CSC 7970 Paper Presentation

Internet Anycast: Performance, Problems, & Potential*

Vaibhav Ravinutala

*Zhihao Li, Dave Levin, Neil Spring, and Bobby Bhattacharjee. 2018. Internet Anycast: Performance, Problems, & Potential. In Proceedings of ACM SIGCOMM (SIGCOMM). ACM, New York, NY, USA, 15 pages. https://doi.org/

Revised Presentation to v2 on 20th February 2020

Outline of this Presentation

- Internet Anycast
- **Quadchart**
- Brief summary of related works
- Performance Analysis
- Anycast Problems: Path Inflation
- Potential Solution : Geographic Hints to BGP
- MyThoughts
- References

Internet Anycast: Performance, Problems, & Potential

Presented by Vaibhav Ravinutala

Objective

→ *"Does anycast provide an intuitively good server selection mechanism?"*

→Parameters : Load balance, Access Latency performance of global anycast

Problem

→ It is evident that IP anycast in its current state can be inefficient, instead of using solutions like geo-replicated service over anycast that require cooperation from a large ISP, this work tries to provide a different fix.

Approach

→ Compares previous studies,

→ Quantifies inefficiencies in IP anycast

→ Novel measurement Technique to compare AS-Level Paths from Clients to multiple IP anycast sites

→ Proposes a fix based on root cause analysis

Solution

→ Geographic Hints to BGP advertisements

→ Easily and Immediately Deployable

→ More democratic fix supporting multiple distinct upstream providers

Outline of this Presentation

- Internet Anycast
- Quadchart
- **Brief summary of related works**
- Performance Analysis
- Anycast Problems: Path Inflation
- Potential Solution : Geographic Hints to BGP
- MyThoughts
- References

Brief summary of related works

→ As as one adds more anycast replicas in locations with many clients, it is generally believed that:
(1) overall client latency will decrease and
(2) load from nearby clients will be more evenly distributed

→ Several studies found internet anycast performance doesn't match basic expectations state above.

→ Ballani et al. "... deployment of anycast replicas such that they share same upstream provider to fix in efficiencies in anycast"

Outline of this Presentation

- Internet Anycast
- Quadchart
- Brief summary of related works
- **Performance Analysis**
- Anycast Problems: Path Inflation
- Potential Solution : Geographic Hints to BGP
- MyThoughts
- References

Performance Analysis

→ On decomposing anycast path inflation and also comparing with unicast representatives to estimate alternate site performance it is found in this study that anycast path inflation is larger than unicast path inflation

→ Here, D-root, C-root, K-root sites are used for that study

→ BGP's poor route selection: routers are presented with routes to two or more anycast replicas each of whom have equal preference, routers often select a distant, high-latency anycast site over the closer, low-latency one. It is observed the best alternative is often an unselected option.

→ BGP's poor route selection is due to lack of useful information to differentiate between distant, high-latency anycast site and a closer, low-latency one.

Performance Analysis

→ Performance Study of Internet-wide anycast: using measurements of DNS root servers

→ Data: Datasets are from D-root's "Root server traffic traces" and RIPE Atlas Probe

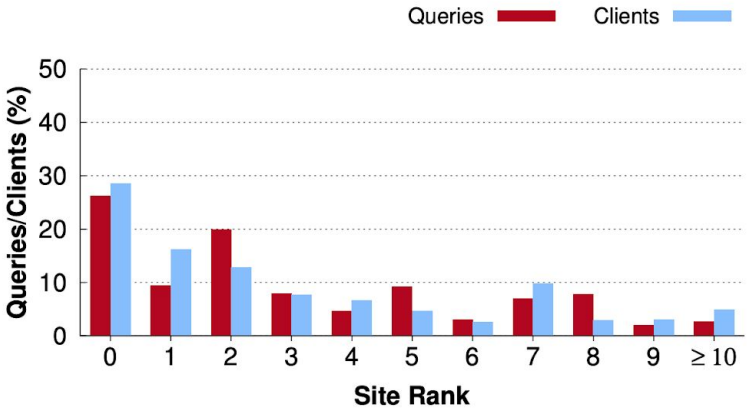
→ Sample Size: D-root "As of Jan 2018,…..D-root received more than 30,000 queries per second, resulting in about 140 GB of trace data per day. RIPE Atlas Probe provide measurements of 9 out of 13 DNS root servers.

