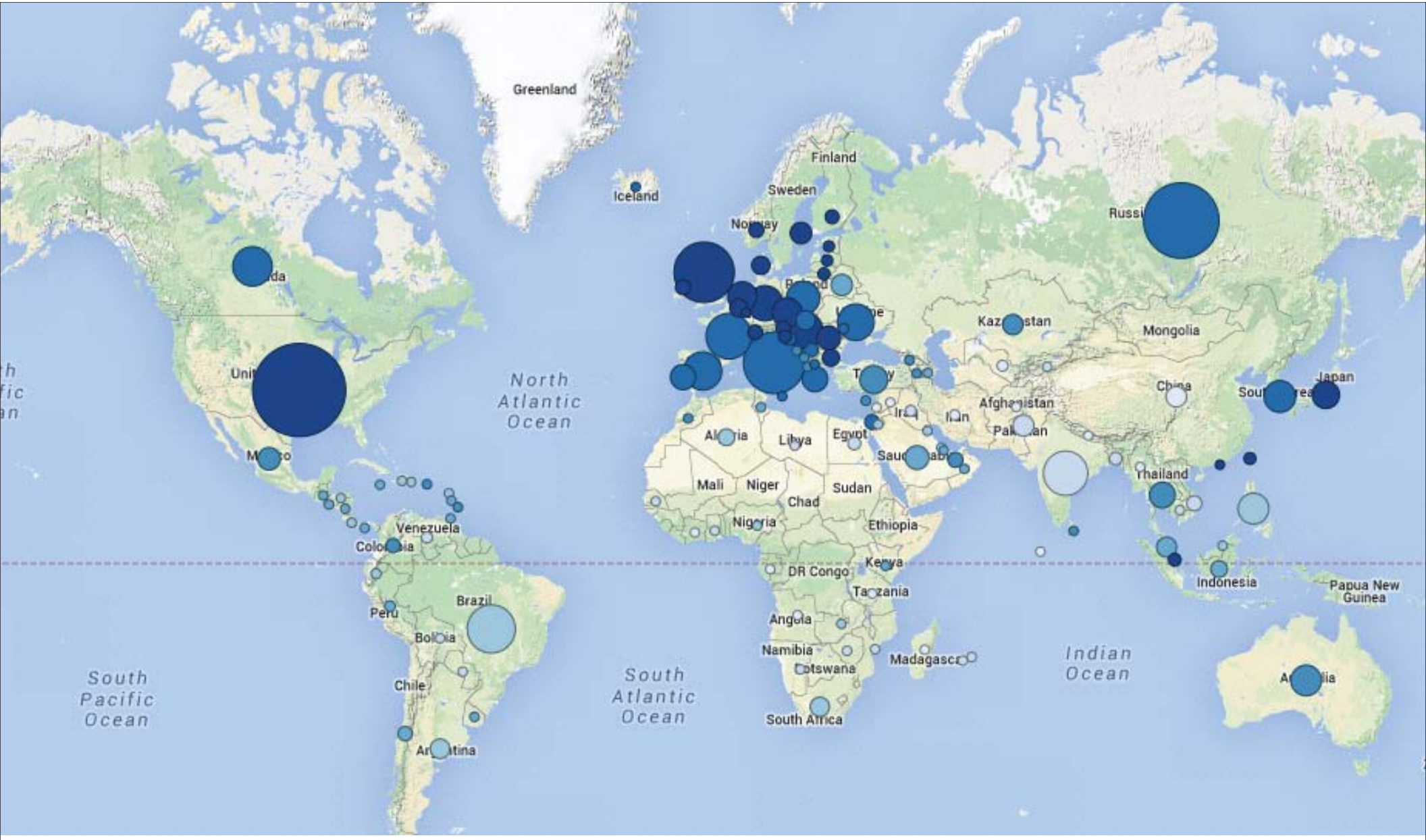
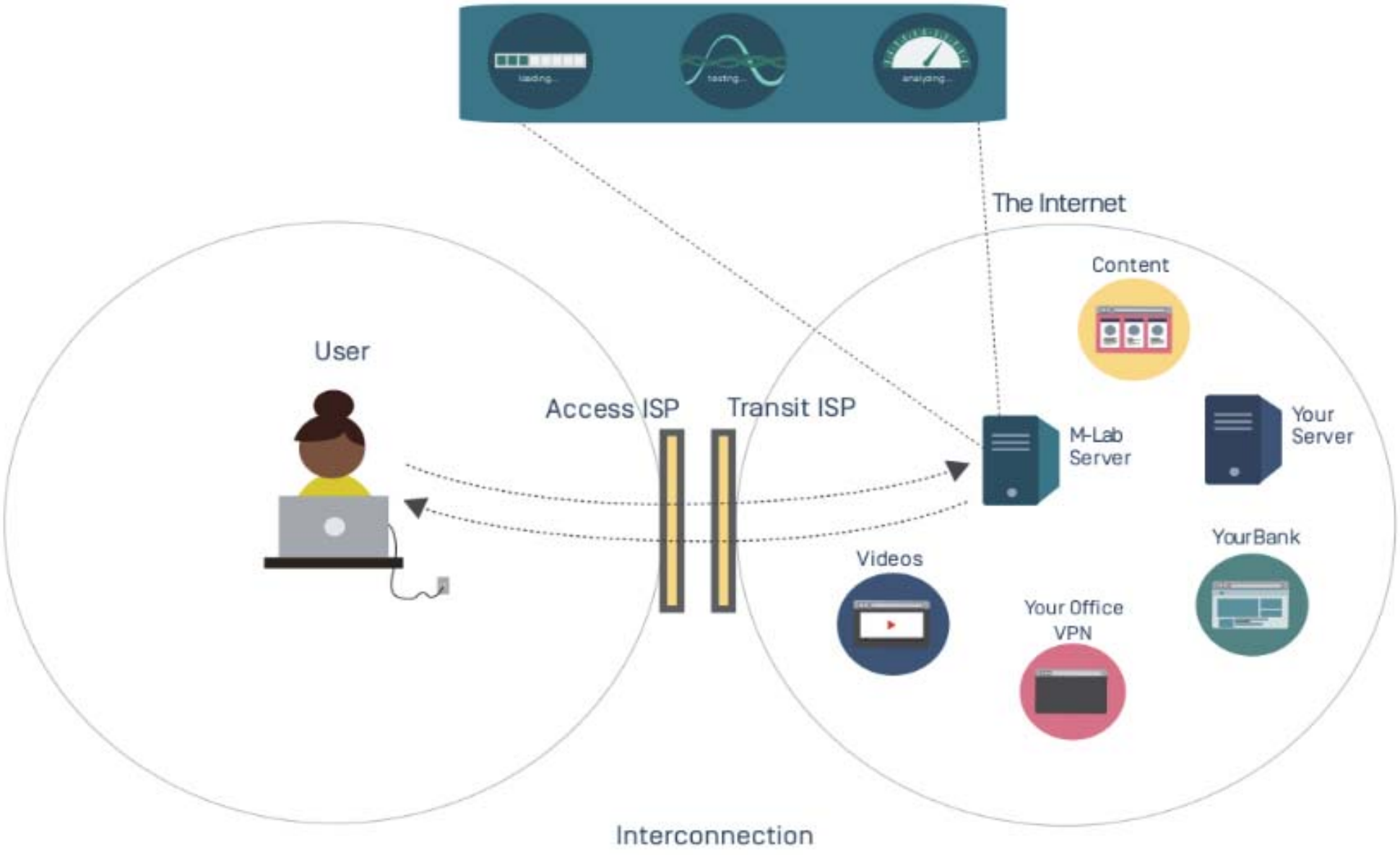
ISP Interconnection and its Impact on Consumer Internet Performance

