

# SHEDDING LIGHT IN THE DARK - THE IMPORTANCE OF INTERNET MEASUREMENTS

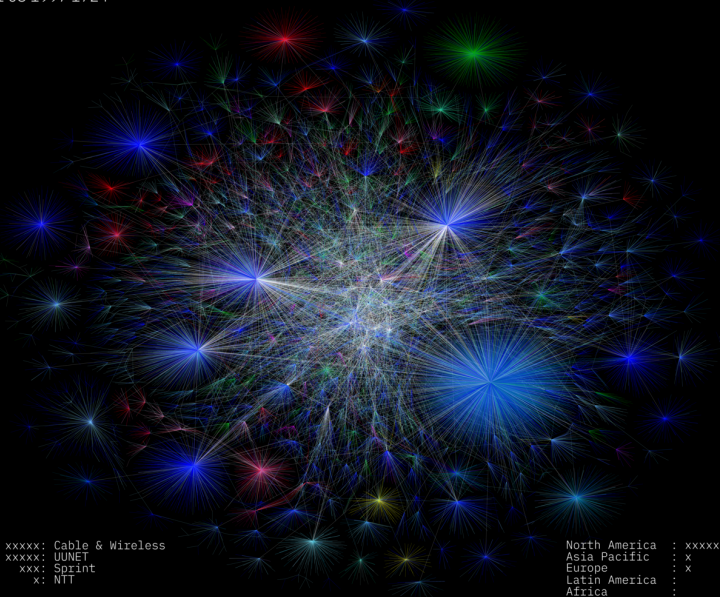
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Franziska Lichtblau

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# GLOBAL ROUTING TABLE 1997<sup>1</sup>

11 08 1997 1724



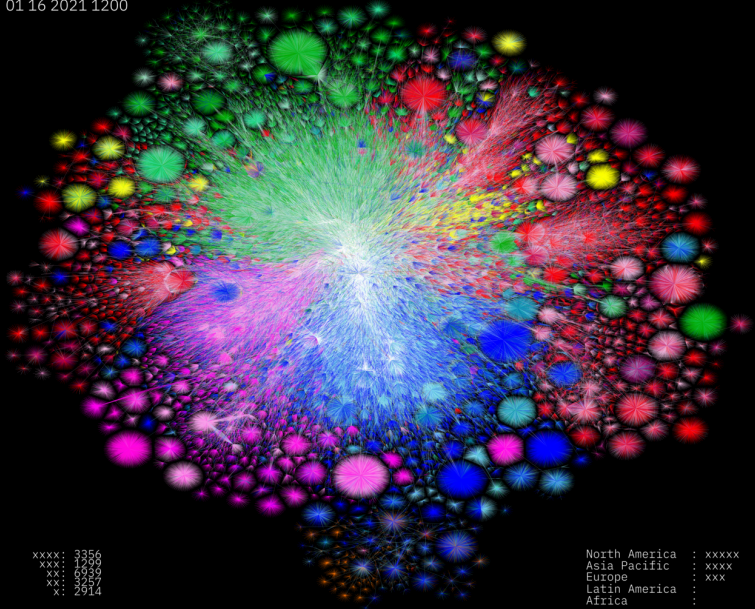
xxxxx: Cable & Wireless  
xxxxx: UUNET  
xxx: Sprint  
x: NTT

North America : xxxxxxxxxxxx  
Asia Pacific : x  
Europe : x  
Latin America :  
Africa :

<sup>1</sup>[ggcf- " "j jj ! bcgXI beZ

# GLOBAL ROUTING TABLE 2021<sup>2</sup>

01 16 2021 1200



<sup>2</sup>[ggcf- " "j jj ! bcgXI beZ

# Internet of Things

Event Organization

Ride Sharing

Highspeed Trading

# Remote Work

Telephony

Industrial Automation

Online Banking

Government Services

Streaming Services

Online Gaming

Home Automation

# News

This presentation

Service availability

Global service coverage

Data integrity

Communication security

Reaction to new demands

Distributed system ! no single source of truth

Constantly evolving

Multi-stakeholder model

Initial design does not focus on measurability

Finding suitable vantage points

Correlating data from different vantage points

Measuring the correct variables

Deploying adequate hardware

Dealing with personal data

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Correlating data from different vantage points

Measuring the correct variables

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**Every Internet measurement study must be carefully tailored to the specific research question.**

## VANTAGE POINTS

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### Data plane

- Actual traffic data
- Sampled flows
- Available through research collaborations
- Privacy sensitive
- Huge amount of data

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Depending on the study data and control plane information can be utilized **alone** or **correlated**.

## IXPs

Central Europe  
Southern Europe  
US East Coast

Interconnecting networks

Core centric view



## ISP

Central Europe  
Residential customers  
Tier-1 transit network

Edge centric view  
+  
Core centric view

Data is stored as ~~not~~ (IXPs) and <sup>1</sup> o (ISP) and  
always kept on-premise.

Very vantage point specific ! relies on specifics about the traffic collection and physical infrastructure which can introduce artifacts:

Very vantage point specific ! relies on specifics about the traffic collection and physical infrastructure which can introduce artifacts:

- Malformed packets created by the flow exporter
- Wrong timestamps
- Different kinds of traffic transported over the same network
- Misconfiguration

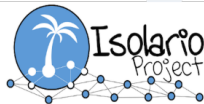
# PUBLICLY AVAILABLE CONTROL PLANE VANTAGE POINTS



23 Collectors  
RIB snapshots  
3 multi-hop collectors



36 Collectors  
RIB snapshots  
6 multi-hop collectors



4 Collectors  
RIB snapshots  
multi-hop collectors with BGP add-path support  
Project discontinued since 2021

Every BGP speaker is responsible for their announcements

#

many **unexpected artifacts** in the wild:

Every BGP speaker is responsible for their announcements

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many **unexpected artifacts** in the wild:

- Announcements for Bogon prefixes
- AS paths containing loops
- Too specific prefixes ( $< /24$  for IPv4)
- Too large prefixes ( $> /8$  for IPv4)
- Private or unassigned ASes
- AS path poisoning
- Very long AS paths (path prepending)

Present a measurement study conducted in 2020, which:

- Addresses **challenges** in the modern Internet
- Highlights the importance of **measurement studies**
- Yields results for **informed decision making**



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

Anja Feldmann, Oliver Gasser, Franziska Lichtblau, Enric Pujol, Ingmar Poesse, Christoph Dietzel, Daniel Wagner, