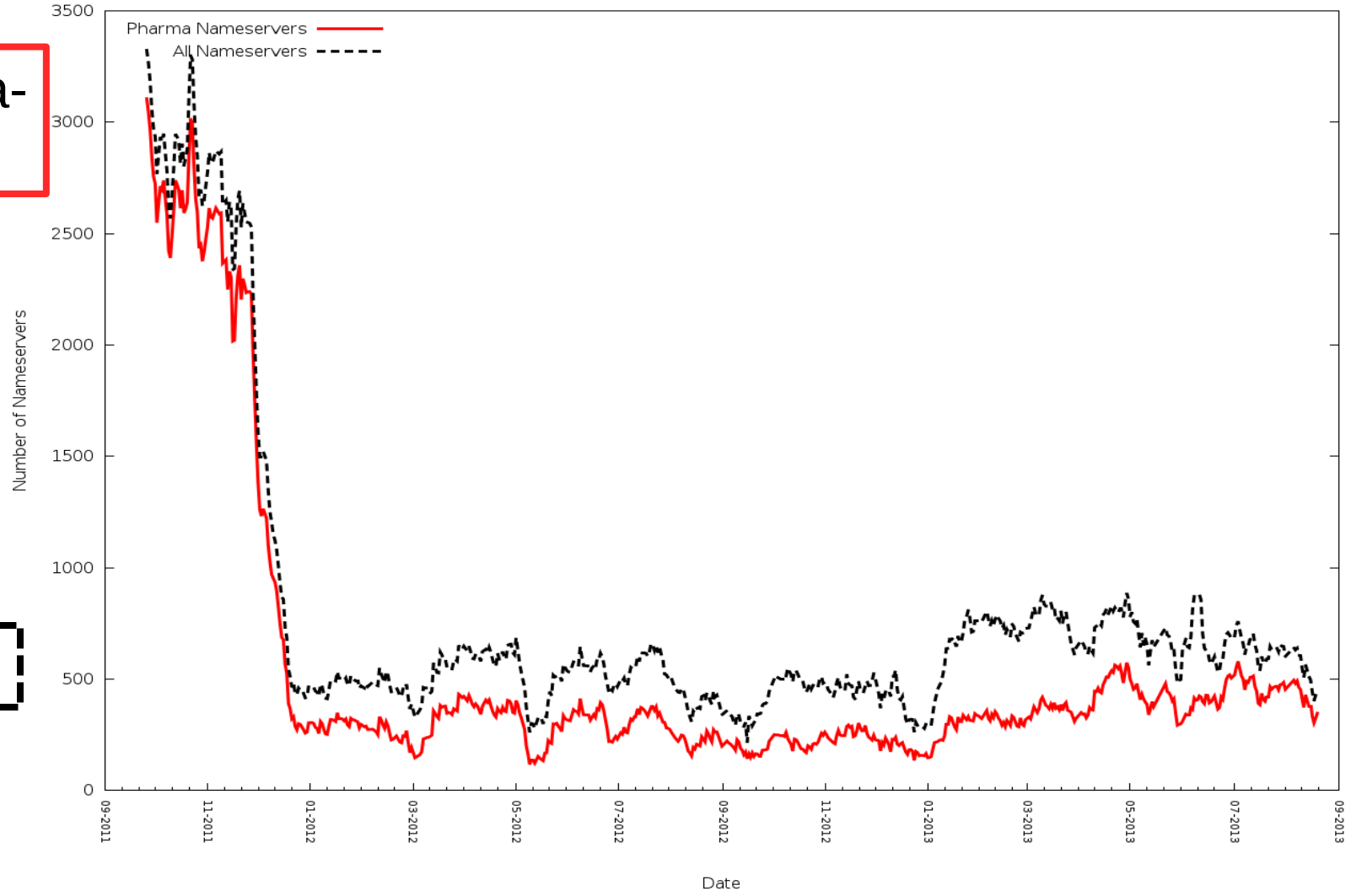
In Passive DNS (2011)

# Changes	# NS change IP	% of total	# NS change ASN	% of total
0	1846152	95.8%	1877654	97.5%
1	68401	2.4%	40422	1.4%
2	5134	0.2%	3276	0.1%
3	1420	0.0508%	1232	0.0441%
4	1177	0.0421%	966	0.0345%
5	1123	0.0402%	684	0.0245%
6	566	0.0202%	450	0.0161%
7	535	0.0191%	388	0.0139%
8	439	0.0157%	279	0.0100%
9	322	0.0115%	220	0.0079%
10	248	0.0089%	152	0.0054%
11	140	0.0050%	76	0.0027%
more	710	0.0254%	568	0.0204%

Following this out 2 years…NS that changed IP 5+ times within 30 days:

Pharma-related

All NS



Is the flux really fast?

