

Independent Network Performance Measurement on Internet Misbehavior

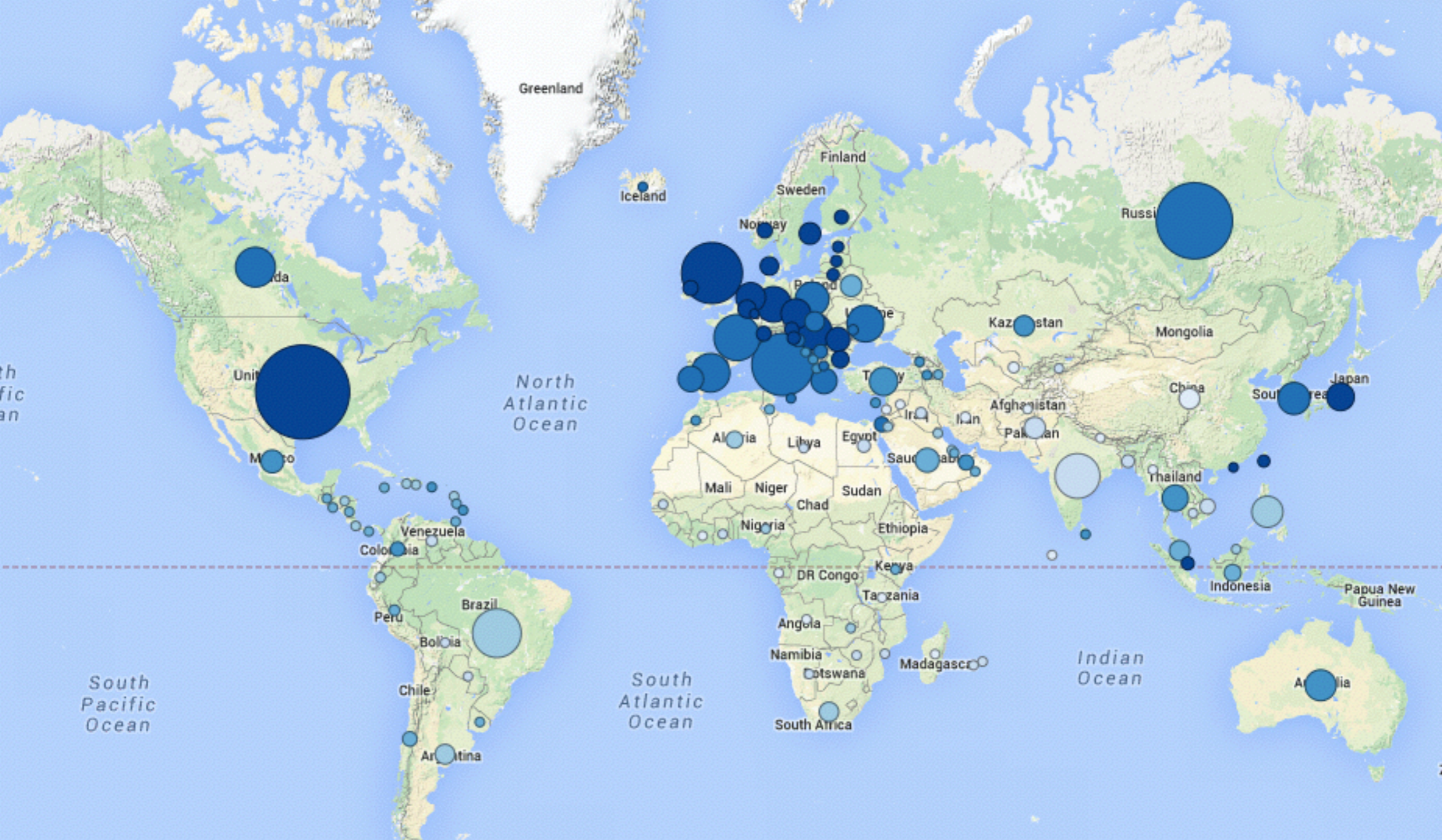
Collin Anderson (@CDA)

MLAB



Global Measurement at Scale

MEASUREMENT LAB



Open, Active
Measurement at Scale

MEASUREMENT LAB

Network Diagnostic Tool

458 commits 12 branches 13 releases 8 contributors

Branch: master ndt / +

Fixed select function usage in c2s test

skostuch authored on Jul 1 latest commit 129692dce1

Admin	Merge AppletIssue120 branch into trunk	2 years ago
Applet	Fixed issue with new client connecting to old server	3 months ago
HTML5-frontend	Merged newest master into MultiplePorts branch	3 months ago
I2util @ 205adc5	Re-add the I2util submodule that I apparently removed somehow	5 months ago
conf	Merged newest master into MultiplePorts branch	3 months ago
config	Check for OpenSSL when configuring	5 months ago
contrib	Add an RPM to use Apache instead of fakewww	a year ago
doc	Merging in branch kkumar_code_organize into trunk. This branch has co...	3 years ago
flash-client	Merged newest master into MultiplePorts branch	3 months ago
janalyze	Fix issue with missing break statement	2 years ago
src	Fixed select function usage in c2s test	3 months ago
tfw	Added info about actual traffic speed.	8 years ago
nitmodules	Re-add the I2util submodule that I apparently removed somehow	5 months ago

Code

Issues 32

Pull requests 1

Wiki

Pulse

Graphs

HTTPS clone URL

https://github.com

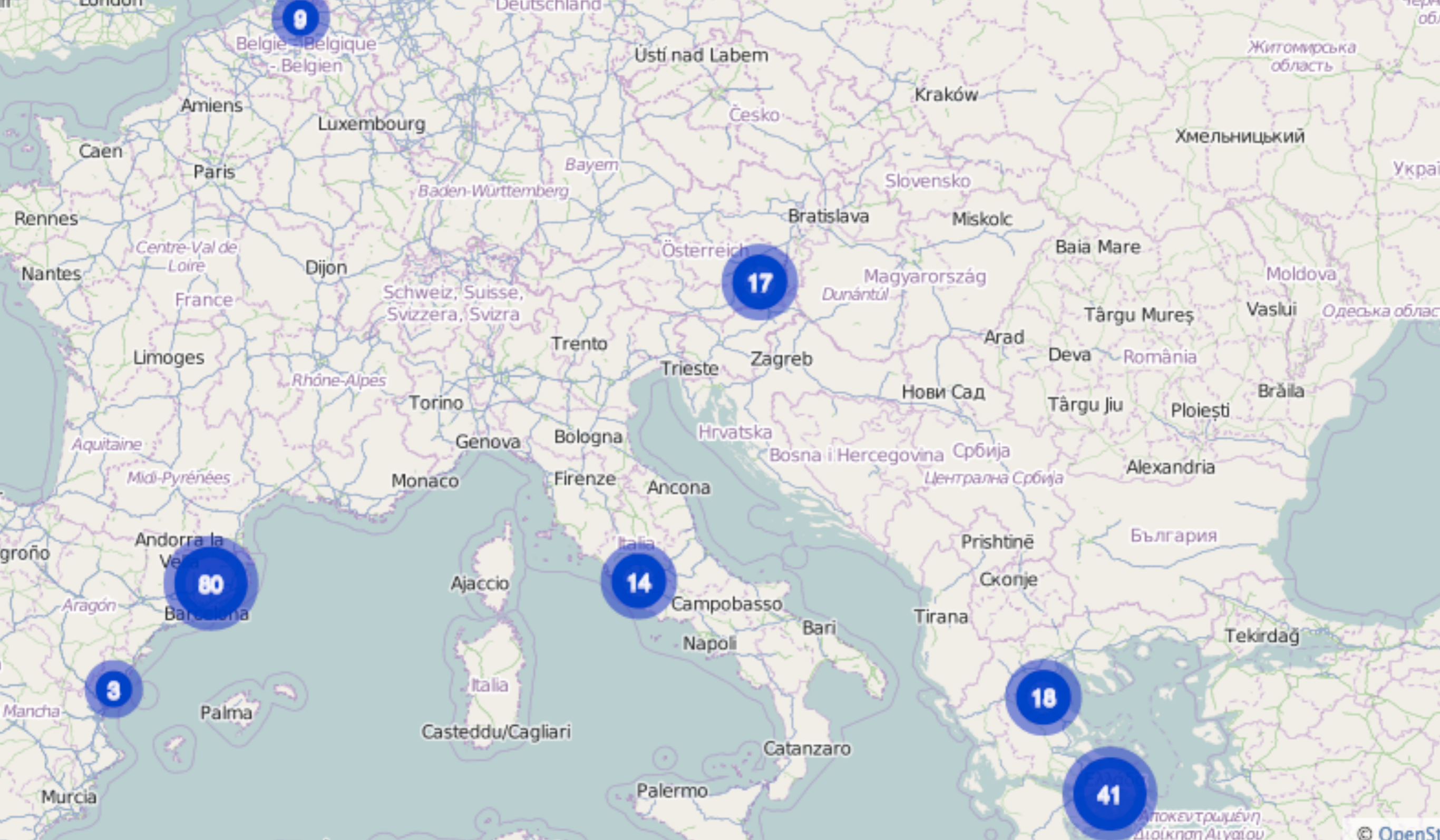
You can clone with HTTPS, SSH, or Subversion.

Clone in Desktop

Download ZIP

Pervasive Measurement From The Edge

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Pervasive Measurement From The Edge

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Bandwidth

Greece, Athens



Results: Upload: 209.71 kbit/s (25.5 kB/s) Download: 1.20 Mbit/s (147.2 kB/s)

(Alternate speed test at [dslreports](#))

Your Upload Speed:

Test Result (209.71 kbit/s)

µTorrent Bandwidth Configuration

Upload Limit:	17.0 kB/s	Upload Slots:	3
Connections (per-torrent):	55	Connections (global):	90
Max active torrents:	1	Max active downloads:	1

Network



Results: Port is open. Your network is properly configured.

Current Port: (0:random)

36379

Automatic Port Mapping (Recommended)

Pervasive Measurement
From The Edge

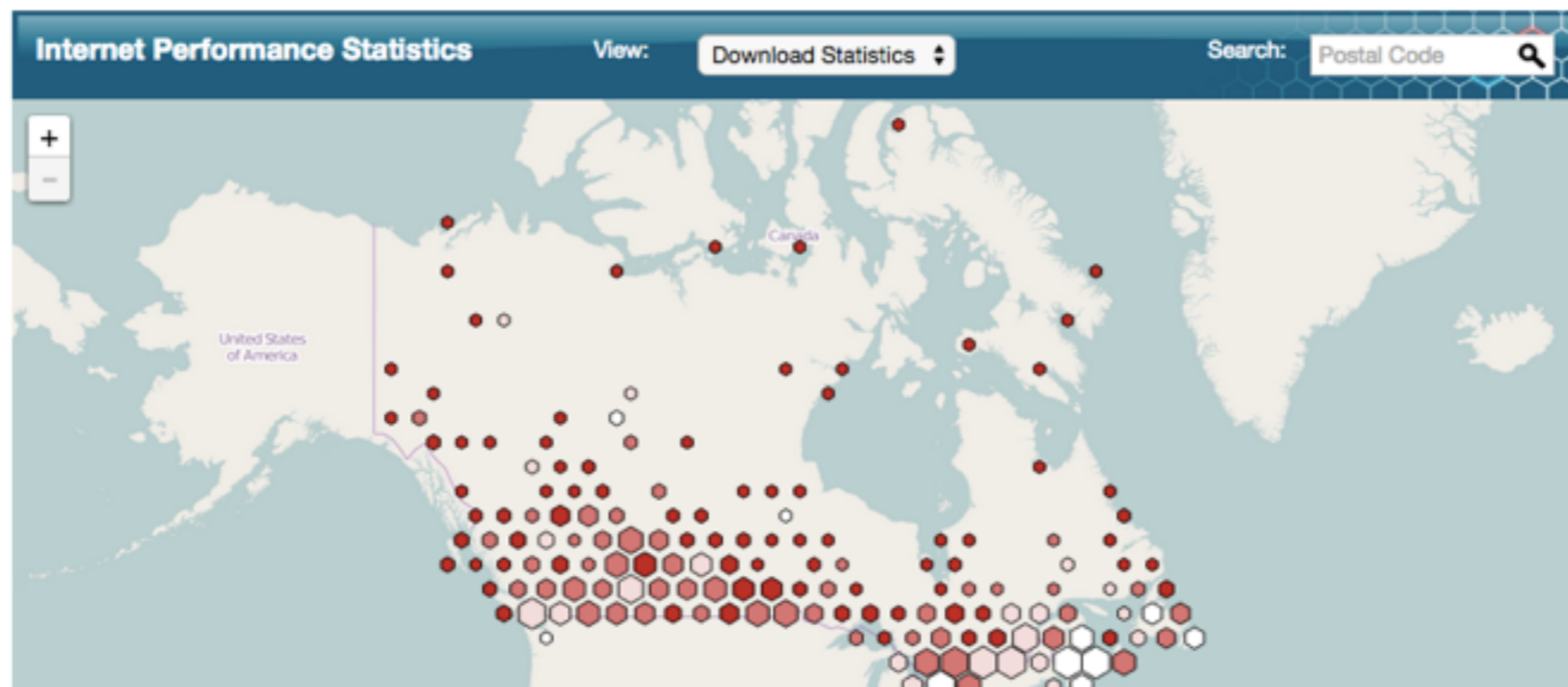
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My Internet Performance Test

For the most accurate results, we recommend using the [Google Chrome](#) browser to run the Internet Performance Test.

Your IP is 12.238.61.12. Based on this, we think you are in Auburn Hills, MI. Verify the information below, edit if needed, and click **Start** to begin.

My Postal Code <input type="text"/>	My ISP <input type="text" value="AT&T Services"/>	Test Server <input type="text" value="Toronto"/>	Start
Upload Speed	My Device	ISP Network	Download Speed



Pervasive Measurement
From The Edge

MEASUREMENT LAB



Steps

Speed

Step 1

2.85 Mbps

Your Connection



Consistency

Good

Fastest Test

2.79 Mbps

Slowest Test

1.49 Mbps

Share Your Results

You just contributed valuable open data that helps Open Internet advocates enforce strong Net Neutrality and ensures you get the speed and access you pay for. Tell your friends and please run the test often.

