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

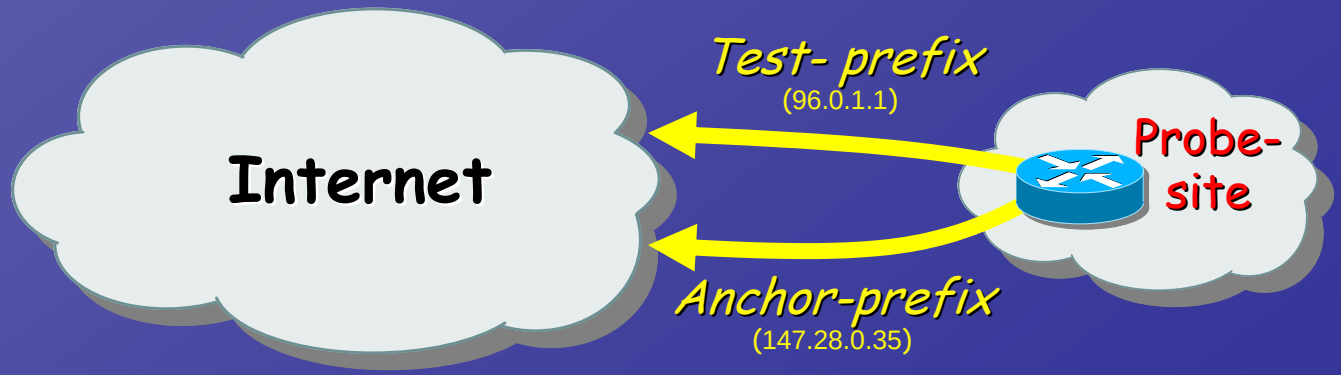
Root Cause Uncovered!

Objectives

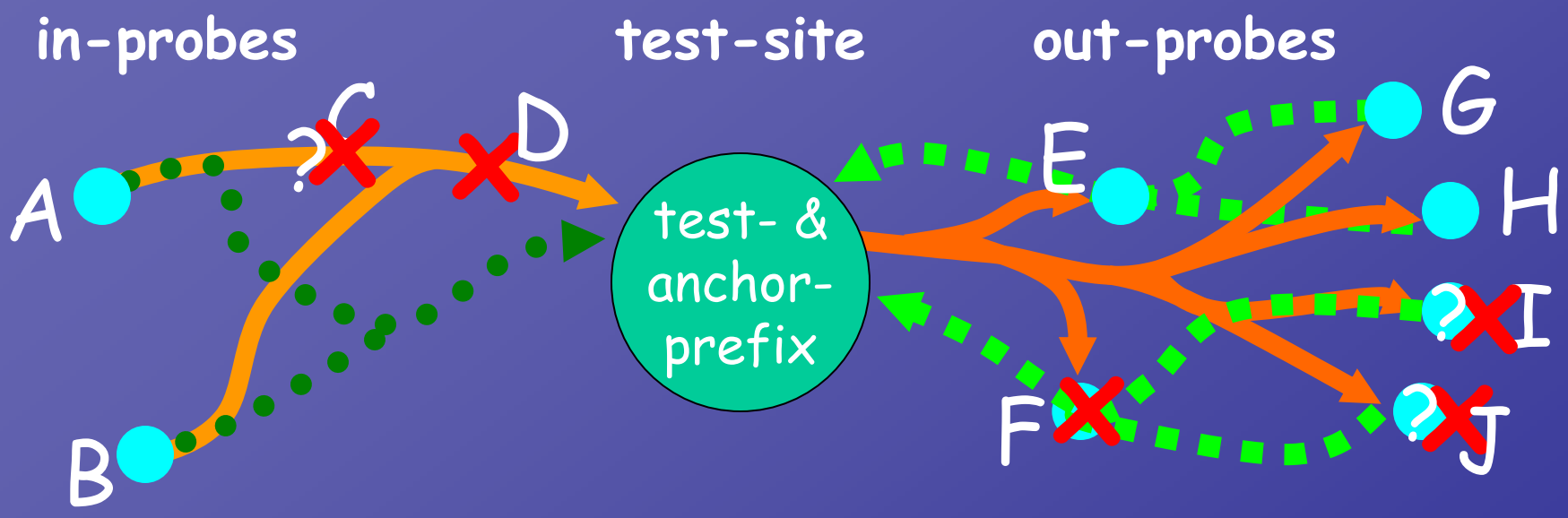
- Develop methodology that is capable of detecting and locating filters that are blocking newly allocated address space
- Analyze reachability status of a newly allocated prefix
- For the experiment, ARIN loaned us
  96.0.0.0/16 97.64.0.0/16
  98.128.0.0/16 99.192.0.0/16

