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Lockdown Effect on Internet Traffic

Gergana Petrova | 26 January 2021 | Roundtable Meeting for Governments

Internet Traffic



- Patterns of human behaviour influence traffic
- Increasing number of events with a disproportionate effect on traffic
 - (e.g. launch of popular games or series episodes, sports matches, OS updates)
- Network operators have redundancies (reserve capacity) to handle peak demand

Study 1



arXiv:2005.06127v2 [cs.NI] 20 Aug 2020

Impact of the COVID-19 pandemic on the Internet latency: a large-scale study

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Abstract

The COVID-19 pandemic dramatically changed the way of living of billions of people in a very short time frame. In this paper, we evaluate the impact on the Internet latency caused by the increased amount of human activities that are carried out on-line. The study focuses on Italy, which experienced significant restrictions imposed by local authorities, but results about Spain, France, Germany, Sweden, and the whole of Europe are also included. The analysis of a large set of measurements shows that the impact on the network can be significant, especially in terms of increased variability of latency. In Italy we observed that the standard deviation of the average additional delay – the additional time with respect to the minimum delay of the paths in the region – during lockdown is $\sim 3 - 4$ times as much as the value before the pandemic. Similarly, in Italy, packet loss is $\sim 2 - 3$ times as much as before the pandemic. The impact is not negligible also for the other countries and for the whole of Europe, but with different levels and distinct patterns.

Keywords: Internet measurements, COVID-19, Latency

1. Introduction

At the time of writing, the coronavirus disease (COVID-19) pandemic is still ongoing and billions of people are under some form of lockdown. The restrictions faced by citizens are more or less stringent, depending on the resolutions adopted by the different governments, but in many cases non-essential activities have been shut down and a large fraction of people is confined at their homes. Many activities that are normally carried out in physical presence are now taking place on-line. As a consequence, the amount of traffic on the Internet increased significantly during the last months.

In this paper, we analyze the impact of the COVID-19 pandemic on the latency of the Internet. Latency is one of the major properties of the network and it is becoming every day more important, as several Internet applications are particularly sensitive to its fluctuations. Examples include on-line videogames [1, 2], video calls, VOIP [3], and IP geolocation [4, 5, 6]. We analyzed a large set of measurements, collected by means of the RIPE Atlas platform [7], to better understand the effects on the network caused by this major change in the way we live.

The analysis focuses on Italy which, in April 2020, has been under lockdown for more than a month, experiencing some of the strictest limitations enforced by authorities: all schools, universities, and non-essential shops are physically closed, and people are authorized to leave their homes only for undeferrable necessities. Distance learning and remote working were applied whenever possible, with a significant increase in usage of virtual-meeting and video-conference applications [8, 9]. Table 1 summarizes the most important events which could have had an impact on the Italian Internet latency. As can be noticed, limitations to citizens

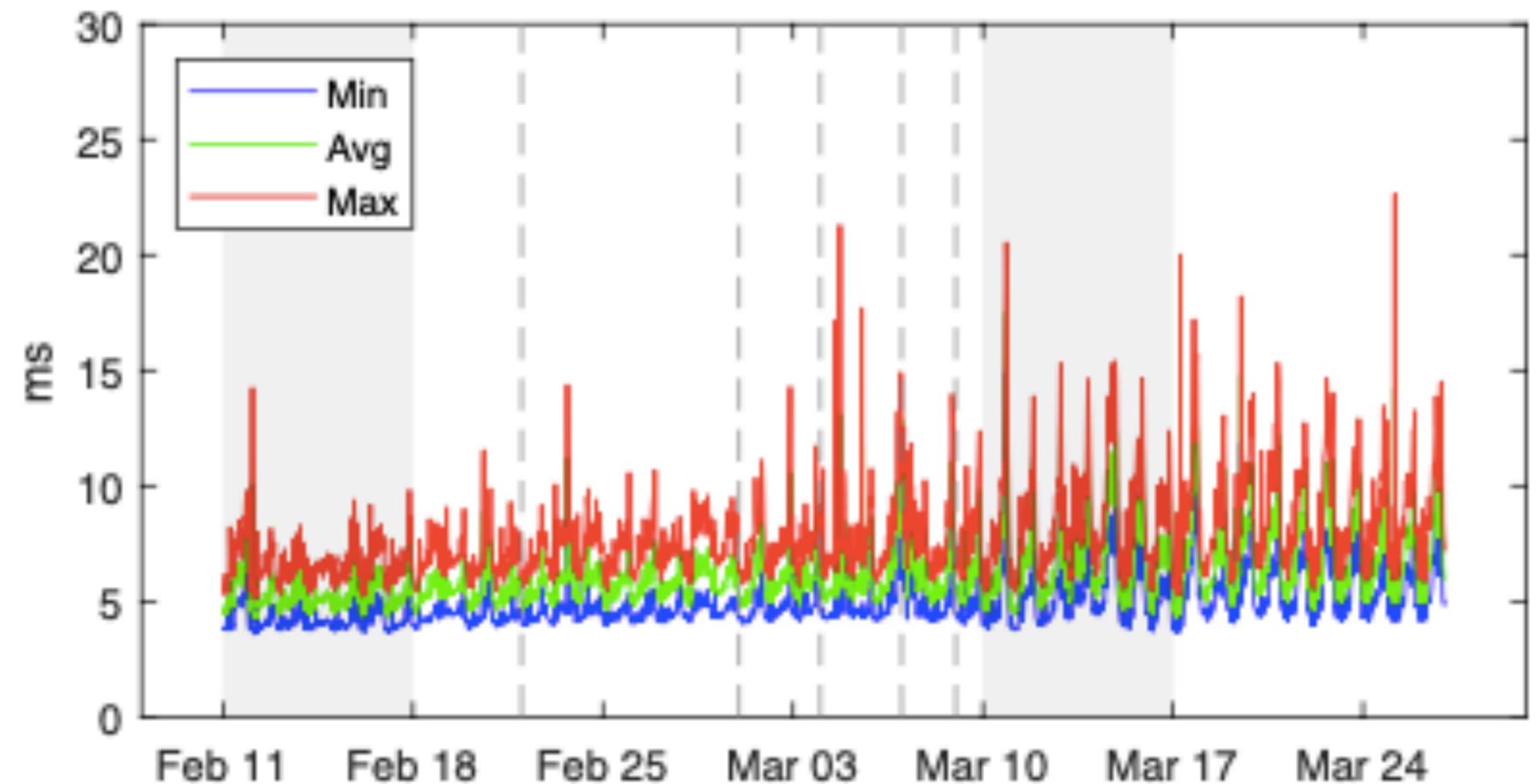
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[link to study](#)