 **Tweet**
 **Share**
 **Mail**

Shareable Link:

<https://www.battleforthenet.com/internethealthtest/?t=eyJ0aW1lX3J1bil6>

Pervasive Measurement From The Edge

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Consumer Measurement and Policy Case Study

Interconnection Disputes in the United States

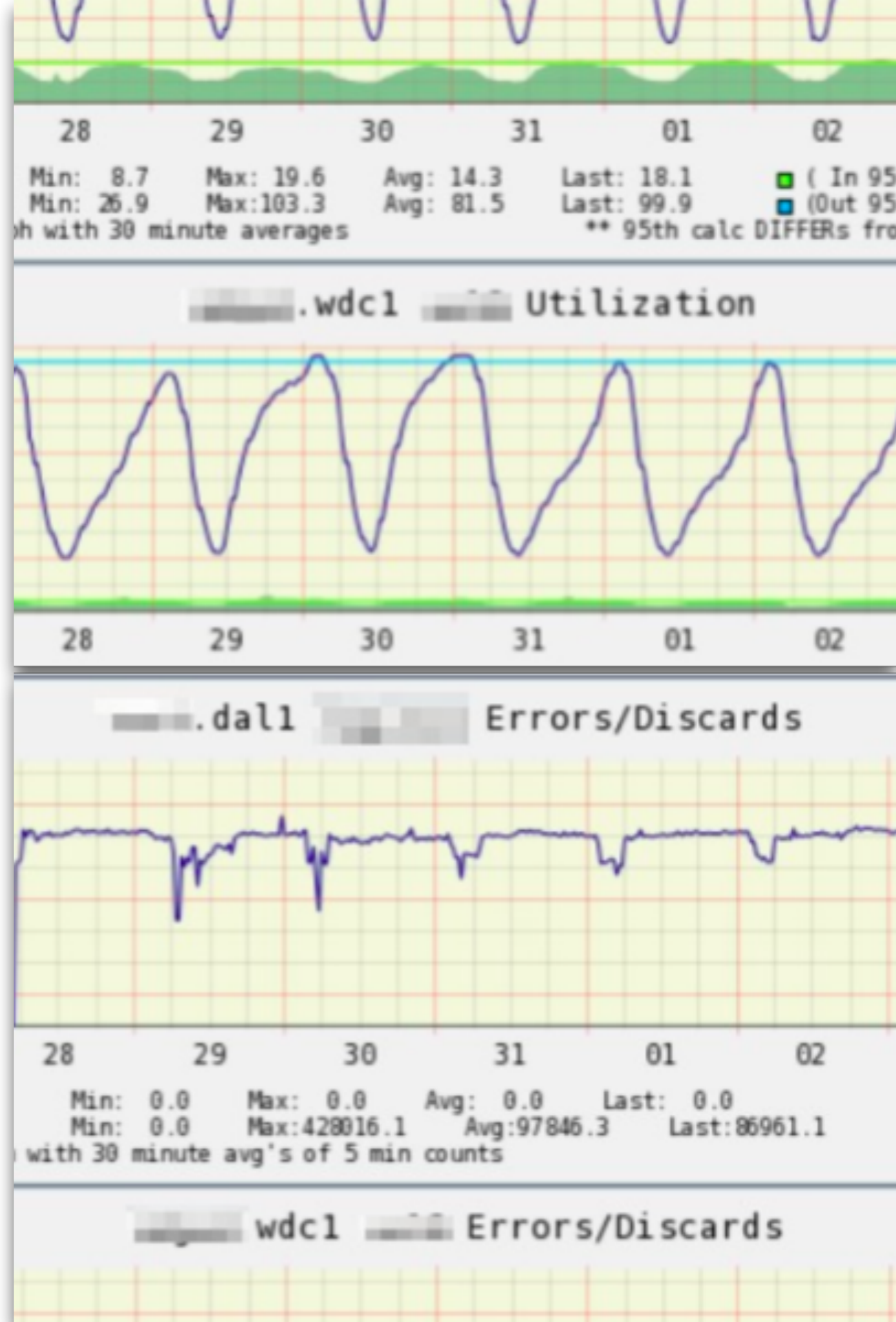
M-Lab's U.S. Footprint

Multiple Transit Providers per City

<i>M-Lab Site</i>	<i>Coun</i>	<i>State</i>	<i>City</i>	<i>Transit provider</i>
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DEN02	US	CO	Denver	Hurricane E.
DEN03	US	CO	Denver	Level3
DEN04	US	CO	Denver	Zayo
DFW01	US	TX	Dallas	Cogent
DFW02	US	TX	Dallas	Tata
DFW03	US	TX	Dallas	Level3
DFW04	US	TX	Dallas	XO
DFW05	US	TX	Dallas	Zayo
IAD01	US	VA	Reston	XO
IAD02	US	VA	Ashburn	Cogent
IAD03	US	VA	Ashburn	Tata
IAD04	US	VA	Ashburn	GTT
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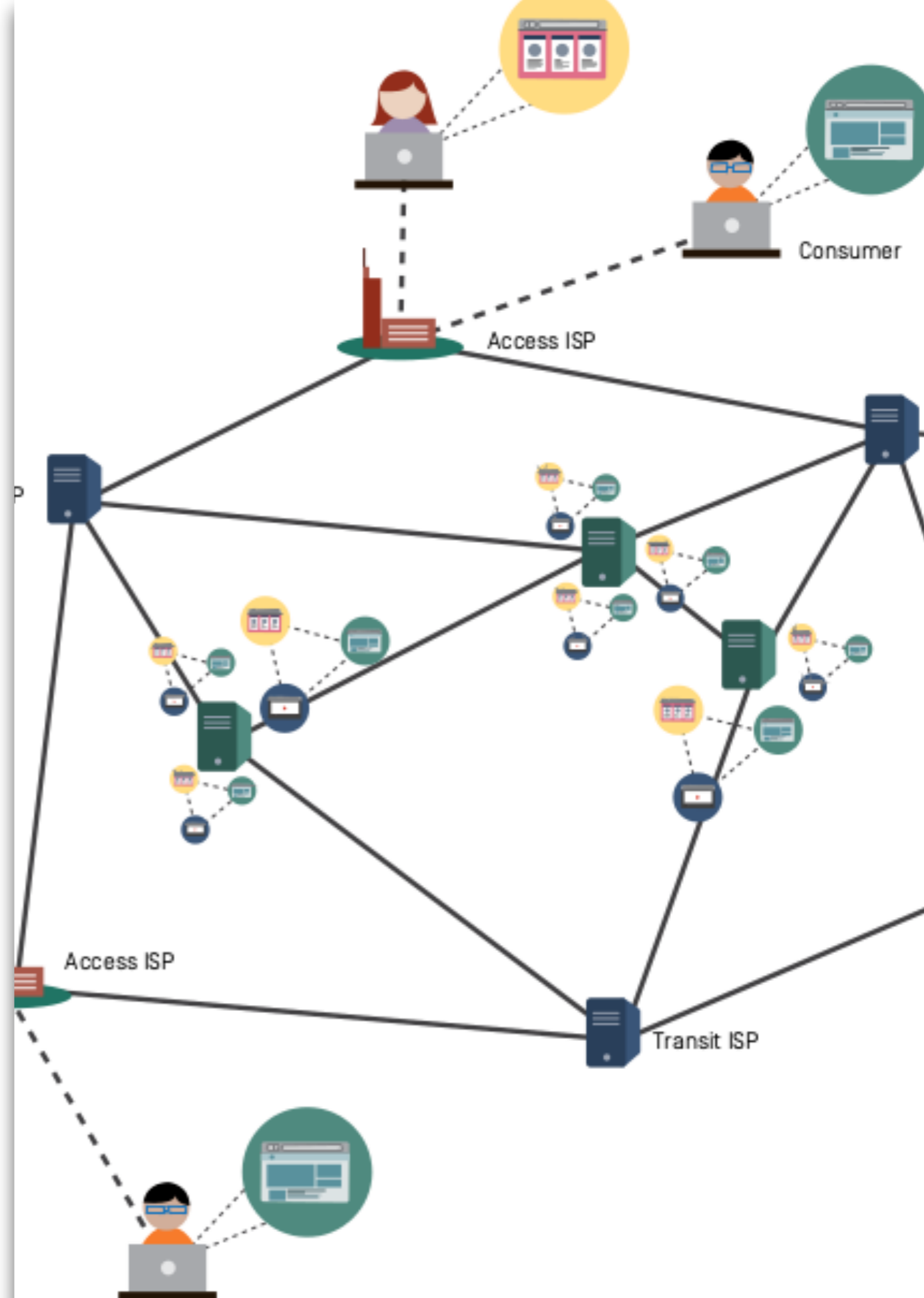
Transparency Problems

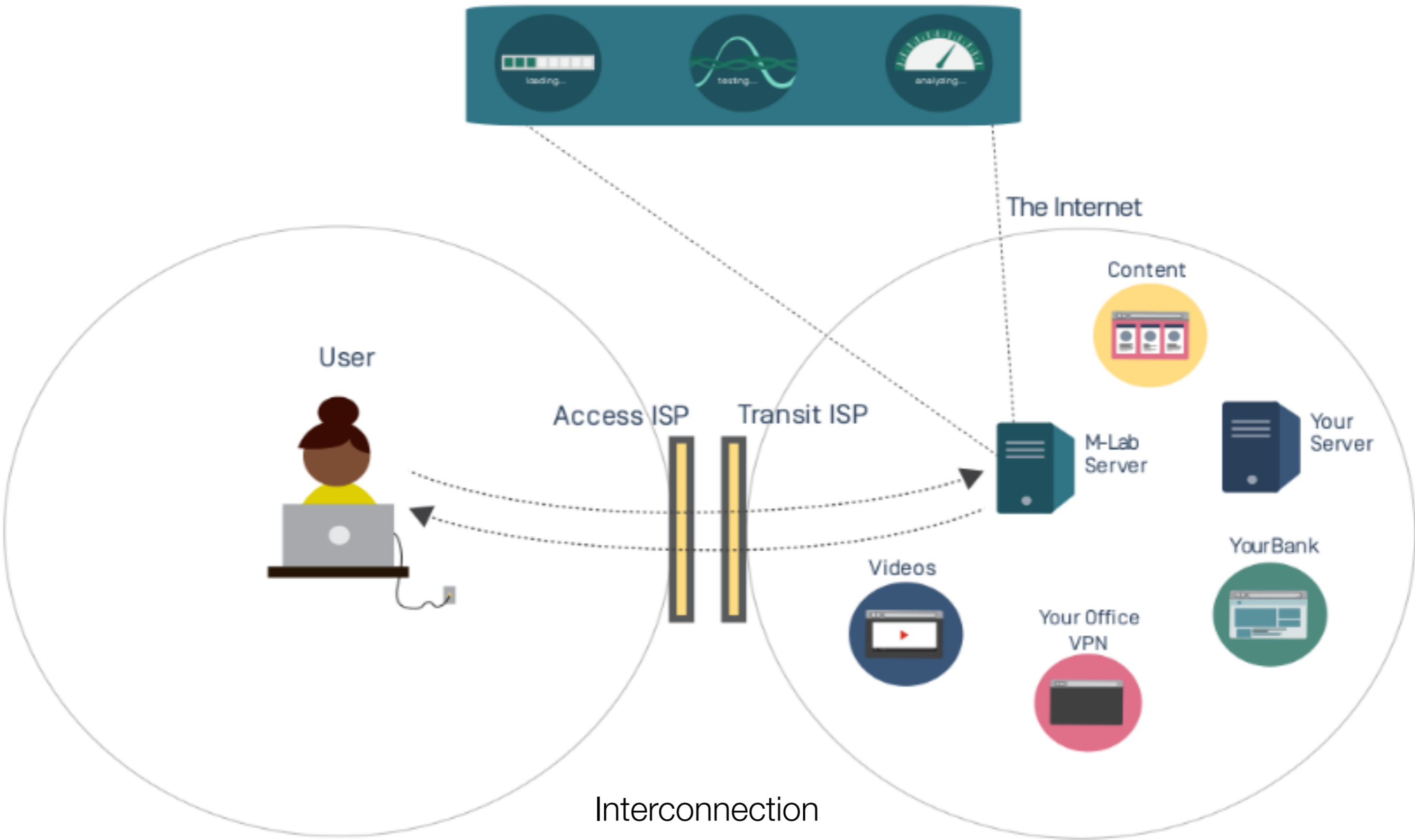
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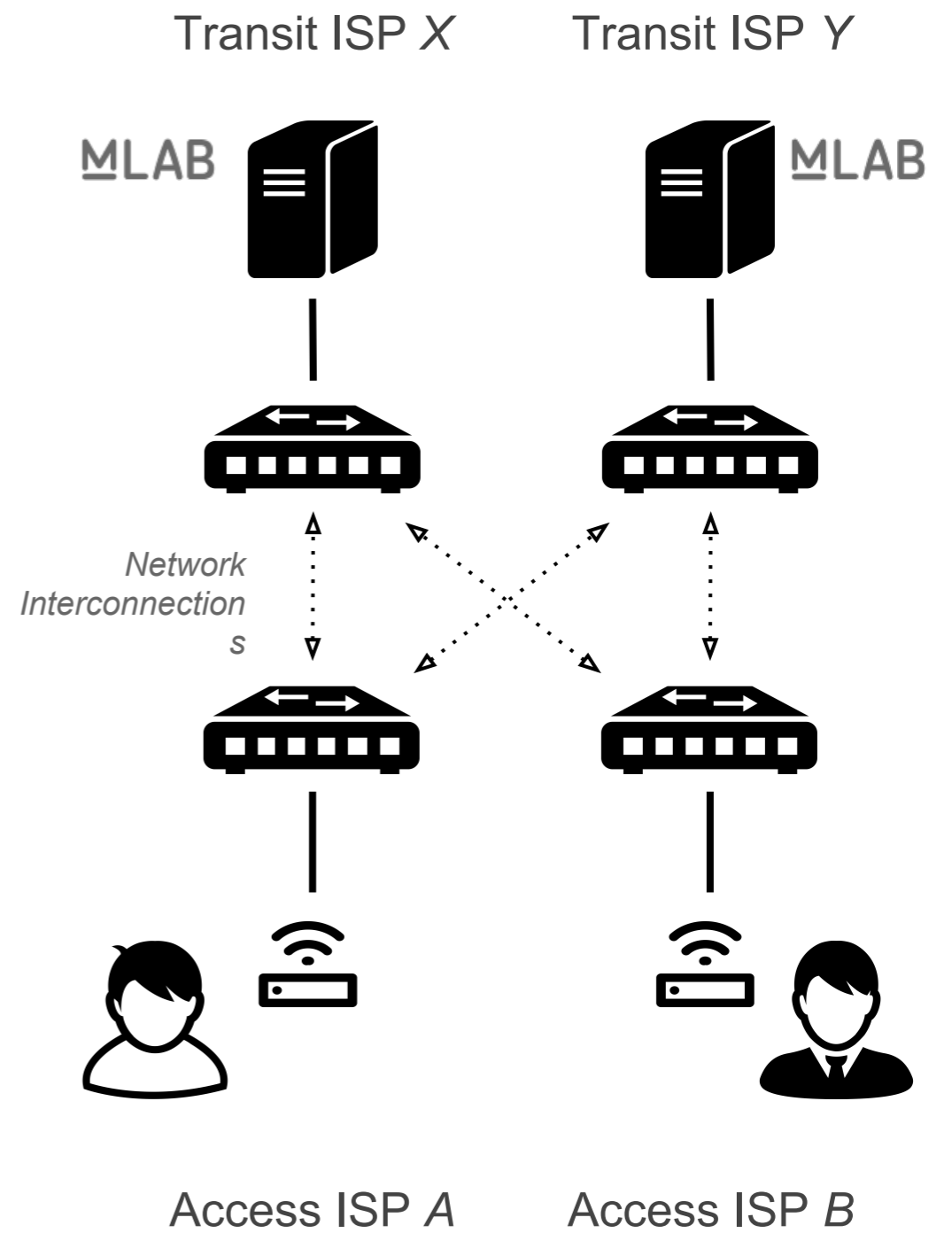


