

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

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RIPE81 Meeting | Virtual | 27-30 Oct 2020

COVID-19 and the Internet

COVID-19 and the Internet

euronews.

Coronavirus: Half of humanity now on lockdown as 90 countries call for confinement

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The Internet is essential in all these efforts, but how well does it cope?

Goals of this presentation

- Understand the **impact** of the COVID-19 pandemic on different types of networks

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- Present our results from **different networks** in the core and at the edge
- Get to know **your experience** during COVID-19

Lots of data

- Edge network: Large European ISP
- Core networks: 3 IXPs in Central Europe, Southern Europe, and at US East Coast
- Academic network: REDIMadrid university network in Madrid

Lots of data, lots of data crunchers

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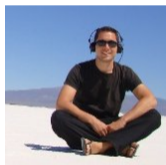
Anja Feldmann
MPII



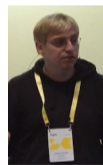
Oliver Gasser
MPII



Franziska Lichtblau
MPII



Enric Pujol
BENOCS



Ingmar Poesel
BENOCS



Christoph Dietzel
DE-CIX



Daniel Wagner
DE-CIX



Matthias Wichtlhuber
DE-CIX



Juan Tapiador
Universidad Carlos III de
Madrid



Narseo Vallina
Rodriguez
IMDEA, ICSI



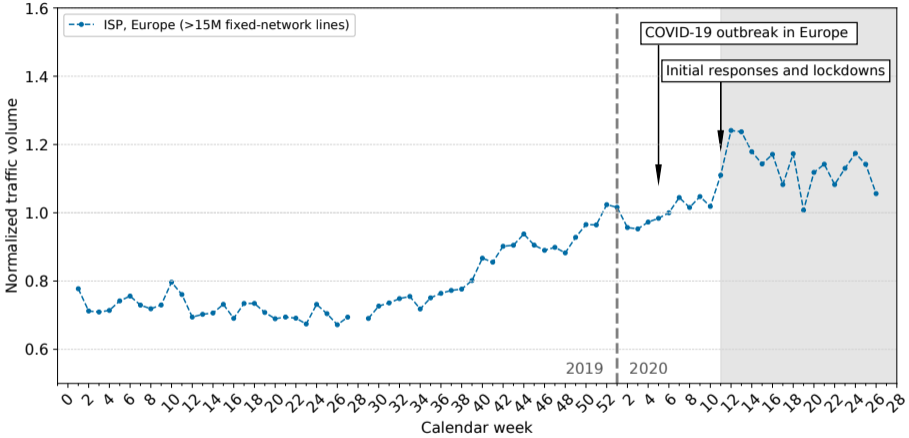
Oliver Hohfeld
Brandenburg University
of Technology