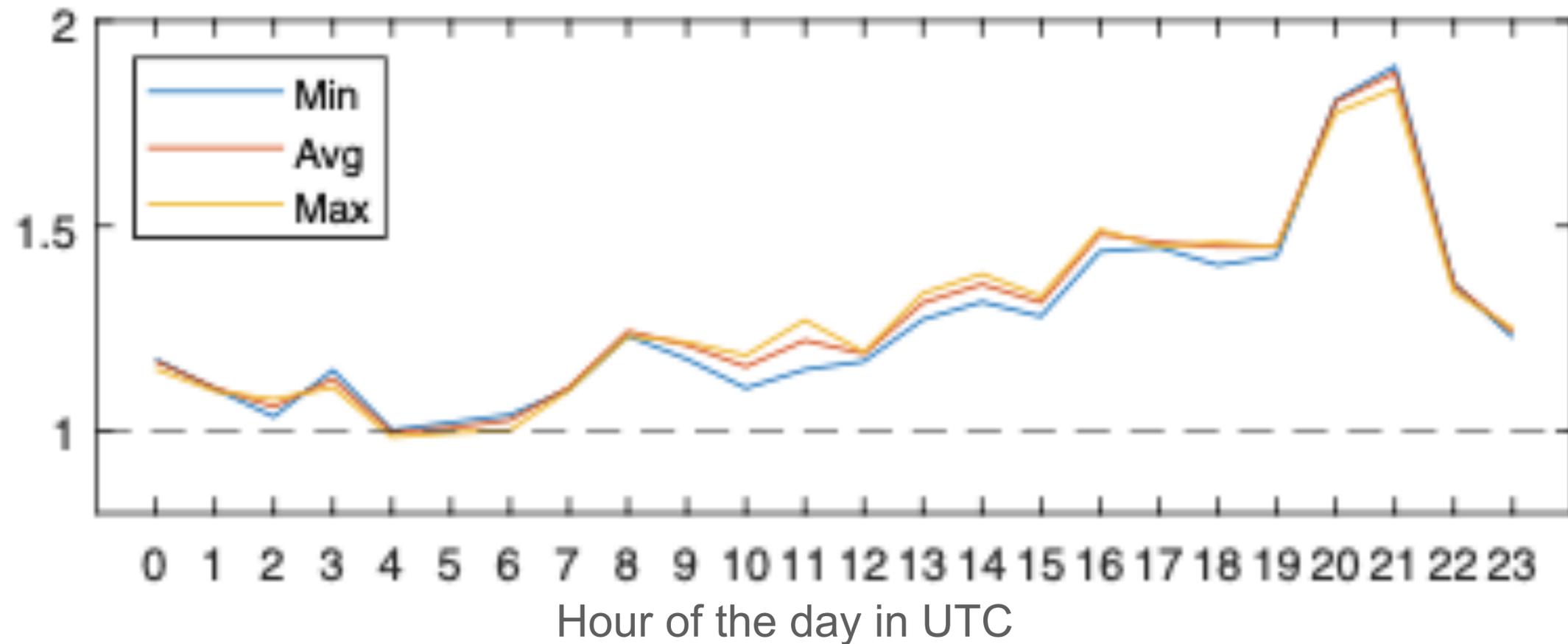
Latency in Italy



22 Feb	Some Italian municipalities (~50 thousand people) quarantined
1 Mar	More municipalities quarantined, gatherings suspended
4 Mar	Schools and universities are shutdown nationwide
7 Mar	Northern Italy put on lockdown (16 million people)
9 Mar	All of Italy put on lockdown
14 Mar	Spain put on lockdown
16 Mar	France put on lockdown
22 Mar	Germany put on lockdown

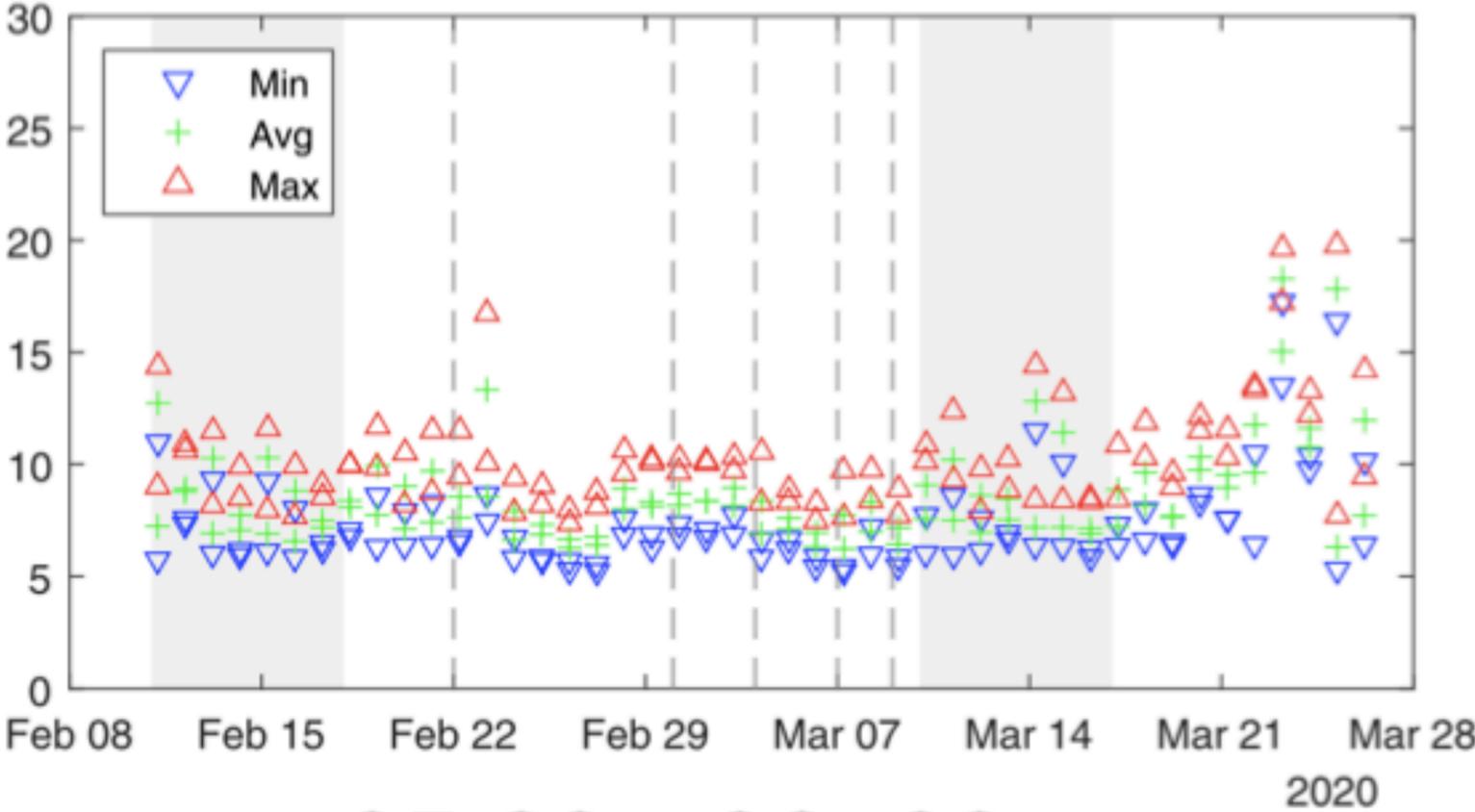


Changing work pattern?