Measurement Lab



How Measurement Lab Collects Information

About 200,000 Test Per Day

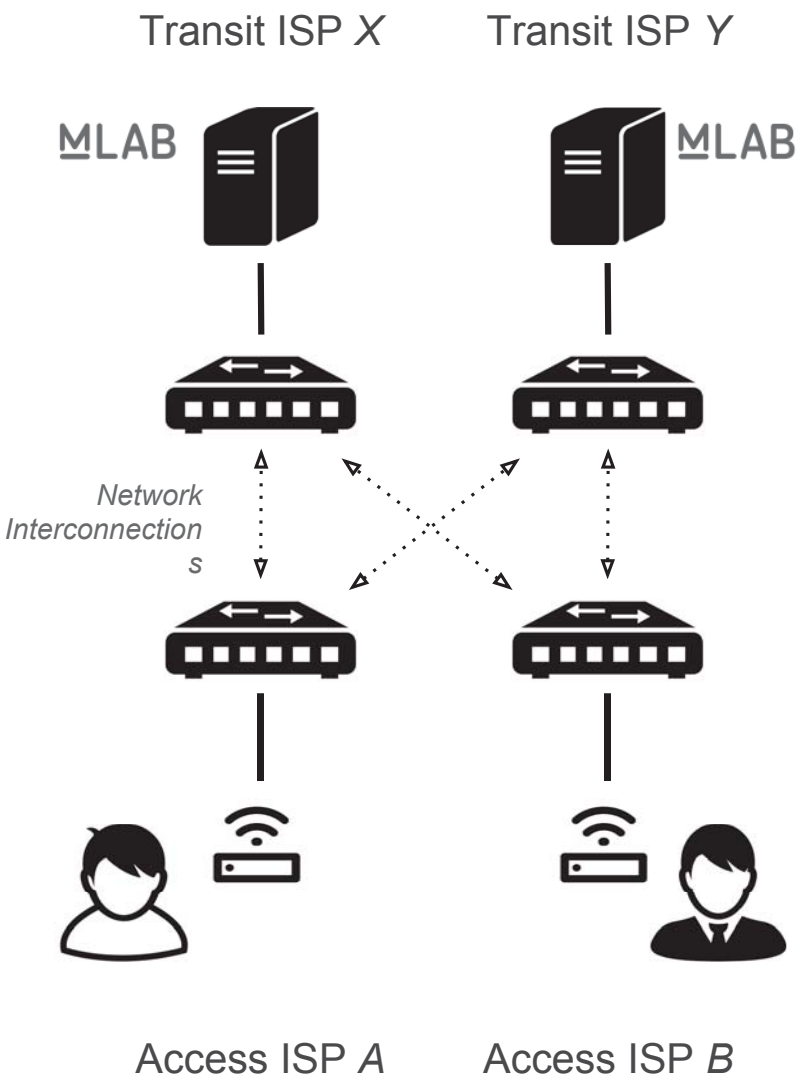


How Measurement Lab Collects Information

Measurements From Everyone

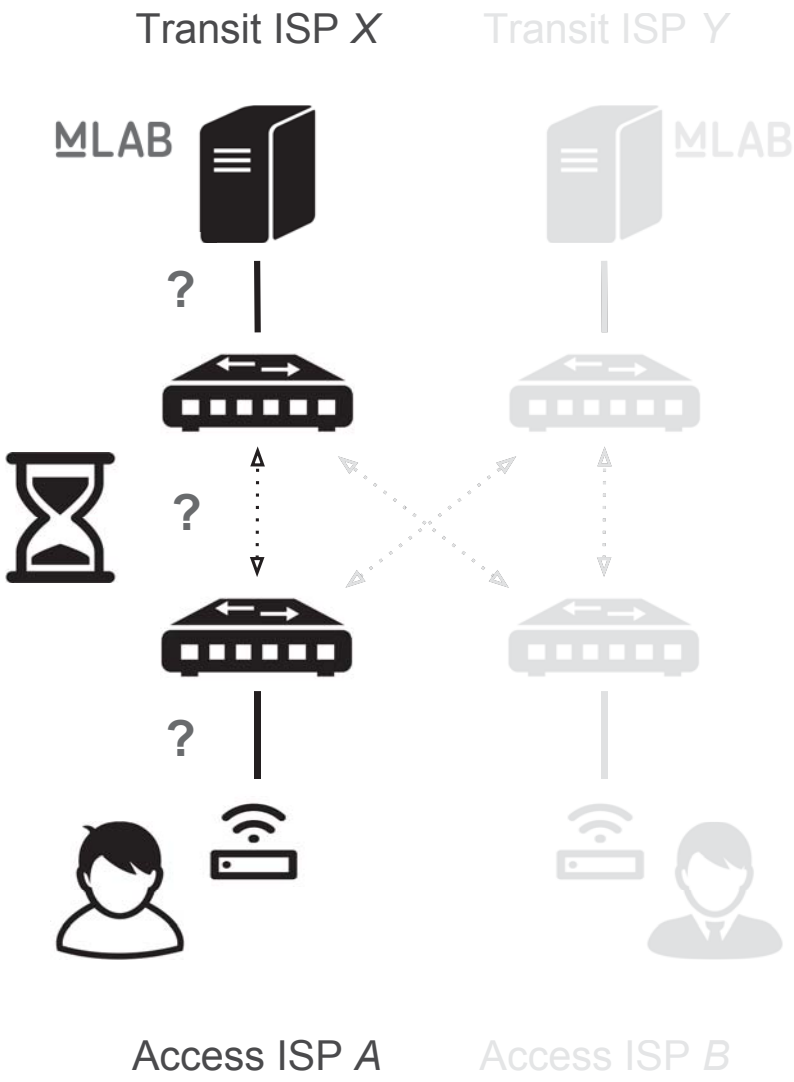
Methodology

Inferring the Source of Congestion



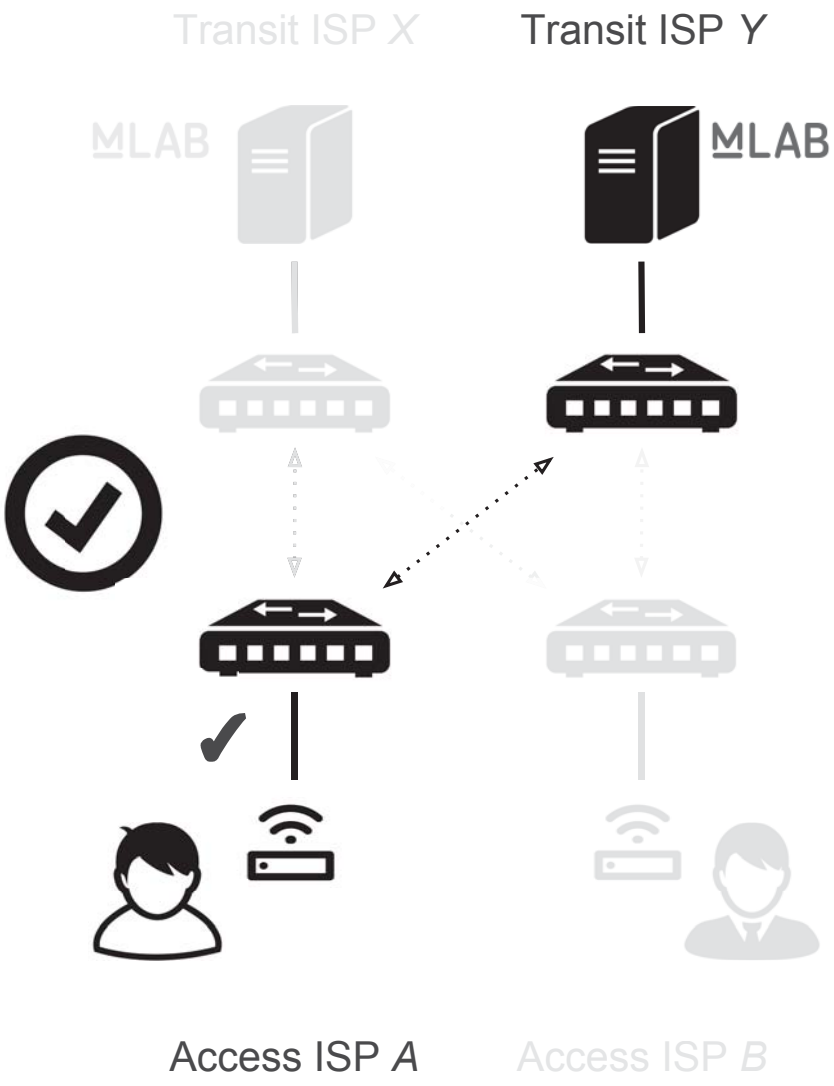
Methodology