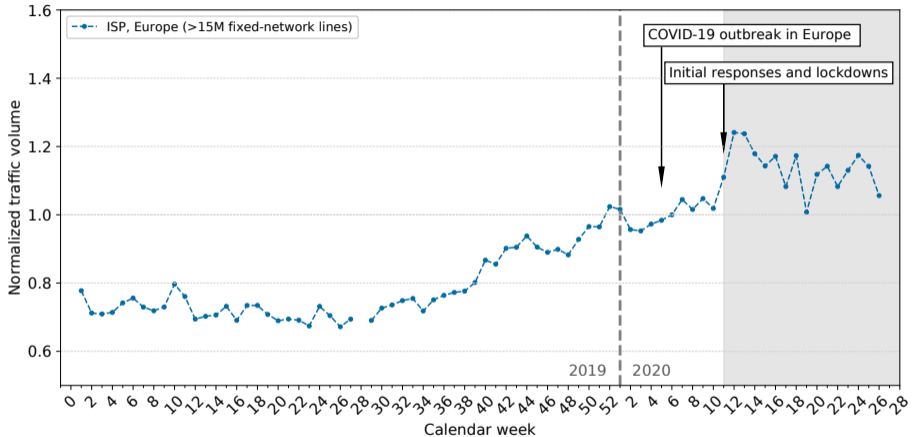
Georgios
Smaragdakis
TU Berlin, MPII

Traffic changes in different networks

Traffic changes from January 2019 to June 2020

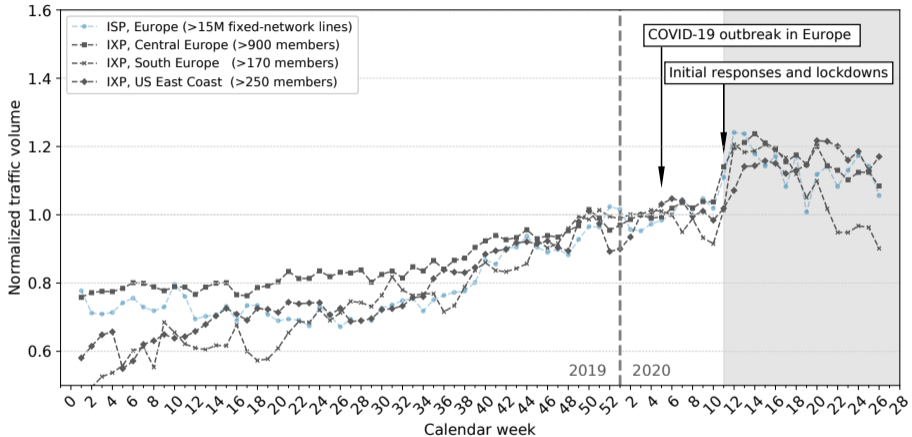


Traffic changes from January 2019 to June 2020



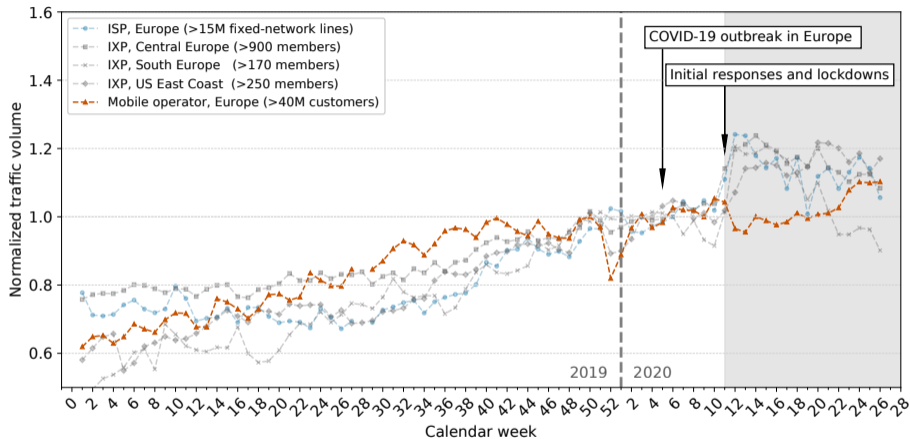
Once the lockdown started the ISP saw a +30% increase in traffic which normally spans over multiple months.

Traffic changes from January 2019 to June 2020



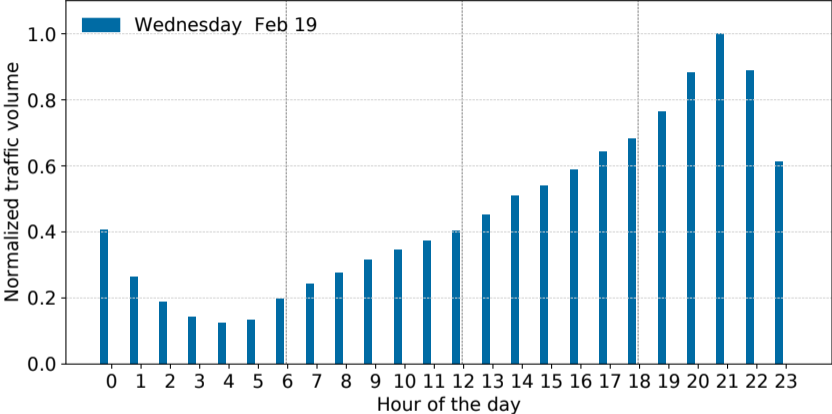
Similar behavior for the IXPs; for the IXP CE and IXP US the traffic levels remain elevated.

Traffic changes from January 2019 to June 2020

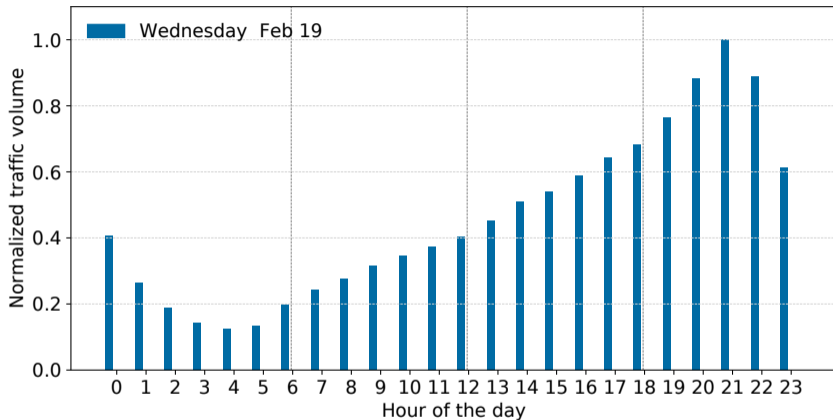


Once the lockdown started mobile traffic decreased measurably and increased again with the first relaxations in mid April.