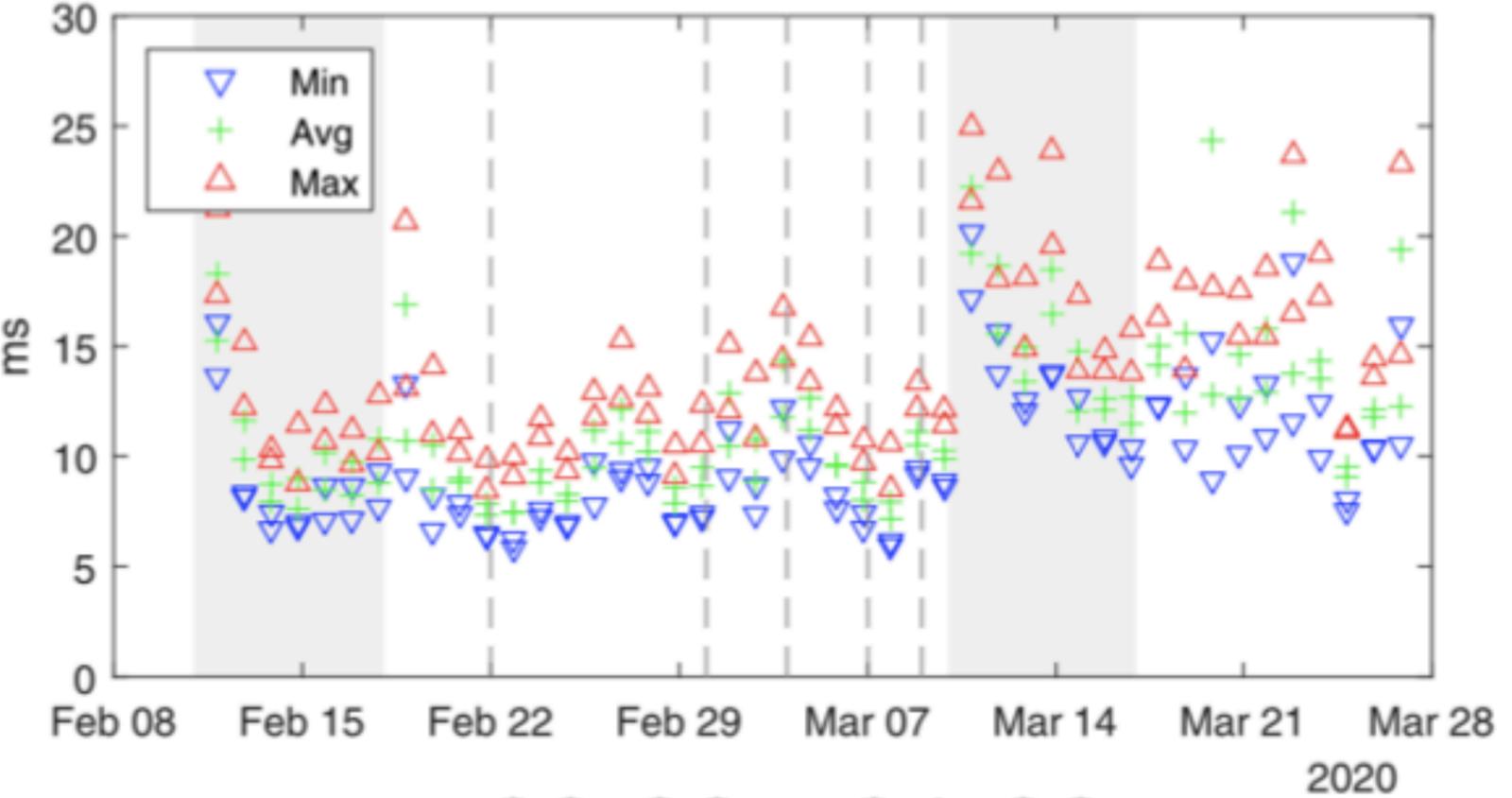


- Mean value of after-before
- Most likely explanation: entertainment

YouTube Traffic



05:00 - 06:00

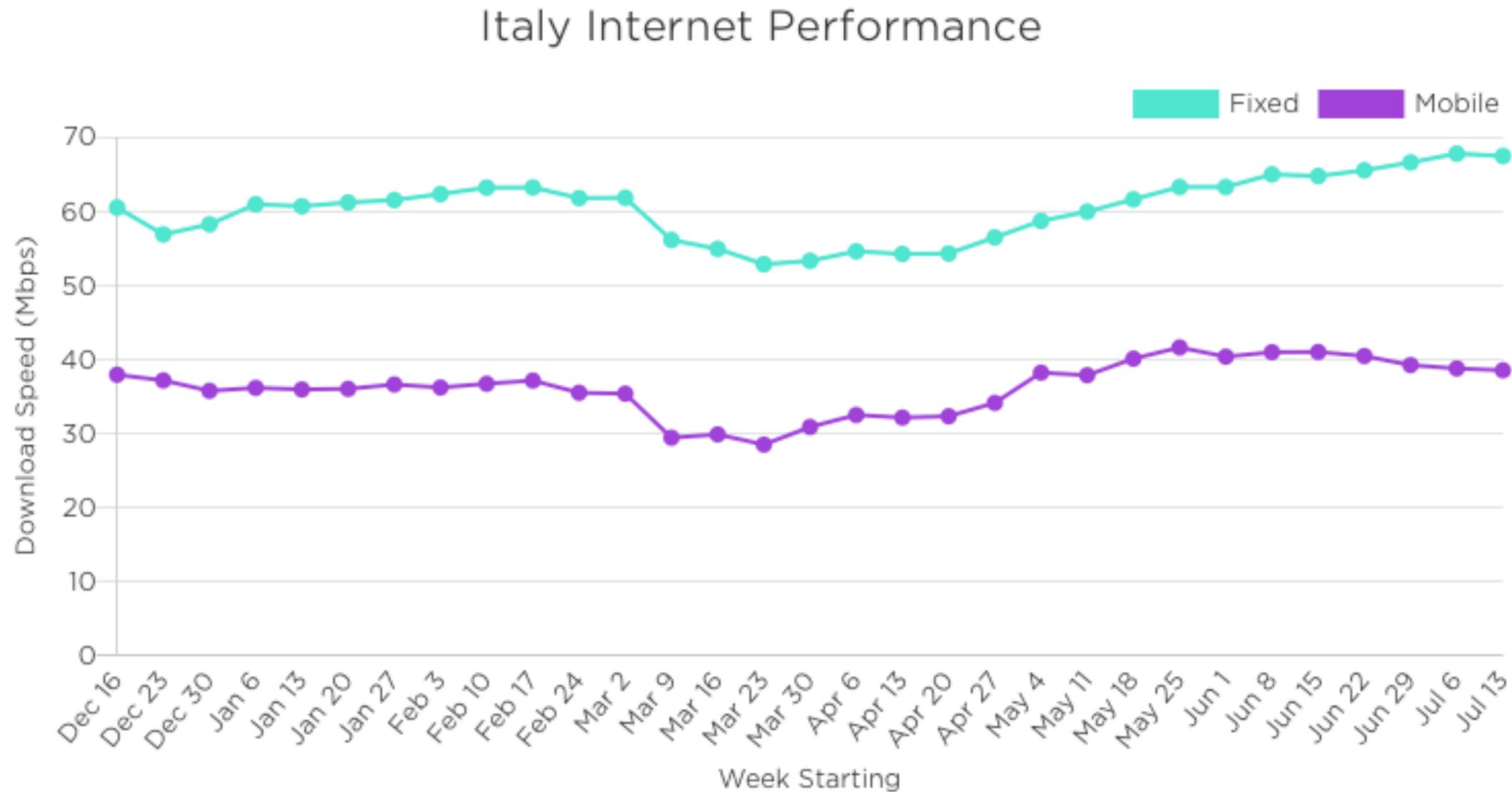


20:00 - 21:00



**Will the Internet infrastructure
keep up with the surge of traffic?**

Italy needed two months (March and April)



France
Greece
Italy
Portugal

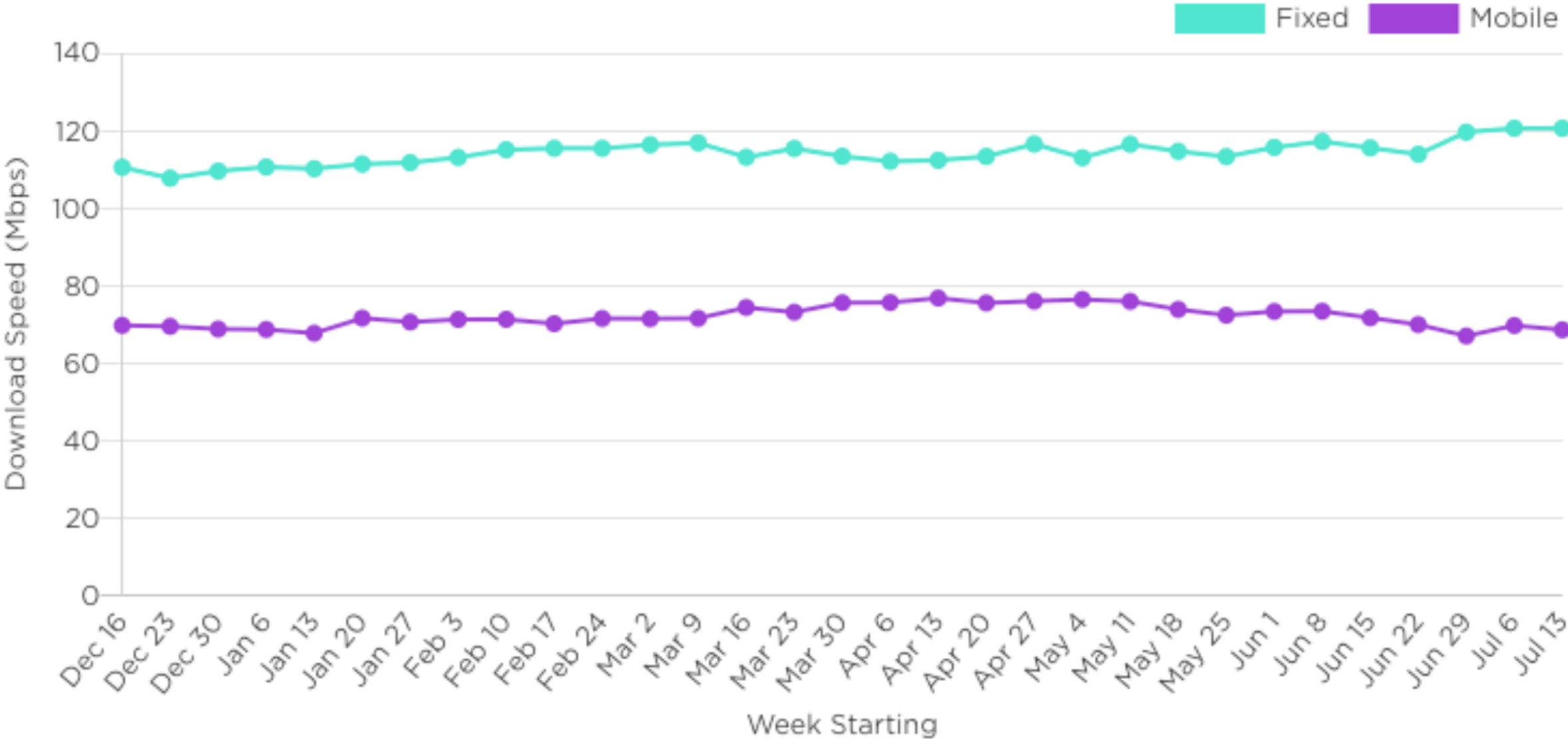
(Less pronounced)
Bulgaria
Cyprus
Ireland
Slovenia
Slovakia
Spain