Inferring the Source of Congestion



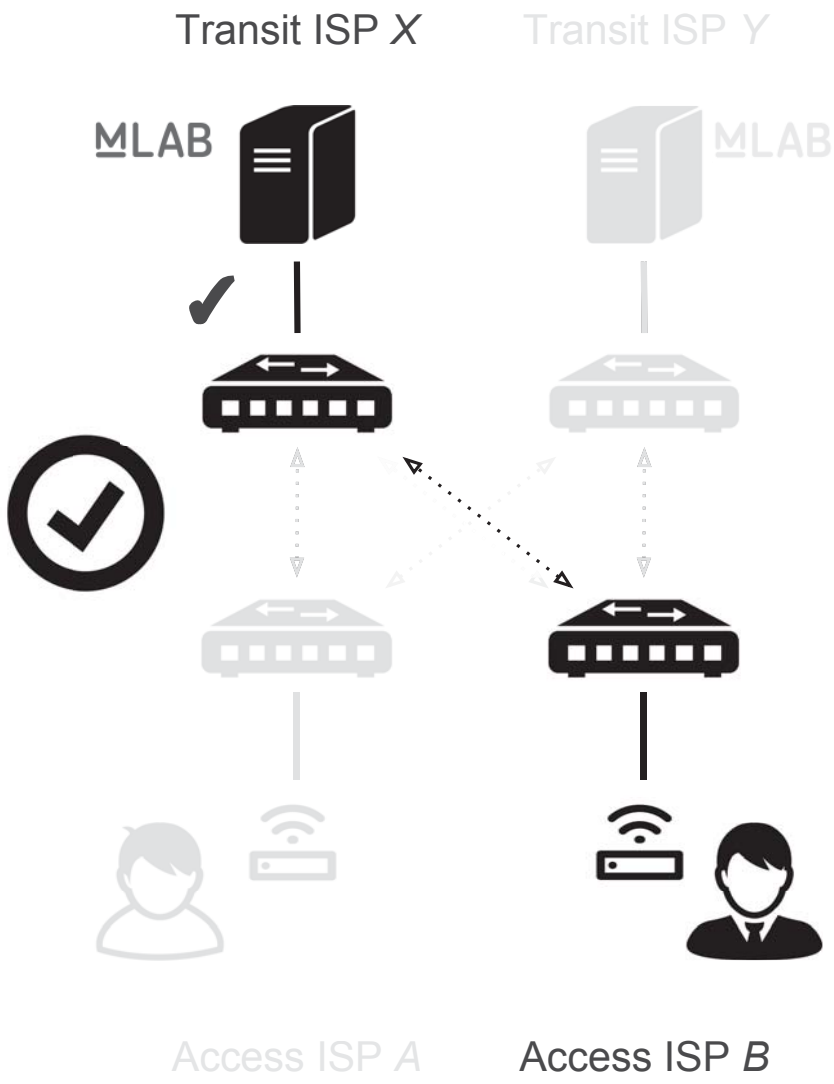
Methodology

Inferring the Source of Congestion



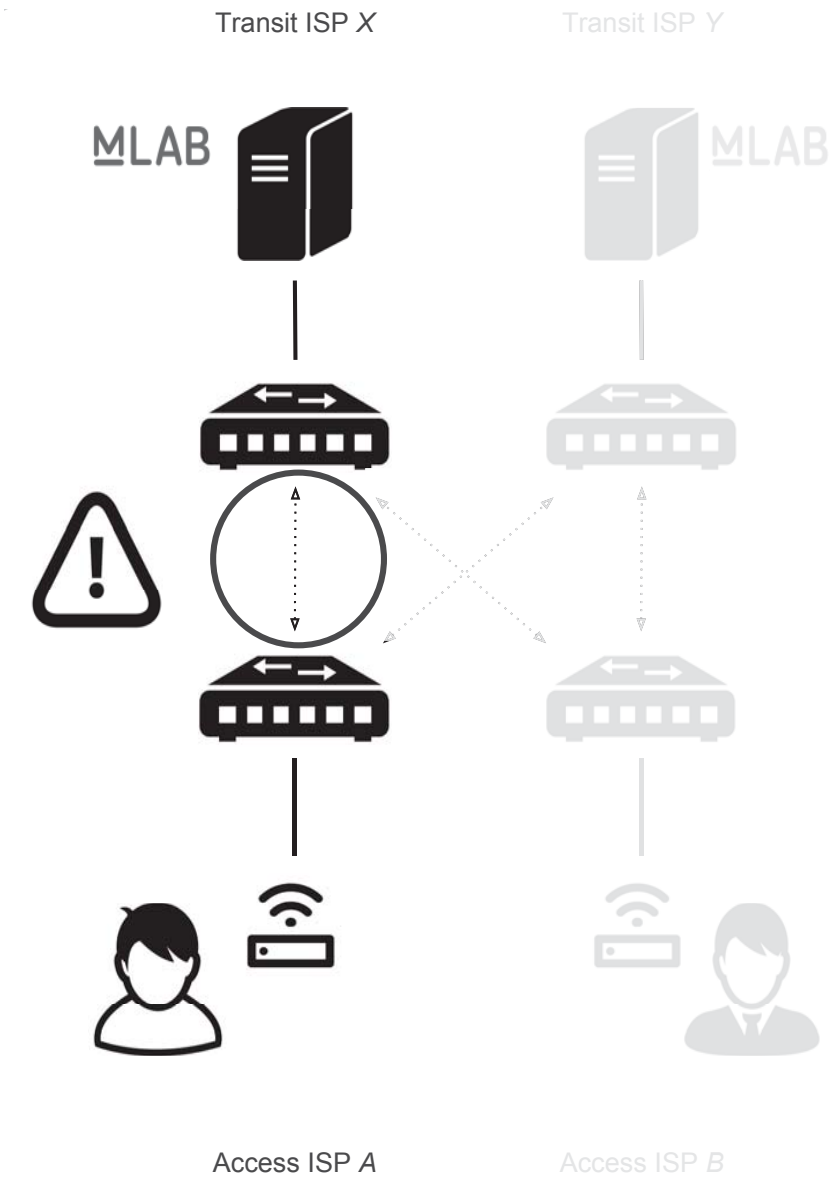
Methodology

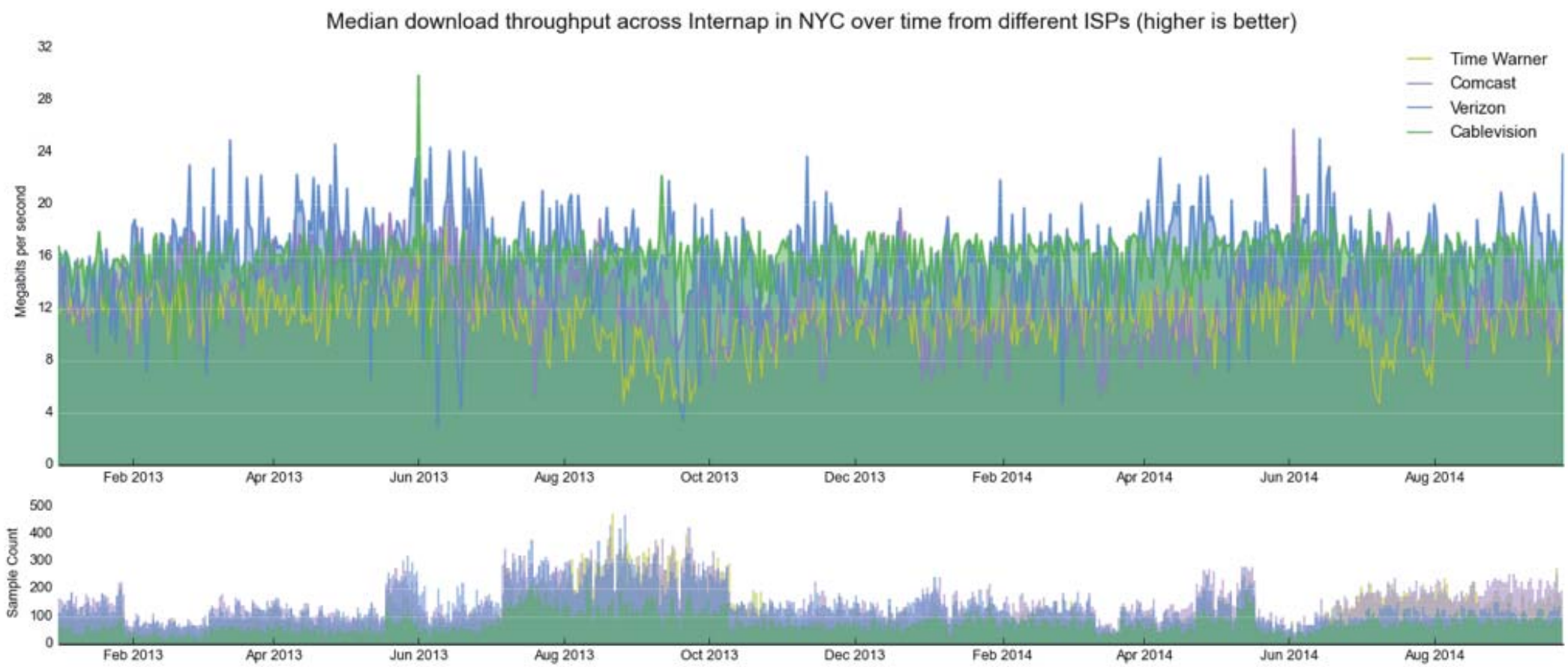
Inferring the Source of Congestion



Methodology

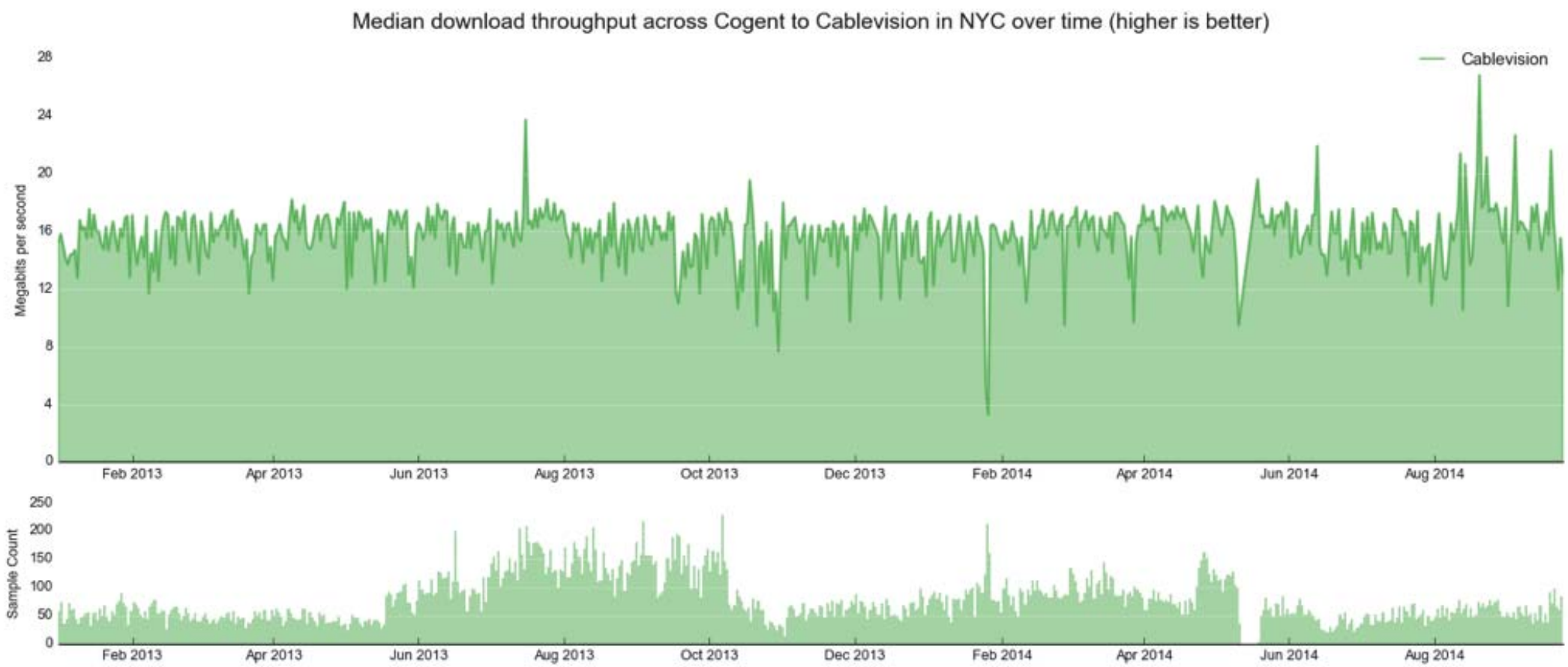
Inferring the Source of Congestion