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



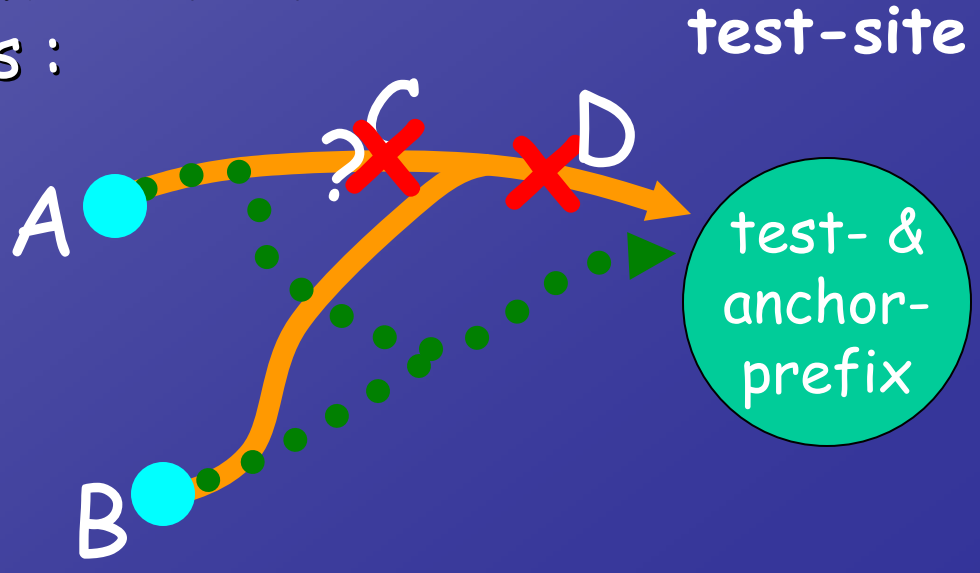
Overview: Approach



- 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

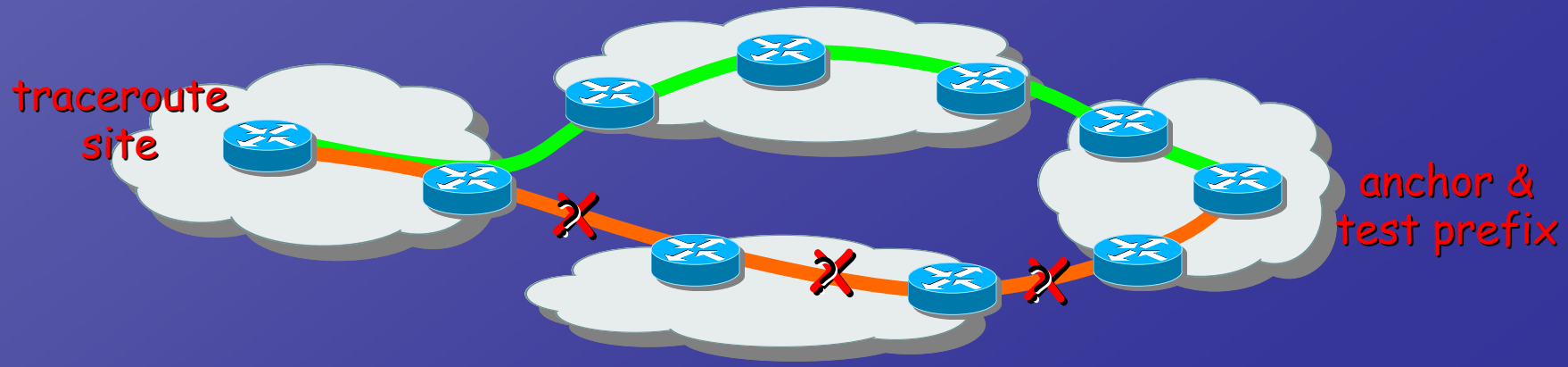
Testing reachability of a new prefix: In-Probes