Changes in workday vs. weekend patterns at the ISP

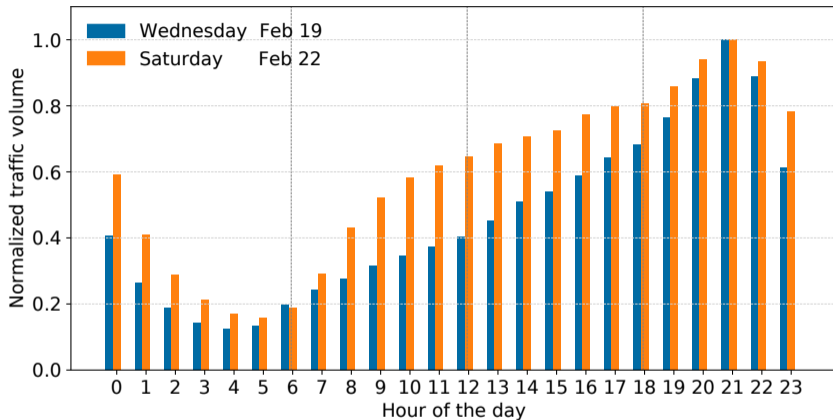


Changes in workday vs. weekend patterns at the ISP



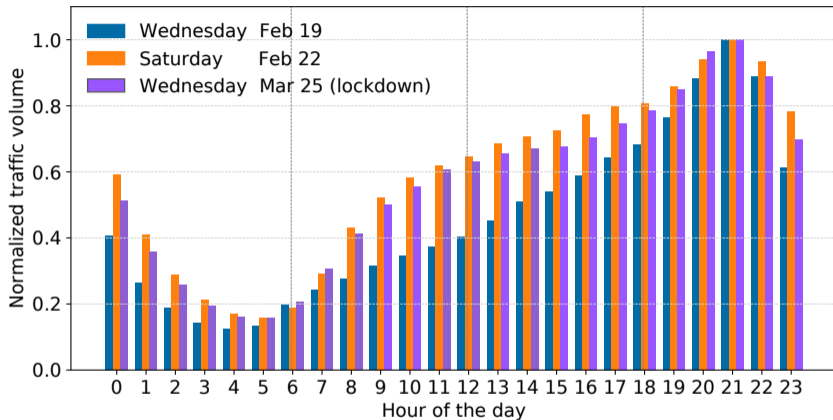
- Regular patterns
 - Workday: Strong increase in evening hours

Changes in workday vs. weekend patterns at the ISP



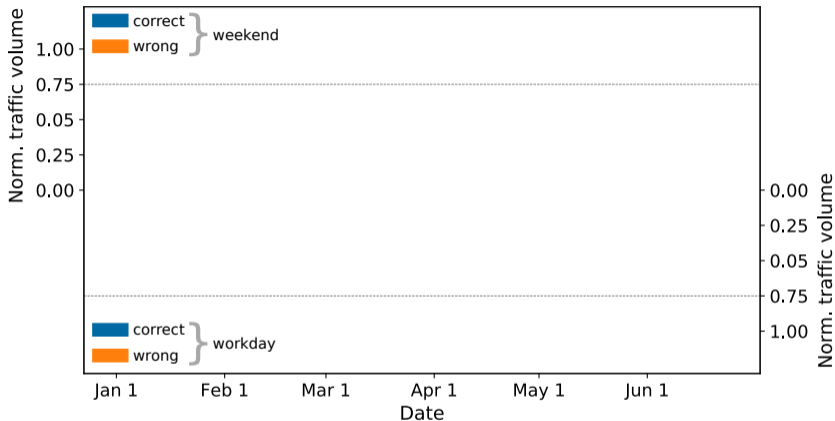
- Regular patterns
 - Workday: Strong increase in evening hours
 - Weekend: More traffic during daytime