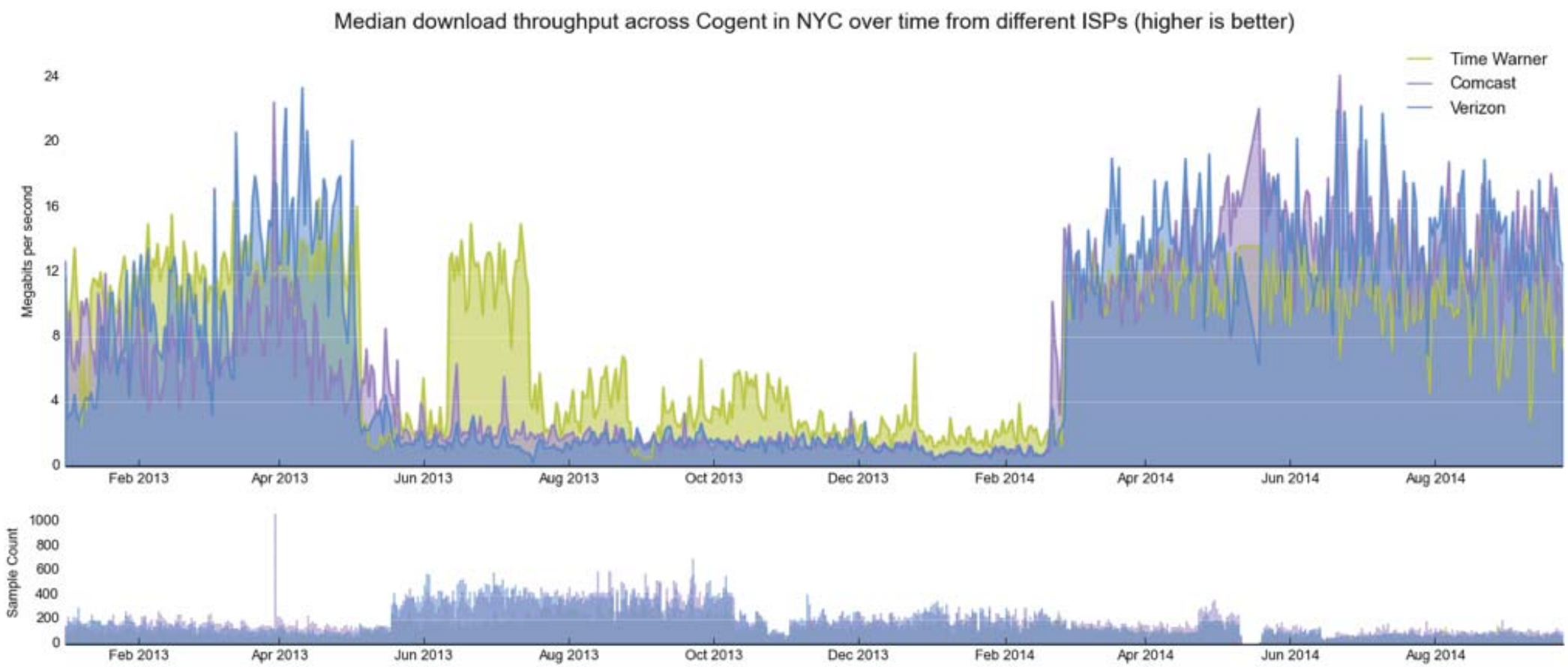
Inferring Sources of Congestion in Practice

US Access ISPs and Cogent (2013-2014)



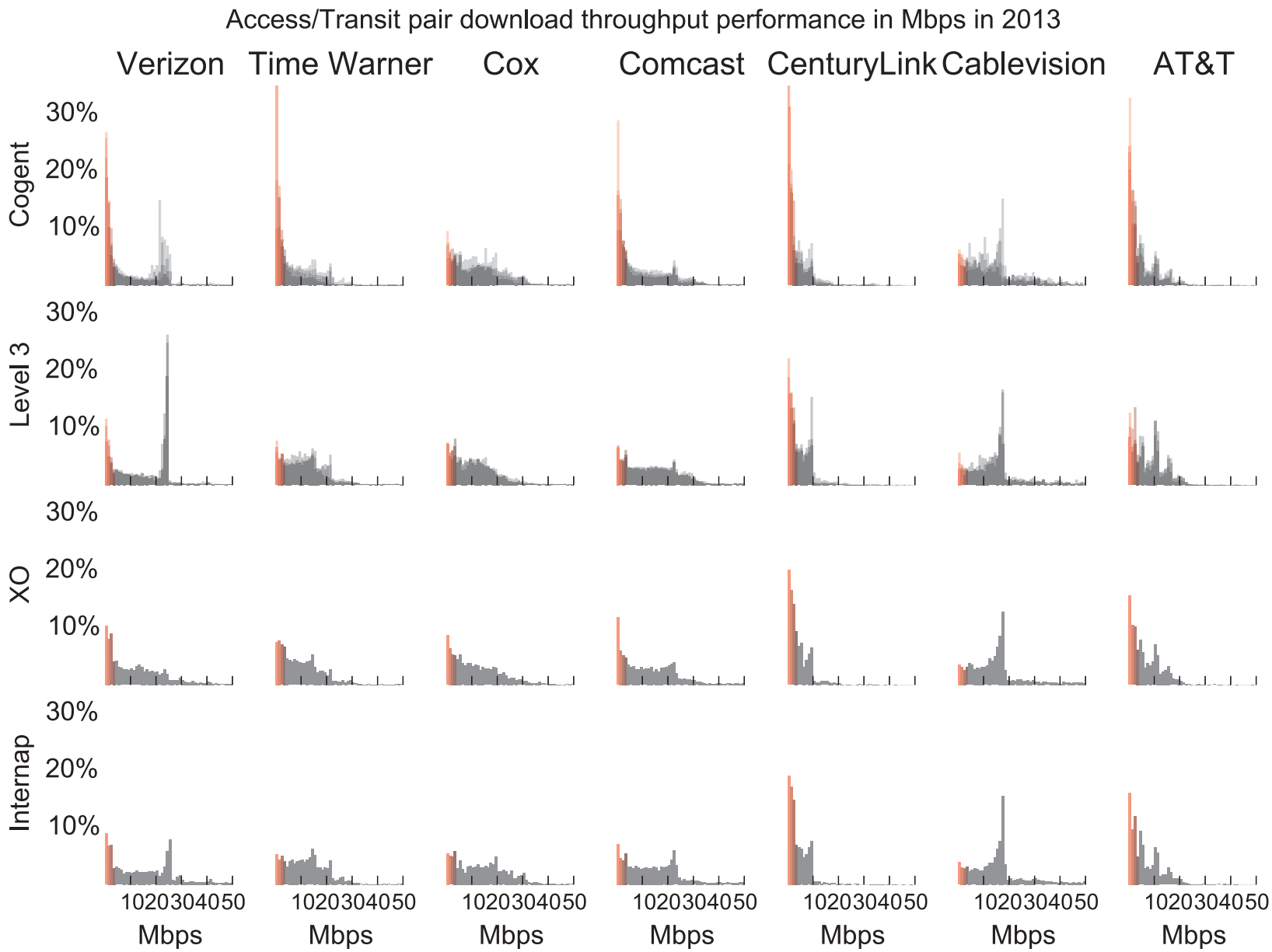
Inferring Sources of Congestion in Practice

US Access ISPs and Cogent (2013-2014)



Inferring Sources of Congestion in Practice

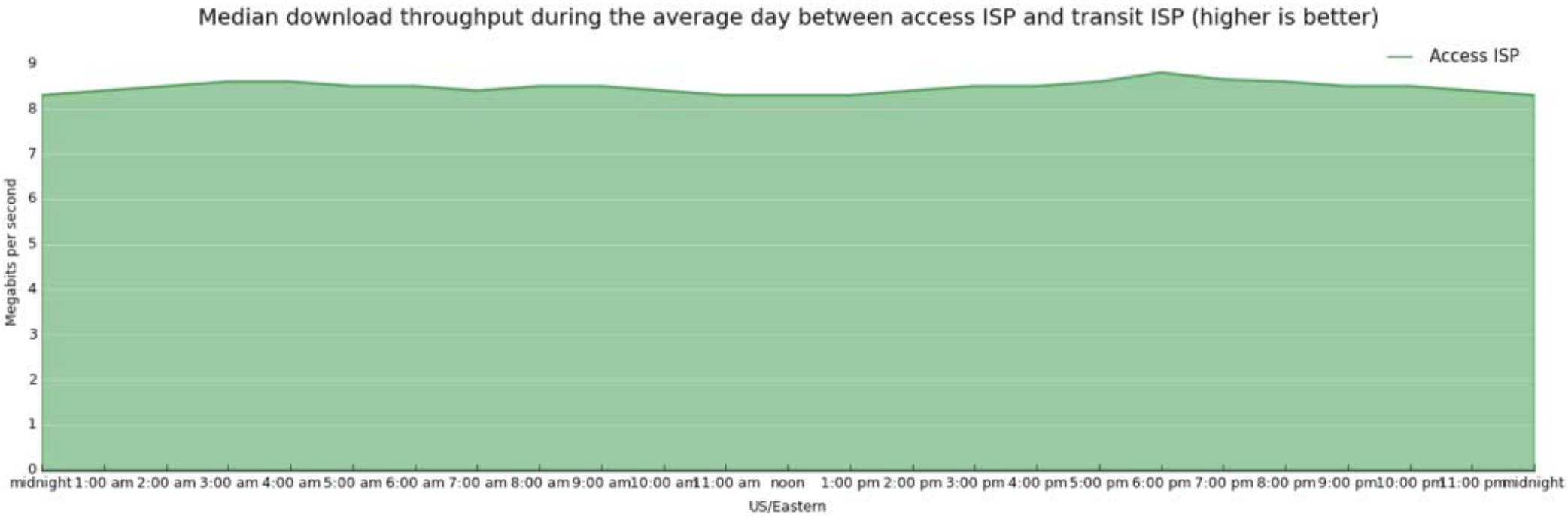
US Access ISPs and Cogent (2013-2014)



