



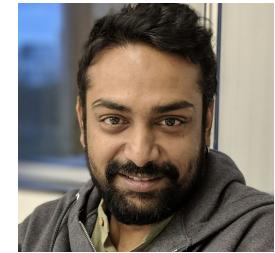
COVID-19 and Internet Traffic Stories

Jana Iyengar
jri@fastly.com

Who am I?

Jana Iyengar

Distinguished Engineer, Fastly



Work on networking and transport performance

Editor of IETF QUIC specs

Chair of IRTF Internet Congestion Control research group

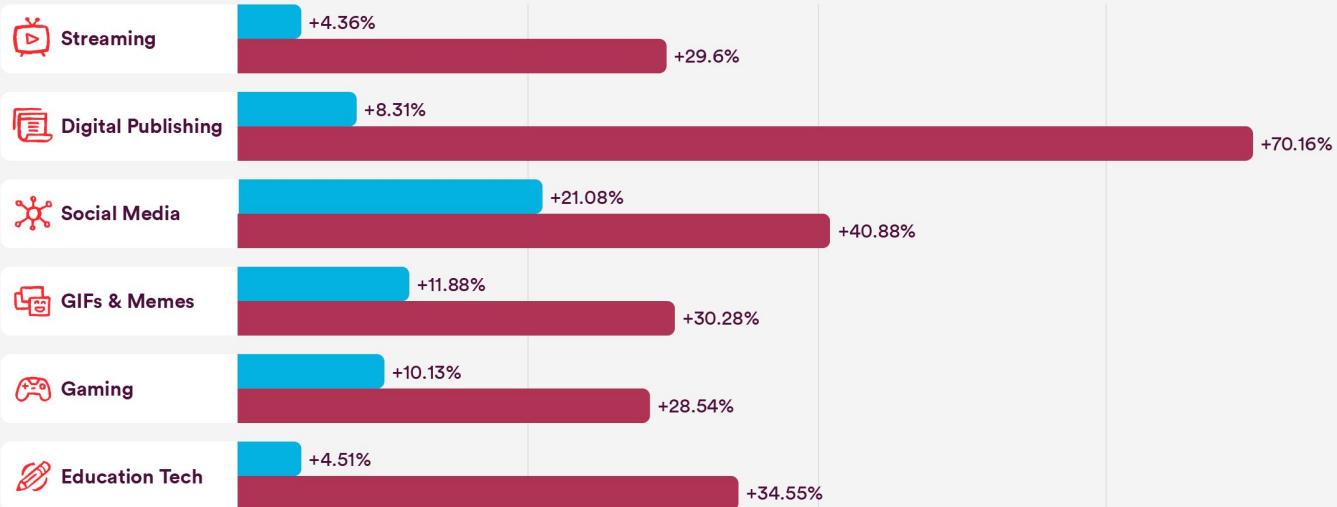
Working on transport since ~2000, on QUIC for 6 years

Traffic trends

Traffic Trends By Industry: Changes in Average Requests Per Second (RPS)

fastly

● PERCENTAGE CHANGE BETWEEN THE WEEK OF JAN 6-12 TO WEEK OF FEB 10-16 ● PERCENTAGE CHANGE BETWEEN THE WEEK OF FEB 10-16 TO WEEK OF MAR 23-29



COVID-19 and Internet Performance

Investigated two key metrics for nationwide traffic

also US state-level analysis

and by income-level

1. **changes in the traffic volume served to those regions**

as a reflection of changes in internet use

measured bytes of traffic

2. **changes in download speed measured at our servers**

as a reflection of internet quality

measured TCP delivery rate from tcp_info

Change between week in Feb and week in March

Country or State	Traffic Change	DL Speed Change
France	↑ 38.4%	↓ 13.9%
Italy	↑ 109.3%	↓ 35.4%
Japan	↑ 31.5%	↑ 9.7%
Spain	↑ 39.4%	↓ 8%
United Kingdom	↑ 78.6%	↓ 30.3%
USA - California	↑ 46.5%	↑ 1.2%
USA - Michigan	↑ 37.9%	↓ 16.1%
USA - New York & New Jersey	↑ 44.6%	↓ 5.5%