- 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

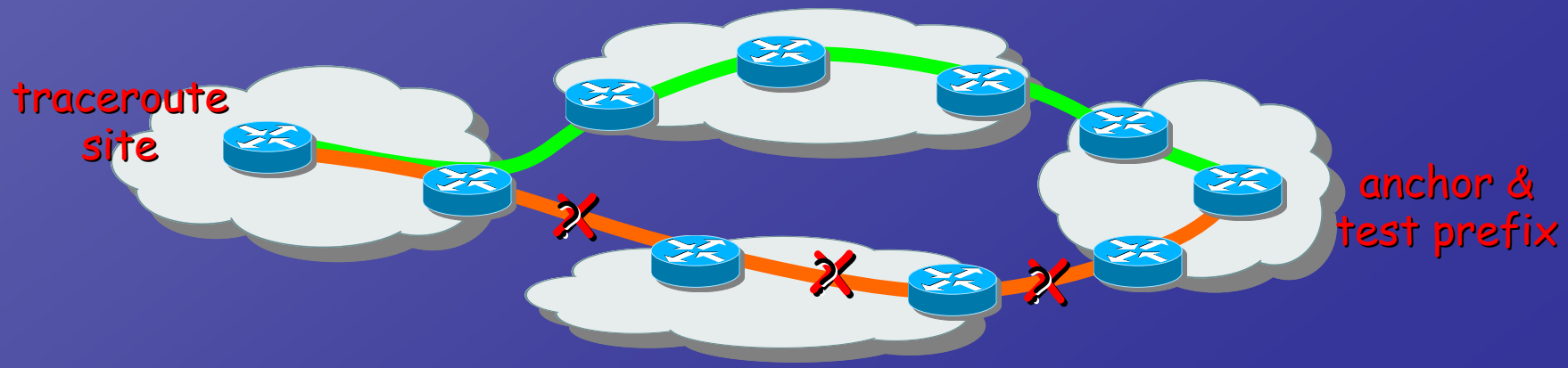
- In-probes give reachability information towards the test and anchor prefixes
- If traceroute from test-prefix traceroute diverges at some point, we build a list of possible candidates that might filter.