Comparative Performance across ISPs

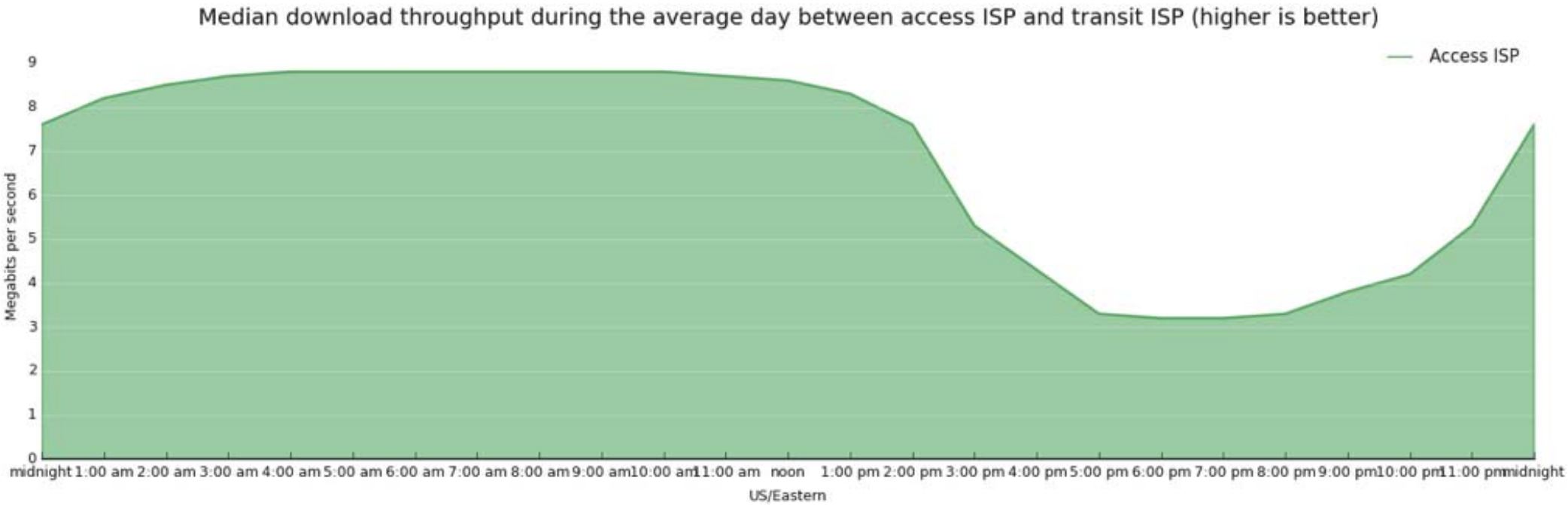
No Access ISPs or Transit ISPs Universally Underperforming