→ Limitations:

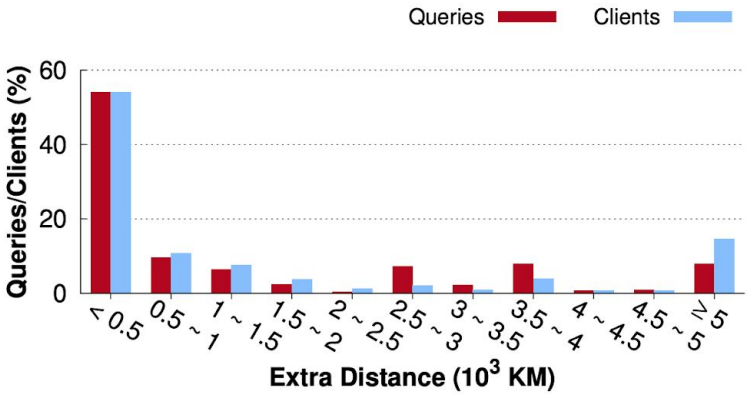
1. D-root extrapolates to anycast performance in general.

2. Passive, does not include Client-side latency measures

Performance Analysis



(a) D-root queries by rank



(b) Distribution of D-root queries by additional distance traveled.

Figure 1: D-root performance based on client traces.

Performance Analysis

→ Figure 1a shows that 2/3 of all queries/clients are somehow "misdirected" by anycast.

→ Figure 1b provides a measure of the cost of these errors, by quantifying the extra distance queries that are not directed to their closest site must travel, shows that over **1/3rd of the queries travel over 1000 km more than minimal, and over 8.0% travel more 5000 km extra.**

Performance Analysis

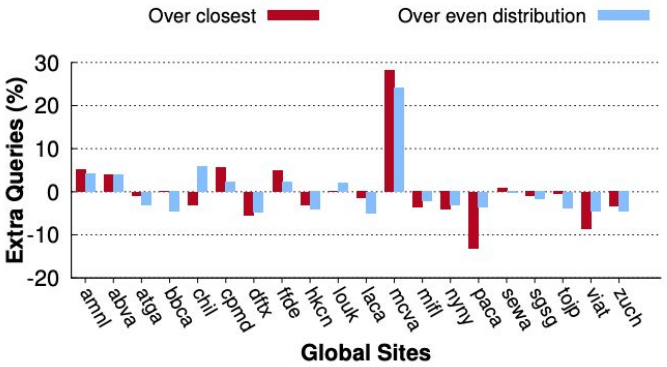


Figure 2: D-root load balance.

Over even distribution bars: fraction of queries, over (or under) the even distribution in which each site (ideally) receives an equal share of queries

Over closest bars: query distribution compared to the scenario when all queries were directed to their geographically closest site.

Both Fig.1 and Fig.2 shows that is neither effective at directing clients to nearby replicas, nor does it balance load particularly effectively.

Performance Analysis : Summary

→ Extra distance each query travelled over their geographically closest site is computed and found over 1/3 queries traveled more than 1000 km extra distance.

These results are compiled over an year from 102B queries,35M IP addresses spread over 190 countries.

→ Average query distance in each week that had additional anycast global site was computed and it is inferred that site count doesn't matter.

→It is found that Anycast does not function as expected due to routing and topology constraints inducing Path Inflation. Path inflation in unicast can be compared to taking a detour where as in anycast it's like going to Milan in Italy while actually intend to Milan in Tennessee.

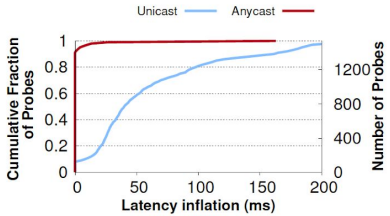
Outline of this Presentation

- Internet Anycast
- Quadchart
- Brief summary of related works
- Performance Analysis
- **Anycast Problems: Path Inflation**
- Potential Solution : Geographic Hints to BGP
- MyThoughts
- References

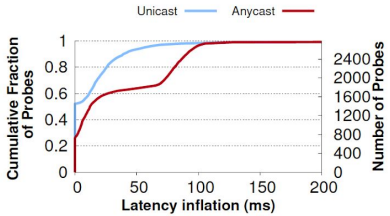
Anycast Problems: Path Inflation

→ Anycast path inflation quantifies the extra cost incurred by anycast by not choosing paths that are available via unicast.

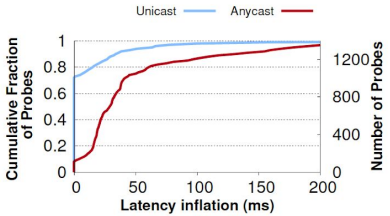
→ Anycast path inflation is larger than unicast path inflation