United Kingdom

CASES

DOWNLOAD SPEED CHANGE %

TRAFFIC CHANGE %



SOURCES

Significant dates on policy changes or announcements in each region were sourced from news and country, regional, state, and local announcements. The COVID Tracking Projects and 2019 Novel Coronavirus COVID-19 (2019-nCoV) Data Repository by Johns Hopkins CSSE informed the confirmed COVID-19 cases trajectory on the regional graphs.

Traffic & Download Speed: A Look at Internet Health

fastly

Italy

CASES

DOWNLOAD SPEED CHANGE %

TRAFFIC CHANGE %



SOURCES

Significant dates on policy changes or announcements in each region were sourced from news and country, regional, state, and local announcements. The COVID Tracking Projects and 2019 Novel Coronavirus COVID-19 (2019-nCoV) Data Repository by Johns Hopkins CSSE informed the confirmed COVID-19 cases trajectory on the regional graphs.

Traffic & Download Speed: A Look at Internet Health

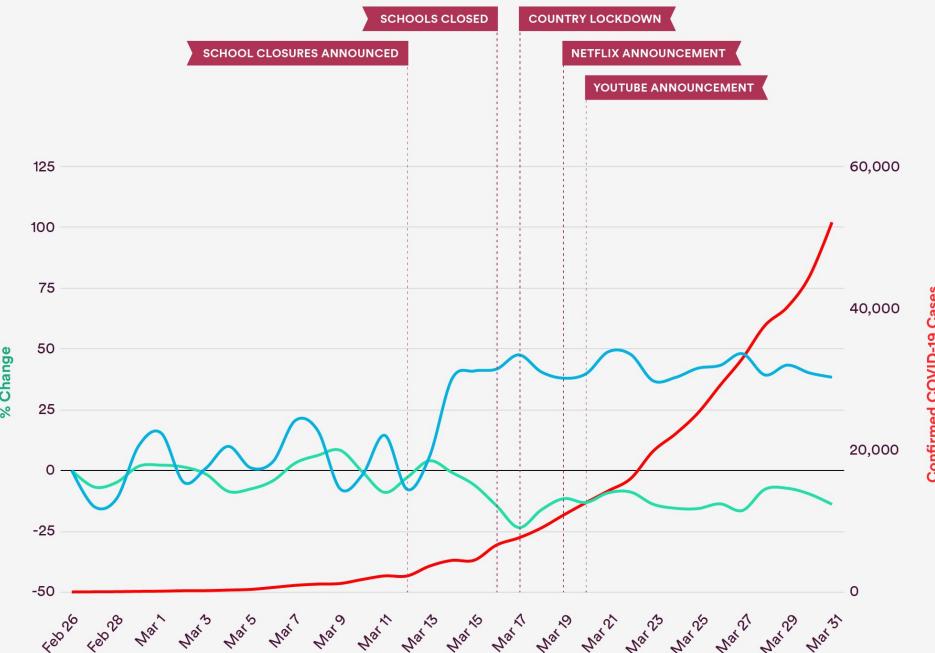
fastly

France

CASES

DOWNLOAD SPEED CHANGE %

TRAFFIC CHANGE %



SOURCES

Significant dates on policy changes or announcements in each region were sourced from news and country, regional, state, and local announcements. The COVID Tracking Projects and 2019 Novel Coronavirus COVID-19 (2019-nCoV) Data Repository by Johns Hopkins CSSE informed the confirmed COVID-19 cases trajectory on the regional graphs.