- Speed continues to increase after May

The Netherlands hardly experienced any change



Netherlands Internet Performance

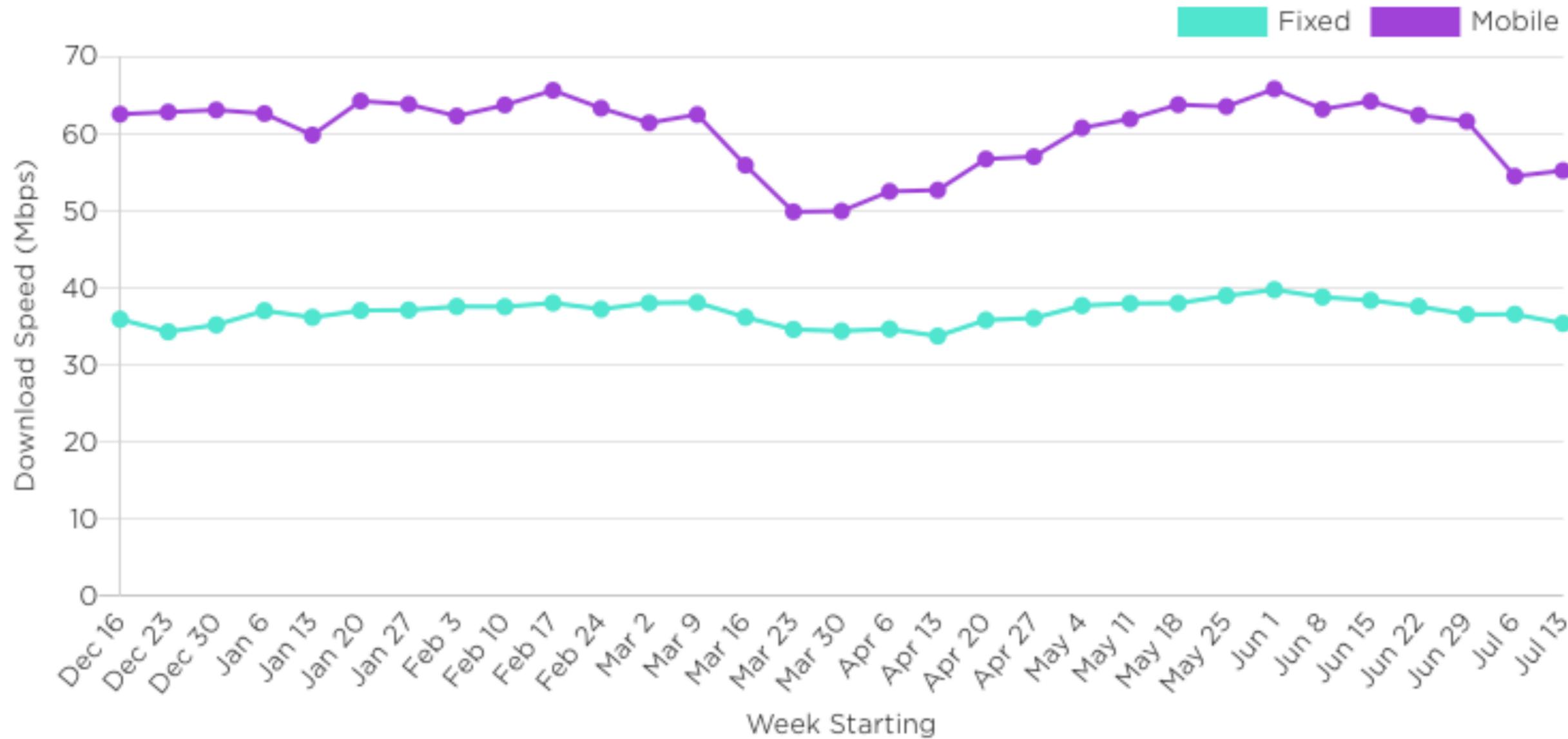


- Belgium
- Hungary
- Denmark
- Latvia
- Lithuania
- Luxembourg
- Poland
- Romania
- Sweden

Croatia compensated with mobile networks



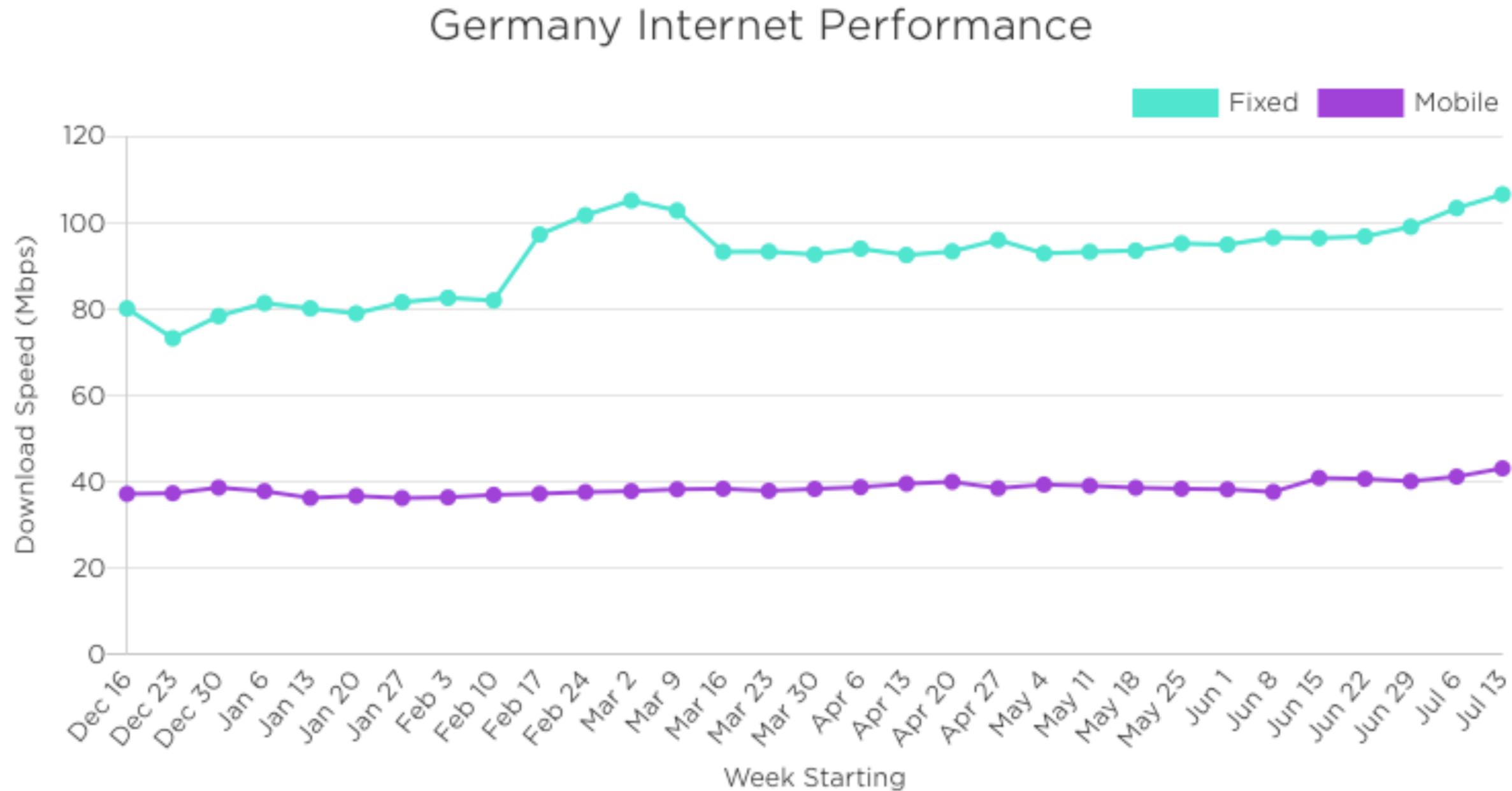
Croatia Internet Performance



Austria
Czechia
Estonia

(Very small change)
Finland

Germany anticipated and prepared



Resounding Success



Country	Fixed	Mobile
Austria	21%	5%
Belgium	9%	2%
Bulgaria	7%	2%
Croatia	-7%	-10%
Cyprus	12%	22%
Czechia	9%	2%
Denmark	2%	-13%
Estonia	1%	-4%
Finland	8%	-1%
France	6%	5%

