Verfploeter: Broad and Load-Aware Anycast Mapping

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Our Starting Goals:

- Develop a technique to:
  - Accurately map anycast catchments
  - Accurately study B’s anycast IPv4 catchments
  - Predict load in advance of changes
  - Study anycast stability over time
Traditional "Active" Anycast Probing

- Traditional techniques require lots of Vantage Points
- e.g. RIPE Atlas
"Verfploeter" uses "Passive" Vantage Points

- Verfploeter uses the Internet as its vantage points
- We collect response traffic to ICMP "pings"
Input: An IPv4 Hitlist

- Previous work supplied us with ICMP-responsive IP-addresses in each IPv4 /24 block:

  Xun Fan and John Heidemann,
  "Selecting Representative IP Addresses for Internet Topology Studies"

- https://ant.isi.edu/datasets/ip_hitlists/

- Example addresses:
  1.0.100.37
  1.0.101.100
  1.0.102.123
  1.0.103.1
  1.0.104.1
  1.0.105.106
  1.0.106.123
RIPE Atlas Coverage of B-Root

(measured 2017/05/15)
Verfploeter Coverage of B-Root

Note: huge scale difference
Tangled: Studying A Larger Anycast Testbed

- Tangled: A 9-site anycast testbed University of Twente
- Tangled provides a more complex anycast test framework

<table>
<thead>
<tr>
<th>Location</th>
<th>Host</th>
<th>Upstream</th>
</tr>
</thead>
<tbody>
<tr>
<td>AU</td>
<td>Sydney</td>
<td>Vultr</td>
</tr>
<tr>
<td>FR</td>
<td>Paris</td>
<td>Vultr</td>
</tr>
<tr>
<td>JP</td>
<td>Tokyo</td>
<td>WIDE</td>
</tr>
<tr>
<td>NL</td>
<td>Enschede</td>
<td>Univ. of Twente</td>
</tr>
<tr>
<td>UK</td>
<td>London</td>
<td>Vultr</td>
</tr>
<tr>
<td>US</td>
<td>Miami</td>
<td>Florida Int. Univ.</td>
</tr>
<tr>
<td>US</td>
<td>Washington</td>
<td>USC/ISI</td>
</tr>
<tr>
<td>BR</td>
<td>Sao Paulo</td>
<td>Florida Int. Univ.</td>
</tr>
<tr>
<td>DK</td>
<td>Copenhagen</td>
<td>DK-Hostmaster</td>
</tr>
</tbody>
</table>

- Note: some locations have common upstreams
RIPE Atlas Coverage of Tangled
Verfploeter Coverage of Tangled

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Do We Need To Look Inside ASes?

Given our significant number of new vantage points:

- Can we study traffic catchments within an AS?
- Do the number of sites seen change:
  - with prefix size?
  - with AS size?
- Can we measure routing stability using Verfploeter?
- ASes announcing more prefixes are likely to see more anycast sites
Sites Seen vs Prefix Size

80% of prefixes smaller than /16 reach a single site
Larger prefixes are more likely to see more sites
Anycast Stability Over 24 Hours

- Measurements taken every 15 minutes using Tangled
- `to_NR`: addresses switching to "not reachable"
- `from_NR`: addresses switching from "not reachable"
Anycast Stability Over 24 Hours

- 3.54M (95%) of VPs maintained catchment
- 89k (2.4%) changed from response to non-responsive
- near the same for flipping back
- 4.6k (0.1%) VPs changed catchment within 2809 ASes
- General Conclusion: anycast is quite stable
## Network Flips

Networks flipping the most:

<table>
<thead>
<tr>
<th>AS</th>
<th>Owner</th>
<th>IPs (/24s)</th>
<th>Flips</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4134</td>
<td>CHINANET</td>
<td>47,963</td>
<td>257,915</td>
</tr>
<tr>
<td>2</td>
<td>7922</td>
<td>COMCAST</td>
<td>3,933</td>
<td>19,133</td>
</tr>
<tr>
<td>3</td>
<td>6983</td>
<td>ITCDELTIA</td>
<td>1,372</td>
<td>15,403</td>
</tr>
<tr>
<td>4</td>
<td>6739</td>
<td>ONO-AS</td>
<td>849</td>
<td>13,347</td>
</tr>
<tr>
<td>5</td>
<td>37963</td>
<td>ALIBABA</td>
<td>2,493</td>
<td>10,988</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td></td>
<td>43,388</td>
<td>188,630</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>108,493</td>
<td>505,416</td>
</tr>
</tbody>
</table>

Notes:

- 63% of the flipping are in these 5 ASes
- CHINANET accounts for 51% of the flips alone
- All the flips recorded are located in 2809 ASes
Verfploeter Sizing Summary

- Verfploeter sees ~430x more network blocks than Atlas
  - Atlas has some unique blocks though
- Difference in /24s seen by Verfploeter and Atlas:

<table>
<thead>
<tr>
<th></th>
<th>Atlas</th>
<th>Verfploeter</th>
</tr>
</thead>
<tbody>
<tr>
<td>/24 blocks seen</td>
<td>8677</td>
<td>3,786,907</td>
</tr>
<tr>
<td>geolocatable</td>
<td>8677</td>
<td>3,786,229</td>
</tr>
<tr>
<td>unique</td>
<td>2079</td>
<td>3,606,300</td>
</tr>
</tbody>
</table>
Verfploeter: Ready For Use

Verfploeter provides a novel mechanism for studying anycast

- Paper:
  - https://www.isi.edu/~johnh/PAPERS/Vries17a.pdf

- Datasets:
  - https://ant.isi.edu/datasets/anycast/index.html#verfploeter

- Software:
  - https://ant.isi.edu/software/verfploeter/index.html

Please feel free to contact us for help or to share your results