Traffic & Download Speed: A Look at Internet Health

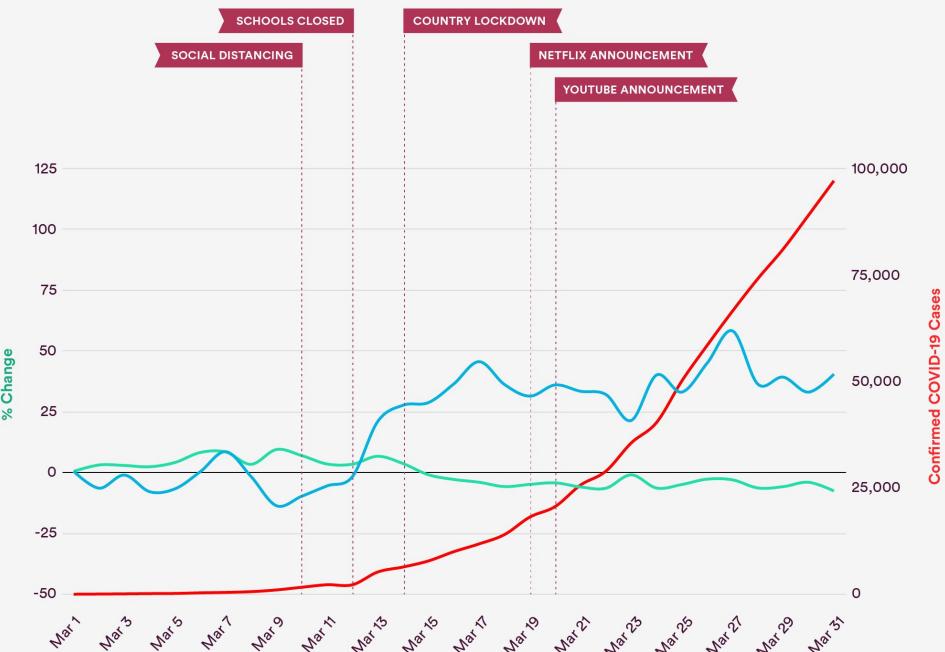
fastly

Spain

CASES

DOWNLOAD SPEED CHANGE %

TRAFFIC CHANGE %



SOURCES

Significant dates on policy changes or announcements in each region were sourced from news and country, regional, state, and local announcements. The COVID Tracking Projects and 2019 Novel Coronavirus COVID-19 (2019-nCoV) Data Repository by Johns Hopkins CSSE informed the confirmed COVID-19 cases trajectory on the regional graphs.

