

Mapping Carleton's Network Topology

Analyzing how Carleton is connected to the rest of the internet

Why this Matters

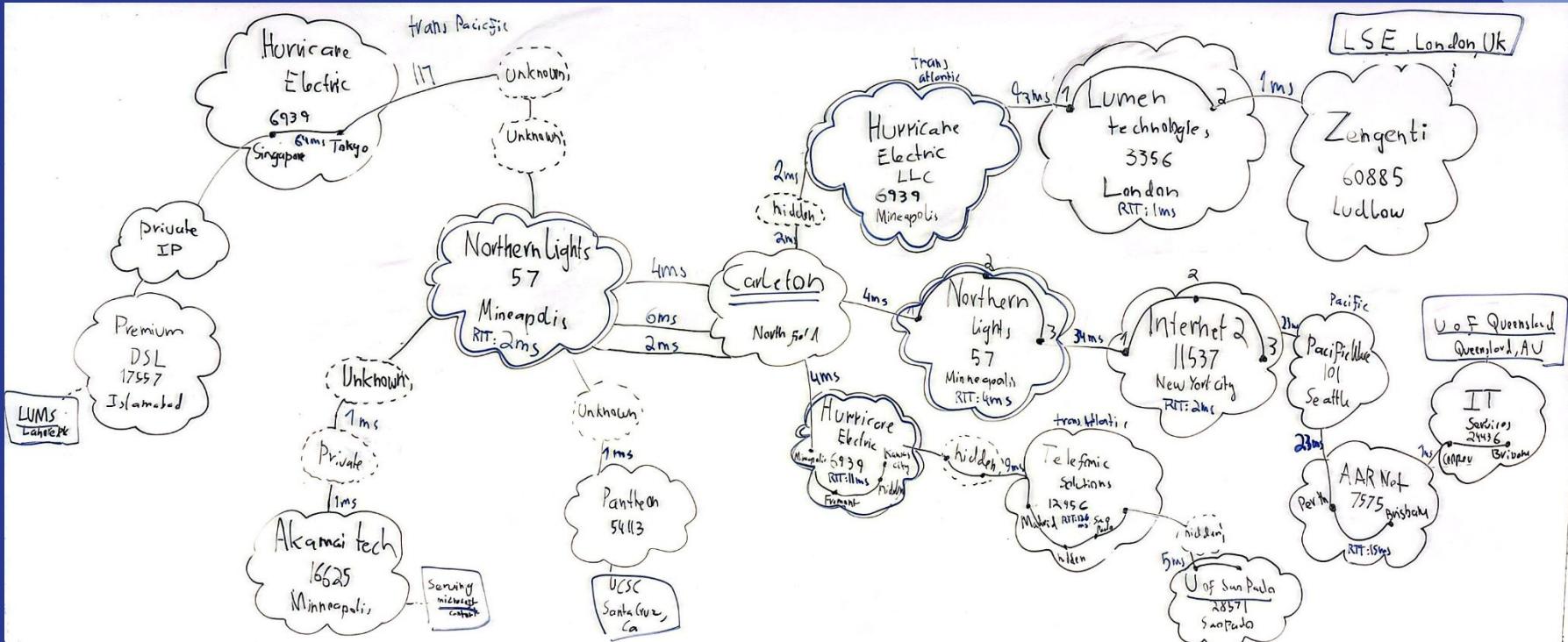
- Traceroutes reveals the **path** data takes through numerous networks to reach its destination.
- It also reveals **how long** this process takes, and what wide area networks are involved.
- We can observe where data spends the **most time** in regional and intercontinental travel.
- We can also learn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

Methodology

Used RIPE probes, and `tracert` and `ping` command to reach the following locations

