RIPE IPmap Single-Radius: Experience and Evaluation

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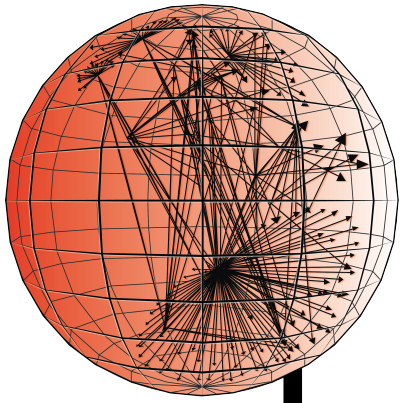

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What is single-radius?

- Single-radius is an active geolocation engine inside the IPmap platform.
- Or use the stand-alone version through the API
  https://ipmap.ripe.net/api/v1/single-radius

- It geolocates a target IP address based on the geographical distance calculated from the one closest Atlas probe.

How does single-radius work?

Given a target IP address:

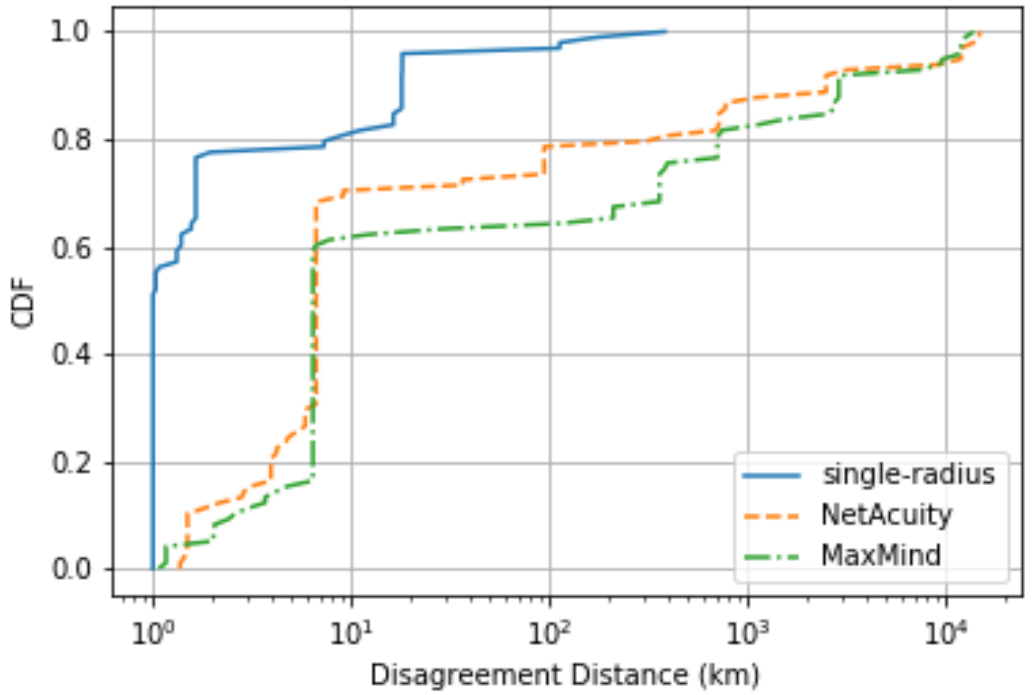
1. Collect pings from Atlas probes in the same AS
2. Select Atlas probe *P* with lowest RTT to target, RTT_{min}

   maximum allowed RTT value is 10ms
3. Convert RTT to radius using *0.67c* as delay-distance coefficient

   $r = 0.67c * RTT_{min} * 0.5$
4. Draw circle with *P* as center
5. Select 100 cities inside the circle closest to the probe (from RIPE's Worlds database)
6. Rank cities by population and number of IXPs inside, and return highest ranked as final result.

Is it accurate?

