Fine Grained Network Path Profiling from Traceroutes
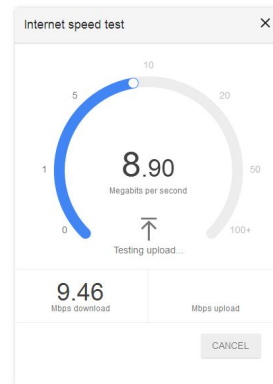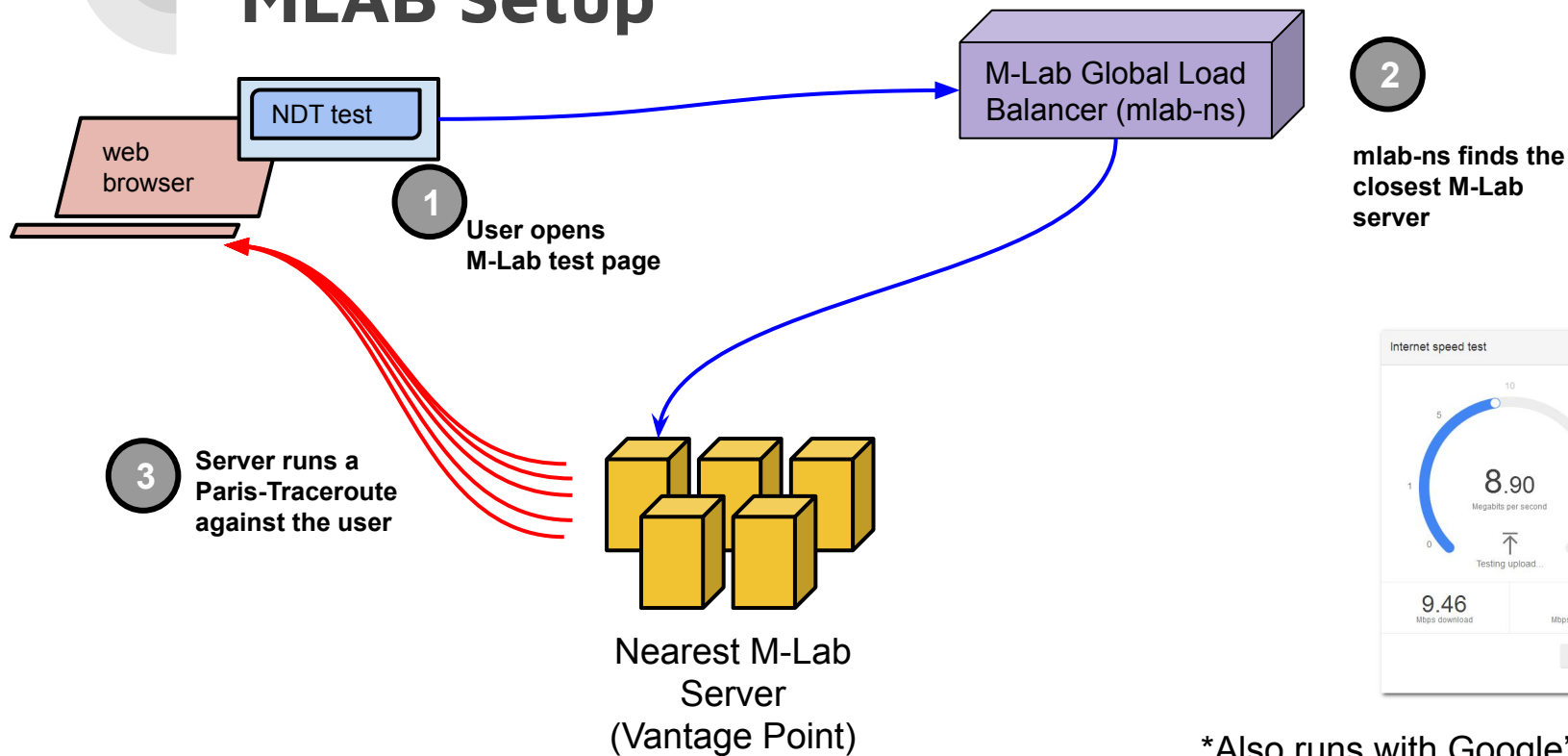
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Challenge

- What is the challenge?
  - Vantage Points (VPs) are servers used to conduct measurements
  - Limitations imposed to number of VPs used
  - Need for calculating the **optimal** VPs according to different metrics
    - Path Similarity
- What we propose:
  - A measurement framework which provides optimal vantage point selection

MLAB Setup

web browser

NDT test

M-Lab Global Load Balancer (mlab-ns)

1 User opens M-Lab test page

2 mlab-ns finds the closest M-Lab server

3 Server runs a Paris-Traceroute against the user

Nearest M-Lab Server (Vantage Point)

Internet speed test ✕

10

5   20

1   **8**.90   50
         Megabits per second

0   ⤒   100+
         Testing upload...

9.46
Mbps download   Mbps upload

CANCEL

*Also runs with Google's speed test!