Changes in workday vs. weekend patterns at the ISP



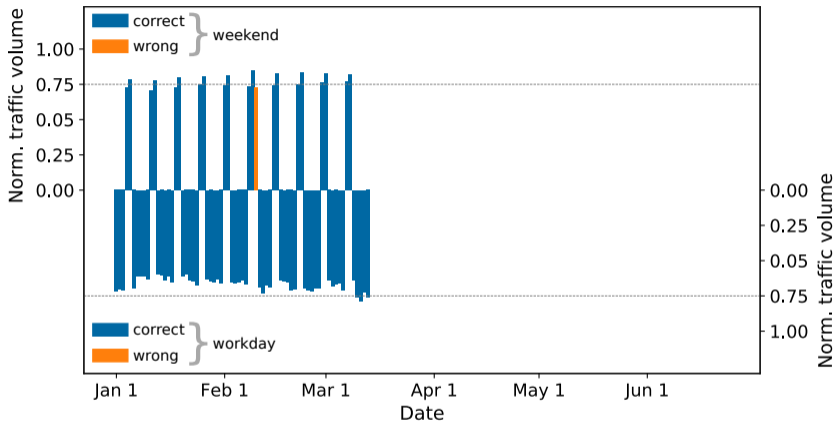
- Regular patterns
 - Workday: Strong increase in evening hours
 - Weekend: More traffic during daytime
- During lockdown: Workdays look more like weekends

Changes in workday vs. weekend patterns at the ISP



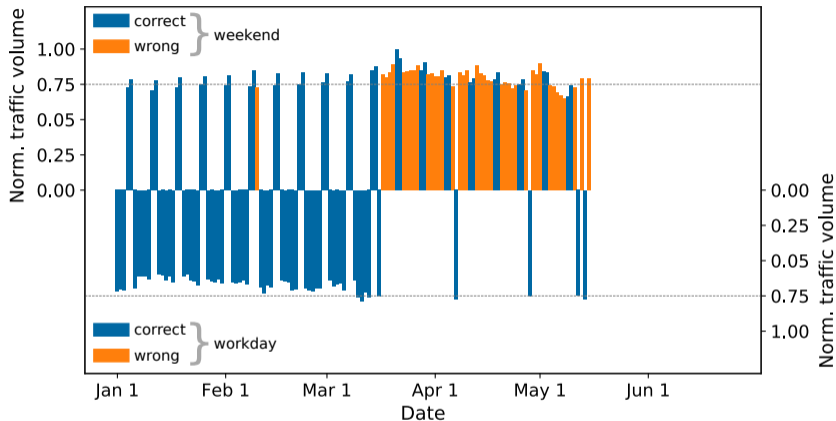
- Classify days into workdays or weekends using traffic patterns

Changes in workday vs. weekend patterns at the ISP



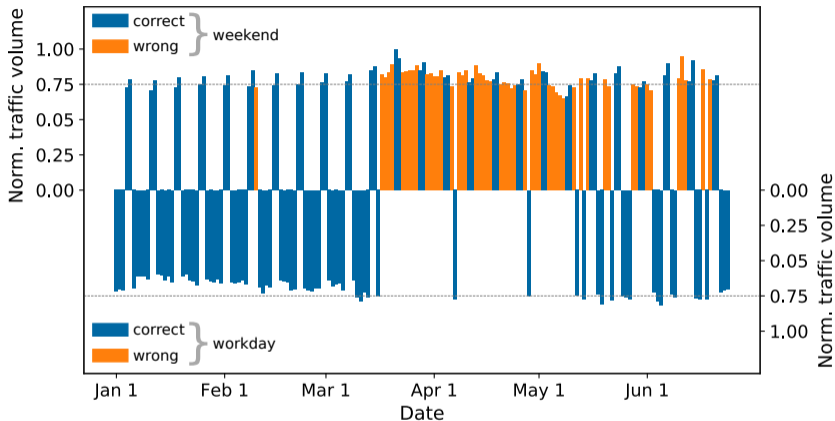
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- During lockdown: Workdays are classified as weekends

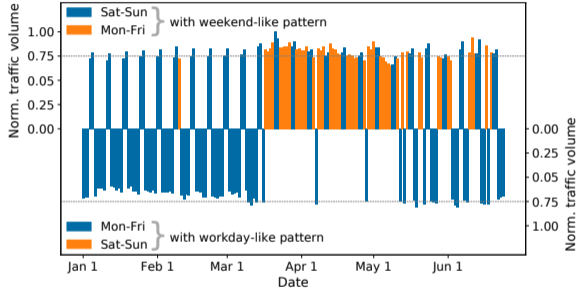
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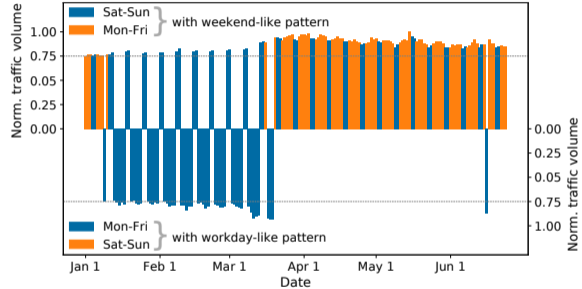
- Classify days into workdays or weekends using traffic patterns
- Pre-lockdown: Most days are classified correctly
- During lockdown: Workdays are classified as weekends; recovering after mid-May