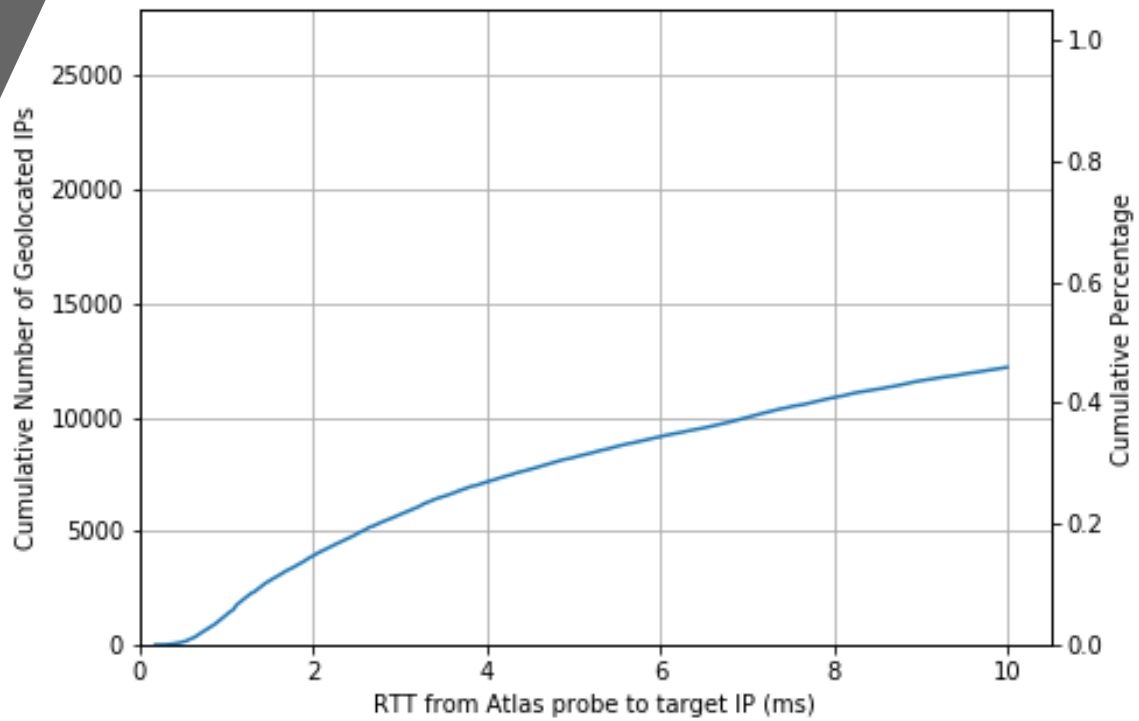
- Error Distance: geographical distance between actual latlong and inferred latong
- Smaller error distance means higher accuracy.
- We define a result is city-level accurate if error distance < 40km
- Evaluation Dataset: 100 hops with RTT < 0.5ms from Ark prefix-probing traceroutes[1]
- ~95% single-radius results have city-level accuracy - better than NetAcuity and MaxMind



1. IPv4 Prefix-Probing Traceroute Dataset: https://www.caida.org/data/active/ipv4_prefix_probing_dataset.xml

Coverage

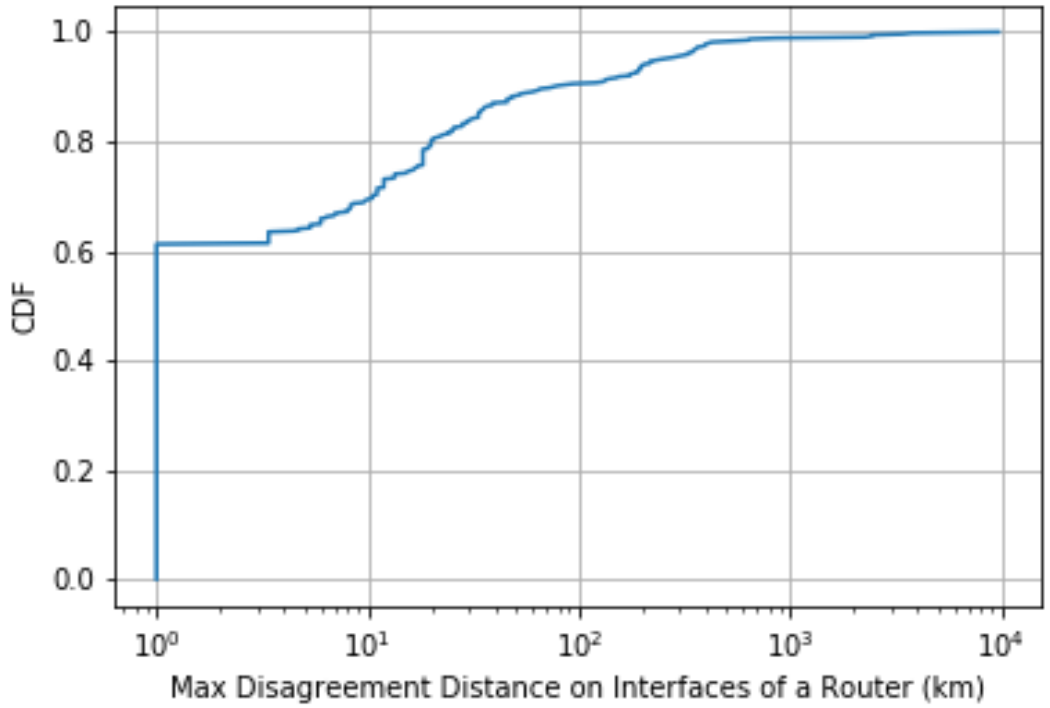
- Good accuracy comes with the price of coverage.
- Evaluation Dataset: 26,559 interconnection IP addresses obtained from manic[1]
- Only 50% IP addresses were geolocated by single-radius