Measuring Performance

Bulk Transfer Capacity

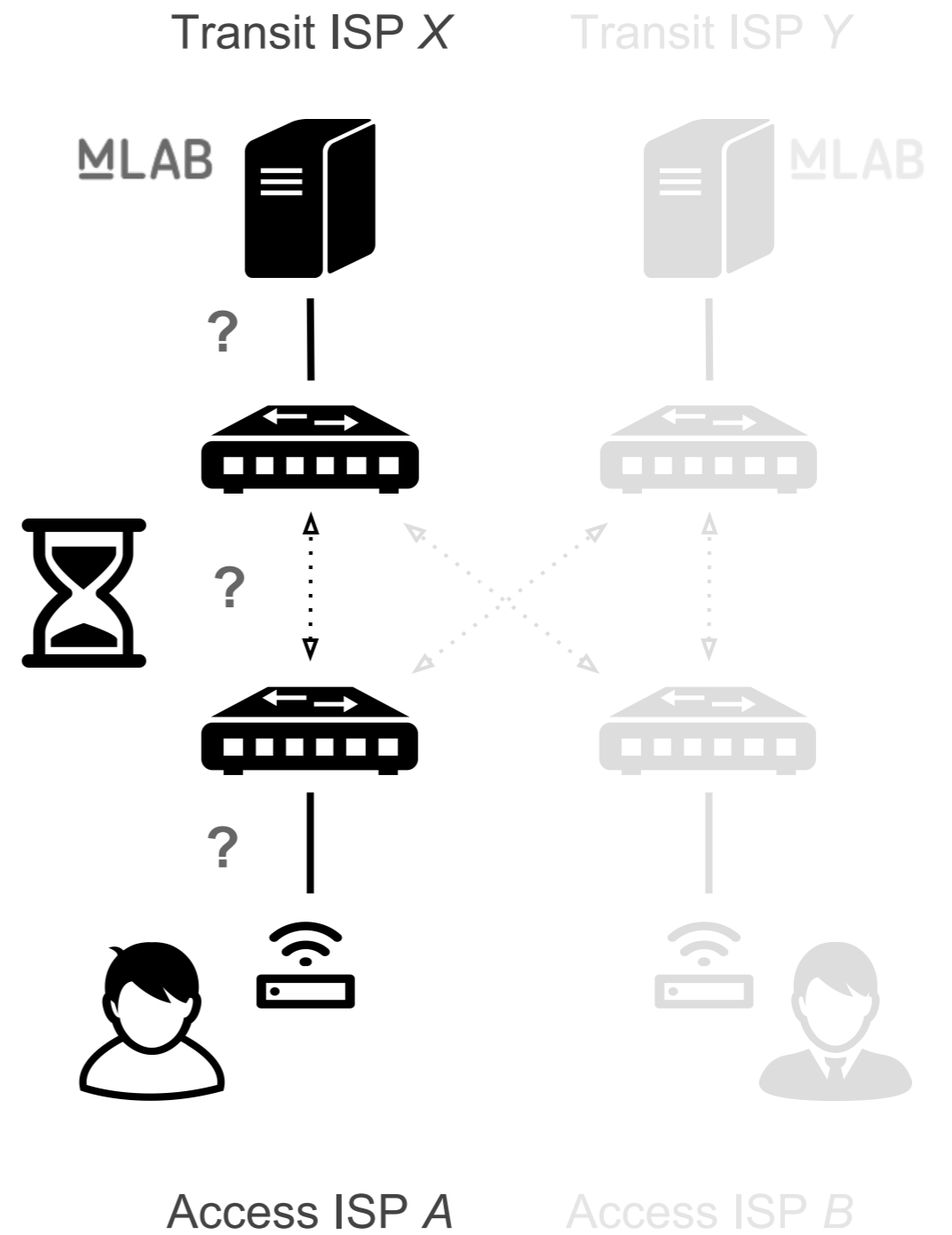
Methodology

Inferring the Source of Congestion



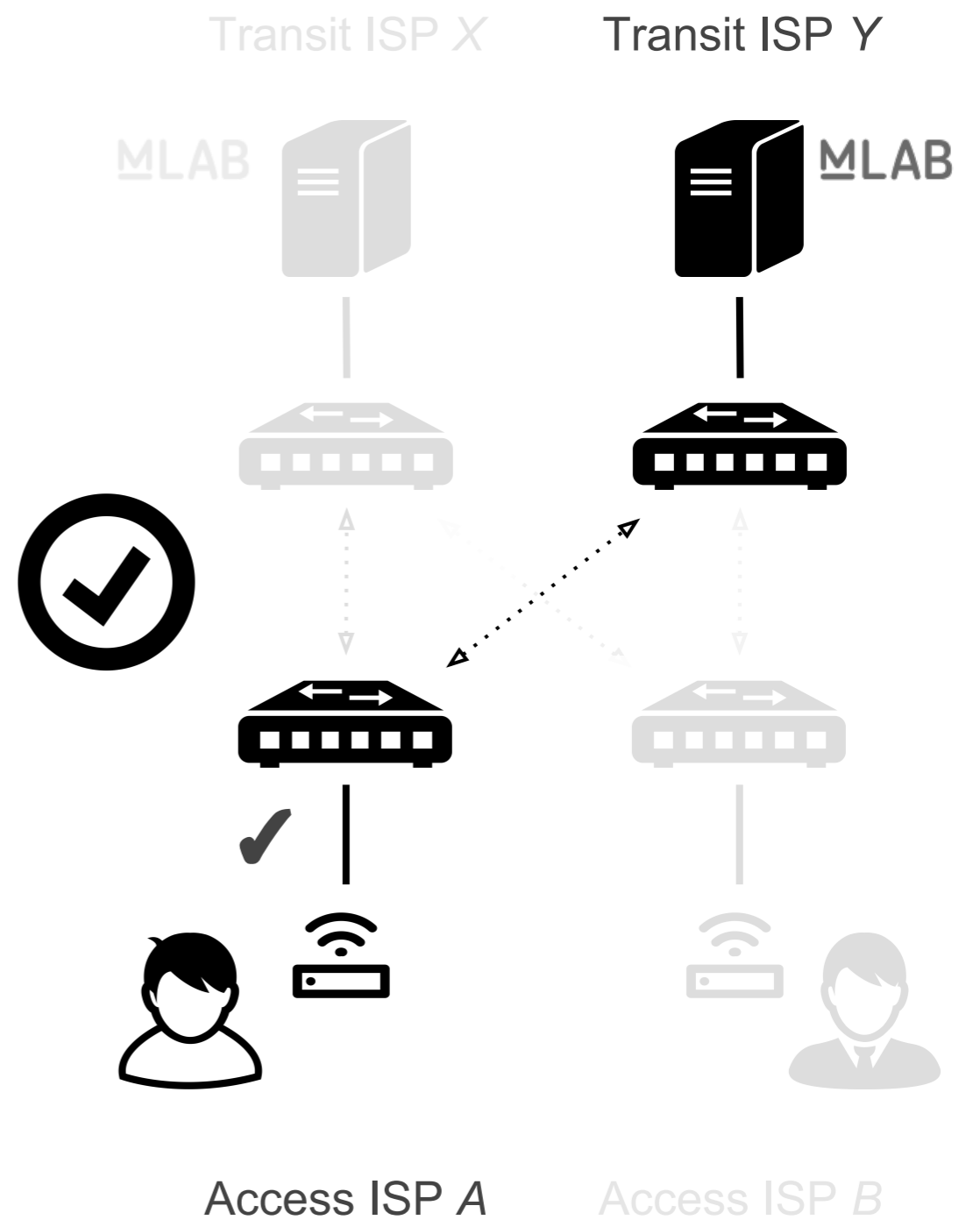
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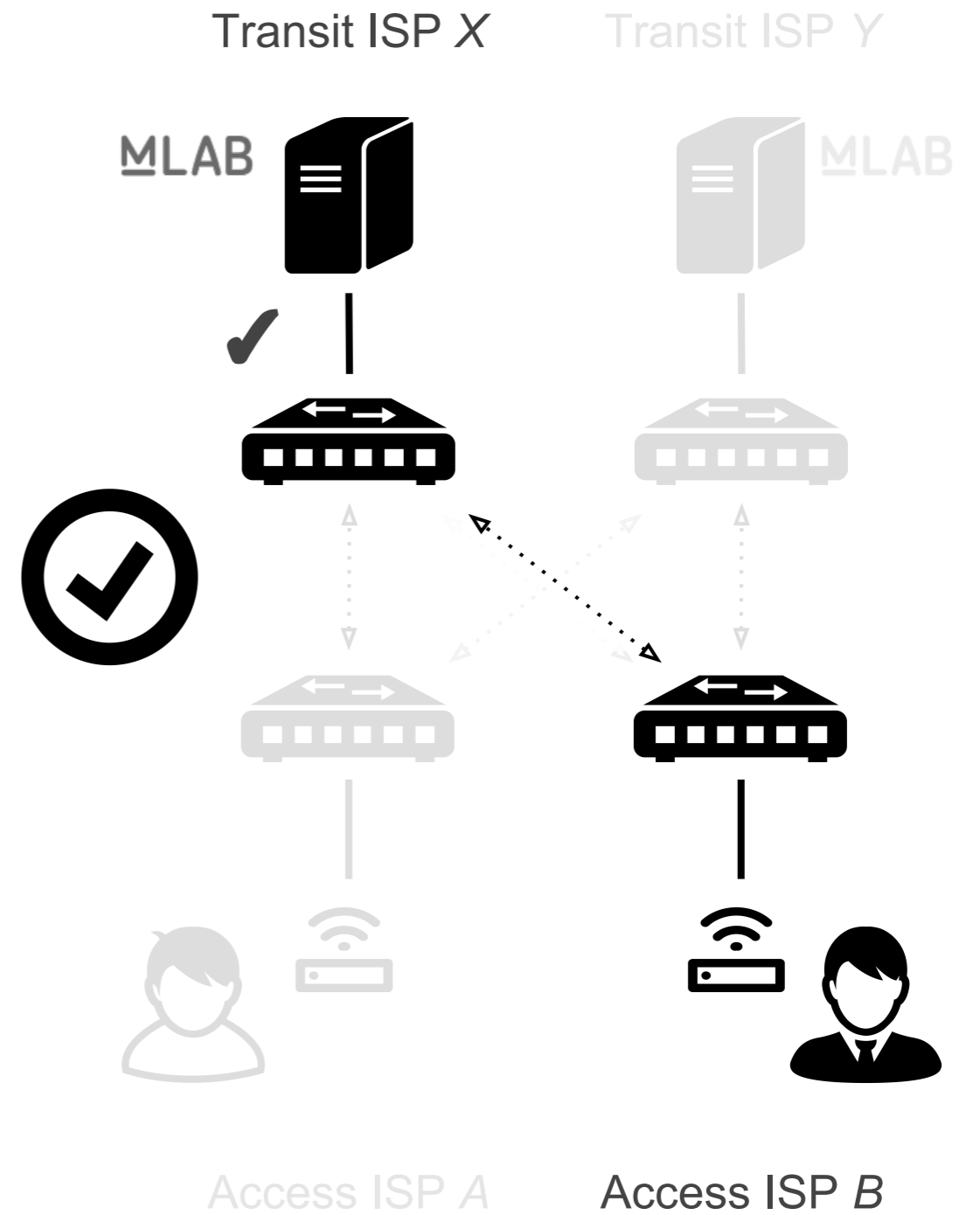
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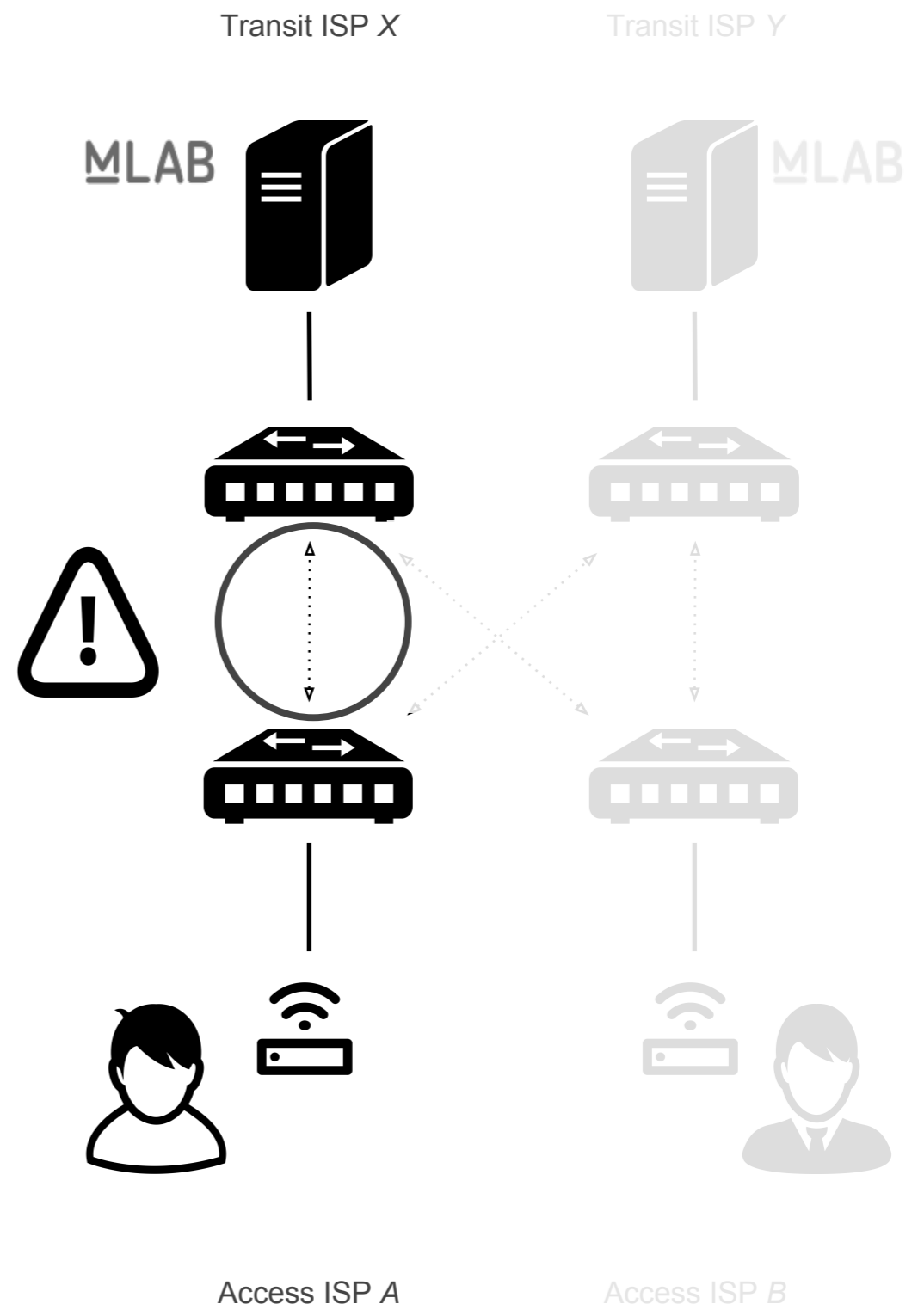
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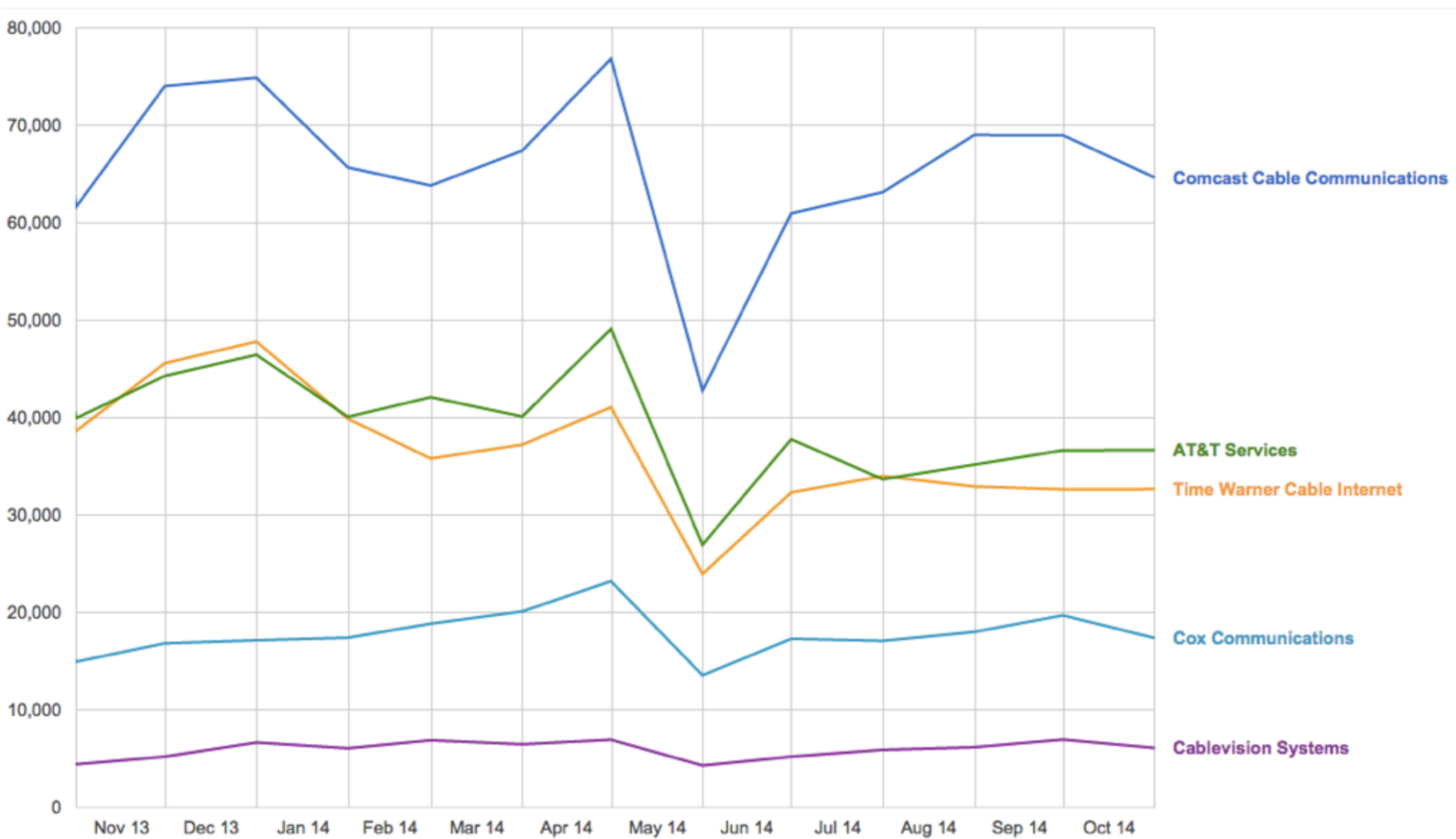
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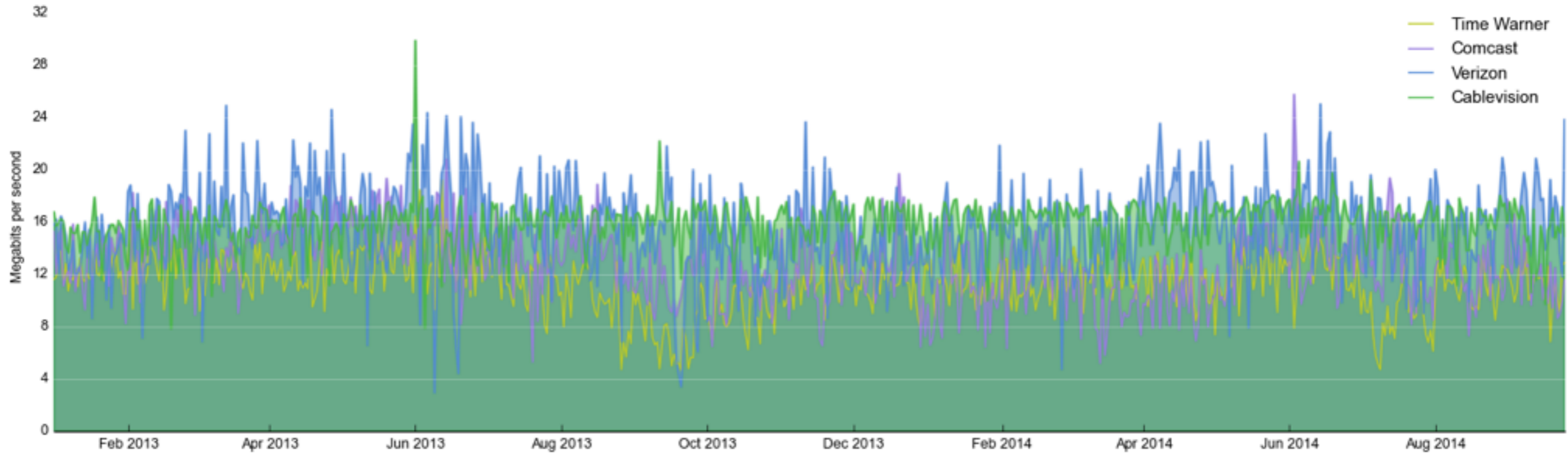