Country	Fixed	Mobile
Germany	1%	14%
Greece	10%	8%
Hungary	11%	-4%
Ireland	-1%	10%
Italy	9%	9%
Latvia	9%	3%
Lithuania	4%	5%
Luxemb.	3%	8%
Luxembourg	3%	8%
Netherlands	4%	-4%

Country	Fixed	Mobile
Poland	2%	8%
Portugal	3%	4%
Romania	8%	5%
Slovakia	14%	-12%
Slovenia	9%	10%
Spain	4%	-9%
Sweden	6%	1%
UK	3%	1%
EU	6%	3%
World	5%	7%

- Percentage change from March to July 2020
- Download speed improved for both fixed and mobile

Study 2



The Lockdown Effect: Implications of the COVID-19 Pandemic on Internet Traffic

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ABSTRACT

Due to the COVID-19 pandemic many governments imposed lockdowns that forced hundreds of millions of citizens to stay at home. The implementation of confinement measures increased Internet traffic demands of residential users, in particular, for remote working, entertainment, commerce, and education, which, as a result, caused traffic shifts in the Internet core.

In this paper, using data from a diverse set of vantage points (one ISP, three IXPs, and one metropolitan educational network), we examine the effect of these lockdowns on traffic shifts. We find that the traffic volume increased by 15-20% almost within a week—while overall still modest, this constitutes a large increase within this short time period. However, despite this surge, we observe that the Internet infrastructure is able to handle the new volume, as most traffic shifts occur outside of traditional peak hours. When looking directly at the traffic sources, it turns out that, while hypergiants still contribute a significant fraction of traffic, we see (1) a higher increase in traffic of non-hypergiants, and (2) traffic increases in applications that people use when at home, such as Web conferencing, VPN, and gaming. While many networks see increased traffic demands, in particular, those providing services to residential users, academic networks experience major overall decreases. Yet, in these networks, we can observe substantial increases when considering applications associated to remote working and lecturing.

CCS CONCEPTS

• Networks → Network measurement.

KEYWORDS

Internet Measurement, Internet Traffic, COVID-19, Traffic Shifts.



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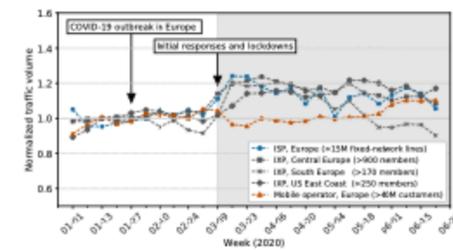


Figure 1: Traffic changes during 2020 at multiple vantage points—daily traffic averaged per week normalized by the median traffic volume of the first up to ten weeks.

ACM Reference Format:

Anja Feldmann, Oliver Gasser, Franziska Lichtblau, Enric Pujol, Ingmar Poesse, Christoph Dietzel, Daniel Wagner, Matthias Wichtlhuber, Juan Tapiador, Narseo Vallina-Rodriguez, Oliver Hohlfeld, and Georgios Smaragdakis. 2020. The Lockdown Effect: Implications of the COVID-19 Pandemic on Internet Traffic. In *ACM Internet Measurement Conference (IMC '20)*, October 27–29, 2020, Virtual Event, USA. ACM, New York, NY, USA, 18 pages. <https://doi.org/10.1145/3419394.3423658>

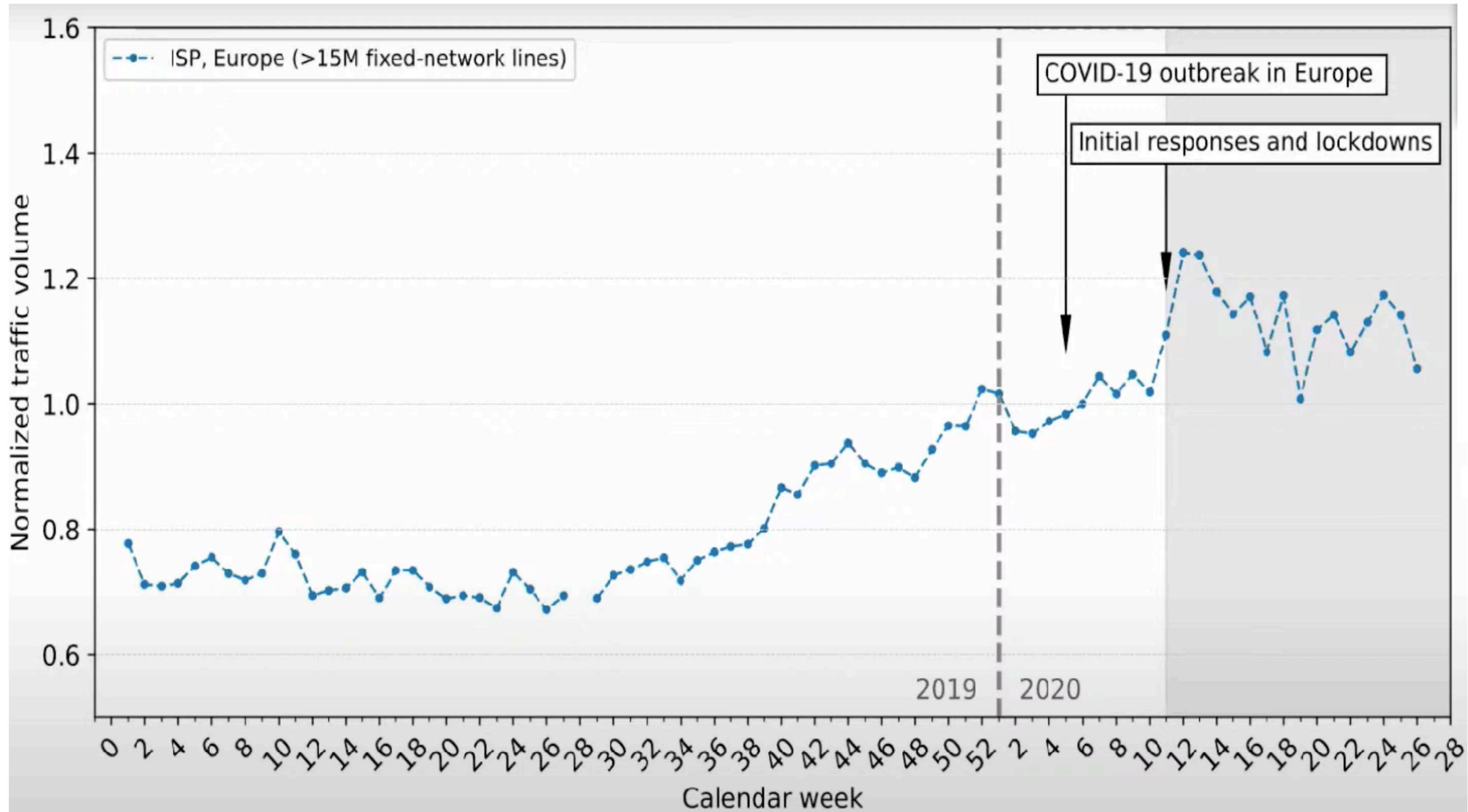
1 INTRODUCTION

The profile of a typical residential user—in terms of bandwidth usage and traffic destinations—is one of the most critical parameters that network operators use to drive their network operations and inform investments [29, 41, 64]. In the last twenty years, user profiles have changed significantly. We observed user profile shifts from peer-to-peer applications in the early 2000s [23, 49, 66], to content delivery and streaming applications in 2010s [7, 24, 35, 37, 52], and more recently to mobile applications [32, 67]. Although changes in user profiles are a moving target, they typically have time scales of years. Thus, staying up to date, e.g., via measurements, was feasible.