1. Measurement and Analysis of Internet Congestion: https://manic.caida.org

Coherence

- Does single-radius return the same results for interfaces on the same routers?
- Router Disagreement Distance: max geographical distance between any 2 interfaces of the same router
- We define a result is city-level coherent if Router Disagreement Distance < 40km
- Evaluation Dataset: ITDK Router Aliases[1]
- Results have city-level coherence on ~85% routers

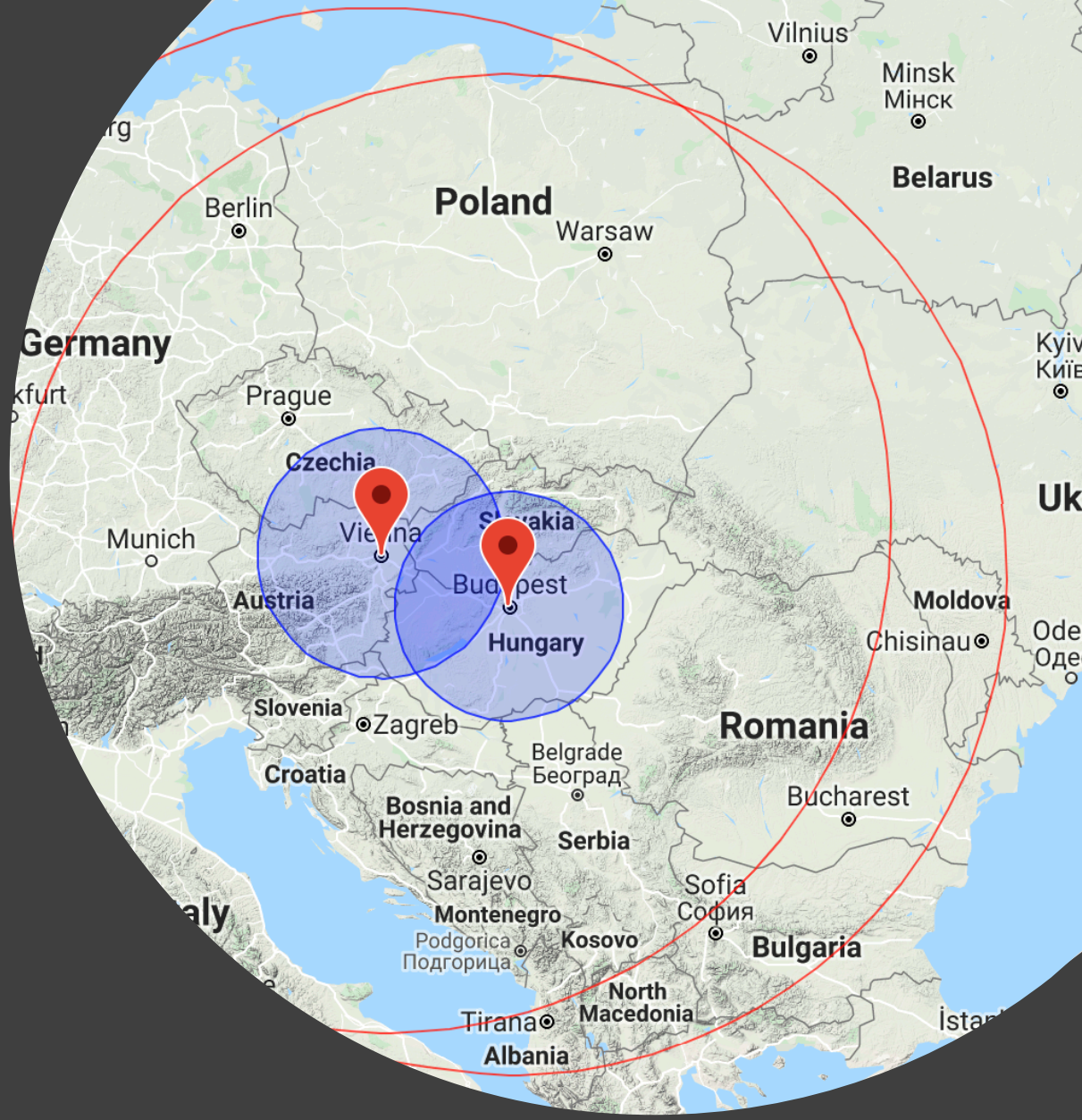


1. Macroscopic Internet Topology Data Kit: http://www.caida.org/data/internet-topology-data-kit/

Example: Incoherent Results

- Single-radius shows 2 interfaces on a router are in Vienna and Budapest, respectively.
- Red markers shows the location of the Atlas probes, both with RTT ~7ms to their target address
- Red circles are centered on Atlas probes with radius ~700km
- Blue circles are smallest enclosing circles all returned cities. (100 cities in each blue circle)

- Speculation: These 2 cities were chosen as final results because they ranked highest (most populous) in their respective circles.



Open Questions

What should be done to deal with incoherent situations? Or for general improvement?

Single-radius is great for very low RTTs, but is the 10ms threshold too high?

When should we consider using multiple probes and calculate intersection region?

Questions?

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