Sufficient Sample

The United States Constitutes
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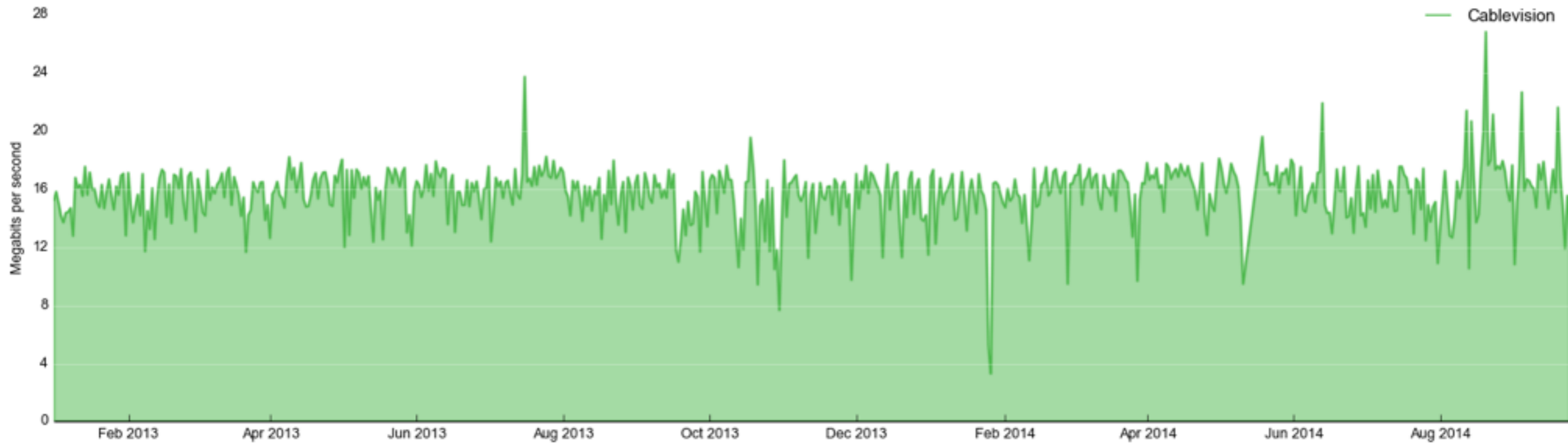
Median download throughput across Internap in NYC over time from different ISPs (higher is better)



Inferring Sources of
Congestion in Practice

Using New York's Comparison

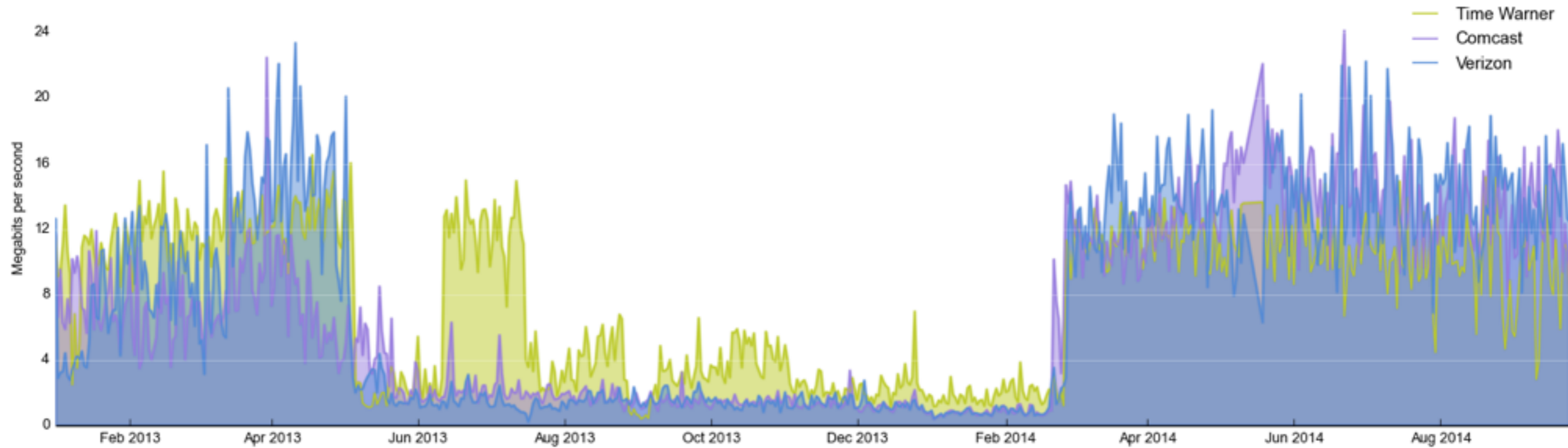
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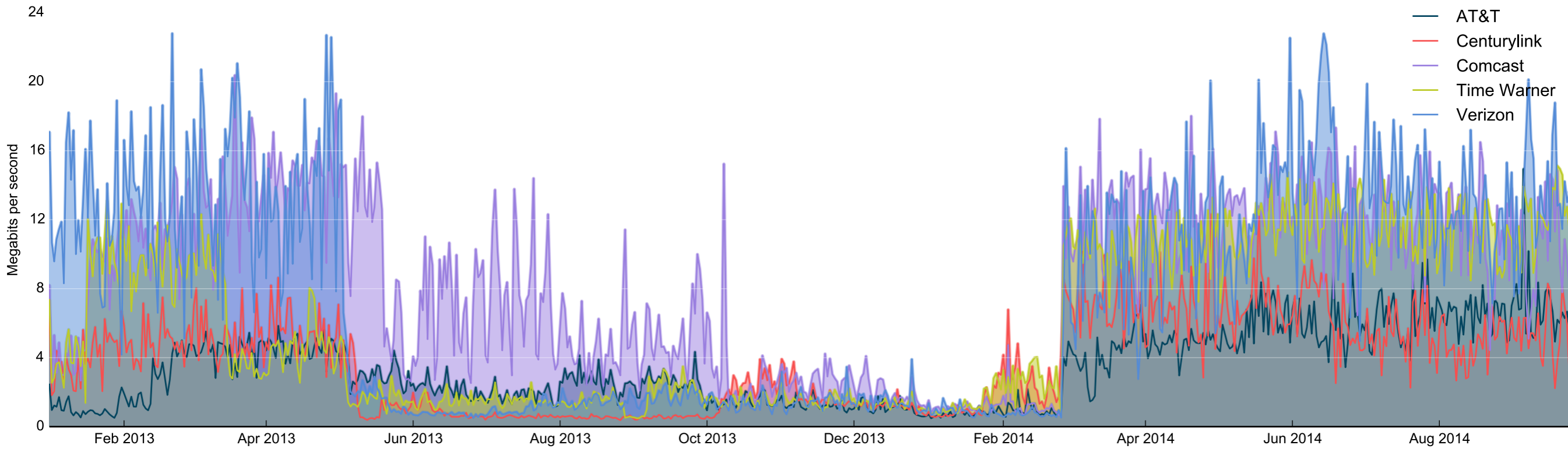
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Inferring Sources of
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US Access ISPs and Cogent (2013-2014)

Median download throughput across Cogent in LA over time from different ISPs (higher is better)

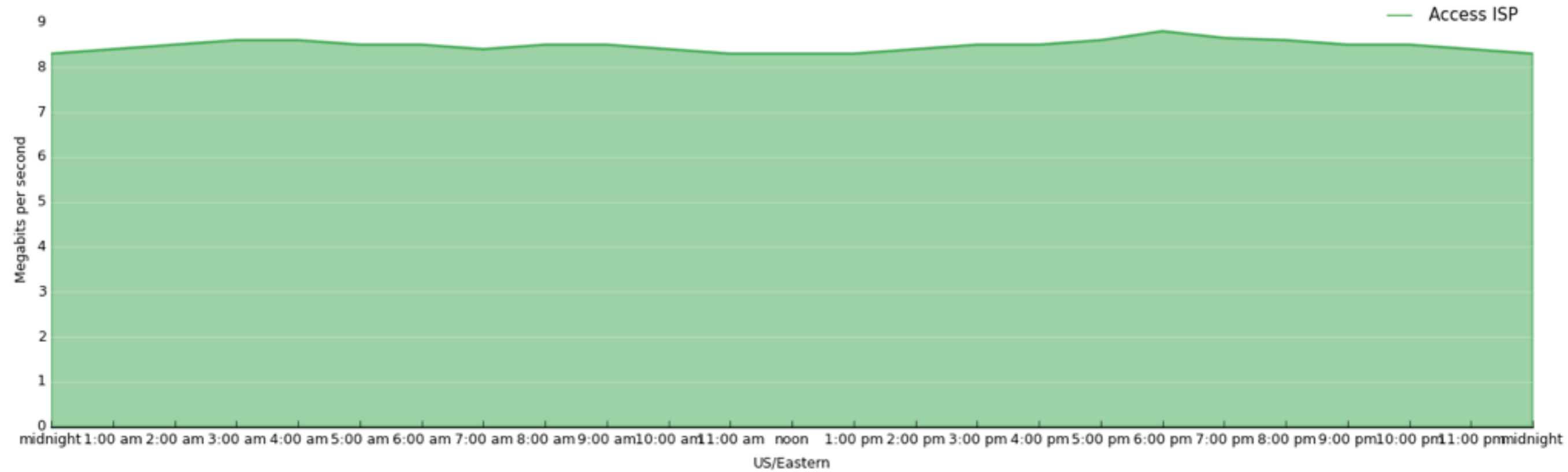


Inferring Sources of Congestion in Practice

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Internet Performance Varies Significantly
Throughout the Day and Across Interconnections

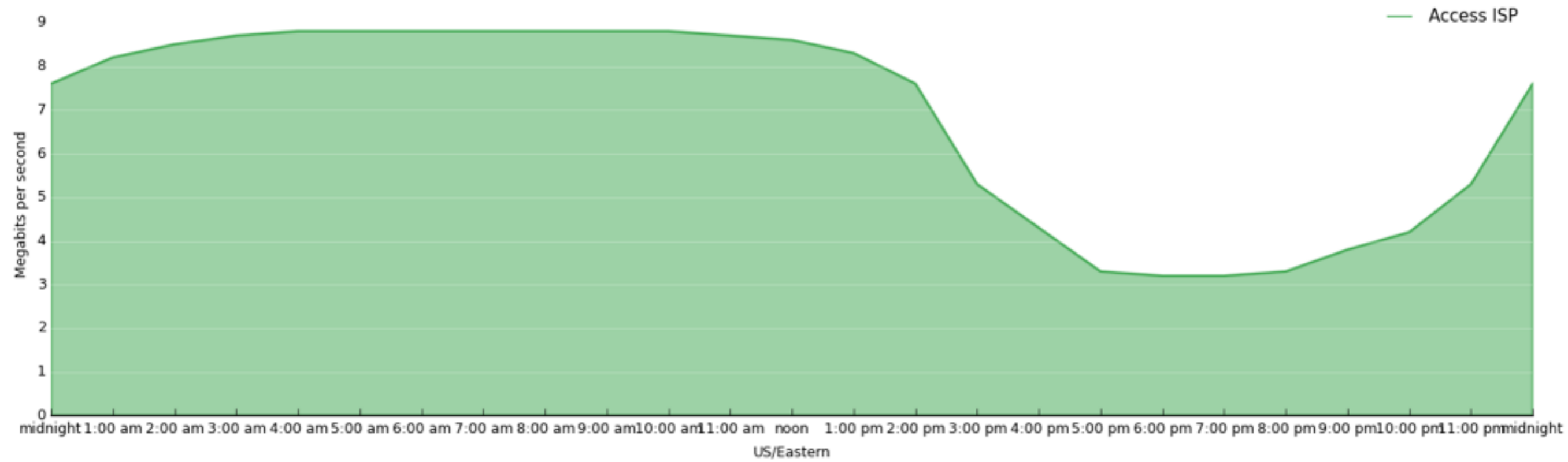
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Diurnal Patterns Are
Instructive