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

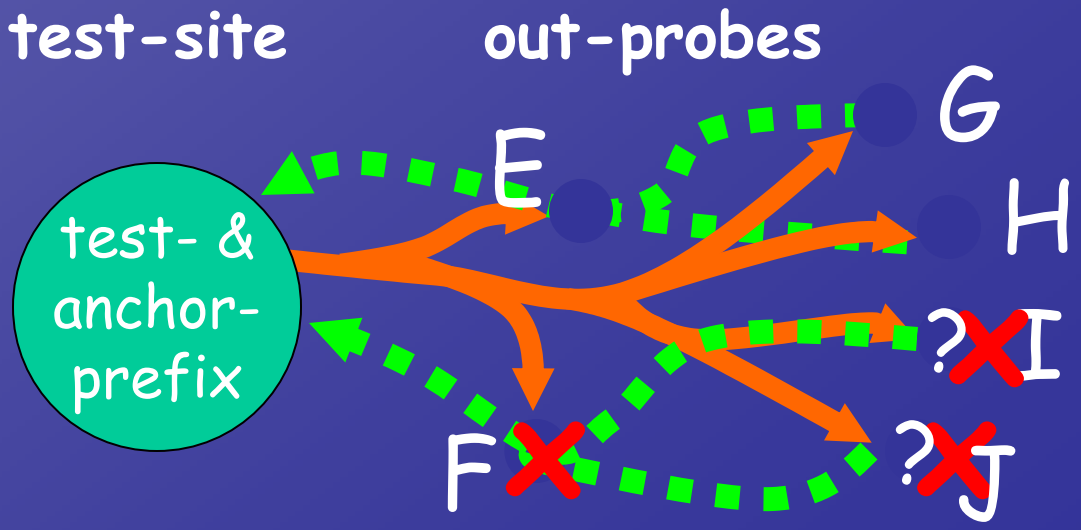
In-Probes: evaluation

- 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)

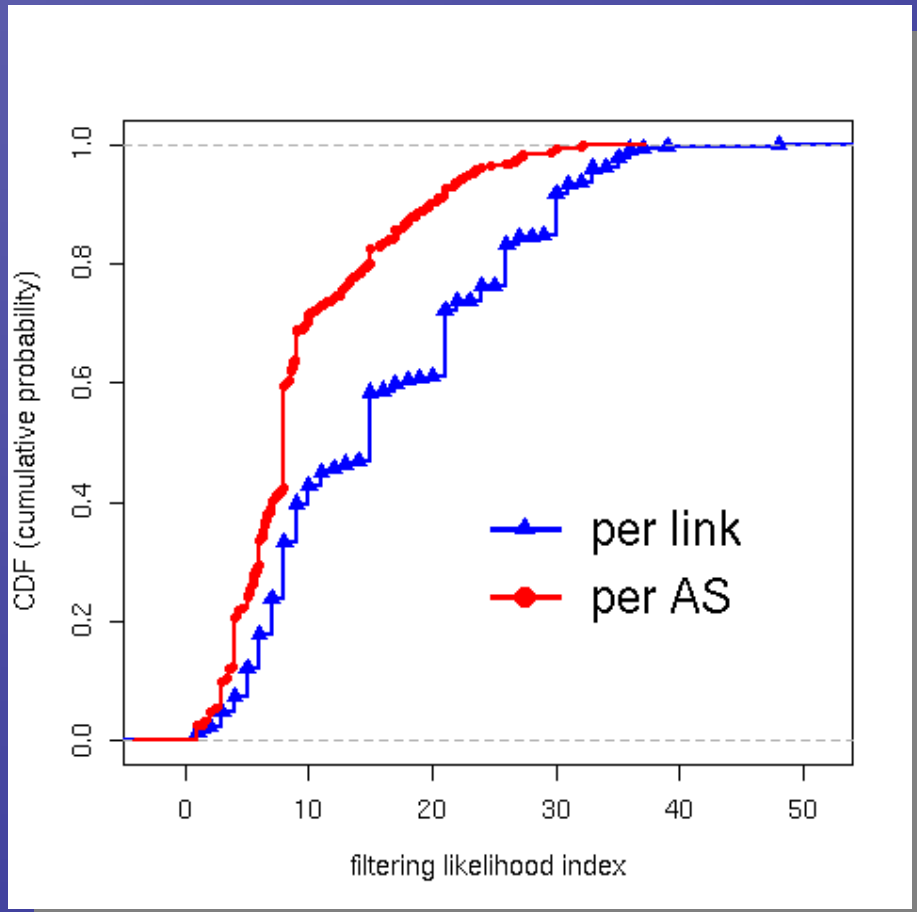
- (~5% not pingable anymore, e.g., dial-up)

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"

=> provides ordering of ASs that are likely to filter



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 filters 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 straight forward.
- 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.

Thanks To

- ARIN for IP space and commissioning research
- CityLink – NZ, a test site
- IIJ - JP, a test site
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- PSGnet – US, a test site
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