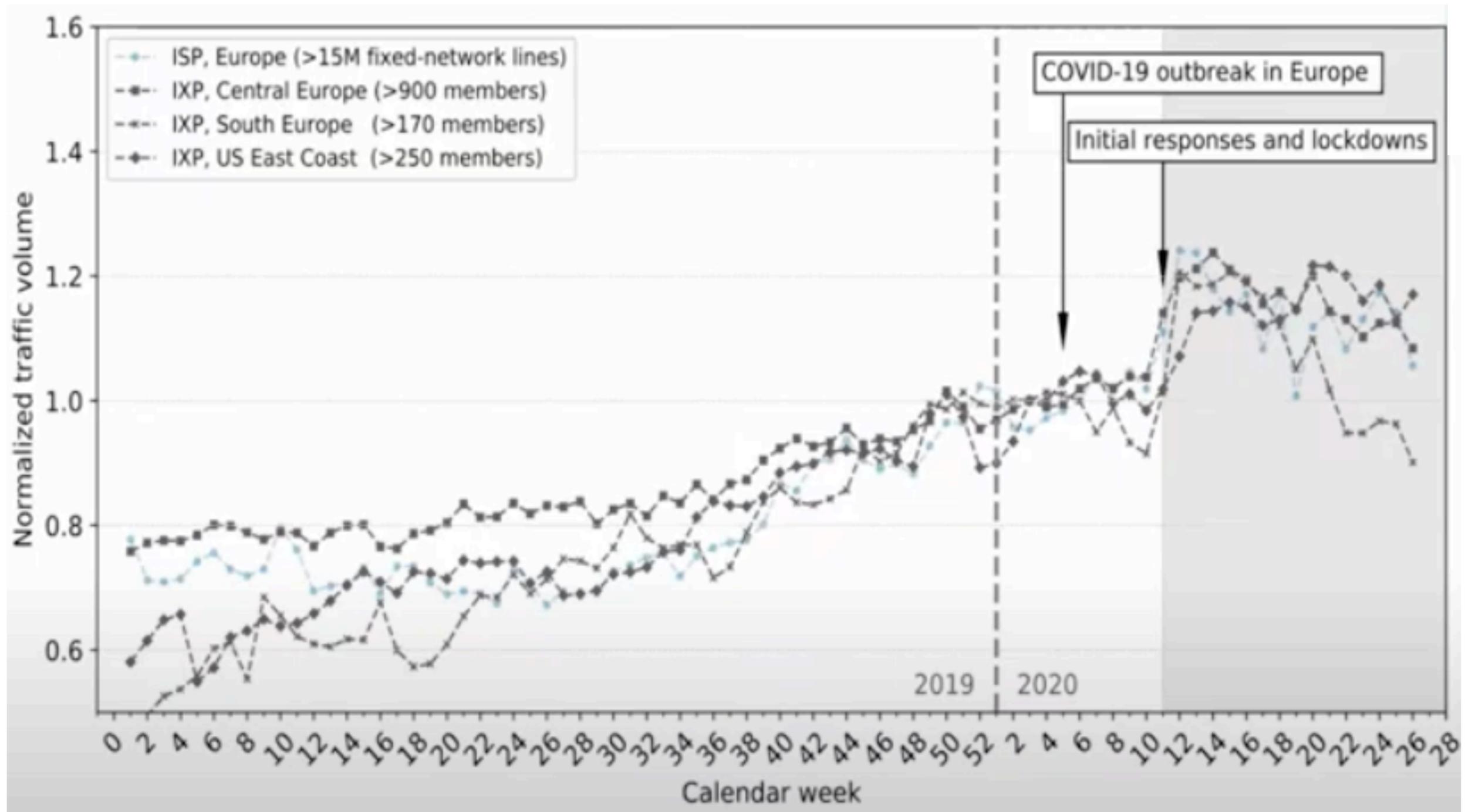
The COVID-19 pandemic is most likely a once in a generation global phenomenon that drastically changed the habits of millions of Internet users around the globe. As a result of the government

[link to study](#)