Expectations of Normal Performance

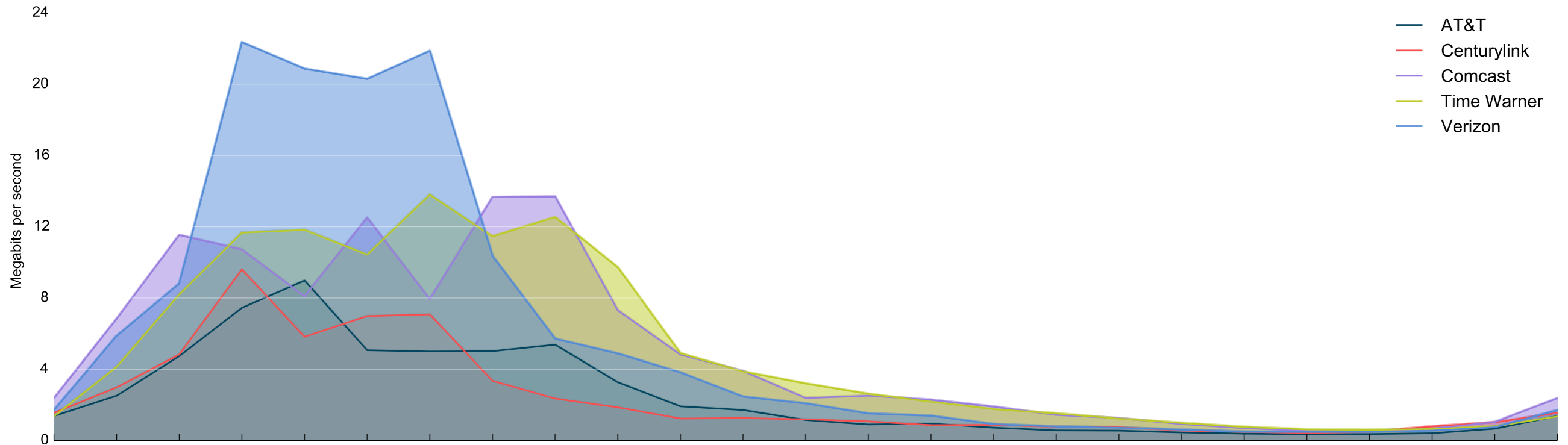
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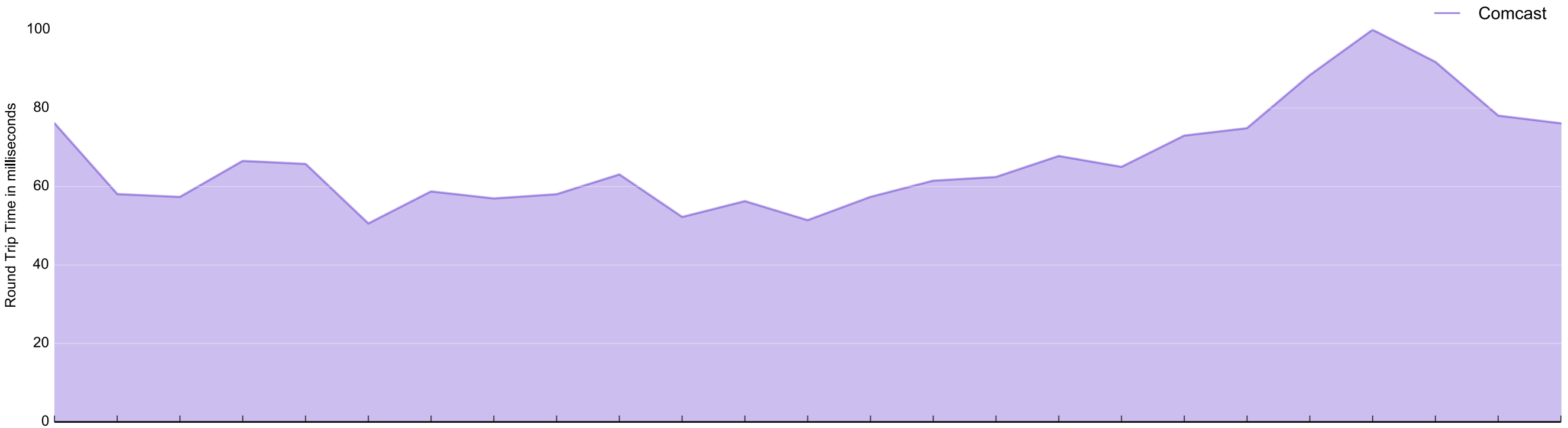
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Diurnal Cycles In Practice

Peak Hours, Peak Disruption

Median RTT during the average day in October 2013 between Level 3 and Comcast in Atlanta (lower is better)

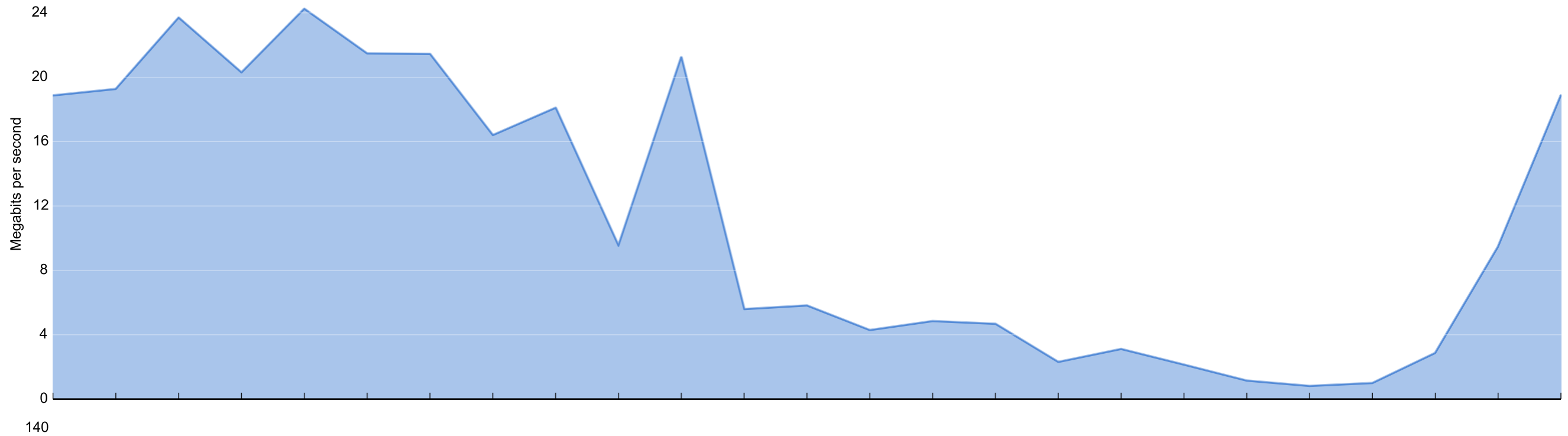


Not Limited to Throughput

Latency Sensitive Applications Affected

Median download throughput during the average day in February 2014 between Level 3 and Verizon in Chicago (higher is better)

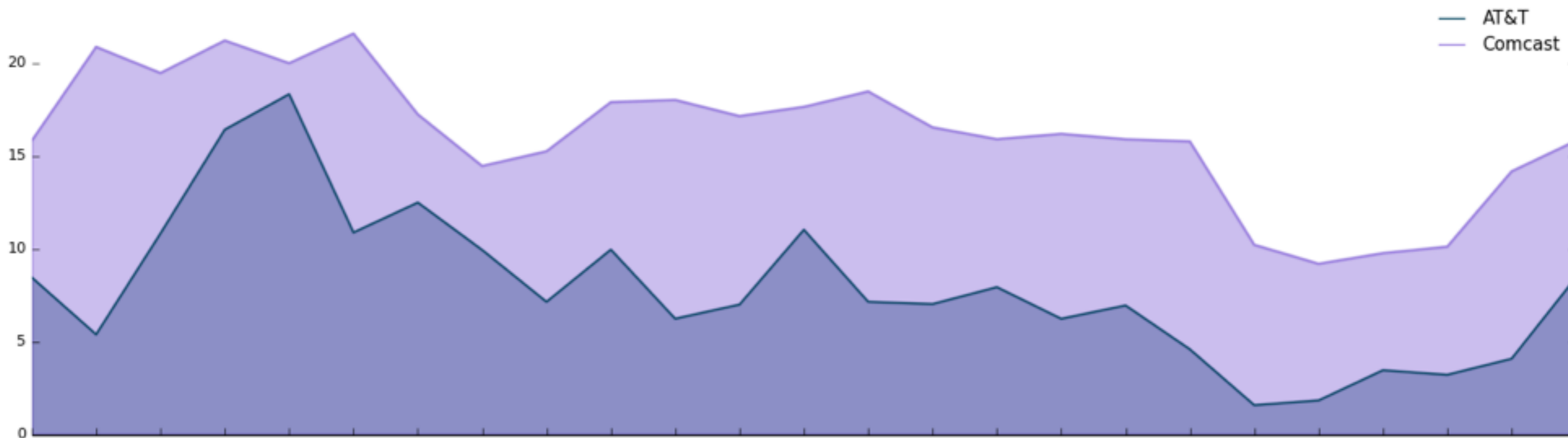
Verizon



Not Limited to One Transit Provider

Level 3 and Verizon

Median download throughput across XO in Washington D.C. for Fall 2014



Congestion is Continuing

Congestion as of Q4 2014

or customers of at&t:



Fine Grain Resolution

Interconnection Observation

prg01	Prague	CZ	50.0833	14.4
par01	Paris	FR	48.858391	2.349
ord05	Chicago_IL	US	41.9786	-87.9
ord04	Chicago_IL	US	41.9786	-87.9
ord03	Chicago_IL	US	41.9786	-87.9
ord02	Chicago	US	41.9786	-87.9
ord01	Chicago_IL	US	41.9786	-87.9
nuq1t	San Francisco Bay Area_CA	US	37.3833	-122
nuq06	San Francisco Bay Area_CA	US	37.3833	-122
nuq05	San Francisco Bay Area_CA	US	37.3833	-122
nuq04	San Francisco Bay Area_CA	US	37.3833	-122
nuq03	San Francisco Bay Area_CA	US	37.3833	-122
nuq02	San Francisco Bay Area_CA	US	37.3833	-122
nuq01	San Francisco Bay Area_CA	US	37.3833	-122
nbo01	Nairobi	KE	-1.319167	36.92
mnl01	Manila	PH	14.5086	121
mil01	Milan	IT	45.464	9.19
mia05	Miami_FL	US	25.7833	-80.2
mia04	Miami_FL	US	25.7833	-80.2
mia03	Miami_FL	US	25.7833	-80.2
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U.S. Deployments

Transit Perspectives

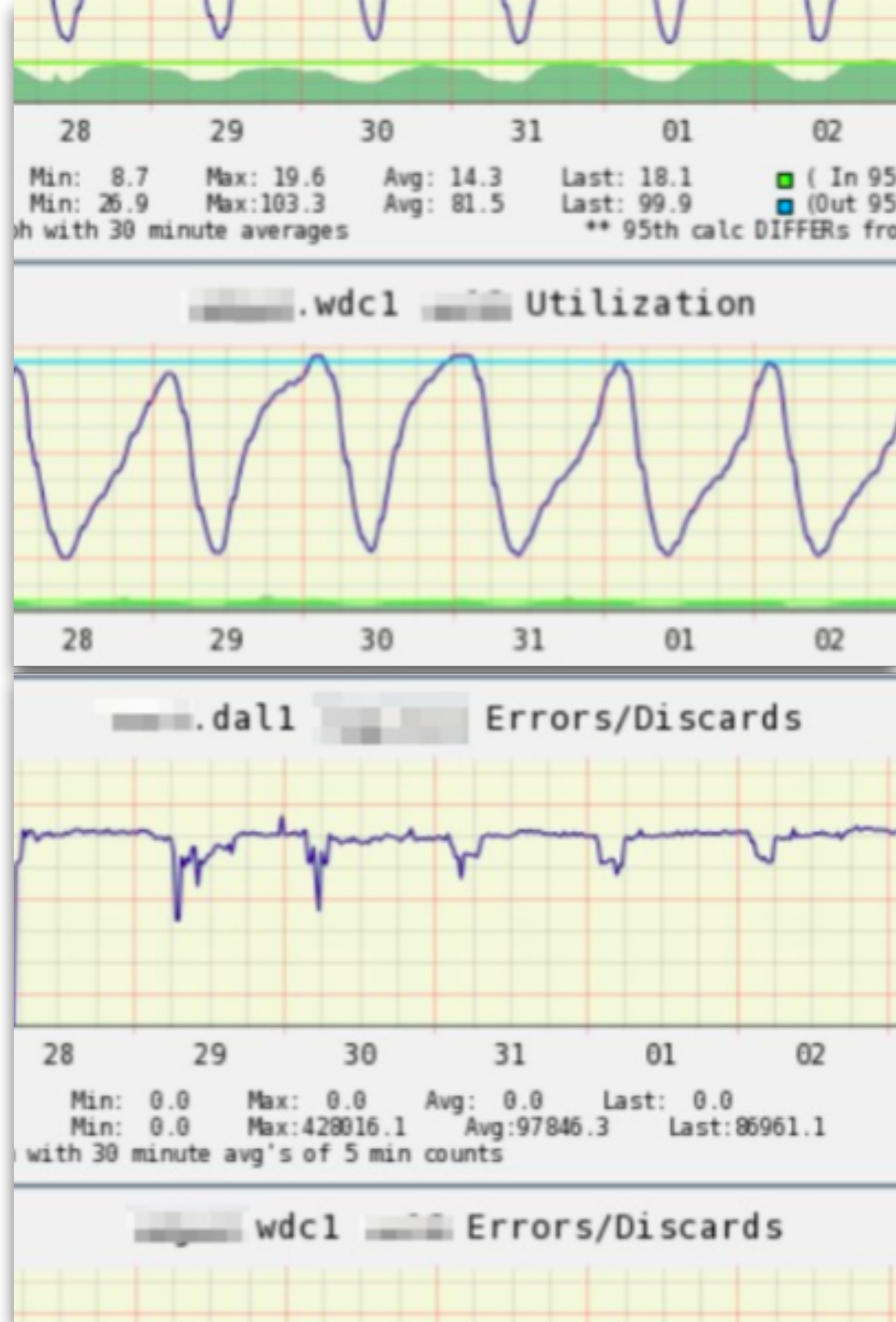
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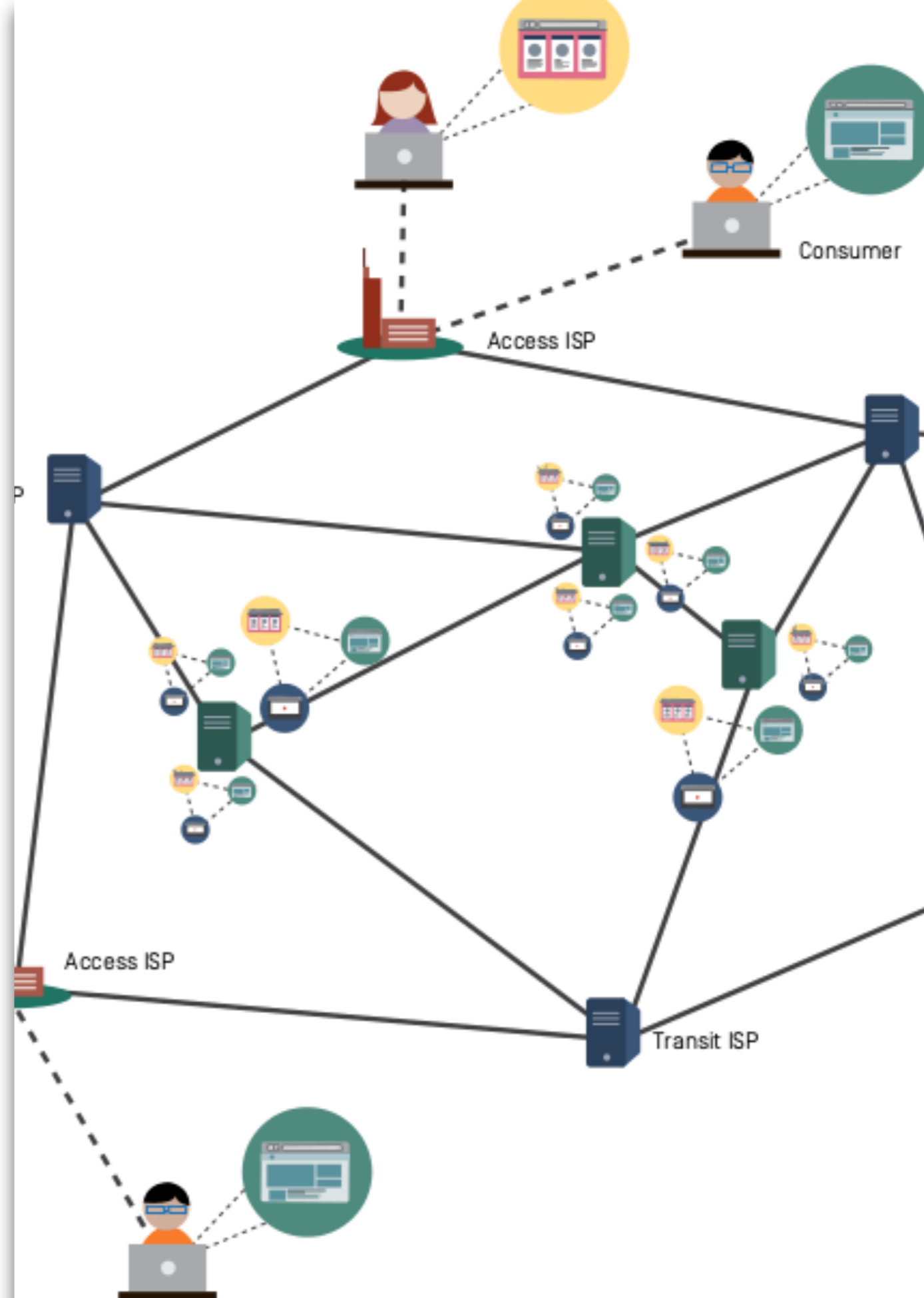
The Regulator's Problem

