

Mapping Carleton's Network Topology

Analyzing how Carleton is connected to the rest of the internet

Why this Matters

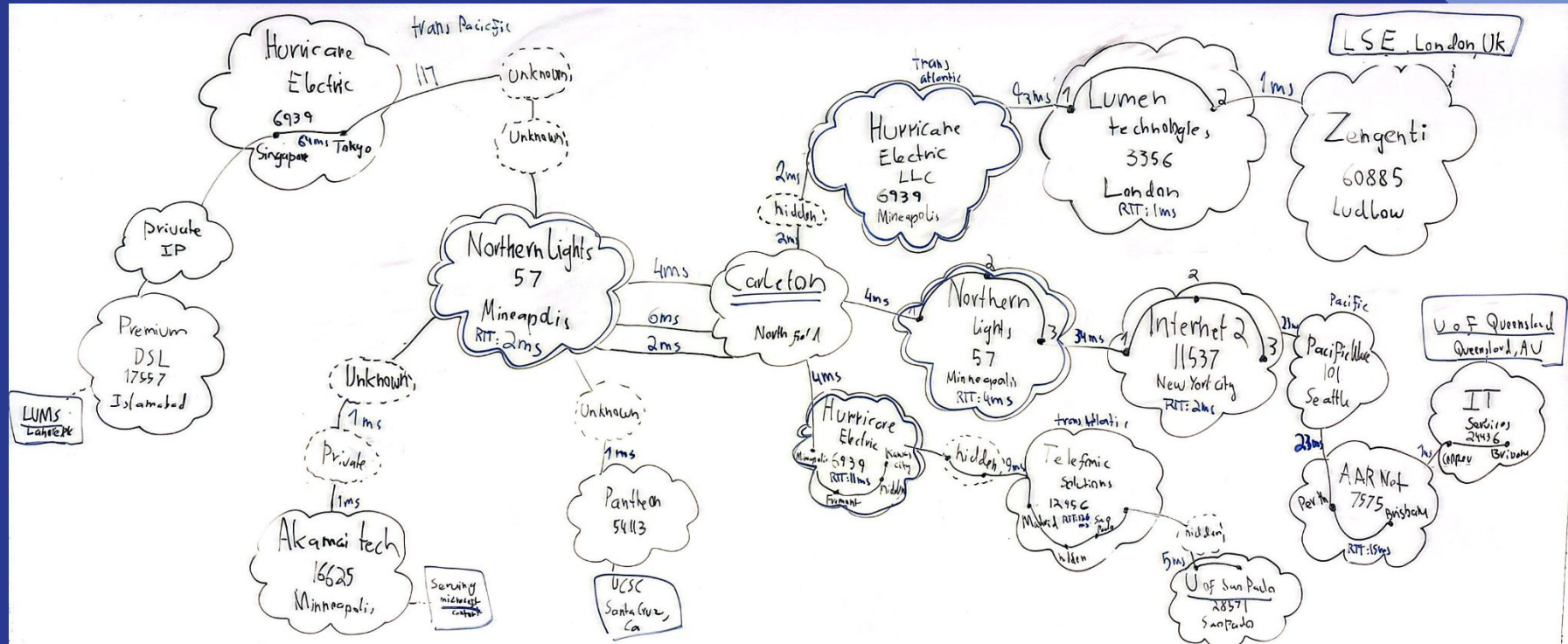
- Using traceroutes reveals the path data takes through numerous routers and networks to reach its destination. It also reveals how long this process takes, and what wide area networks are involved.
- We can observe where data spends the most time in regional and intercontinental travel.
- We can also learn what WANs and ISPs are involved in forwarding and handing off the data.
- This can be used to study bottlenecks.

Methodology

For the analysis, I used the `tracert` and `ping` command to reach different websites, and studied the traceroutes. RIPE was used for locally measured times. The locations were chosen to allow me to get as wide a picture about connectivity as possible and included the following:

- Lahore University of Management Sciences, Lahore, Pakistan
- London School of Economics, London, England
- University of Queensland, Brisbane, Queensland, Australia
- University of California, Santa Cruz, California, United States
- University of São Paulo, São Paulo, Brazil
- Microsoft Corporation, United States

The Topology



Observations

- **Most time spent:** HE on the routes to LUMS (Pakistan), and University of Queensland (Australia). Also on Telefontic Solutions. This makes sense since intercontinental. Also reveals they are poorly connected.
- **Connection:** Carleton is directly connected to Northern Lights (Minnesota area) and Hurricane electric (Tier 1), as all traceroutes went through them.

Northern lights handles regional transfer, and HE handles intercontinental.