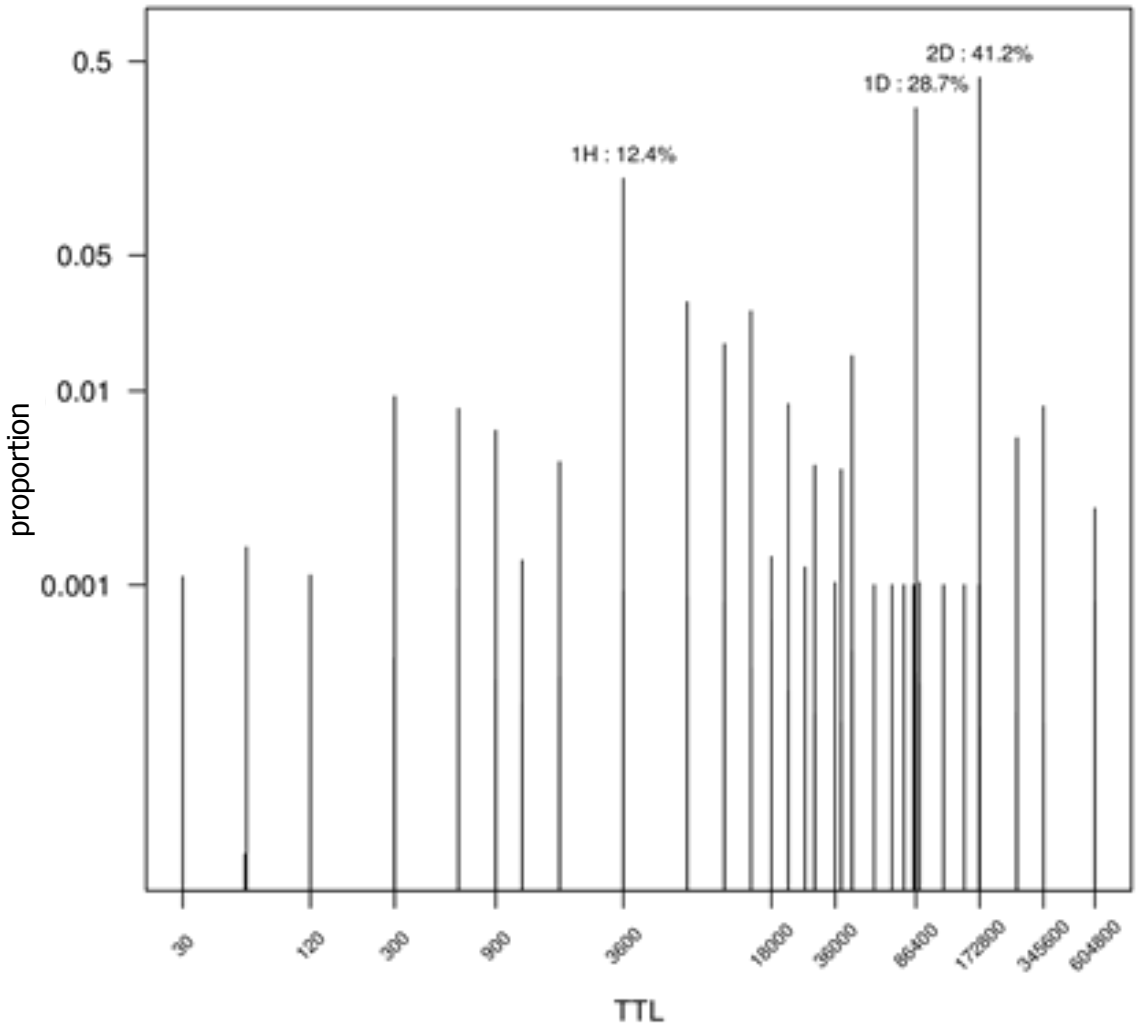
Well, no.

But most NS record TTLs are quite long.

Note *log-log scale*.

82.3% of pDNS TTLs are 1 of 3 values [1 hour, 1 day, 2 days]

(760M records)



So what?

- NS flux is rather slow
- But a high confidence indicator.
- Also, blocking the NS has a bigger effect than blocking a single domain.

I don’t think anyone looks at this in order to block things. Does anyone here? Has anyone tried and not had success?

Future Work

- I could try to “Prove” that these NS are bad
- I can’t run incidents to ground at Internet scale, but I could try taking a sample.
- And intersecting with a dozen or more black lists is, surprisingly, not necessarily fruitful
  - A CERT white paper (CERTCC-2013-39) details this http://www.cert.org/netsa/publications/blacklists_CERTCC-2013-39.pdf
- Continue to keep track of this, for awareness of badness.

Practically – flow analysis

- You can keep track of this at your NS and prevent it from talking to these suspicious domains
  - Request Policy Zone in BIND, for example
- For those of you that don't have RPZ installed
  - Track DNS requests to these NS in flow
  - Since the NS's IPs only change on the order of hours, a cron to update an IP set would be reasonable.

```
rwfilter --dipset=flux_NI.set --dport=53
```

  - If you've got a enterprise-wide recursive server that everyone should use, you should only see the 1 IP talking out

`rwfilter --dipset=flux_NI.set --dport=53`

Notes

- Assumes flow sensor at the edge
- If you've got a enterprise-wide recursive server that everyone should use, you should only see the 1 source IP talking out
- If you find client machines directly making DNS requests to suspicious NS, avoiding the usual recursers, that's worse news

Questions/comments?

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