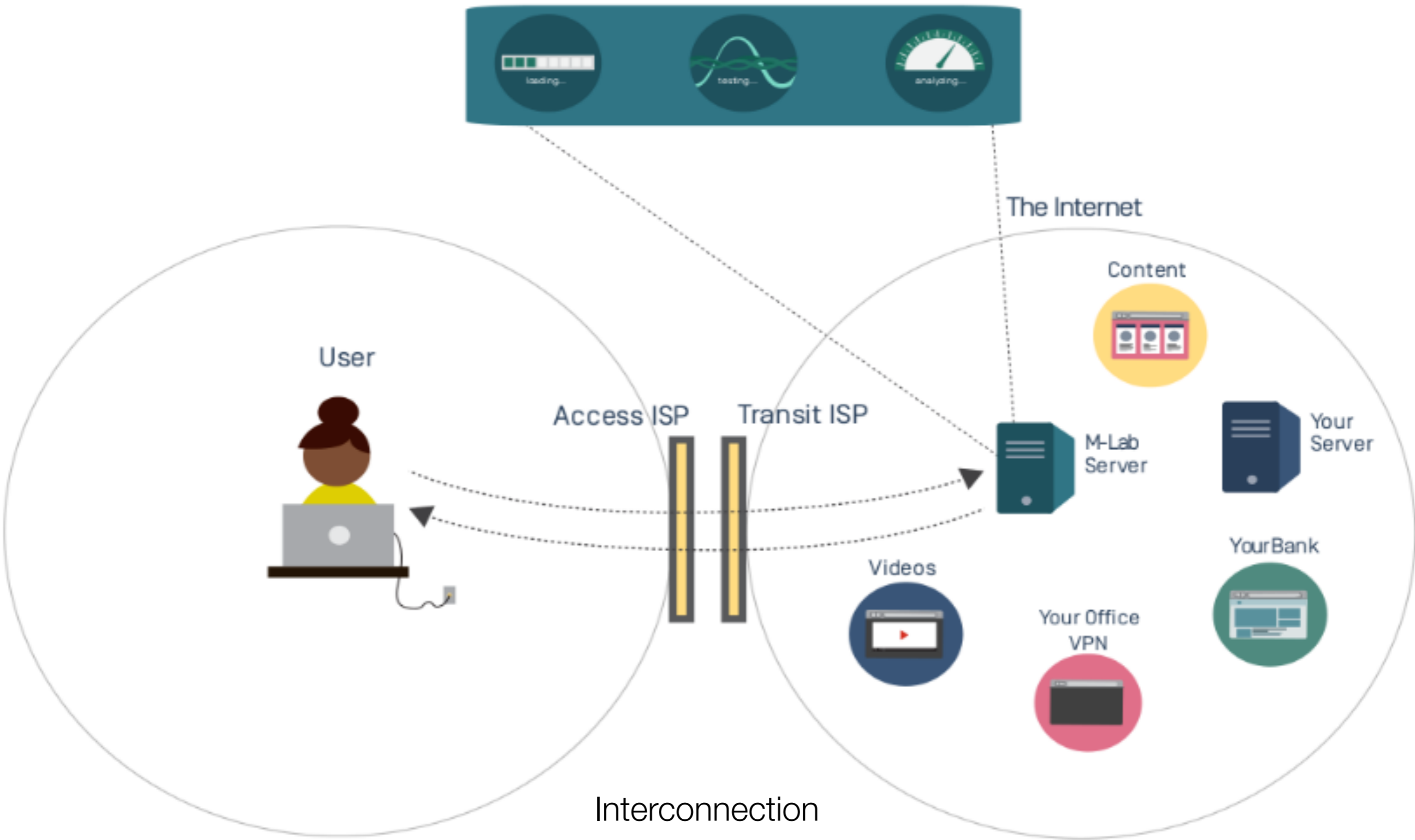
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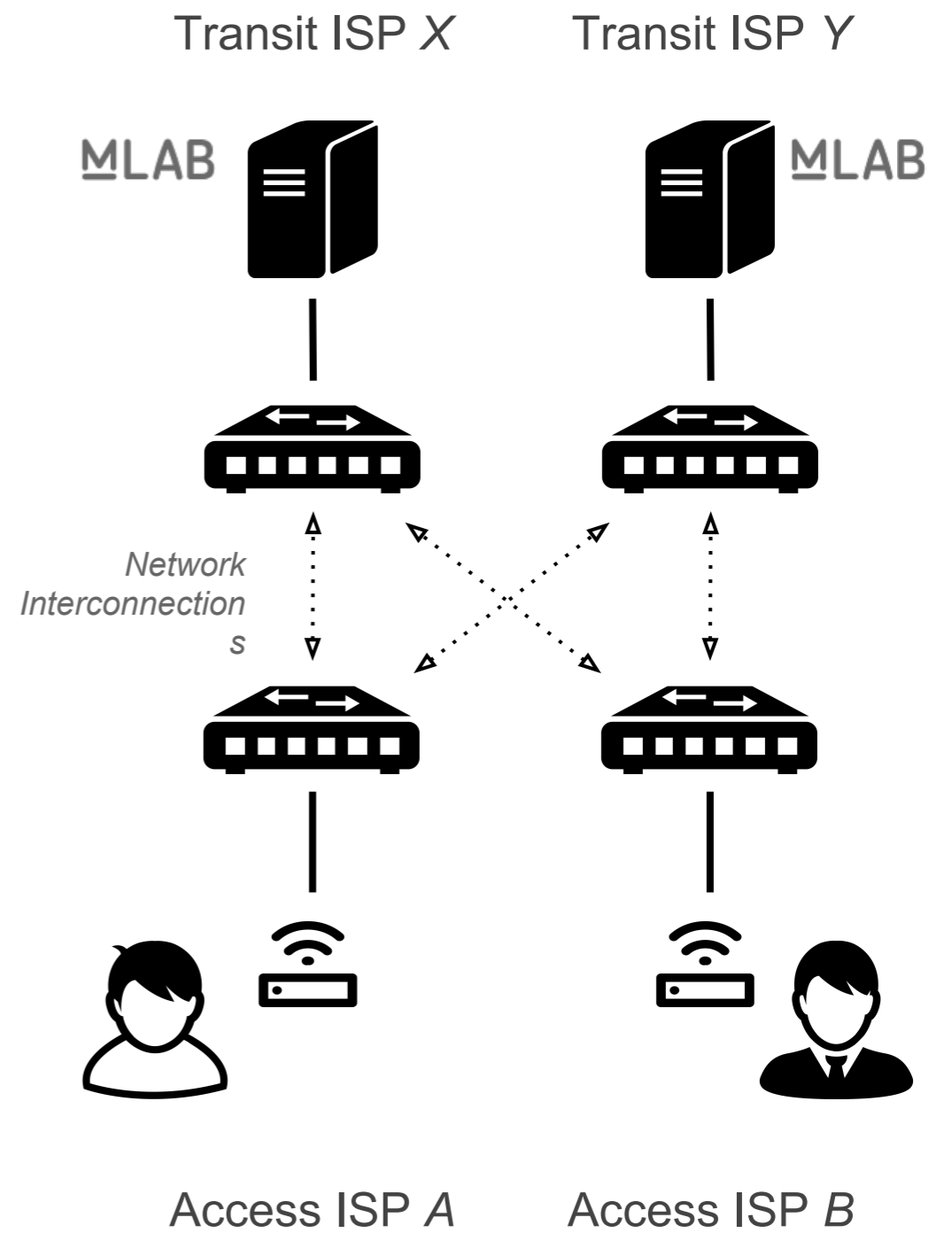