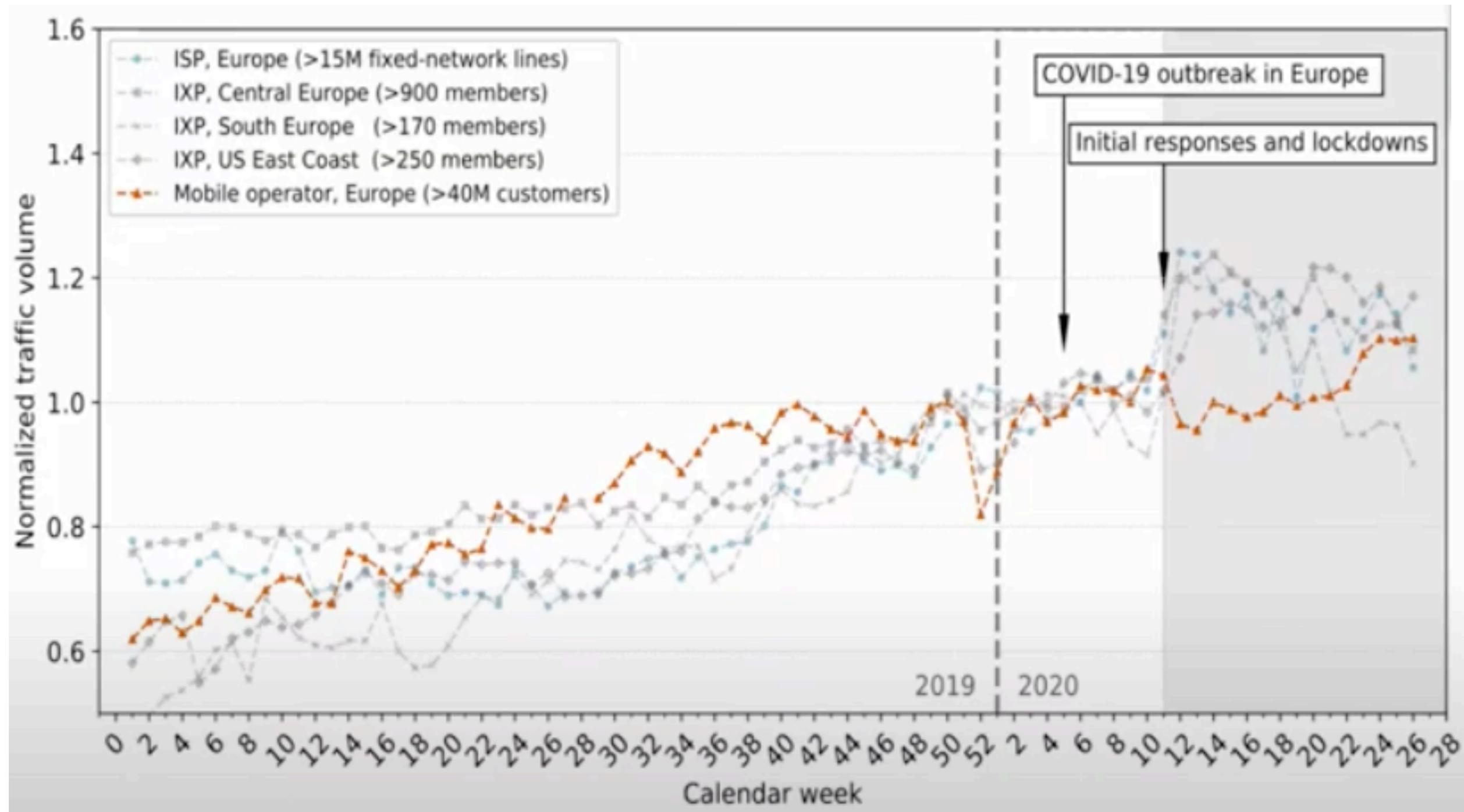
30% increase in traffic



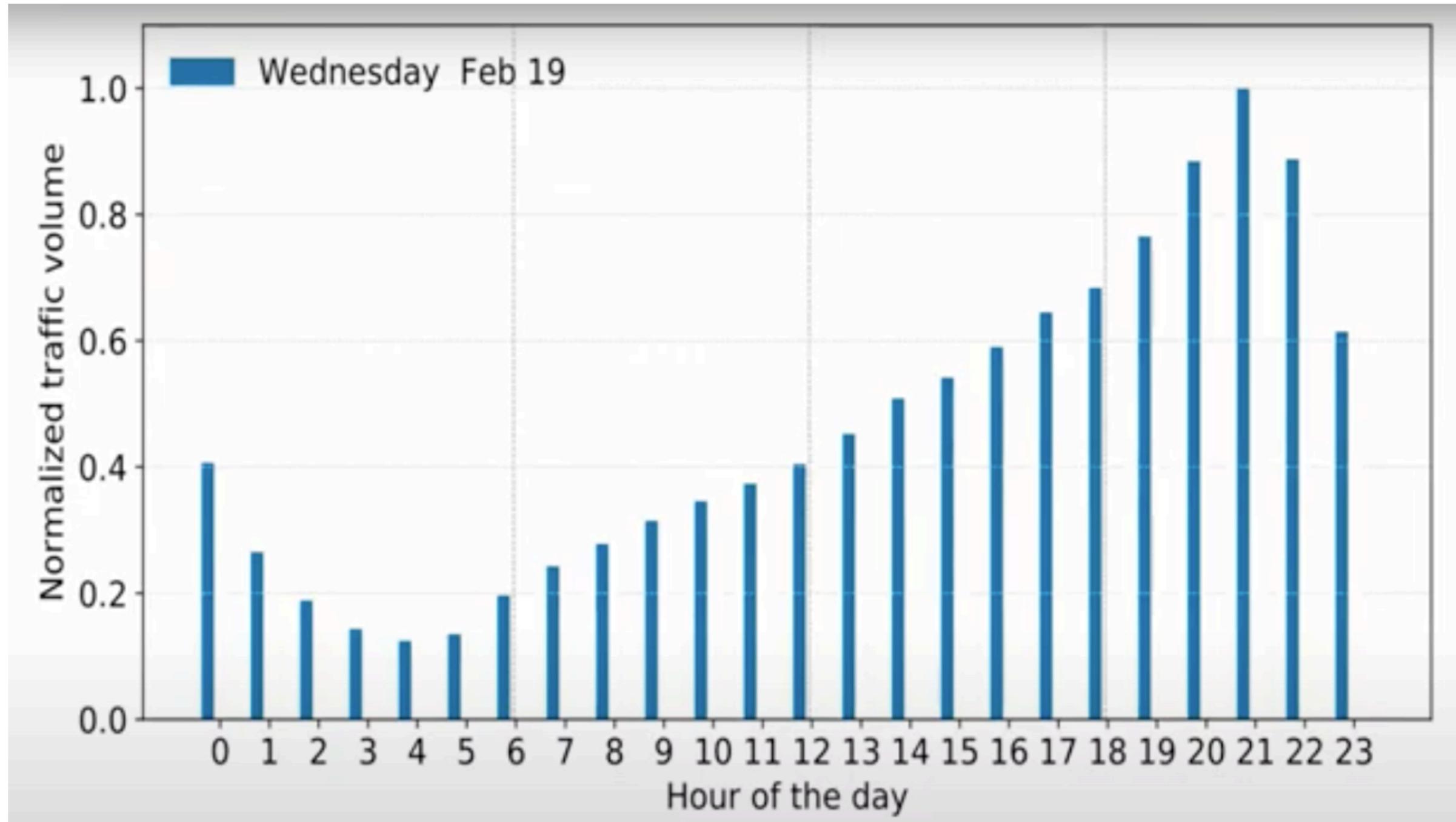
Similar increase at IXPs



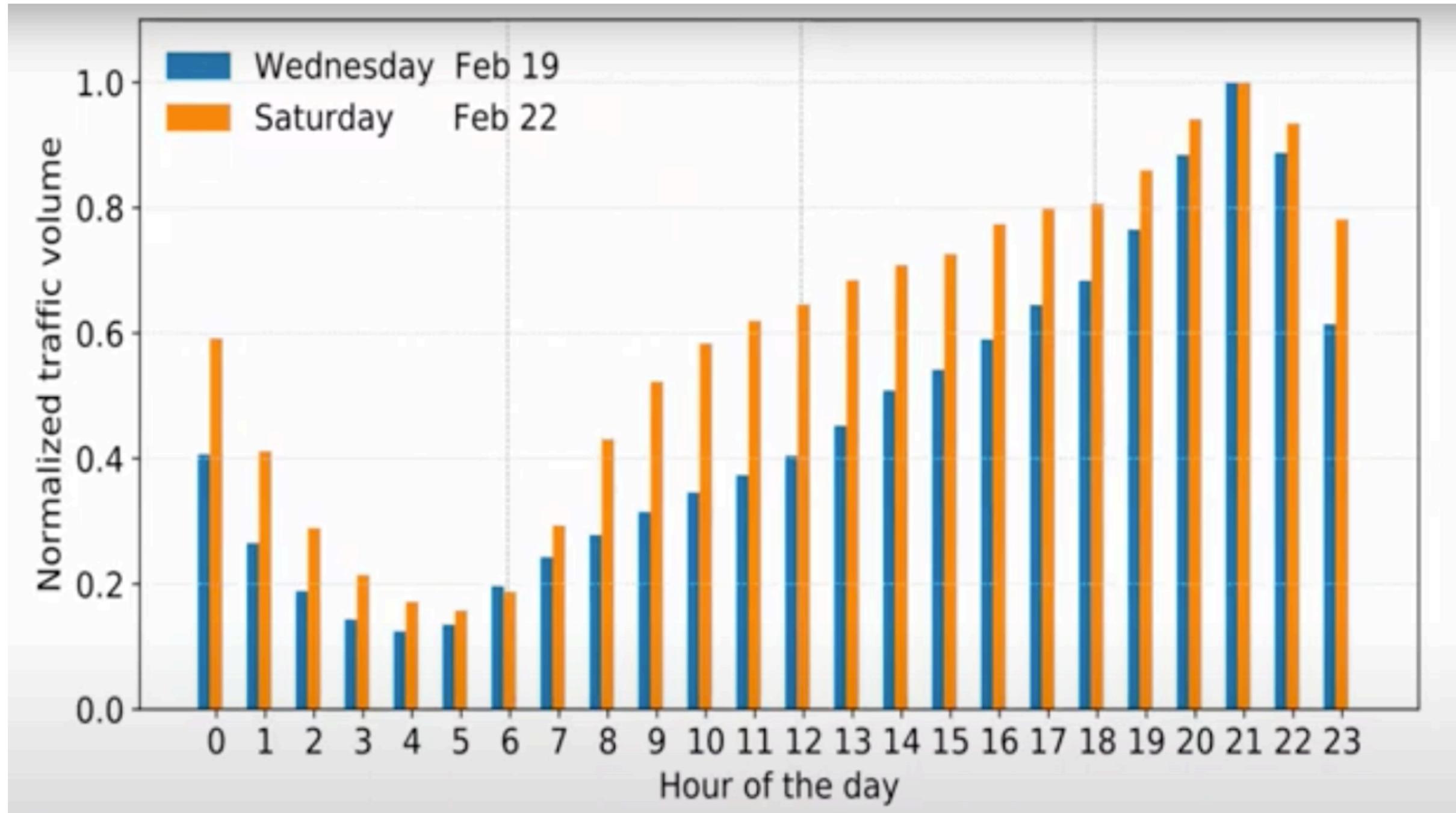
Mobile traffic decreases as people stay home