Traffic & Download Speed: A Look at Internet Health

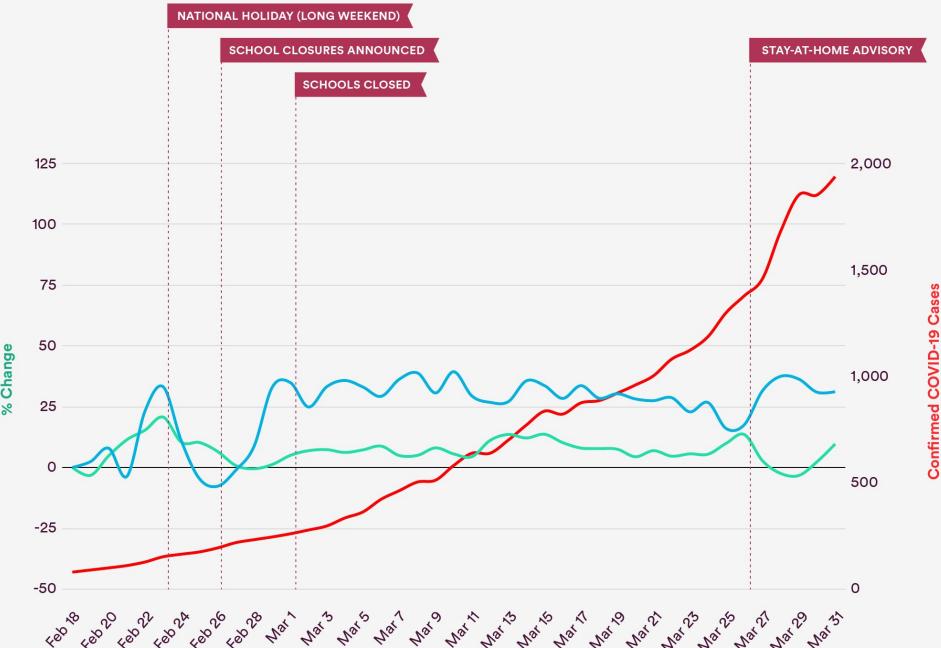
fastly

Japan

CASES

DOWNLOAD SPEED CHANGE %

TRAFFIC CHANGE %



SOURCES

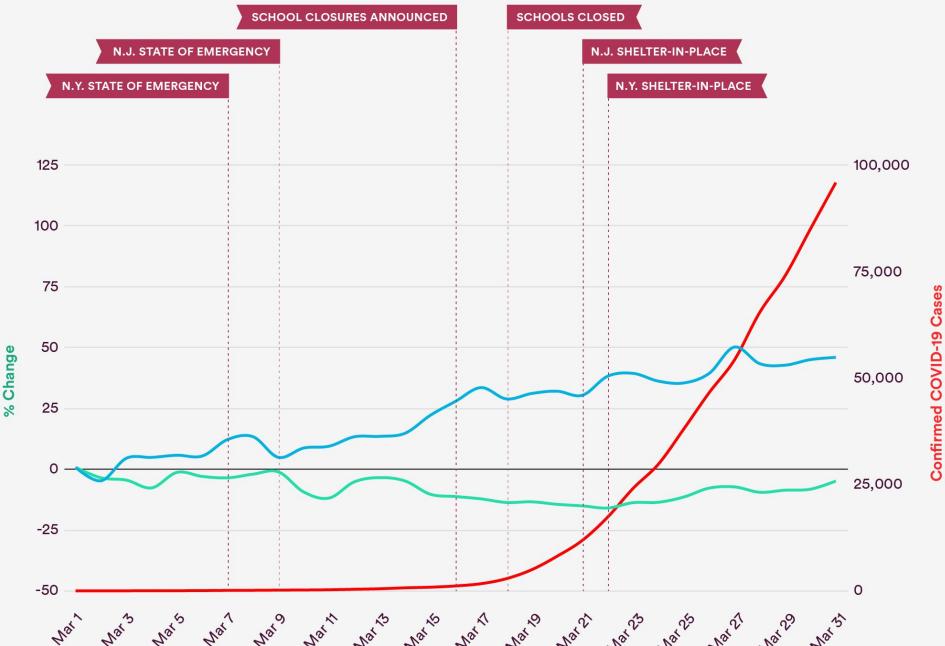
Significant dates on policy changes or announcements in each region were sourced from news and country, regional, state, and local announcements. The COVID Tracking Projects and 2019 Novel Coronavirus COVID-19 (2019-nCoV) Data Repository by Johns Hopkins CSSE informed the confirmed COVID-19 cases trajectory on the regional graphs.

New York & New Jersey

CASES

DOWNLOAD SPEED CHANGE %

TRAFFIC CHANGE %



SOURCES

Significant dates on policy changes or announcements in each region were sourced from news and country, regional, state, and local announcements. The COVID Tracking Projects and 2019 Novel Coronavirus COVID-19 (2019-nCoV) Data Repository by Johns Hopkins CSSE informed the confirmed COVID-19 cases trajectory on the regional graphs.

COVID-19 and Internet Performance

Traffic increases triggered by public policy announcements.

Quality degradation is more gradual, with homeward shift.

The line between weekdays and weekends has disappeared.

The internet has fared well thus far, thanks to elasticity.

Is everyone impacted equally?

