Investigating Location-Aware Advertisements in Anycast IP Networks

Savvas Kastanakis, Vasileios Giotsas, Ioana Livadariu, Neeraj Suri
Our mental model of Anycast Routing

- Transparent service replication
- Minimize user latency
- Used in root DNS servers and CDNs
Actual Anycast Routing

- Anycast Routing is affected by many factors:
  - PoP Geolocation
  - **Routing Policies**
  - PoP Traffic Load
Selective Announcements

An Anycast AS can selectively announce its prefixes to specific ASes or locations in order to load balance traffic and costs.

(a) Selective announcement per AS.  
(b) Selective announcement per location.
Contributions

In this work:

1. We measure the adoption of *Selective Announcements* across Anycast ASes
2. We identify the *Receivers of Selective Anycast Prefix Announcements*
3. We measure the *Regionality of Receivers*, i.e., the degree at which an AS decides to propagate an anycast prefix across regional over global neighbors

The results of our work underscore the necessity to *take geolocation into consideration* when modelling the Interdomain Routing System.
Methodology Overview: How to geolocate the Receivers of Selective Anycast Prefix Announcements?

1. **Identify Anycast ASes and Prefixes**
2. **Collect, filter and parse RIBS**
3. **Infer Selective Announced Anycast Prefixes**
4. **Geolocate Receivers of the Selective Anycast Prefix Announcements**
5. **Geolocate ASes**
Step 1: Identify Anycast IP Networks and IP Prefixes

We extract all anycast ASes and their respective anycast prefixes through the bgp.tools API and the bgp.tools Github repository.
Step 2: Collect, Filter and Parse Routing Tables

For each anycast prefix observed through BGPStream we collect all the AS-paths installed in the routing tables of the vantage points.

| <dump-type> | <elem-type> | <record-ts> | <project> | <collector> | <router-name> | <router-ip> | <peer-ASn> | <peer-IP> | <prefix> | <next-hop-IP> | <AS-path> | <origin-AS> | <communities> | <old-state> | <new-state> |
When an AS receives a route towards an anycast prefix through a more expensive route than expected, the prefix is labeled as *Selective Announced Prefix*. 
Selective Announcements is a common practice in Anycast ASes

From a total of 691 anycast ASes, 84.06% announce at least one selective anycast prefix and 80% of the selective anycasters announce all of their prefixes selectively.
Group the Receivers of Selective Announcements per Region

Client in Region A

Zero or More Intermediate ASes

Global
Regional 1
Regional 2
Regional 3

Global

Anycast AS

Prefix announcement

PoP1
PoP2

Global
Step 4: Augment ASes with Country-level Characteristics

To uncover regional trends and disparities in anycast deployment we geolocate all ASes into their respective *countries* through Maxmind and PeeringDB.
Step 4: Reduce the country-level to region-level granularity

An AS is labeled as ‘regional’ if: **more than 90% of its prefixes AND more than 90% of its peering locations** reside under the same region.
Step 5: Group the Receivers of Selective Announcements per Region

We group all direct neighbors of the Anycast AS per the end-user (source AS) region:

- AS-path to a Selective Anycast Prefix
- Anycast Origin AS
- Receiver of Selective Anycast Prefix
- Region of Source AS
Regionality of the Receivers of Selective Announcements

Regionality = # of regional neighbors / # of total neighbors
Regionality of the Receivers of Selective Announcements

Regionality = # of regional neighbors / # of total neighbors

(i) Fastly.  
(f) Zenlayer.  
(b) BytePlus.
Future Work: Reasoning on Regionality

Factors which drive the need for selective routing towards regional neighbors:

a. **deficiency of a centralized backbone** by the anycast AS

b. lower transit fees

c. strict regulatory conditions
A. User-to-site mapping in anycast deployments relies heavily not only on the geolocation factor but also on the routing policies across ASes.

B. Large part of anycast ASes deploy selective announcements for all of their anycast prefixes restricting the propagation of anycast prefixes for traffic engineering purposes.

C. Anycast networks often resort to leveraging regional providers to establish connections between their PoPs and the end-users.

Contact: s.kastanakis@lancaster.ac.uk