Diurnal Trends Matter



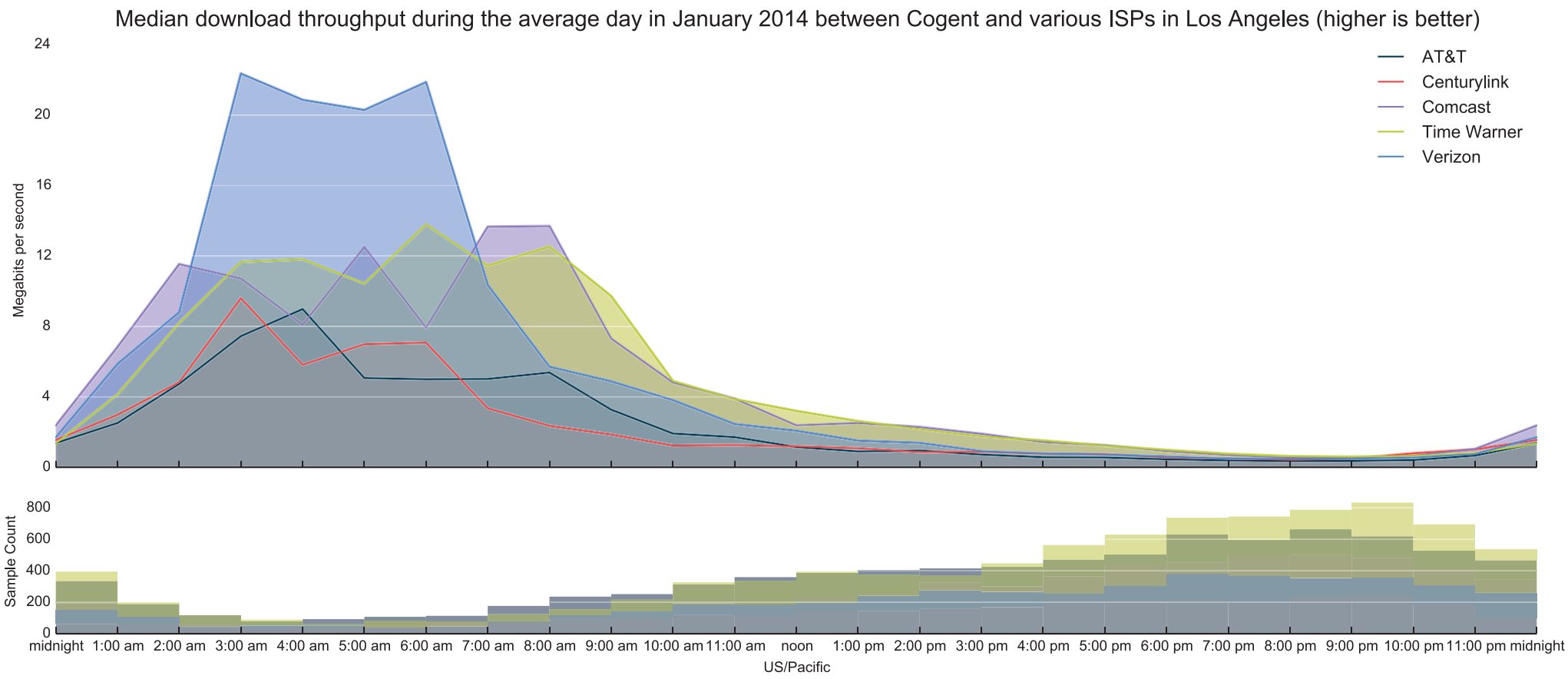
Diurnal Patterns Are Instructive

Expectations of Normal Performance

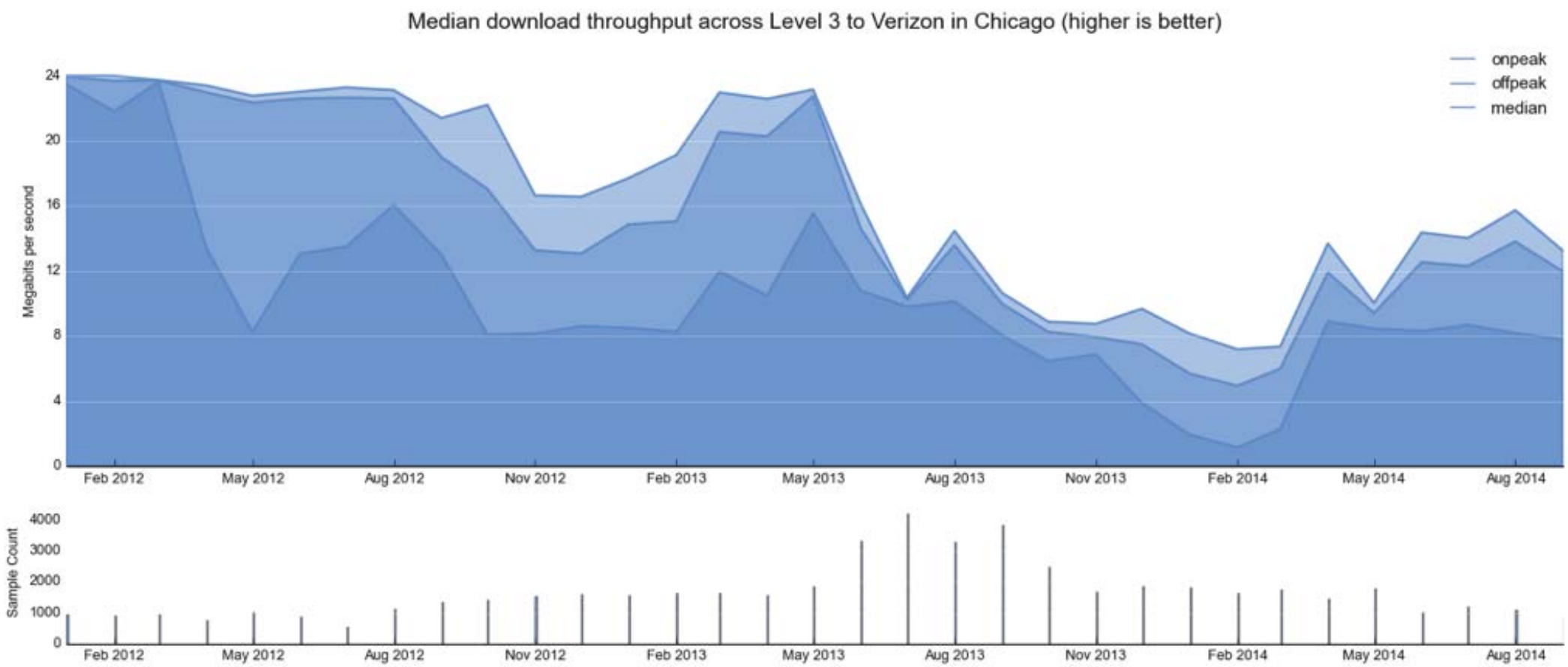


Diurnal Patterns Are Instructive

Expectations of Congested Performance



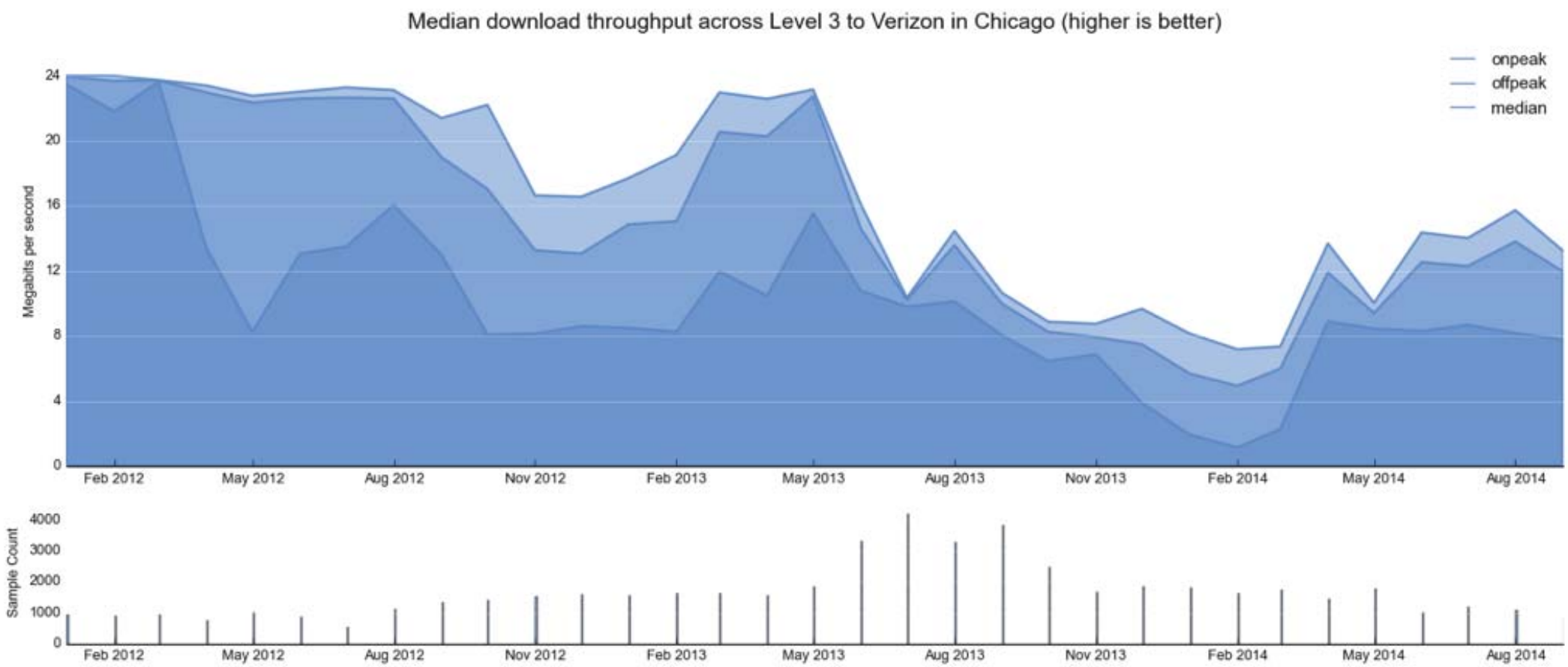
Diurnal Cycles In Practice



Diurnal Patterns Are Instructive

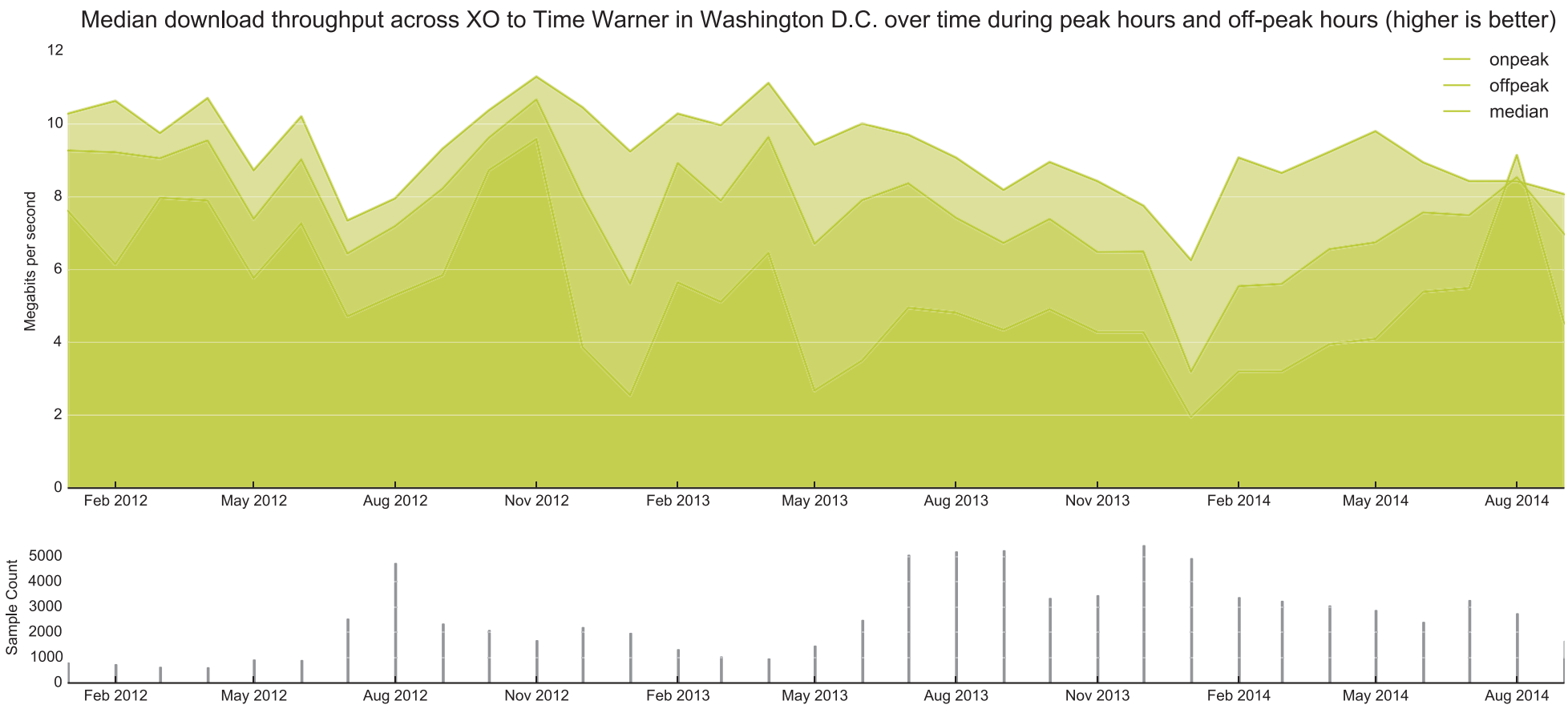
Peak Congestion Can Augur Future Degradation

Congestion affecting consumers has not been limited to interconnections with Cogent