(a) C-root



(b) D-root

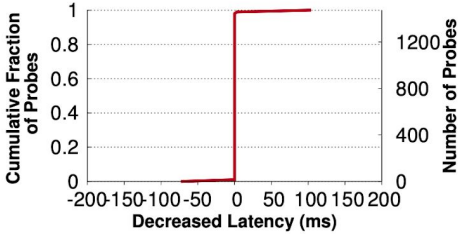


(c) K-root

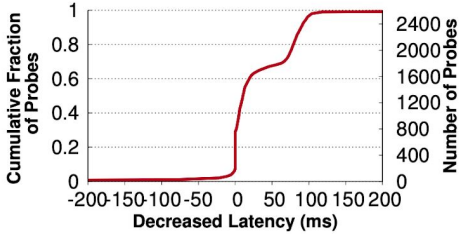
Outline of this Presentation

- Internet Anycast
- Quadchart
- Brief summary of related works
- Performance Analysis
- Anycast Problems: Path Inflation
- **Potential Solution : Geographic Hints to BGP**
- MyThoughts
- References

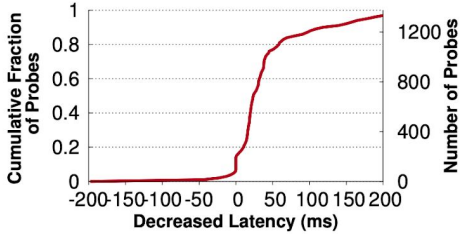
Potential Solution : Geographic Hints to BGP contd.



(a) C-root



(b) D-root



(c) K-root

It is found that by simply embedding geographic location hint on BGP provides a significant improvement in performance

Potential Solution : Geographic Hints to BGP

Performance Study of Internet-wide anycast: using measurements of DNS root servers

1. Geo-locate the source of the query by IP address using the MaxMind
2. Measure distance from the query source to all D-root sites.
3. For a query, the closest site is ranked 0, the next closest rank 1, and so on.
4. Compute the same measure for each source IP address (client) as well

Geographic distance as an approximation of expected latency

Results compiled over one year, and from over 102B queries and 35M IP addresses, representing over 190 countries, show that there is significant room for improving the Internet Anycast

Potential Solution : Geographic Hints to BGP

→ Embed geographic location of the anycast sites reachable through the announcement

→ Use BGP community attributes
- ➢ Two 16-bit values X:Y
- ➢ X represents the AS number that sets the community
- ➢ Y encodes the latitude and longitude

*Slide 27 from Presentation on "Internet Anycast: Performance, Problems and Potential Zhihao Li, Dave Levin, Neil Spring, Bobby Bhattacharjee" http://www.cs.umd.edu/projects/droot/anycast_slides.pdf

Outline of this Presentation

- Internet Anycast
- Quadchart
- Brief summary of related works
- Performance Analysis
- Anycast Problems: Path Inflation
- Potential Solution : Geographic Hints to BGP
- **MyThoughts**
- References

My Thoughts

→ I agree to the author's view to avoid one upstream provider as it will result in a single point of failure.

→ This work presents attempts to quantify inefficiencies in IP anycast. a more democratic, easily and immediately deployable **FIX** to reduce anycast latency inflation using **GEO-HINTS**

→ Title of the paper implied as the paper would be study on Anycast but the paper actually tries to propose a new method

→ I opine, even if they try to embed hints with BGP and theoretically get the required performance, the proposed method would require several ISPs to reconfigure, which apparently is highly unlikely.

Outline of this Presentation

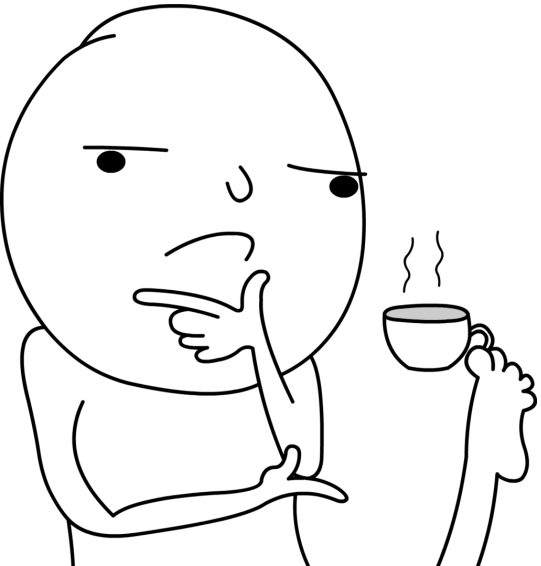
- Internet Anycast
- Quadchart
- Brief summary of related works
- Performance Analysis
- Anycast Problems: Path Inflation
- Potential Solution : Geographic Hints to BGP
- MyThoughts
- **References**

References

→Presentation on “Internet Anycast: Performance, Problems and Potential Zhihao Li, Dave Levin, Neil Spring, Bobby Bhattacharjee” http://www.cs.umd.edu/projects/droot/anycast_slides.pdf

→ Zhihao Li, Dave Levin, Neil Spring, and Bobby Bhattacharjee. 2018. Internet Anycast: Performance, Problems, & Potential. In Proceedings of ACM SIGCOMM (SIGCOMM). ACM, New York, NY, USA, 15 pages. https://doi.org/

Queries??




thank
you