Changes in workday vs. weekend patterns: ISP vs. IXP

ISP

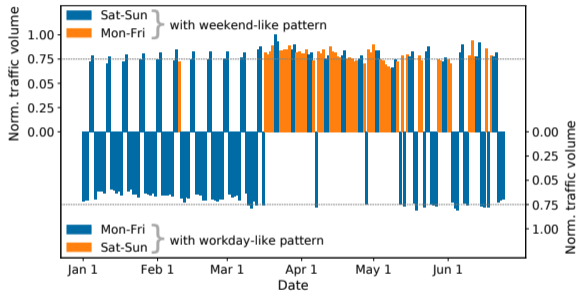


IXP

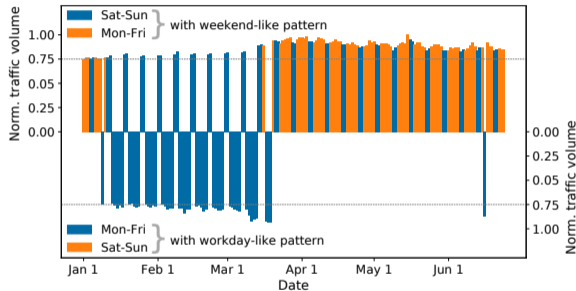


Changes in workday vs. weekend patterns: ISP vs. IXP

ISP



IXP



- At both vantage points workdays are mostly classified as weekends

Poll

Q: Did the traffic in YOUR network change during the lockdown?

- Increase in traffic (more than 10%)
- No significant change (0–10%)
- Decrease in traffic

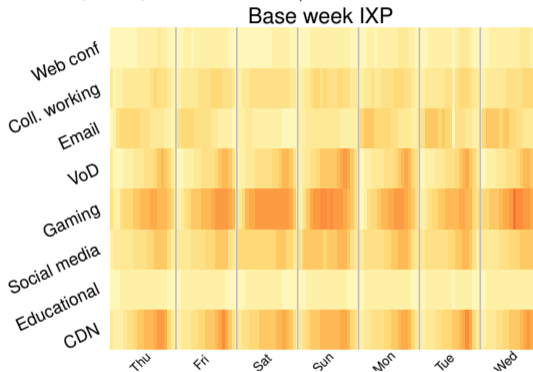
Application-level traffic changes

Classify traffic by application class

- Classify based on transport ports and src/dst ASes

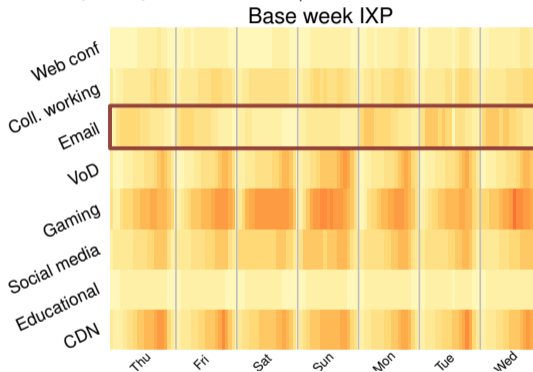
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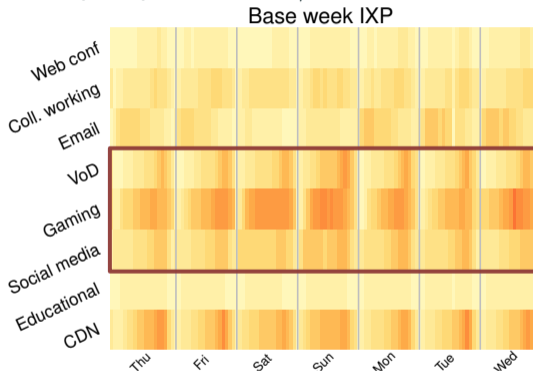
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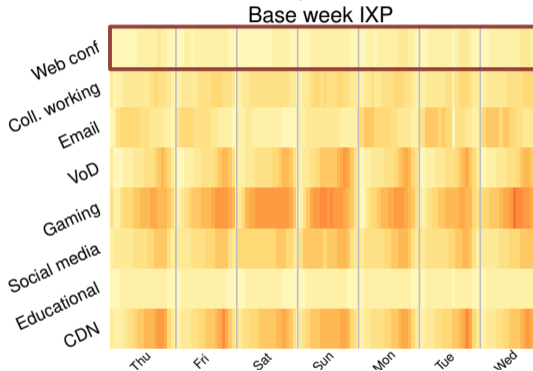
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- Email during working hours
- Video, gaming, and social media during evening hours