Level 3 and Verizon

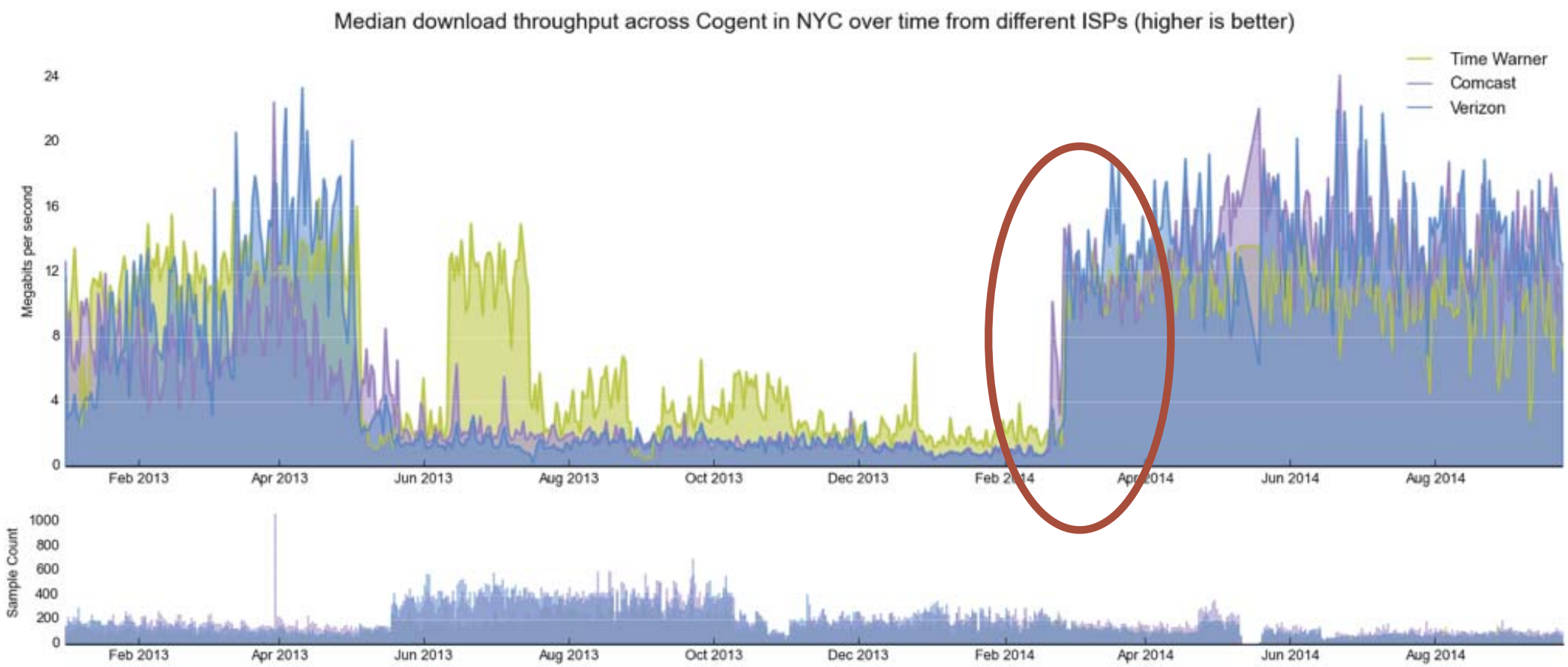
Ongoing



XO and Time Warner Cable

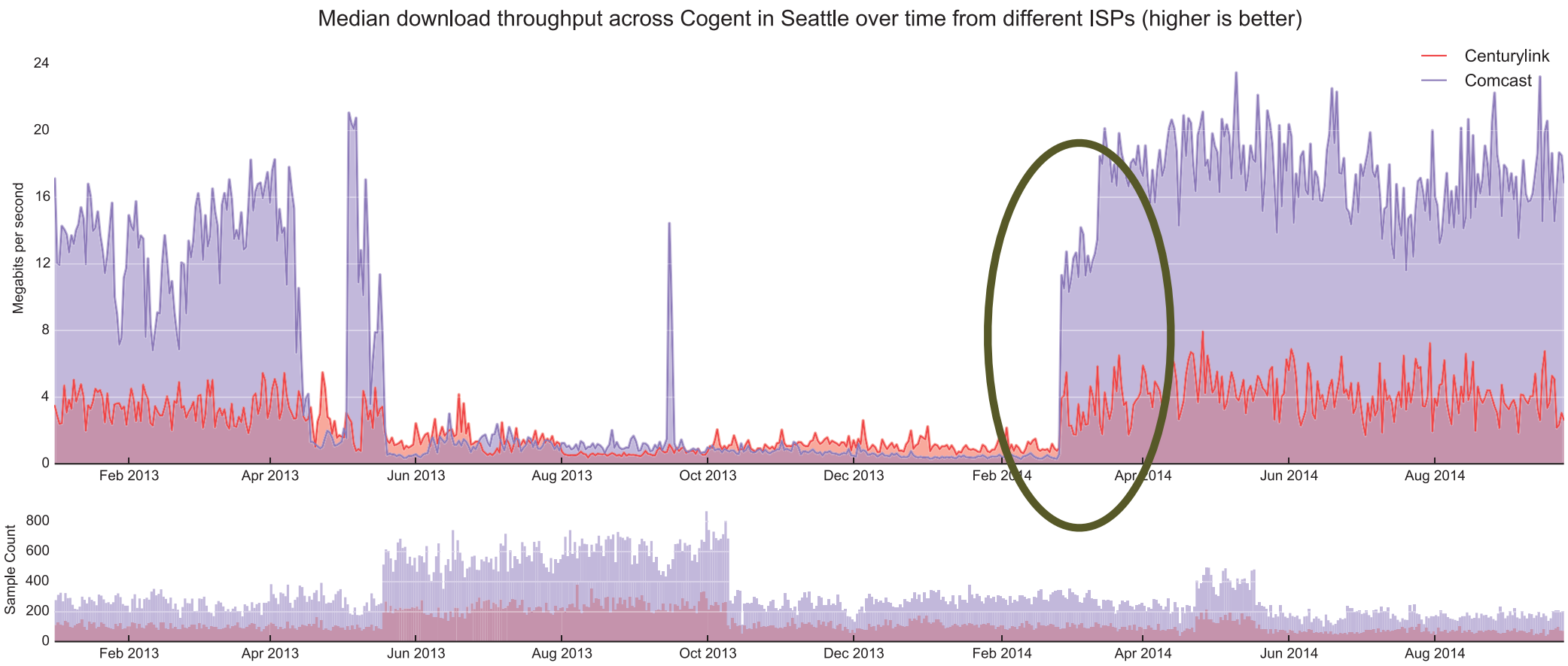
Ongoing

Serendipitous Discovery



What Happened in Late February?

Cross the Board Increases



What Happened in Late February?

Cross the Board Increases

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in 8235, options [nop,nop,TS[|tcp]>
14:49:05.790410 IP (tos 0x0, ttl 64, id 996, offset 0, flags [DF], proto TCP (6), length 52)
    38.106.70.147.51494 > pool-108-41-239-212.nycmny.fios.verizon.net.49998: Flags [.], seq 0, ack 49361641, wi
options [nop,nop,TS[|tcp]>
14:49:05.790400 IP (tos 0x48, ttl 55, id 38409, offset 0, flags [DF], proto TCP (6), length 1500)
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options [nop,nop,TS[|tcp]>
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options [nop,nop,TS[|tcp]>
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    38.106.70.147.51494 > pool-108-41-239-212.nycmny.fios.verizon.net.49998: Flags [.], seq 0, ack 49370329, wi
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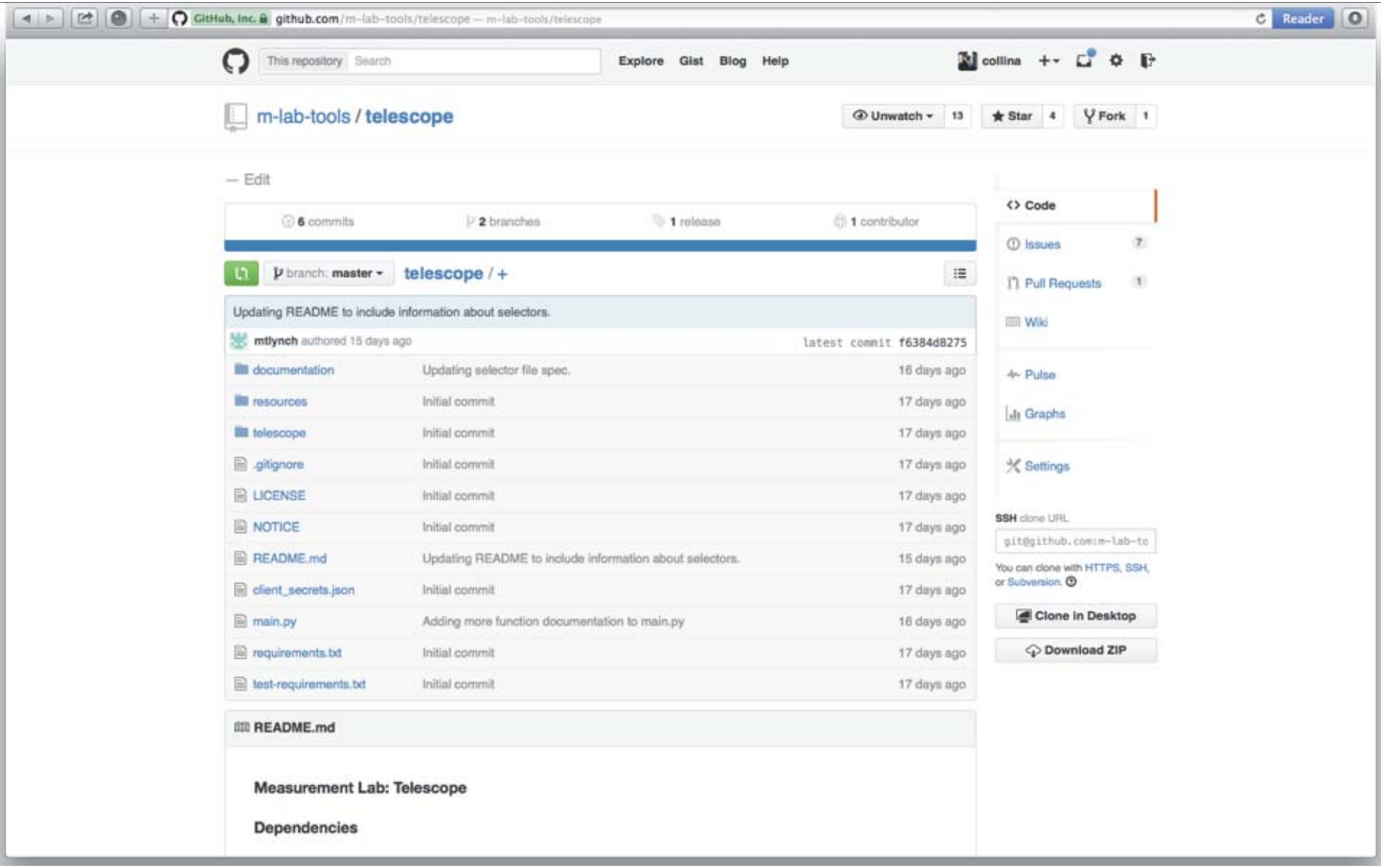
DSCP Changes!