- **Connectedness:** America is the best connected (<10 ms), Europe is strong (about 150 ms), Asia is weak (about 250 ms), Oceania is moderate (about 220 ms), and South America is strong (about 150 ms)

RIPE Times

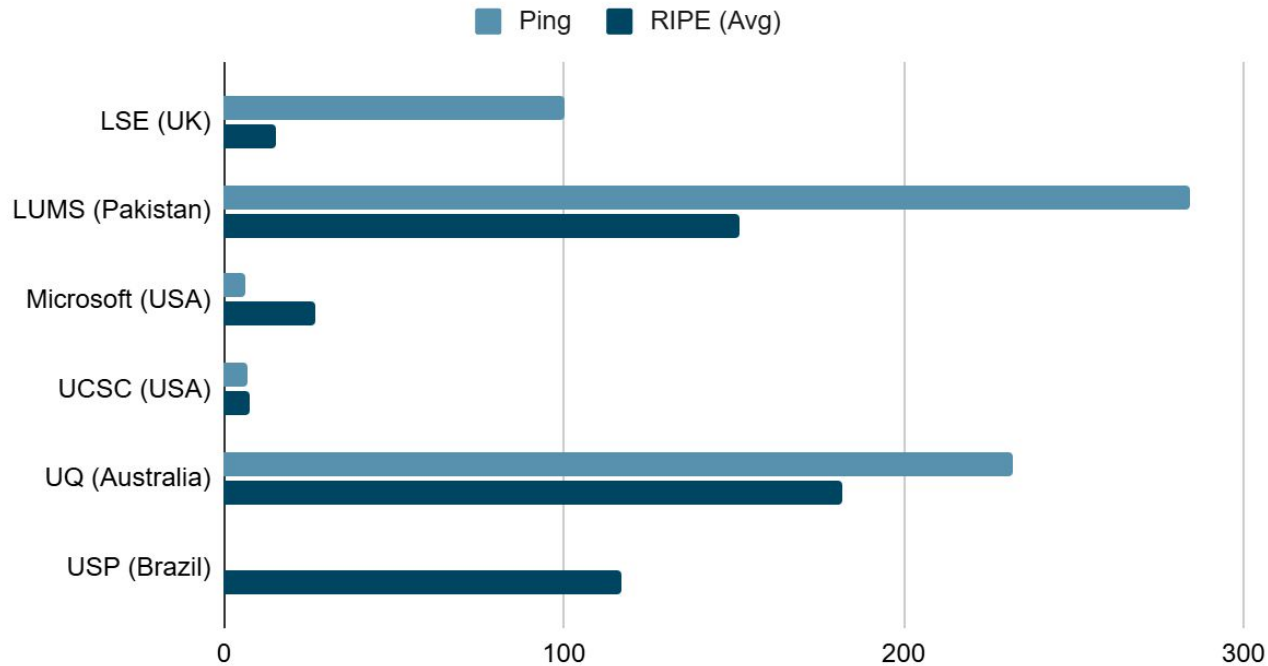
Destination	Google (ms)	Wikipedia (ms)	Facebook (ms)	Average (ms)
London School of Economics (London, UK)	12	12	23	15
Lahore University of Management Sciences (Lahore, Pakistan)	326	99	32	152
Microsoft / Akamai Edge (Minneapolis, MN, USA)	48	27	5	27
University of California, Santa Cruz (Santa Cruz, CA, USA)	8	10	5	8
University of Queensland (Brisbane, Queensland, Australia)	165	202	180	182
University of São Paulo (São Paulo, Brazil)	111	130	109	116

Route Trip Times and Pings

Destination	Avg Ping RTT (ms)	Min / Max RTT (ms)	Traceroute Final RTT (ms)
London School of Economics (London, UK)	100	100/101	101
Lahore University of Management Sciences (Lahore, Pakistan)	284	271/278	278
Microsoft (Minneapolis, MN, USA)	6	6/7	7
University of California, Santa Cruz (Santa Cruz, CA, USA)	7	6/14	7
University of Queensland (Brisbane, Queensland, Australia)	232	226/228	227
University of São Paulo (São Paulo, Brazil)	-	151/152	152

Comparison

Points scored



Explanation

- Since RIPE measures local connectivity, the times are much lower
- Traceroutes go from Carleton to London, whereas RIPE just goes from London to, for example, Google, which likely has a local server.
- Times for RIPE and ping within the US are similar, since local connectivity is strong.
- Intercontinental travel adds a lot of latency.
- Traceroutes show true latency end-to-end
- RIPE shows latency for local internet services

Drawbacks and Conclusion

- Numerous * * * Request timed outs.
- Private IPs (10.x.x.x)
- ICMPs are lowest priority so blocked
- Only get traces from responsive routers.

Overall, HE is the backbone of connections, especially intercontinental ones. Latency also degrades internationally, and RIPE is not completely representative.