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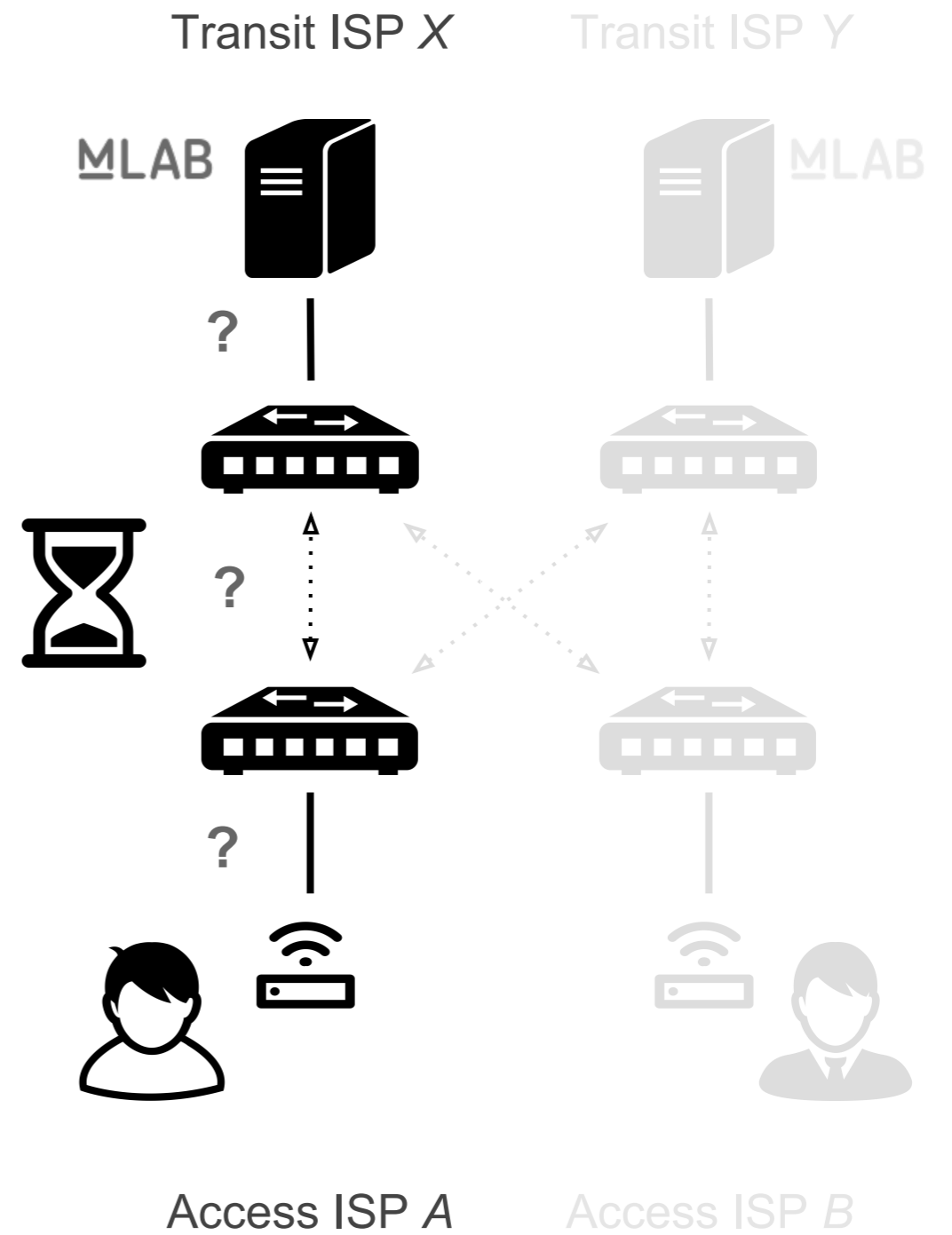
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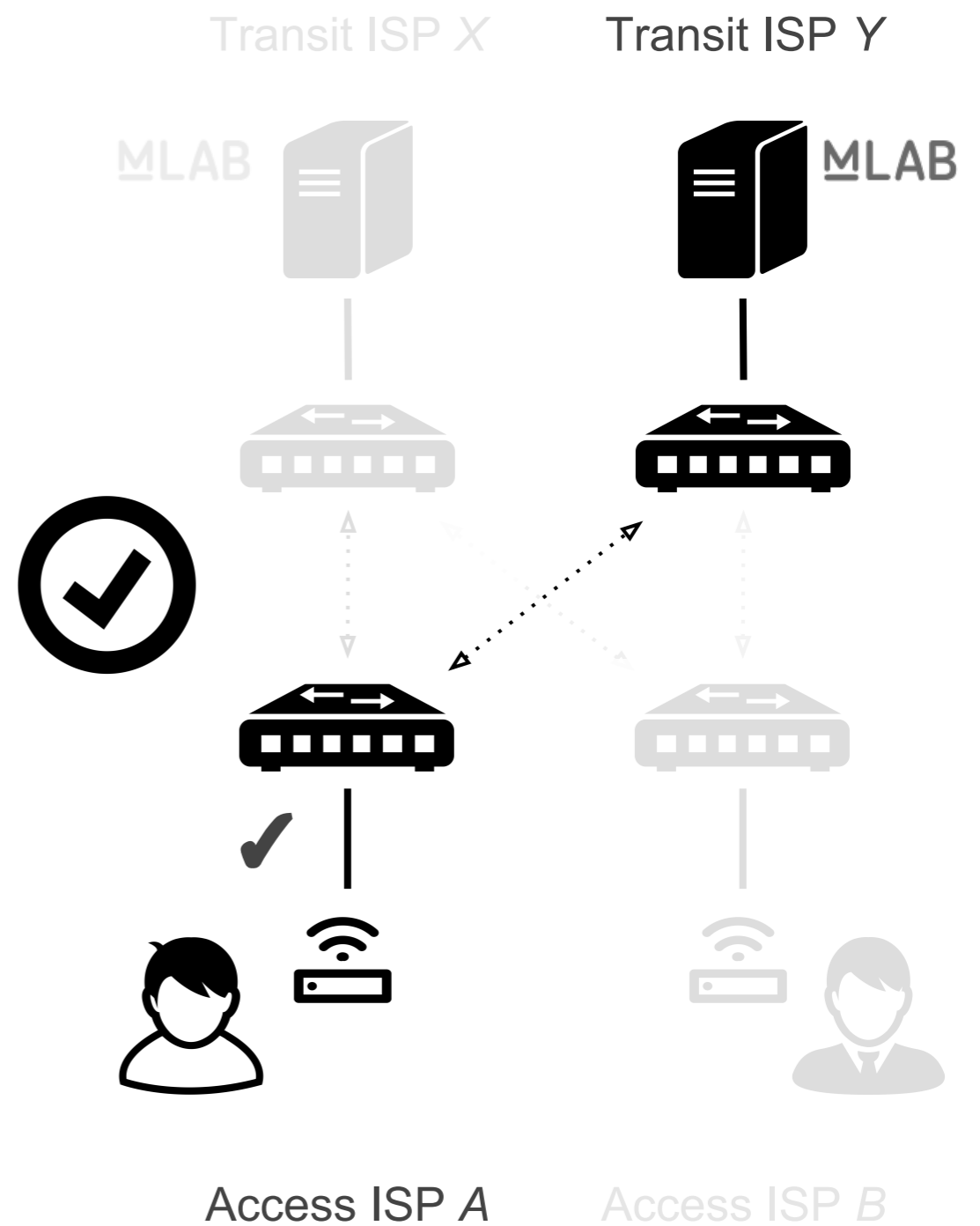
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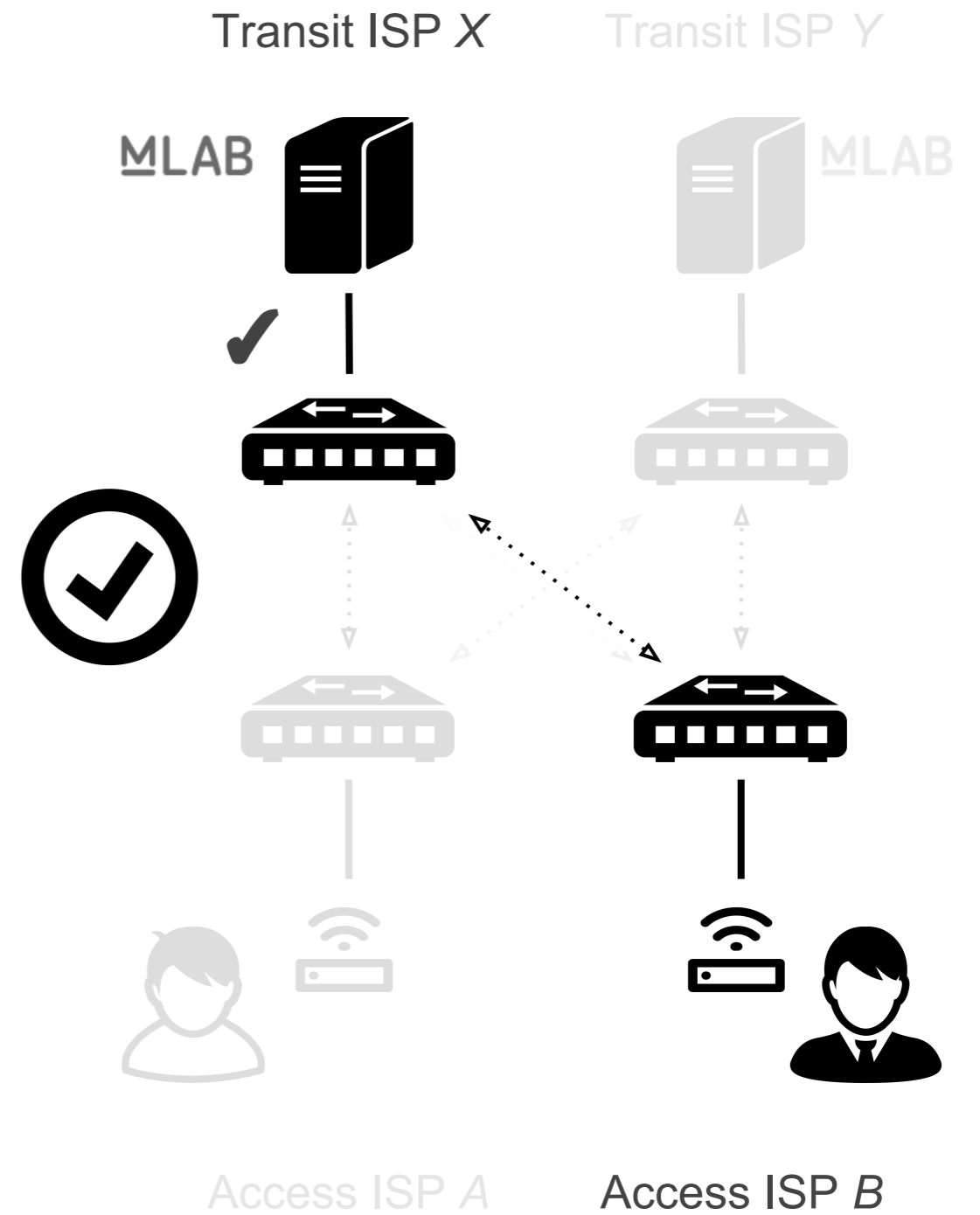
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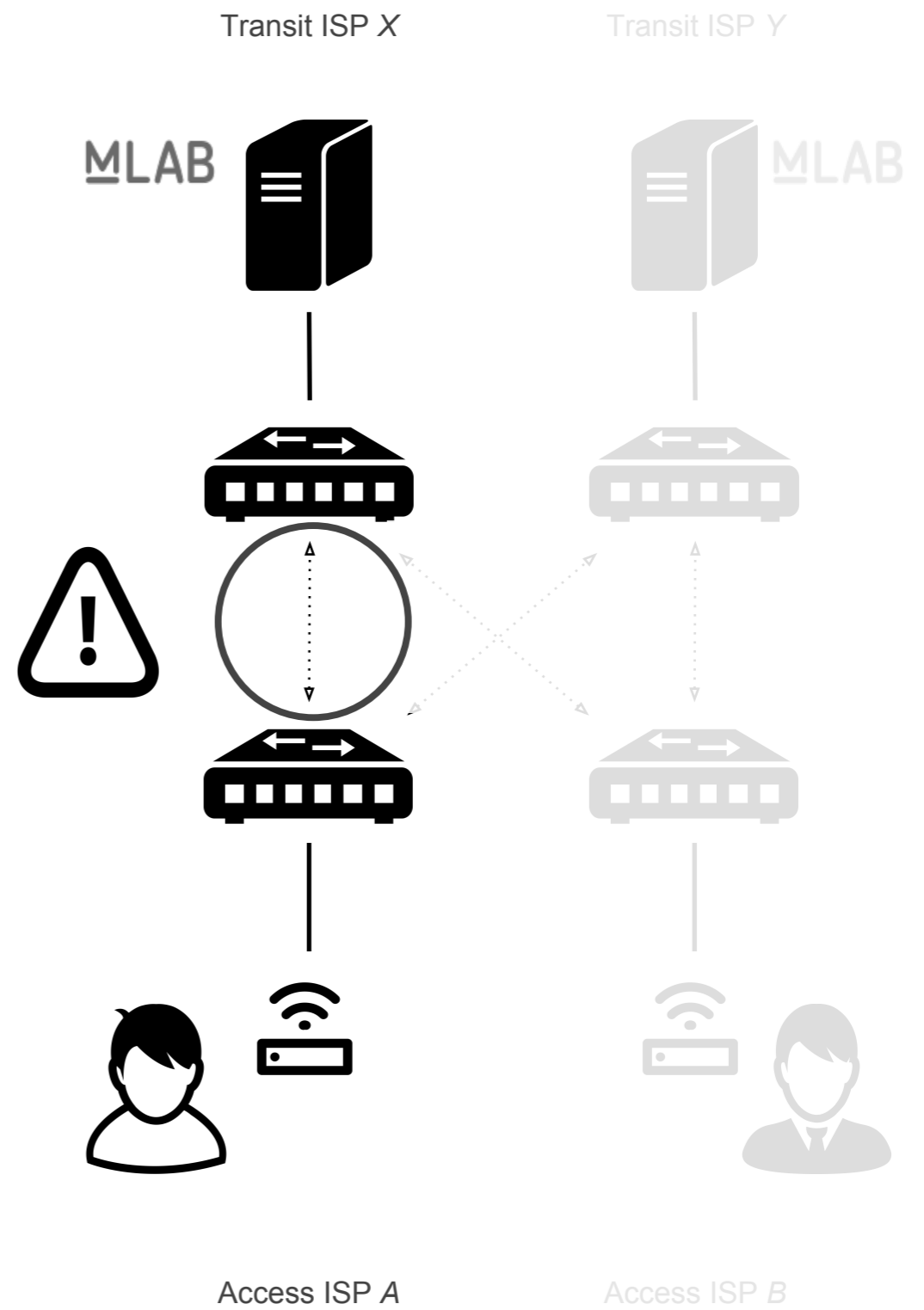
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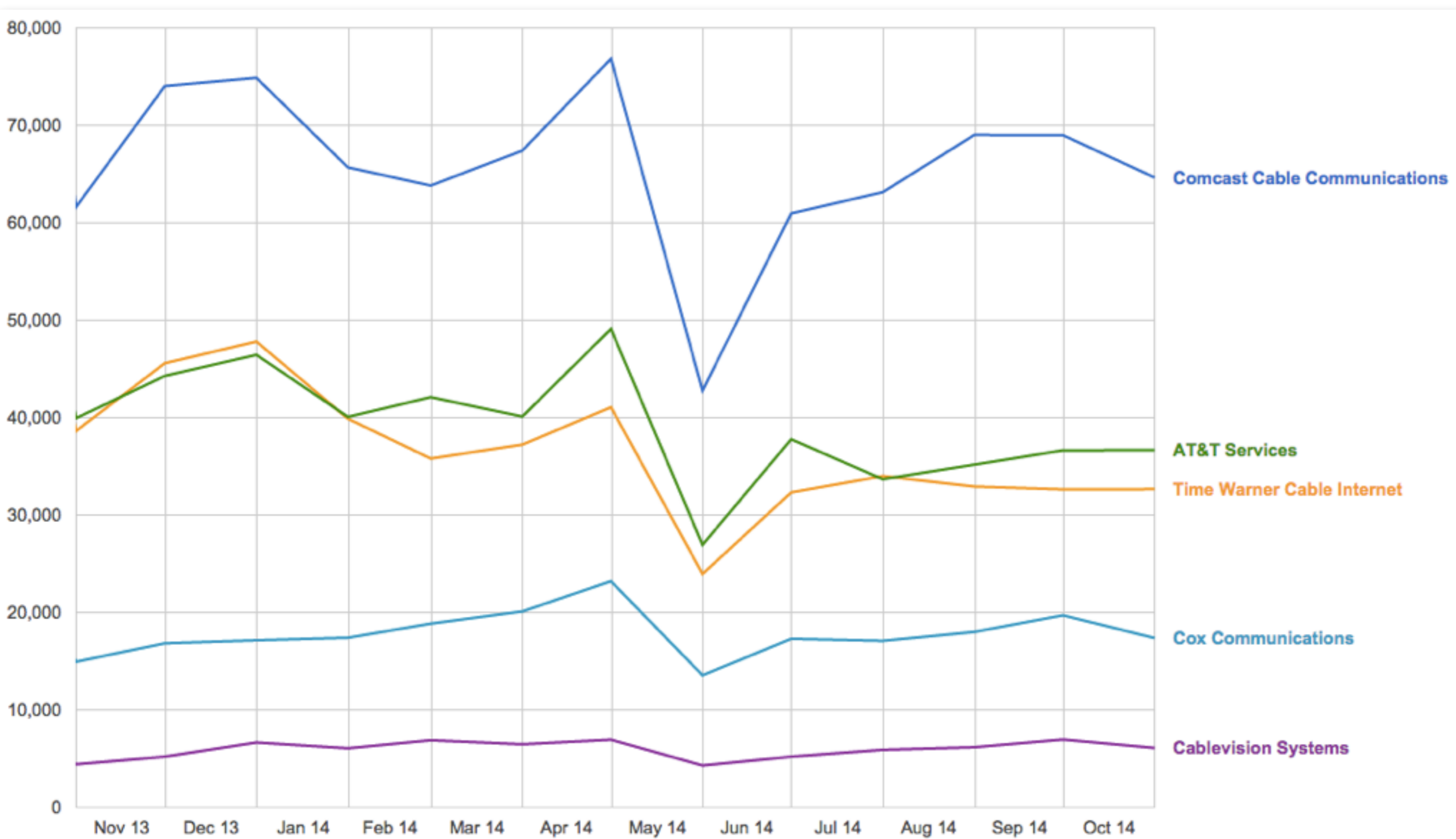
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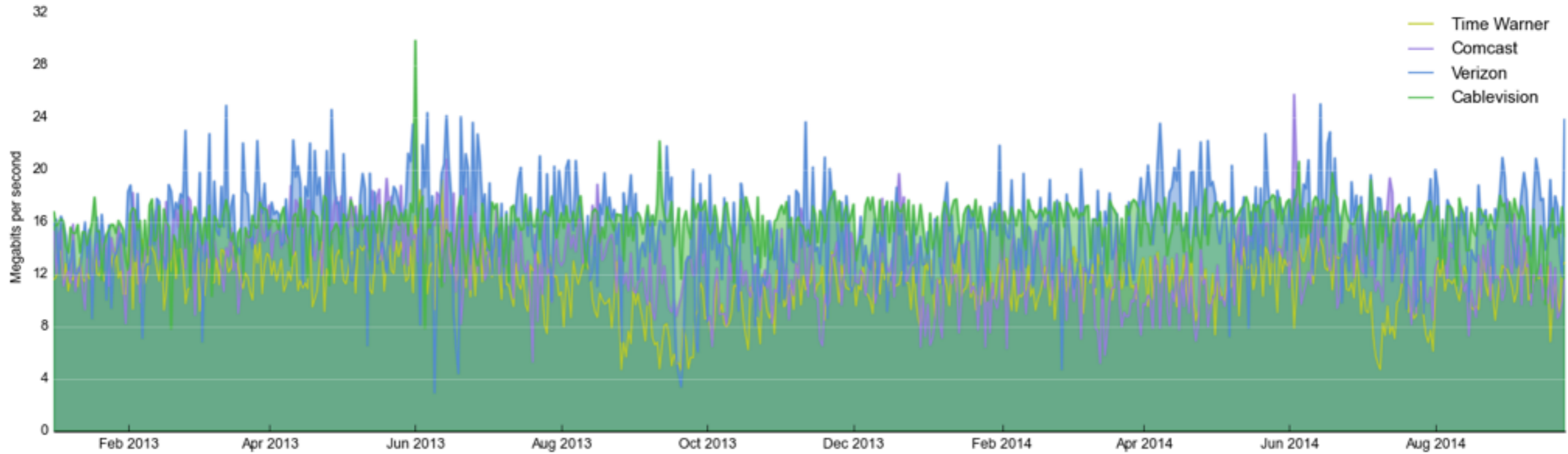