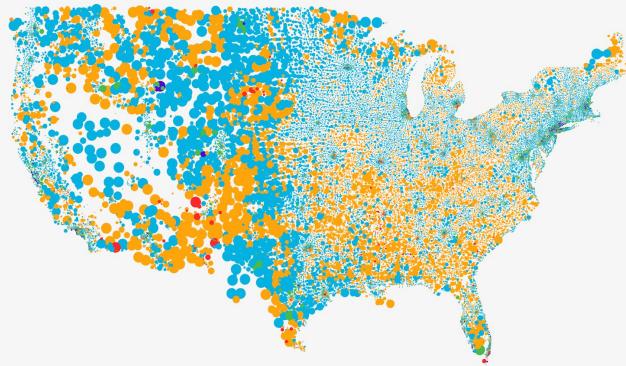
Set out to understand impact of COVID-19 on low-income families

Average income per ZIP Code in the U.S.

fastly

- LOWEST INCOME
Less than \$30,000
- LOW INCOME
\$30,000-\$49,999
- MEDIAN INCOME
\$50,000-\$99,999
- HIGH INCOME
\$100,000-\$199,999
- HIGHEST INCOME
\$200,000 and up

CONTINENTAL U.S.



ALASKA



HAWAII

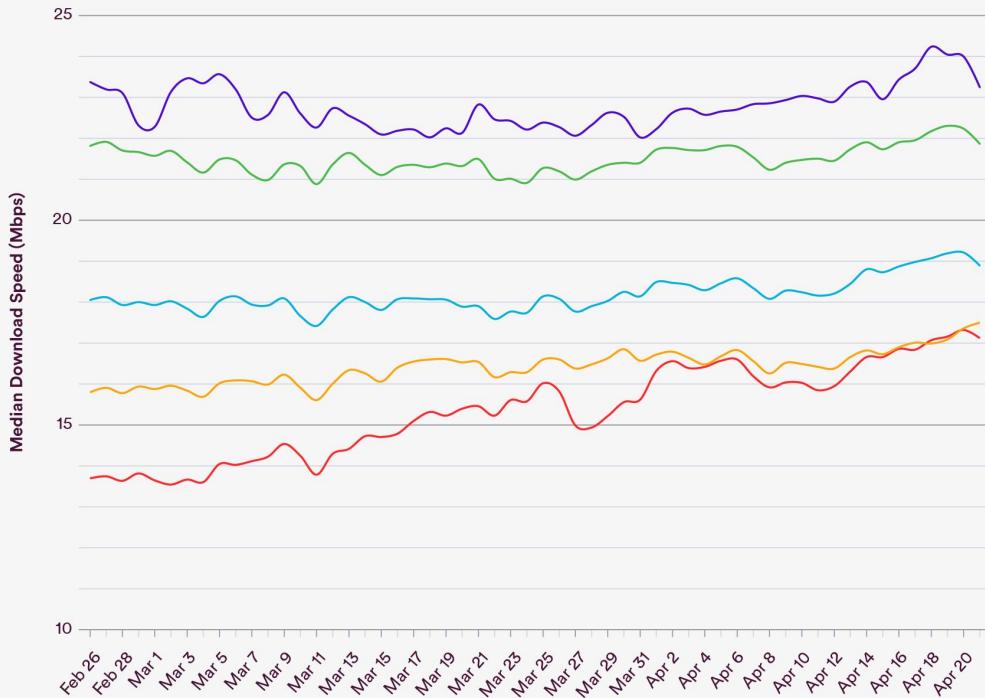


SOURCES & METHODOLOGY

Fastly referenced the average Adjusted Gross Income per return per zip code, from Internal Revenue Service data for 2017.

Median download speed by average income per ZIP Code in the U.S.

