

Through the Looking Glass

Analyzing Geolocation Providers Using Looking Glasses and Active Measurements

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IPinfo

What is a Looking Glass?

Introduction

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Conclusion

- Vantage points (VP) allowing control (BGP routes) and data (ping, traceroute, HTTP) plane measurements
- Prospective user can test network throughput and latency, for free
- LGs used as free and independent VPs, so are there any costs?

Contributions

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- LGs often used as a VP tool, rather than studied themselves
- Uncertain locations:
 - LGs give many RTT-disconfirmed locations
 - Cases due to mis-ingested data, or hard-to-detect deviations
- Evaluating LGs:
 - Find weaknesses by geolocation to locate LGs
 - In some cases, all geolocation providers inaccurately locate the LG

Methodology: Looking Glasses

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- 4487 public LGs across 144 countries
- LG servers collected on best-effort basis
- Except when analyzing LG coverage, filter away LG IPs where:
 - LGs without a city, and
 - Any RTT-disconfirmed LG IPs

Methodology: RTT measurements

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- Active measurements using IPinfo's probe network
 - 1300+ servers in 600 cities and 170 countries
- ICMP/ICMPv6 latency measurement to each LG IP
- RTT converted to a radius at $\frac{2}{3}c$, and radii intersected into a polygon

Methodology: Geolocation Providers

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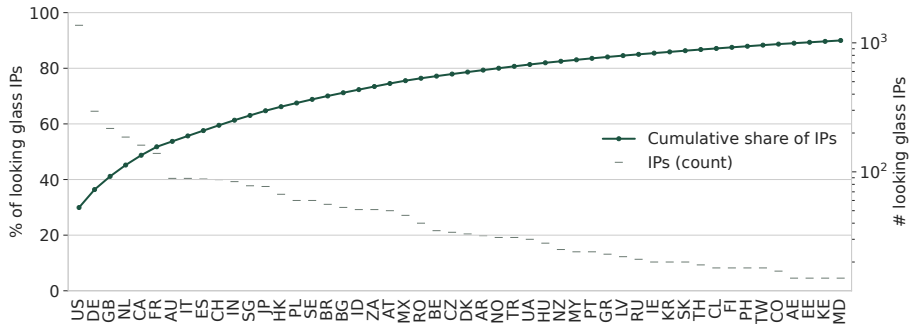
Providers

Conclusion

- 6 geolocation DBs from 4 vendors
 - DB-IP Lite/Paid, IP2Location, IPinfo, and MaxMind Free/Paid
 - Some provide a GeoNames entry and GPS coordinate
 - Where only provides GPS coordinate, map to nearest GeoNames centroid
- LGs:
 - Normalize to GeoNames entry
 - If coordinate provided, use it. Otherwise map to coordinate of GeoNames entry
 - Conflicting locations when inferring resolve to most populous city

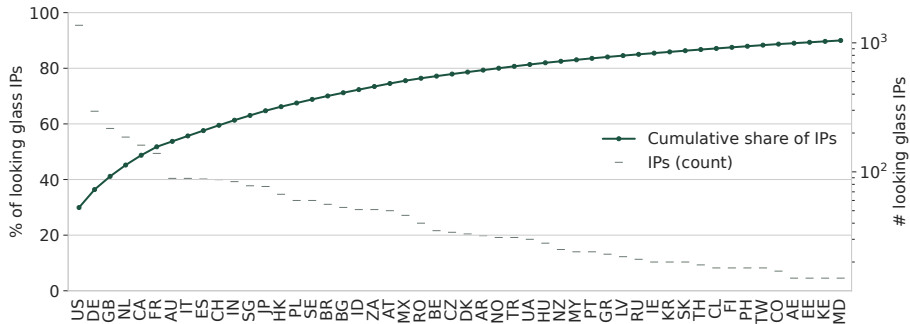
Results

Coverage



- Countries have heavy-tailed distribution, with
 - 6 countries for 50% of LG IPs
 - 50 countries for 90% of LG IPs

Coverage



- Countries have heavy-tailed distribution, with
 - 6 countries for 50% of LG IPs
 - 50 countries for 90% of LG IPs
- Still covers 144 countries
- Predominance in North America and Europe, and lower coverage in Africa and China

Active Measurements

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- 9 of 18 LG providers have at least one RTT-disconfirmed location
 - 56 (IPv4) and 27 (IPv6) LG IPs are RTT-disconfirmed

Active Measurements

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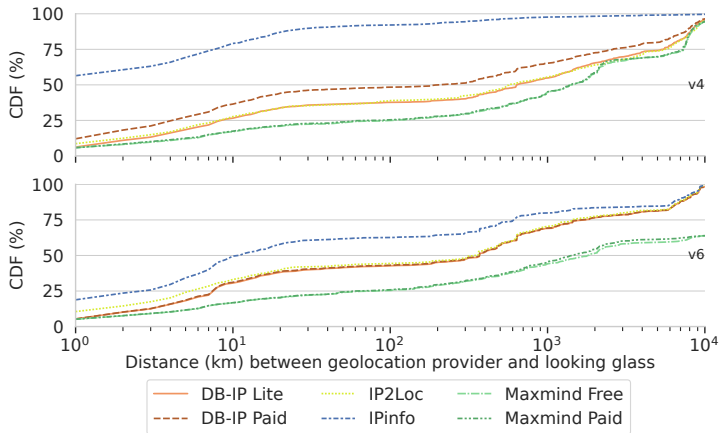
- 9 of 18 LG providers have at least one RTT-disconfirmed location
 - 56 (IPv4) and 27 (IPv6) LG IPs are RTT-disconfirmed
- Error types:
 - Wrong external info
 - Irregular internal patterns:
cr [0-9] -<IATA> [0-9]

→ Errors at level of LG IPs and LG providers

The screenshot shows the NavicoSoft website with a focus on server hosting in the United Kingdom. The header includes the company name and navigation links for Hosting, Domain, Digital Marketing, Design, and Development. A 'Network Test' section allows users to check network speed for various locations, with 'Vancouver' selected. Below this, three server plans are listed: Sydney V1 (\$18/mo), Sydney V2 (\$24/mo), and Sydney V3 (\$36/mo). Each plan includes details on CPU, RAM, disk space, bandwidth, and IP addresses.