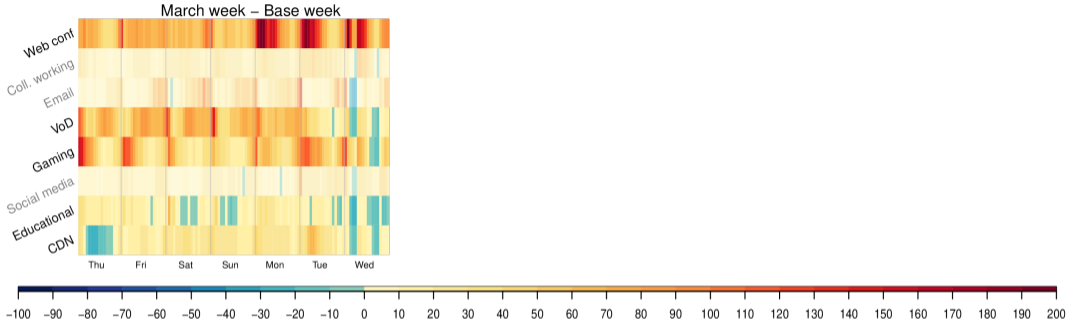
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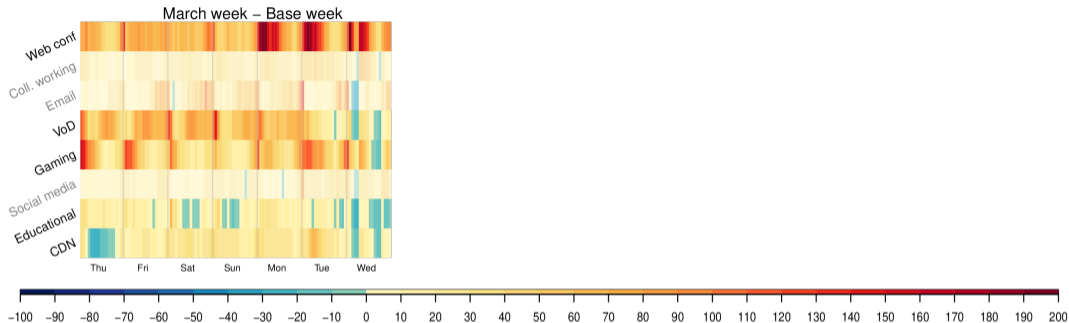


- Email during working hours
- Video, gaming, and social media during evening hours
- Hardly any web conferencing

Changes in application classes: Central European IXP



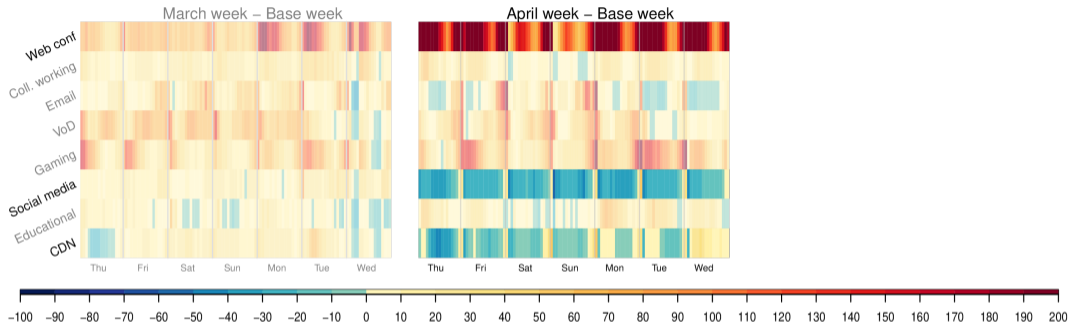
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March:

- Increase in web conf., VoD, and gaming
- Partial decrease in CDN and educational traffic