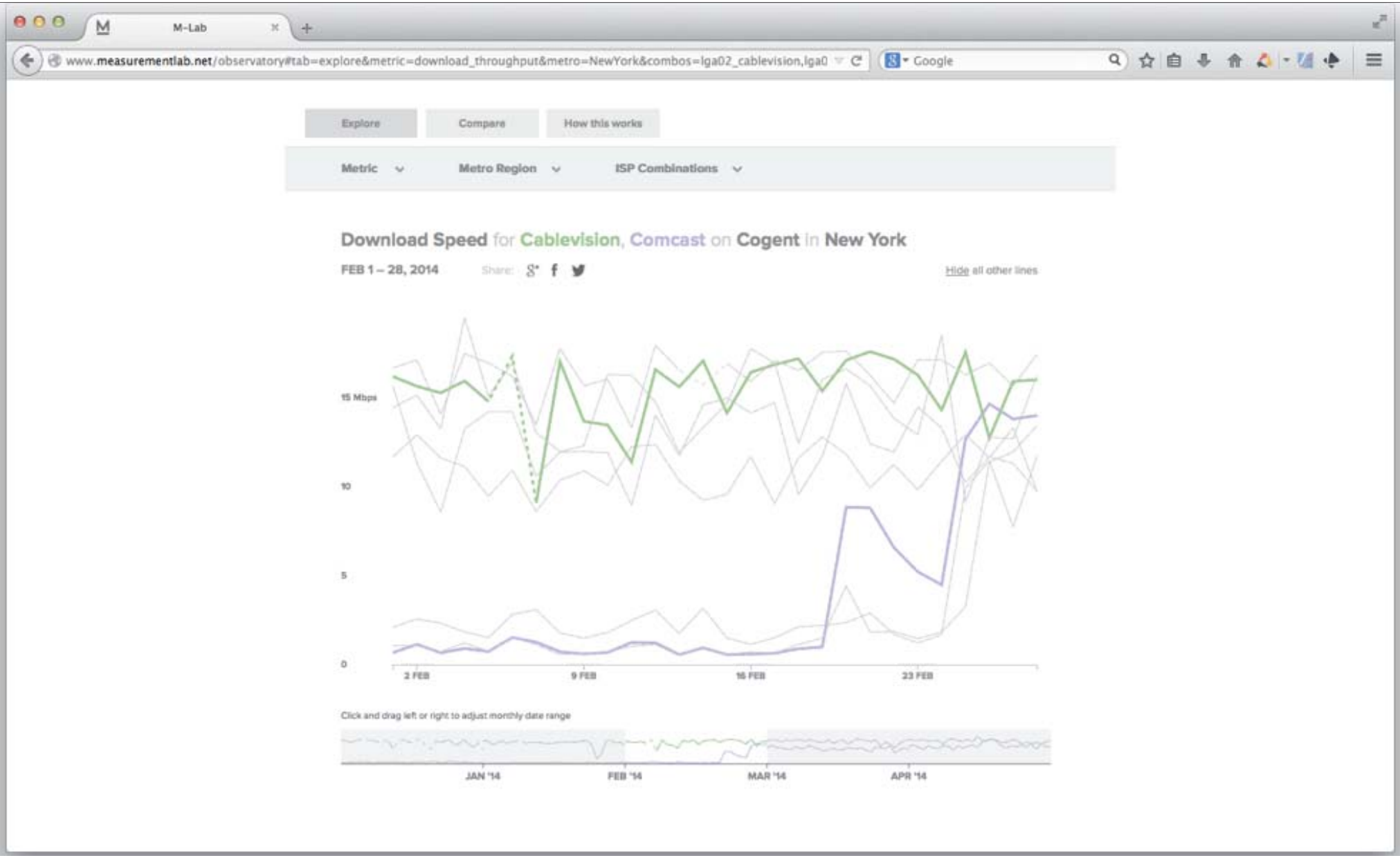
Cross the Board Increases

Extending the Interconnection Study



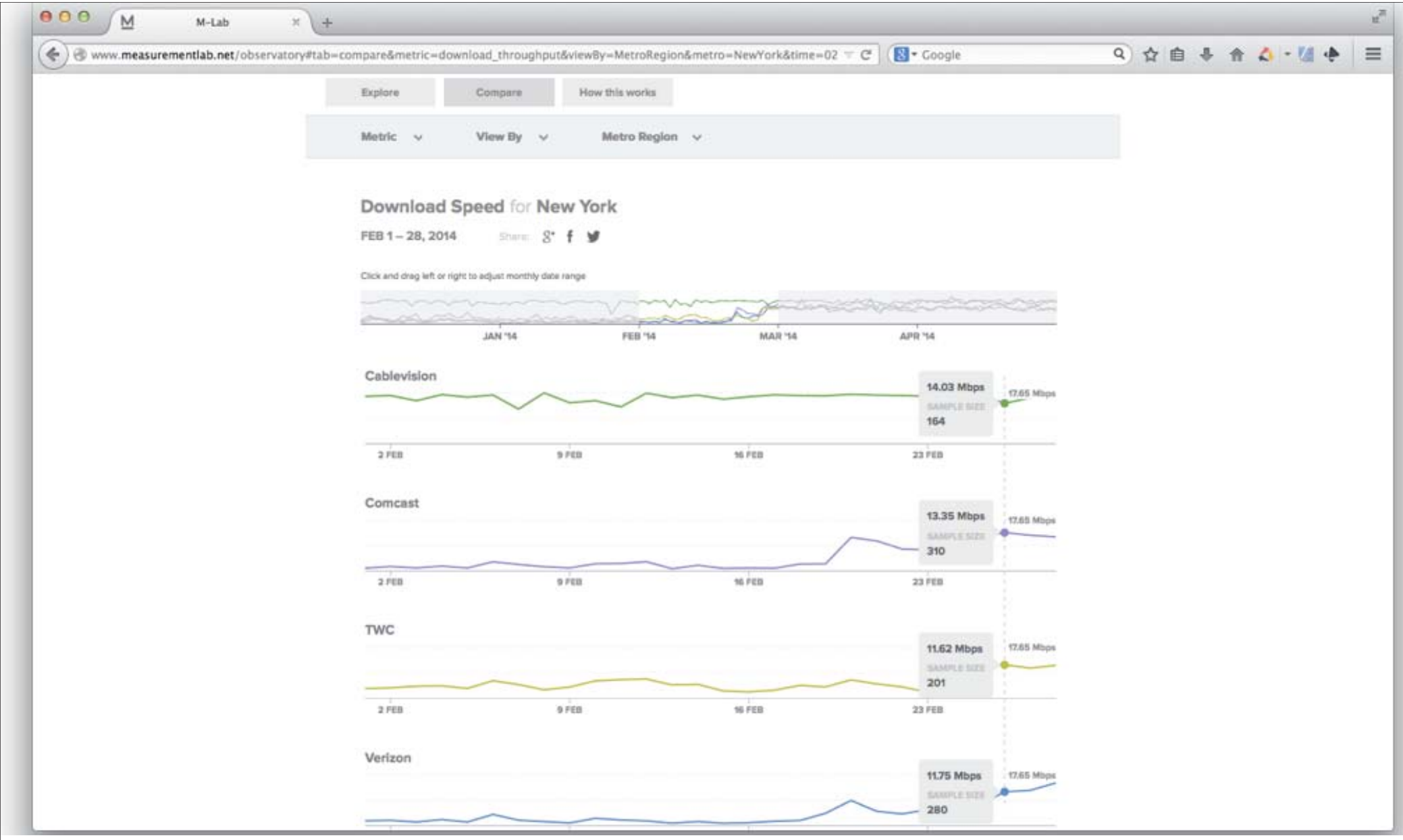
Measurement Lab Telescope

Python to extract M-Lab data



Measurement Lab Observatory

Currently US Only



Measurement Lab Observatory

Currently US Only

Review, Clarifications and Conclusions

Our data shows that traffic from specific Access ISP customers across interconnections with specific Transit ISPs experienced degraded performance, and that this degradation forms a pattern wherever specific Access ISPs and Transit ISPs exchange traffic.

Research Limitations

- We cannot determine which actors or actions are “responsible” for observed degradation.
- Path data is not included in the scope of this report (but it is collected and consulted by M-Lab).
- We cannot identify the precise cause of performance problems (e.g. a broken router) in a path between a client.

There is still much more in the dataset. Measurement Lab will continue to extend interconnection research.

measurementlab.net