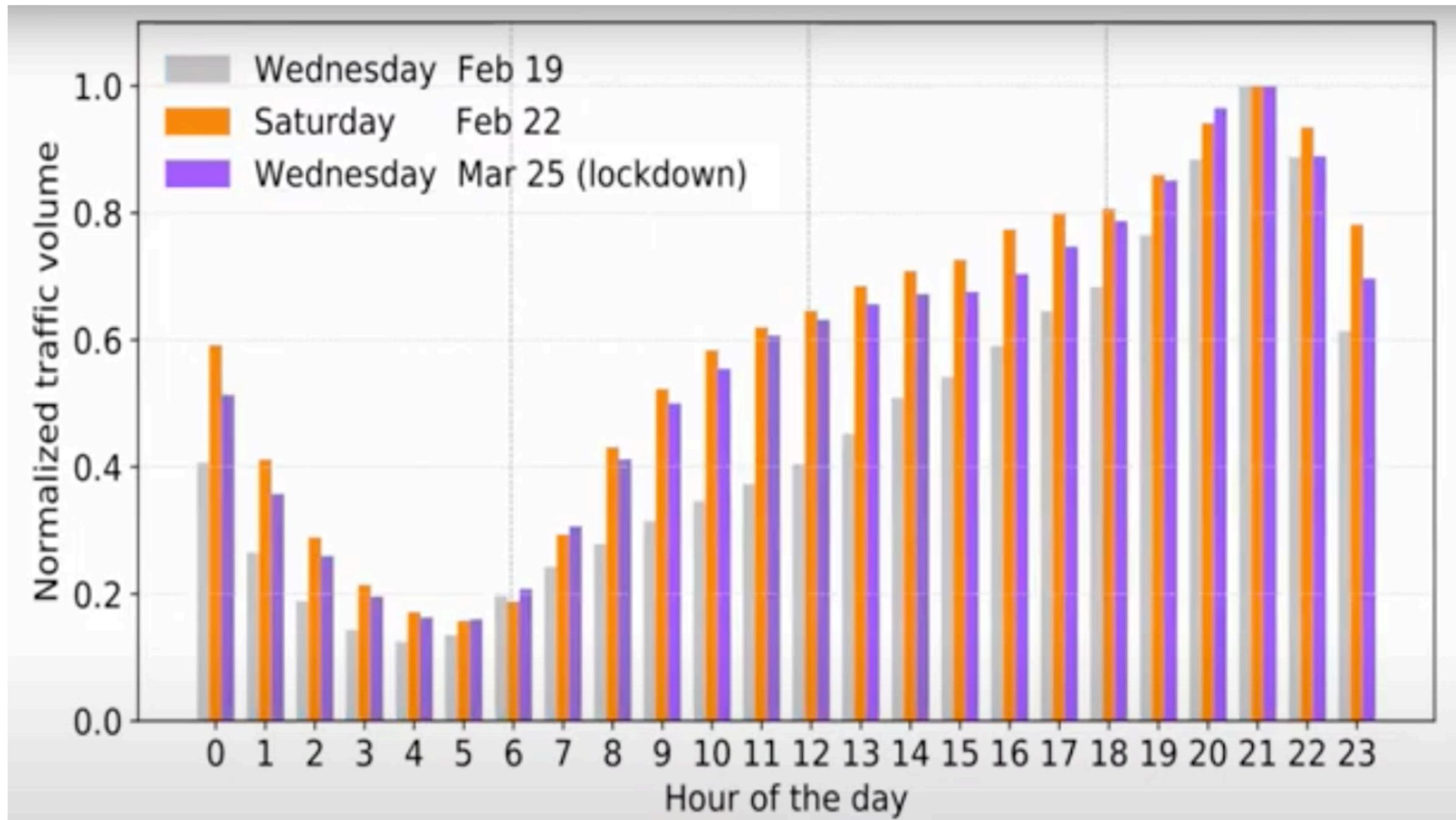
Pre-lockdown workday



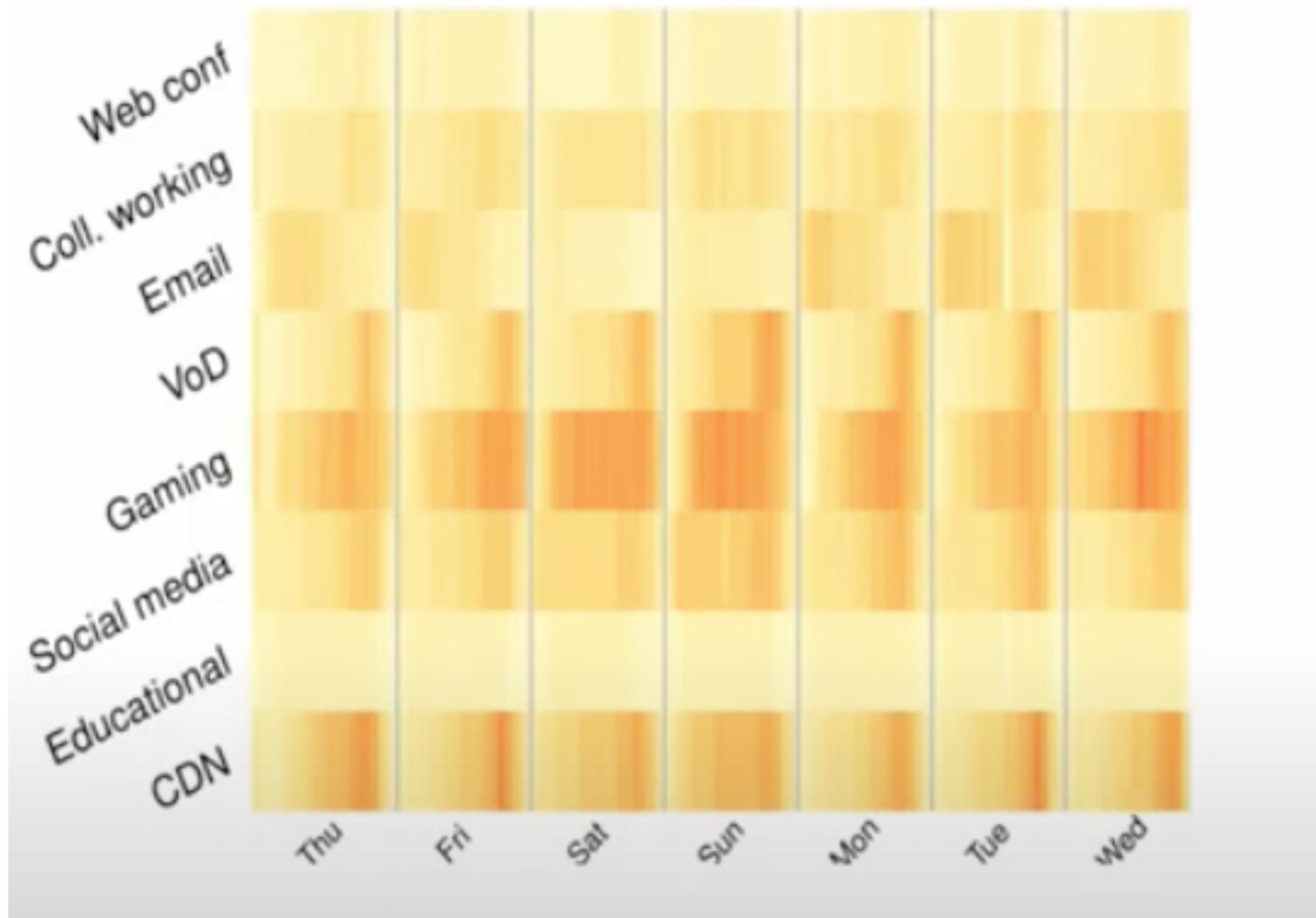
Pre-lockdown weekend



Lockdown weekday



Pre-Lockdown Usage Heat Map



- Email during working hours
- Video, gaming and social media in the evening
- Little web conferencing

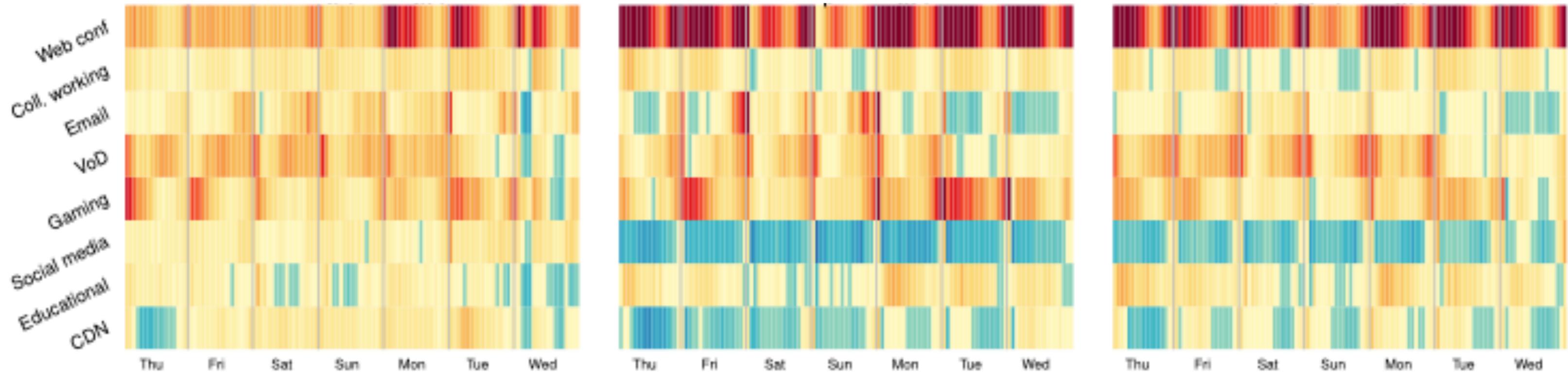
Lockdown and Post-Lockdown Usage Heat Map



March - Base (Feb.)

April - Base (Feb.)

June - Base (Feb.)



Conclusion: The Internet is Resilient



- 30% surge in traffic resulted in minor loss of speed and higher latency, but no major breakdown
- Return to original speed took roughly two months
- Industry had an adequate response without regulatory intervention or help
- Traffic patterns on workdays start to look more like weekends
- Large growth in web conferencing, video, and gaming traffic



Questions



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