Sydney V1	Sydney V2	Sydney V3
\$18/ mo*	\$24/ mo*	\$36/ mo*
Order Now	Order Now	Order Now
• Cpu 1 vCore • Ram 512 MB • Disk Space 10 GB • Bandwidth 500 GB @ 1 Gbps • IP(s) 1	• Cpu 1 vCore • Ram 1 GB • Disk Space 30 GB • Bandwidth 1.5 TB @ 1 Gbps • IP(s) 1	• Cpu 2 vCore • Ram 2 GB • Disk Space 40 GB • Bandwidth 2 TB @ 1 Gbps • IP(s) 1

Geolocation Providers: Distance to LG



- Overall IPinfo gives closest location to the LG

Geolocation Providers: Distance to LG

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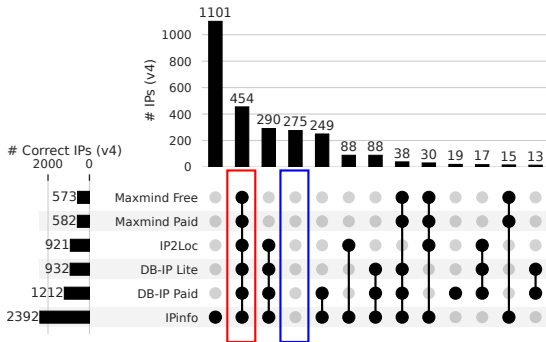
Measurements

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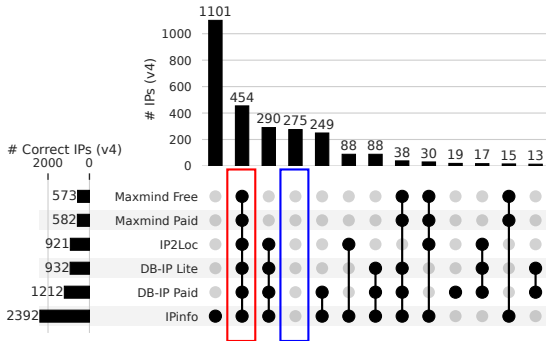
Conclusion

- Paid version not always better (ie. MaxMind)
 - At city-level (IPv4):
 - DB-IP Lite vs. DB-IP Paid: 22.0% vs. 30.4%
 - MaxMind Free vs. MaxMind Paid: 15.9% vs. 16.0%
- Lower overall match rate for IPv6
 - At city-level:
 - IPv4: 15.9–78.3%
 - IPv6: 14.8–48.2%

Geolocation Providers: Overlapping Geolocation

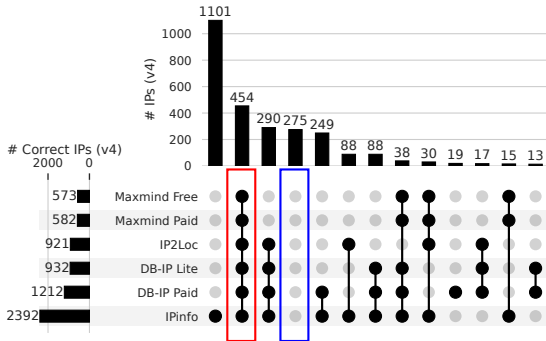


Geolocation Providers: Overlapping Geolocation



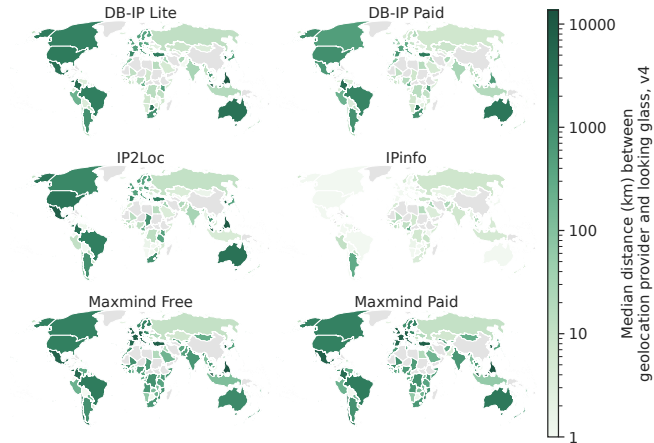
- 20km nearness threshold
 - “All near set”: Geolocation providers converge to “same” location
 - “All far set”: Some LG IPs difficult to locate for all geolocation providers
- Cannot use geolocation providers wholesale (must validate)

Geolocation Providers: Overlapping Geolocation



- 20km nearness threshold
 - “All near set”: Geolocation providers converge to “same” location
 - “All far set”: Some LG IPs difficult to locate for all geolocation providers
- Cannot use geolocation providers wholesale (must validate)
- “Nearness” threshold selection:
 - Change in % size of near/far set decelerates at 20km+.

Geolocation Providers: Spatial Distribution



- IPinfo doing best when looking over many different countries
- More factors contribute to error than country size alone

Conclusion

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- 9 of 18 LG providers have at least one RTT-disconfirmed location
- Geolocation databases differ in ability to locate LGs
 - In some cases, all geolocation providers mislocate LGs
 - IPinfo doing best on LG IPs (RTT-confirmed, distance to LG)