Diagnosing the Location of Bogon Filters

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Problem: “Bogon filters”

• ISPs often filter unallocated address space to protect themselves from malicious attacks and unwanted traffic.

• Over time unallocated address space may become allocated and legitimately announced address space...

• Problem: Filters need to be updated but seem often not to be
Root Cause
Uncovered!
Objectives

• Develop methodology that is capable of detecting and locating filters that are blocking newly allocated address space

• Analyze reachability status of a newly allocated prefix

• For the experiment, ARIN loaned us
  96.0.0.0/16  97.64.0.0/16
  98.128.0.0/16  99.192.0.0/16
Testing reachability of a new prefix

- Terminology:
  - **Test-prefix**: newly allocated prefix to be tested
  - **Anchor-prefix**: well-established prefix whose reachability should be fine
  - **Probe-site**: router that announces both the test-prefix and the anchor-prefix
Overview: Approach

- **In-probes**: traceroutes from public traceroute servers to test- & anchor-prefix.

- **Out-probes**: traceroutes **from test-site** towards pingable IPs. Source addresses are both test-IP and anchor-IP.
Testing reachability of a new prefix: In-Probes

- Two IPs hosted at the same location:
  - anchor IP: well established, hopefully unfiltered
  - test IP: newly allocated address
- Assume that they are propagated in the same way (as they are announced from the same location)
- From each traceroute-server, run two traceroutes:
  to test-IP and
  to anchor-IP
In-Probes: Principles

- In-probes give reachability information towards the test and anchor prefixes.
- If traceroute from test-prefix traceroute diverges at some point, we build a list of possible candidates that might filter.
**In-Probes: Limitation**

- Catch only filters that are between public traceroute-server/looking glass and test-site.

=> can only find limited number of filters, but identifies intermediate ASs that filter.
In-Probes: measurements

- Advertise test and anchor prefixes from 4 probe-sites: Seattle (USA), Munich (DE), Wellington (NZ), Tokyo (JPN)

- 480 public traceroute serves and PlanetLab nodes. Mainly US & Europe, but covering 56 countries

- Many volunteers from NANOG posting
In-Probes: results

Categories:

- “good” (anchor and test take exactly same path)
  - 66.9%
- “diverging inside” (anchor and test take different paths)
  - 20.6%
- Test stops, but anchor ok
  - 8.6%
- Failure (either anchor or anchor and test failed)
  - 3.9%
In-Probes: results

• Derive candidate links, eliminate unlikely candidates.
• Remaining candidate links:
  • ~ 34 ASs that may contain incorrectly configured filters.

http://psg.com/filter-candidates.txt
In-Probes: evaluation

- **Advantages:**
  - traceroutes go around bogon filters
  - known details about IP-level path

- **Disadvantages:**
  - traceroute site MUST be “behind” bogon filter
  - Never enough traceroute sites available

- **Goal:** test as many ASs as possible for reachability

- **Solution:** “out-probes”
Testing for usable reachability:

**Out-Probes**

- **Out-probe**: ping and traceroute performed *from* test-IP and anchor-IP *towards* external IP addresses
- Return-Path is of interest, but unknown
- What we learn is which AS has connectivity
- Why it works:
  - high AS coverage
  - only usable connectivity
Out-Probes: measurements

- Perform ping from test-sites (test-IP and anchor-IP) towards a large set of pingable-IP addresses (46,569) in 18,574 different ASs.
- If ping comes back => usable reachability :) (~85% of all probes)
- If ping does not come back => annotate anchor link with “proximity” index. (~10% of all probes)
  => roughly 2,500 ASs (!) (depends on probe site)
- (~5% not pingable anymore, e.g., dial-up)
Out-Probes: measurements

- Build filtering likelihood index based on “proximity” and per AS observations

- **x-axis index:** aggregate all observations, normalize, and weight with “proximity index”

$\Rightarrow$ provides ordering of ASs that are likely to filter

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**CDF (cumulative probability)**

- per link
- per AS

**filtering likelihood index**

0.0 0.2 0.4 0.6 0.8 1.0

0 10 20 30 40 50
Out-Probes: Initial validation

• We derived 443 candidate ASs that are likely to filter.

• Manual search for 15 traceroute servers within those 443 candidate ASs:
  • 7 filter
  • 5 do not filter themselves, but have no usable [up-stream] connectivity.

=> 12 out of 15 (=80%) correctly identified
3 failed, but validation was taken at different time. Thus, ASs might have changed filter in meantime.
Summary: In- and Out-Probes

- **Out-probes** tell about “usable reachability”:
  - Find areas of non-reachability
  - Larger coverage (currently > 85% of Internet ASs)
  - No information about: return path and thus non-optimal paths

- **In-probes** tell us about filters on the path:
  - Reachability available - goal: detect intermediate filters
  - Smaller coverage
  - Many traceroute servers are needed at the “edge”
Further Work

• Sent list of candidate suspected bogon filtering links to ISPs, waiting for their feedback to validate our analysis
• Increasing number of in-probes to have more information about location of bogon filters and their number
• How accurate can we be in identifying bogon filters using measurements?
• How would we quantify that accuracy?
• How many out-probes are needed/useful?
Results – Out-Probes

• We can identify unreachable places: Via out-probes we can see if an IP is not well routed.
• Aside from small issues related to ICMP, we know that if the probe doesn't come back that there is NO usable connectivity. That's simple and straightforward.
• It is possible to achieve a reasonable coverage of the Internet (<18k ASs).
• The methodology produces usable results.
Results – In-Probes

• We can go a step further and detect places where there is "non-optimal" connectivity.

• Keep in mind that with the in-probes we mainly look at traceroutes that BOTH reach the destination.

• We would very much like more validation by the operator community
How you can help...

- We plan to establish an ongoing service.
- For that we need:
  - pingable addresses
    Tell us about addresses that we can ping once in a while and we make sure that you have connectivity to newly allocated prefixes.
  - traceroute servers
    Tell us about traceroute servers, so that we can improve the quality of our inference.
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