HLOC: Hints-Based Geolocation Leveraging Multiple Measurement Frameworks

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Problem Statement

- Validate the location information in domain names
- Build a framework which:
  - is easy to use and scalable
  - combines different measurement technologies/frameworks
- Focus on router domain names
- Evaluate these with the chosen validation algorithm
- Compare the results with:
  - IP location databases (fast with unknown reliability [1])
  - Previous DNS-based approaches, e.g., DRoP [2]

Validation Algorithm

\[ \text{dist(probe, host)} < x \]

- \( x \) is the threshold distance between probe and suspected host location (we chose \( x = 1000 \text{ km} \))
- From the set of the nearest probes a random one is selected

\[ \text{RTT(probe, host)} < a + 2 \cdot \text{dist(probe, host)} \quad \text{c} \cdot c_0 \]

- \( a \) is the maximal buffer time (we chose \( a = 9 \text{ ms} \))
- The analysis shows a linear growth of validated location hints

\[ \text{maxError}(a, x) = 2 \cdot x + a \cdot (c \cdot c_0) \]

- Our maximal error is 2900 km
- 80% of the measurement probes used for validation are closer than 29 km to the suspected location
- For these measurements the maximal error is 950 km

Trie Data Structure

- Contains all codes for a fast search process
- Returns all prefixes and all codes in the subtree of a key
- Labels are matched against the trie and all codes are found by slicing recursively the first character

Approach

- Modular architecture with independent steps

Examples

- be2590 rcr21 dub01.atlas.cogentco.com
  - rcr Fulton City Airport in Rochester, Indiana US
  - dub Dublin, Ireland (1.9 ms)
- te0-0-0-2 nr11.b020473-0.dub02.atlas.cogentco.com
  - dub Dublin, Ireland (2.2 ms)
- ae-0.facebook.amstnl2.nl.bb.gin.ntt.net
  - ams (IATA): Amsterdam, Netherlands (2.3 ms)
  - face (ICAO): Ceres, South Africa
  - ace (IATA): Lanzarote, Spain
  - ceb (IATA): Lapu-Lapu City, Philippines
- … (8 more matches)
- cr-01.0v-00-04.anx
  - cr-01.atlas.cogentco.com
  - … (8 more matches)

Outlook

- Improve the probe selection algorithm
- Measure more than one time per location per host
- Modularize the code architecture for better configuration
- Use a database for a flexible analysis and higher performance
- Integration into RIPE Atlas

Long Term goals

- Visualize possible location areas with the help of measurements
- Build a web service to geolocate host
- Integrate more measurement frameworks

Checkout github.com/tumi8/hloc for the source code
Contributions are welcome!

References


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