fastly



● HIGHEST INCOME
\$200,000 and up

● HIGH INCOME
\$100,000-\$199,999

● MEDIAN INCOME
\$50,000-\$99,999

● LOW INCOME
\$30,000-\$49,999

● LOWEST INCOME
Less than \$30,000

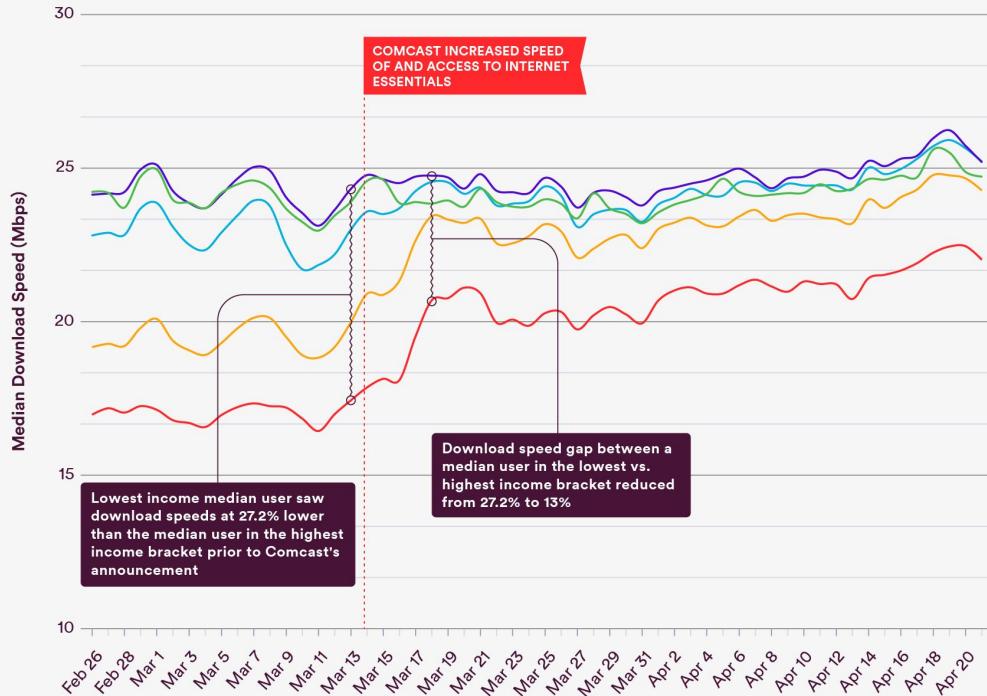
SOURCES & METHODOLOGY

Fastly referenced the average Adjusted Gross Income per return filed with the Internal Revenue Service's 2017 return data per ZIP code™. To calculate download speeds, Fastly used the TCP delivery rate (from `tcp_info`) measured at its servers, and filtered out connections from large organizations that were clearly not residential connections. Only large connections (more than 100KB transferred) were considered, as well as the top and bottom five percentiles of delivery rate samples to discard outliers coming from estimation errors, night time usage, and from any non-residential connections left in the dataset. Fastly classified the resulting connections into the five income groups based on the ZIP code they originated from.

ISPs can help address the digital divide

fastly.

Comcast median download speeds by income



HIGHEST INCOME
\$200,000 and up

HIGH INCOME
\$100,000–\$199,999

MEDIAN INCOME
\$50,000–\$99,999

LOW INCOME
\$30,000–\$49,999

LOWEST INCOME
Less than \$30,000

SOURCES & METHODOLOGY

Fastly referenced the average Adjusted Gross Income per return filed with the Internal Revenue Service's 2017 return data per ZIP code™. To calculate download speeds, Fastly used the TCP delivery rate (from `tcp_info`) measured at its servers, and filtered out connections from large organizations that were clearly not residential connections. Only large connections (more than 100KB transferred) were considered, as well as the top and bottom five percentiles of delivery rate samples to discard outliers coming from estimation errors, night time usage, and from any non-residential connections left in the dataset. Fastly classified the resulting connections into the five income groups based on the ZIP code they originated from.

Fastly referenced Comcast's announcement on March 14:
<https://corporate.comcast.com/press-releases/internet-essentials-low-income-broadband-coronavirus-pandemic>

ISPs can help address the digital divide

fastly.

Cox Communications median download speed by income



COVID-19 and Internet Performance

More equitable distribution is possible.

ISPs have the power and ability to close the digital divide in a meaningful way.

<https://www.fastly.com/blog/how-covid-19-is-affecting-internet-performance>

<https://www.fastly.com/blog/digital-divide>