Passive Detection of Misbehaving Name Servers

Jonathan Spring, Leigh Metcalf
netsa-contact (AT) cert.org
NANOG 59, Phoenix

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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.
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 just published (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

- Look for name servers that move IP addresses.
- Map IPs to ASNs, and look at IP changes that also change ASN.
- 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)

<table>
<thead>
<tr>
<th># Changes</th>
<th># NS change IP</th>
<th>% of total</th>
<th># NS change ASN</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2734327</td>
<td>97.8%</td>
<td>2754332</td>
<td>98.5%</td>
</tr>
<tr>
<td>1</td>
<td>52741</td>
<td>1.9%</td>
<td>36645</td>
<td>1.3%</td>
</tr>
<tr>
<td>2</td>
<td>4855</td>
<td>0.2%</td>
<td>1846</td>
<td>0.1%</td>
</tr>
<tr>
<td>3</td>
<td>551</td>
<td>0.0197%</td>
<td>635</td>
<td>0.0227%</td>
</tr>
<tr>
<td>4</td>
<td>198</td>
<td>0.0071%</td>
<td>838</td>
<td>0.0300%</td>
</tr>
<tr>
<td>5</td>
<td>233</td>
<td>0.0083%</td>
<td>531</td>
<td>0.0190%</td>
</tr>
<tr>
<td>6</td>
<td>482</td>
<td>0.0172%</td>
<td>500</td>
<td>0.0179%</td>
</tr>
<tr>
<td>7</td>
<td>660</td>
<td>0.0236%</td>
<td>401</td>
<td>0.0143%</td>
</tr>
<tr>
<td>8</td>
<td>706</td>
<td>0.0252%</td>
<td>224</td>
<td>0.0080%</td>
</tr>
<tr>
<td>9</td>
<td>607</td>
<td>0.0217%</td>
<td>30</td>
<td>0.0011%</td>
</tr>
<tr>
<td>10</td>
<td>478</td>
<td>0.0171%</td>
<td>19</td>
<td>0.0007%</td>
</tr>
<tr>
<td>11</td>
<td>138</td>
<td>0.0049%</td>
<td>9</td>
<td>0.0003%</td>
</tr>
<tr>
<td>more</td>
<td>152</td>
<td>0.0053%</td>
<td>118</td>
<td>0.0041%</td>
</tr>
</tbody>
</table>
In Passive DNS (2011)

<table>
<thead>
<tr>
<th># Changes</th>
<th># NS change IP</th>
<th>% of total</th>
<th># NS change ASN</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1846152</td>
<td>95.8%</td>
<td>1877654</td>
<td>97.5%</td>
</tr>
<tr>
<td>1</td>
<td>68401</td>
<td>2.4%</td>
<td>40422</td>
<td>1.4%</td>
</tr>
<tr>
<td>2</td>
<td>5134</td>
<td>0.2%</td>
<td>3276</td>
<td>0.1%</td>
</tr>
<tr>
<td>3</td>
<td>1420</td>
<td>0.0508%</td>
<td>1232</td>
<td>0.0441%</td>
</tr>
<tr>
<td>4</td>
<td>1177</td>
<td>0.0421%</td>
<td>966</td>
<td>0.0345%</td>
</tr>
<tr>
<td>5</td>
<td>1123</td>
<td>0.0402%</td>
<td>684</td>
<td>0.0245%</td>
</tr>
<tr>
<td>6</td>
<td>566</td>
<td>0.0202%</td>
<td>450</td>
<td>0.0161%</td>
</tr>
<tr>
<td>7</td>
<td>535</td>
<td>0.0191%</td>
<td>388</td>
<td>0.0139%</td>
</tr>
<tr>
<td>8</td>
<td>439</td>
<td>0.0157%</td>
<td>279</td>
<td>0.0100%</td>
</tr>
<tr>
<td>9</td>
<td>322</td>
<td>0.0115%</td>
<td>220</td>
<td>0.0079%</td>
</tr>
<tr>
<td>10</td>
<td>248</td>
<td>0.0089%</td>
<td>152</td>
<td>0.0054%</td>
</tr>
<tr>
<td>11</td>
<td>140</td>
<td>0.0050%</td>
<td>76</td>
<td>0.0027%</td>
</tr>
<tr>
<td>more</td>
<td>710</td>
<td>0.0254%</td>
<td>568</td>
<td>0.0204%</td>
</tr>
</tbody>
</table>
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 (Another CERT white paper in press, CERTCC-2013-39, demonstrates this)
- Continue to keep track of this, for awareness of badness.
Hope

It’d be nice if registries could put rules on zone file changes that looked for this and nipped it in the bud

• In the mean time
  • You can keep track of this at your NS and prevent it from talking to these suspicious ones
    • (RPZ, firewall, etc.)
Questions/comments?