Methodology: Dataset

- We analyze Paris-Traceroute measurements
    - Downloaded raw data from the MLAB measurement platform
    - Country level geolocation (MaxMind)
    - IP-to-AS level transformation using CAIDA dataset

Enriching raw M-Lab data

```
traceroute [(196.49.14.204:33458) -> (35.192.37.249:44246)], protocol icmp, algo exhaustive, duration 25 s
 1  P(6, 6) 196.49.14.193 (196.49.14.193)  0.268/0.305/0.342/0.022 ms
 2  P(6, 6) 81.199.8.105.satcom-systems.net (81.199.8.105)  0.822/0.922/1.018/0.078 ms
 3  P(6, 6) 10.233.1.34 (10.233.1.34)  98.542/106.650/145.808/17.514 ms
    MPLS Label 24104 TTL=1 | 24163
 4  P(6, 6) 10.46.0.217 (10.46.0.217)  98.516/107.231/145.903/17.348 ms !T2
    MPLS Label 24008 TTL=2 | 24163
 5  P(6, 6) 10.46.0.41 (10.46.0.41)  98.692/123.581/149.340/24.765 ms
 6  P(6, 6) 81.199.44.161.satcom-systems.net (81.199.44.161)  98.230/107.471/145.242/16.981 ms
 7  P(6, 6) 74.125.242.83 (74.125.242.83)  99.318/111.343/146.777/16.296 ms
 8  P(6, 6) 216.239.59.5 (216.239.59.5)  100.105/115.388/160.059/20.266 ms
    MPLS Label 737424 TTL=1
 9  P(6, 6) 72.14.236.9 (72.14.236.9)  178.697/280.029/344.061/57.008 ms
    MPLS Label 507558 TTL=1
10  P(6, 6) 209.85.252.38 (209.85.252.38)  193.086/282.540/347.793/51.006 ms
    MPLS Label 696760 TTL=1
11  P(6, 6) 209.85.143.103 (209.85.143.103)  235.658/358.594/455.048/75.778 ms
    MPLS Label 424059 TTL=1
12  P(6, 6) 216.239.47.182 (216.239.47.182)  202.041/265.573/364.999/57.552 ms
13  P(0, 6)
14  P(0, 6)
15  P(0, 6)
```

```json
{
  "srcIP": "216.66.68.166",
  "dstIP": "68.34.13.28",
  "srcAS": "6939",
  "dstAS": "7922",
  "results": {
    "1": {
      "as": "6939",
      "cc": "US",
      "ip": "216.66.24.165",
      "rtts": [
        "0.311",
        "1.299",
        "5.620",
        "1.934"
      ]
    },
    "2": {
      "as": "6939",
      "cc": "US",
      "ip": "184.105.80.5",
      "rtts": [
        "10.219",
        "10.875",
        "13.434",
        "1.159"
      ]
    },
```

Methodology: Metrics

Metrics of interest:

- Path (or Hop) Latency Entropy
- Path Similarity (Kullback-Leibler Divergence)

Parameterized with:

- AS-level information
- Country-level information

Framework Overview

- Lightweight

```python
class Hop():
    def __init__(self, idx, AS, ip, rtts, CC=None):
        self.idx = idx
        self.AS = AS
        self.CC = CC
        if rtts == 'null' or rtts is None:
            self.probes = [0]
        else:
            self.probes = [float(r) for r in rtts]

class MeasurementProfile():
    def __init__(self, hops, dst_ip, src_ip, dst_as, src_as):
        self.dst_ip = dst_ip
        if src_as is None:
            self.src_as = 0
        else:
            self.src_as = src_as
        self.dst_as = dst_as
        self.src_ip = src_ip
        self.hops = hops
        self.last_rtt = np.median(self.hops[-1].probes)
```

Evaluation

Conclusion

Our work

https://github.com/pgigis/vantage-point-similarity
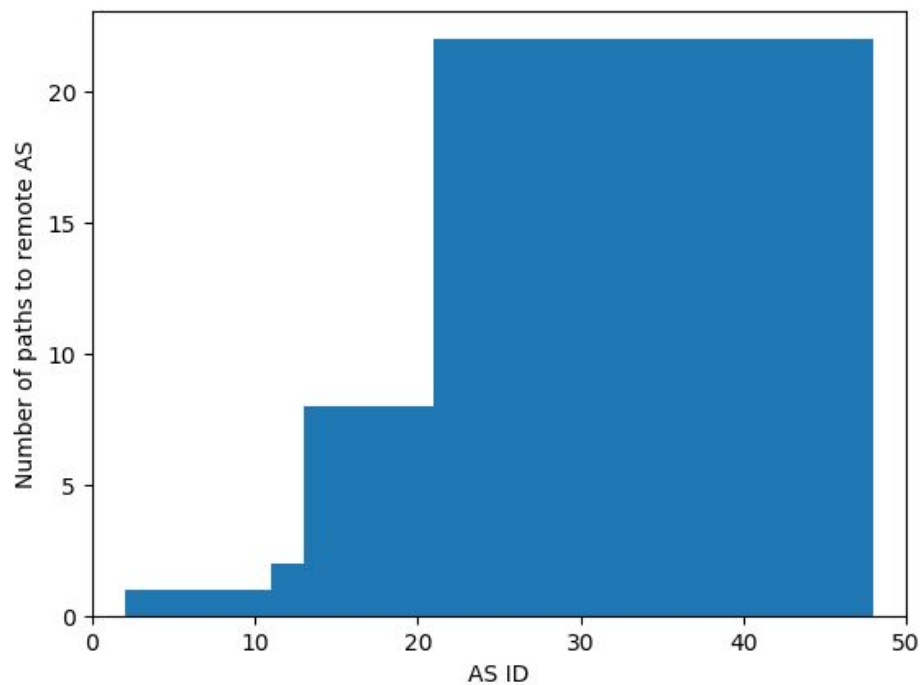
Thoughts

- Brought together students from diverse backgrounds
- One day is short!
    - Much time spent transforming data
- Thanks to our mentors from MLab: Chris, Georgia and Angelos!