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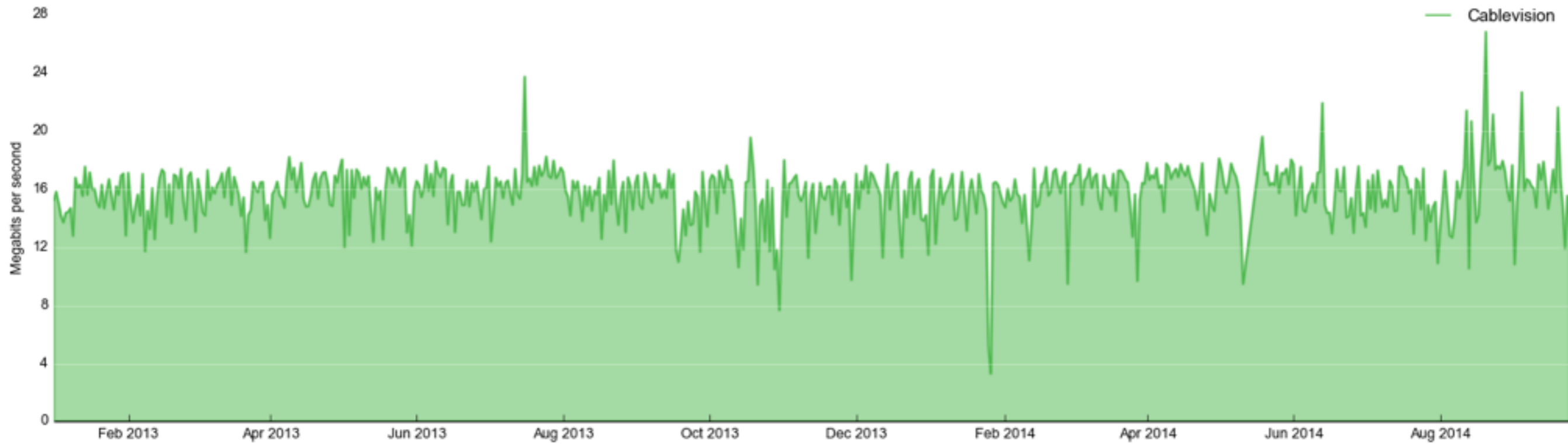
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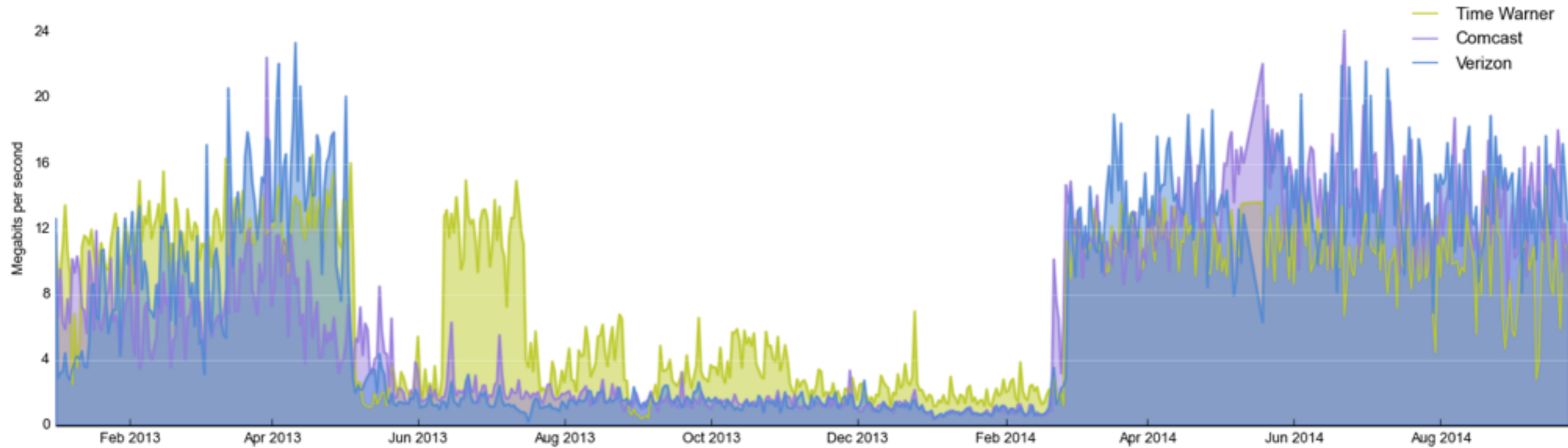
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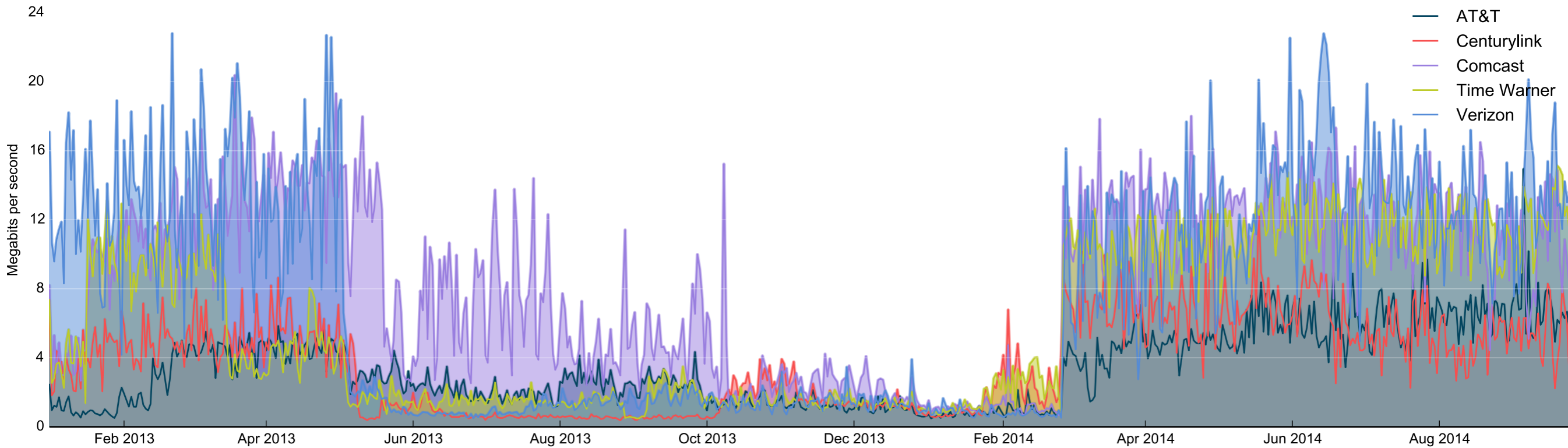
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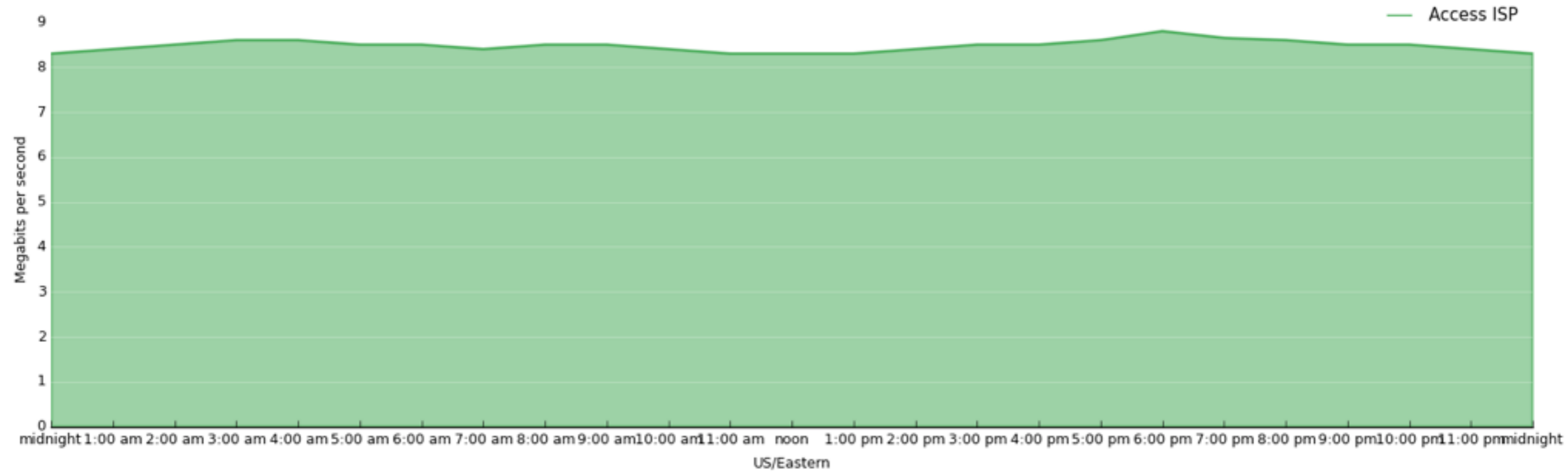


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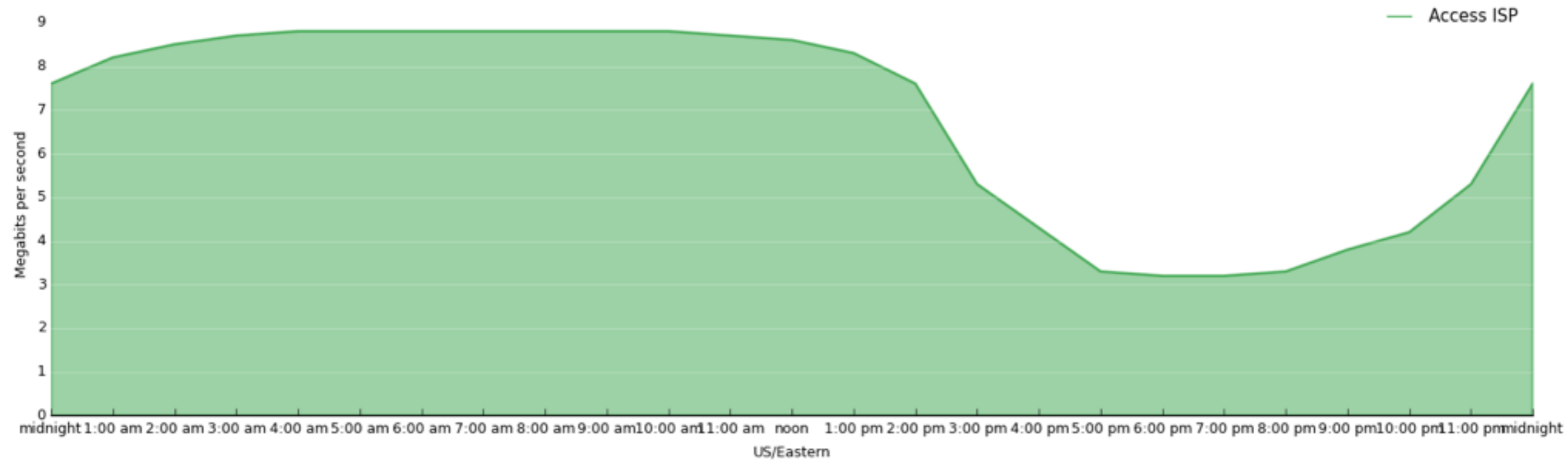
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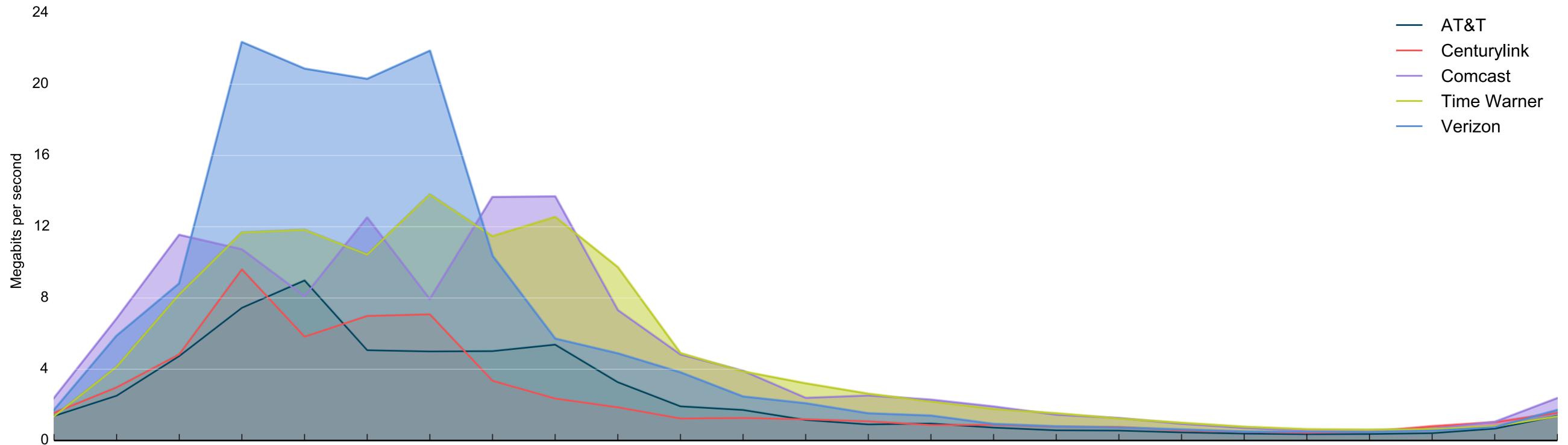
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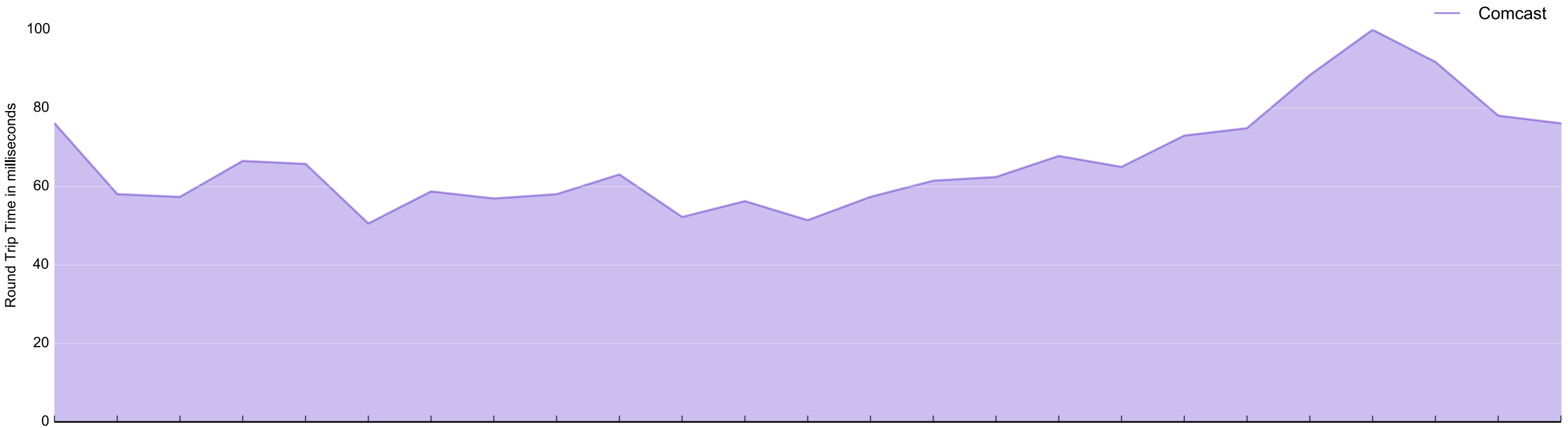
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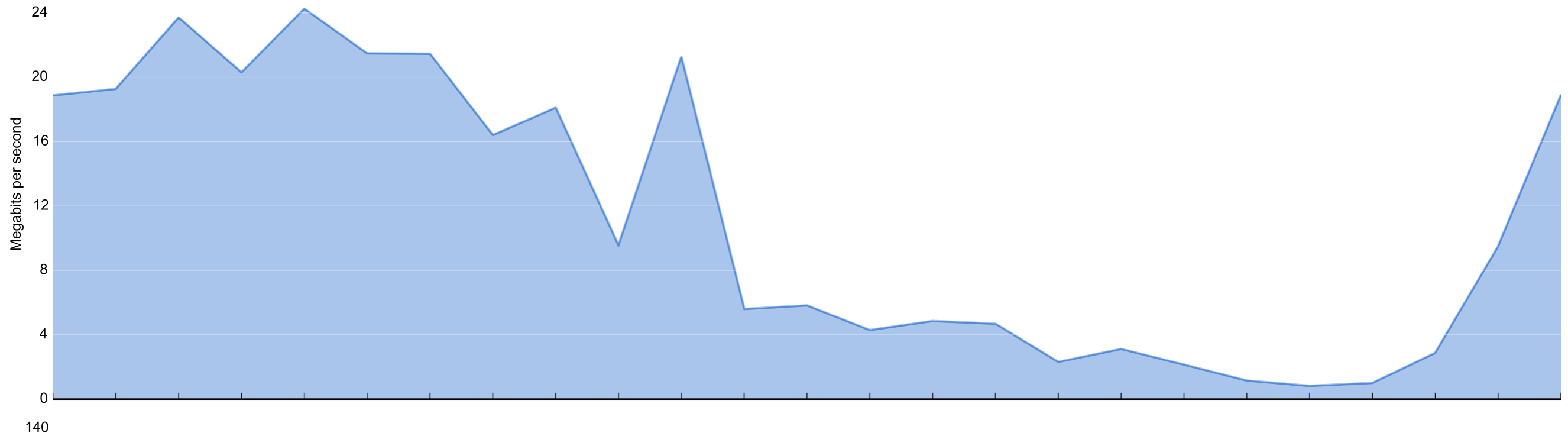


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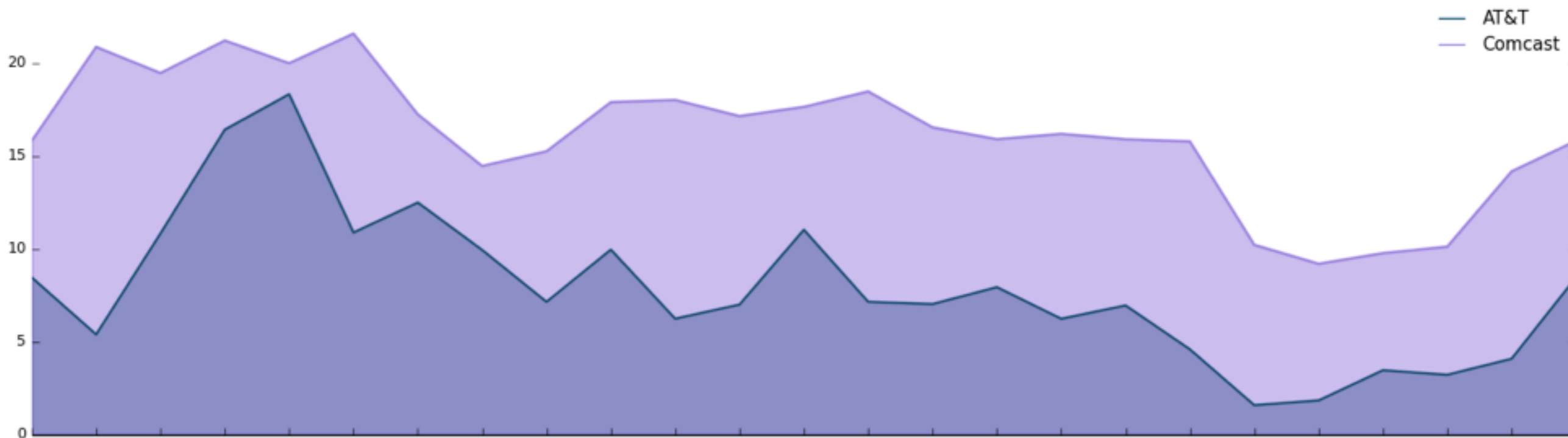
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