Changes in application classes: Central European IXP



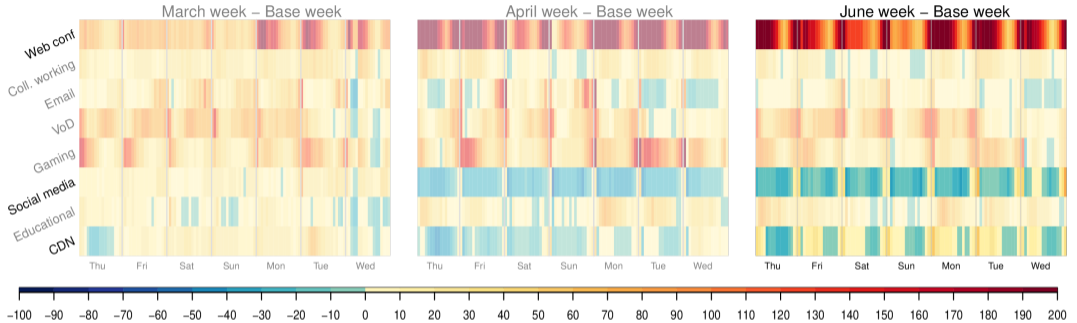
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April:

- Strong increase in web conf.
- Decrease in CDN and social media traffic

Changes in application classes: Central European IXP



March:

- Increase in web conf., VoD, and gaming
- Partial decrease in CDN and educational traffic

April & June:

- Strong increase in web conf.
- Decrease in CDN and social media traffic

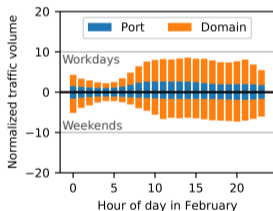
VPN identification

- Port-based: Well known port/proto combinations exclusively used by VPN services
- Domain-based: For TCP/443 traffic, IPs labeled *vpn*, but not www.

VPN traffic: Central European IXP

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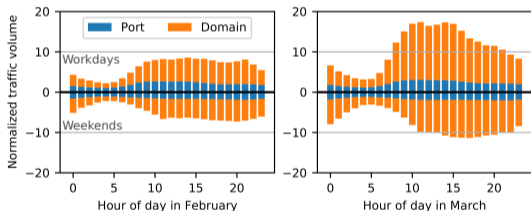
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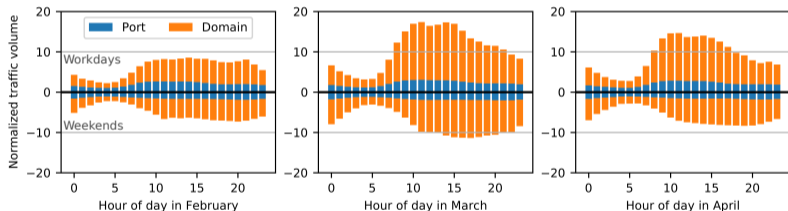


- 200% increase in VPN traffic in March during working hours

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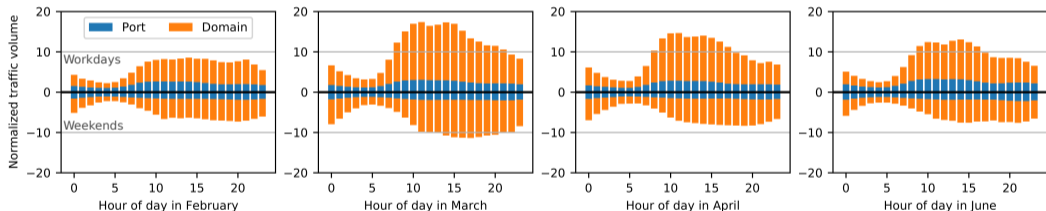


- 200% increase in VPN traffic in March during working hours
- Slight decrease in April

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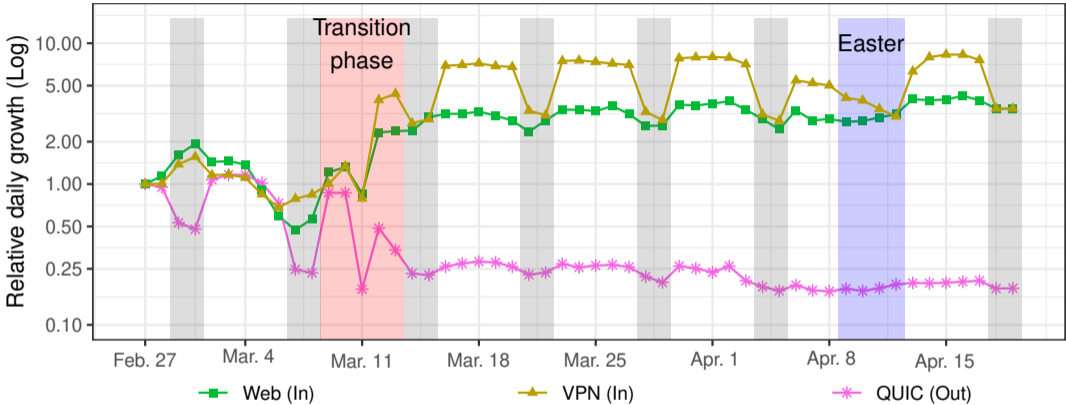
Poll

Q: Did certain parts of the traffic in YOUR network change during the lockdown?