- 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

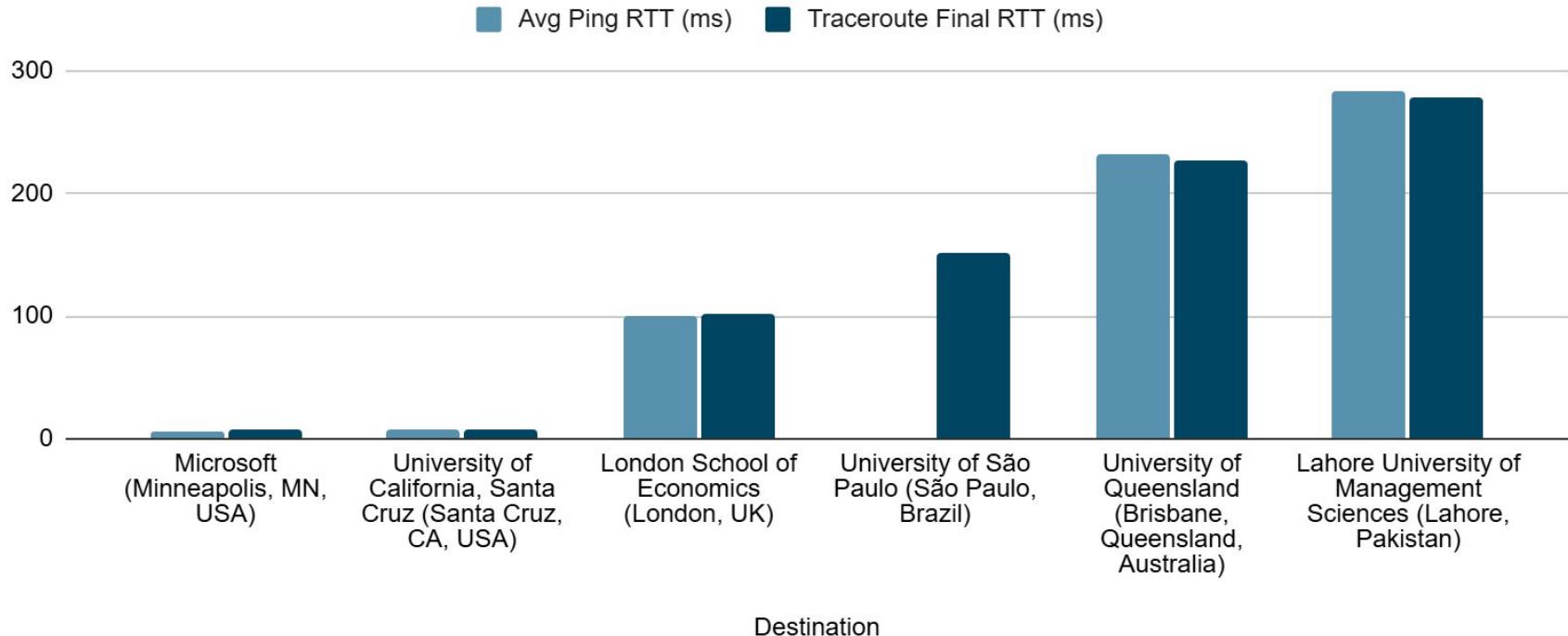


Observations

- **Most time spent:**
 - HE on the routes to Pakistan, and Australia
 - Telefonic Solutions to Brazil
 - 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.
 - HE provides intercontinental transfer
 - NL provides regional transfer

Ping and Traceroute

Avg Ping RTT (ms) and Traceroute Final RTT (ms)



Route Trip Times and Pings

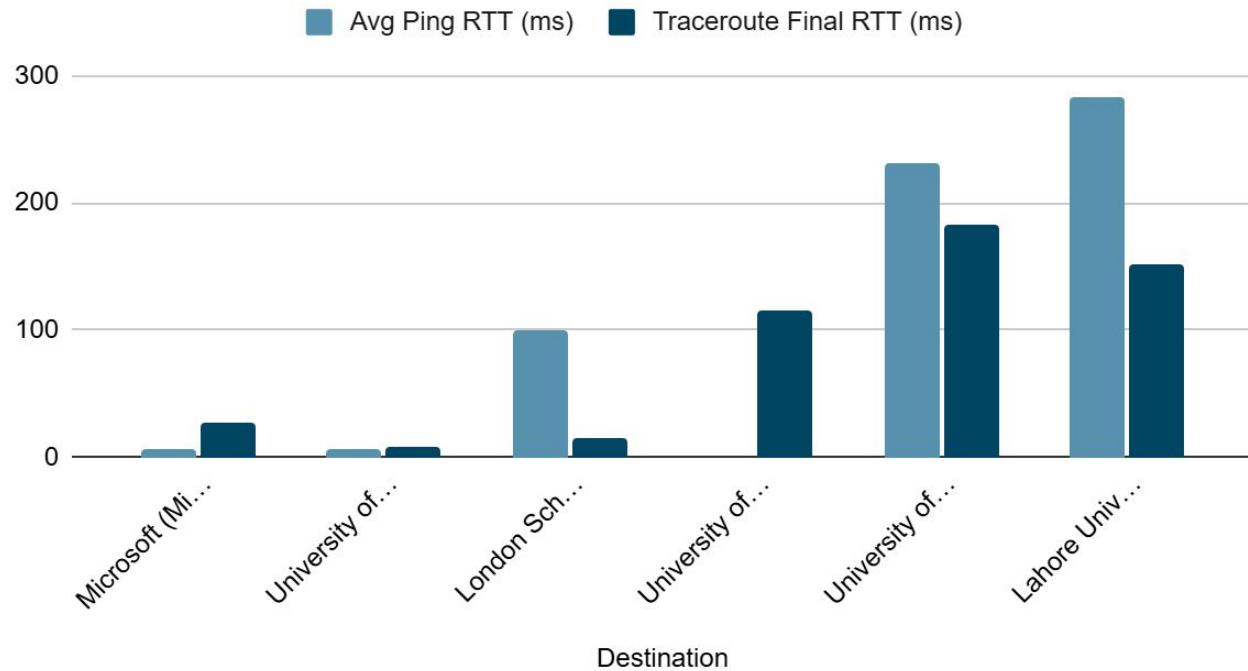
Destination	Avg Ping RTT (ms)	Min / Max RTT (ms)	Traceroute Final RTT (ms)
Microsoft (Minneapolis, MN, USA)	6	6/7	7
University of California, Santa Cruz (Santa Cruz, CA, USA)	7	6/14	7
London School of Economics (London, UK)	100	100/101	101
University of São Paulo (São Paulo, Brazil)	No Response	151/152	152
University of Queensland (Brisbane, Queensland, Australia)	232	226/228	227
Lahore University of Management Sciences (Lahore, Pakistan)	284	271/278	278

RIPE Times

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

Comparison

Avg Ping RTT (ms) and Traceroute Final RTT (ms)



Explanation

- 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.
- 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)

Latency also degrades internationally, and RIPE is not completely representative.