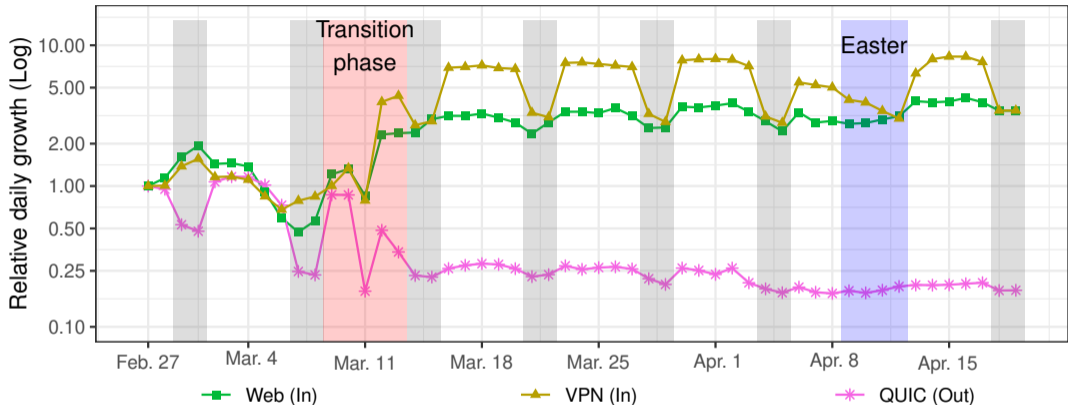
- Increase for certain parts of the traffic
- Decrease for certain parts of the traffic
- Increase & decrease for certain parts of the traffic
- No change

How did edu traffic change?

Daily connections for different traffic classes at REDIMadrid



Daily connections for different traffic classes at REDIMadrid

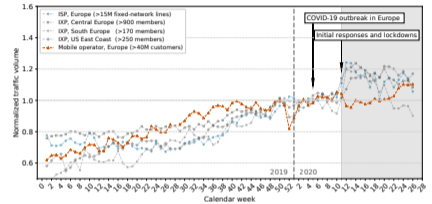


- Increase in incoming web and VPN traffic
- Decrease of outgoing QUIC traffic

What we found

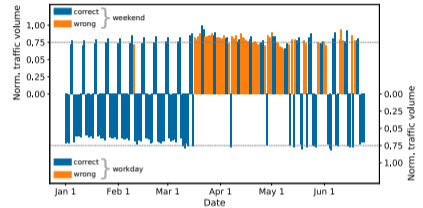
People change → traffic changes

- Traffic increase of **15-30%** within a few **days**



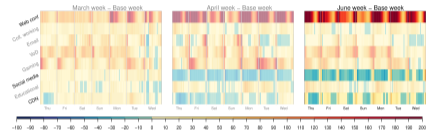
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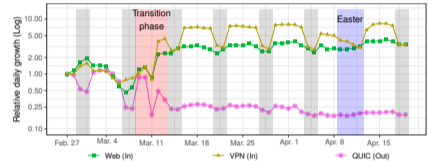
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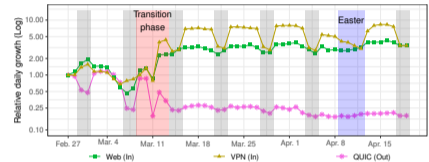
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The impact of the **COVID-19** pandemic is directly reflected in changes to **Internet traffic.**

Poll

Q: Is YOUR network prepared for a second lockdown?

- Yes, better than for the first lockdown
- Yes, similarly as for the first lockdown
- No, we are just hoping for the best

How did the Internet do?

The Internet at our vantage points was able to cope with

- Major demand changes
- Major application changes

How did **YOUR** Internet do?

The Internet at our vantage points was able to cope with

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How was **your** experience?

- How well did your network cope?
- Did you see changes in traffic patterns?
- Did you experience outages, congestion, etc.?
- Did you have to provision additional capacity?
- ...

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Is this the **new normal**?

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[arXiv:2008.10959](https://arxiv.org/abs/2008.10959)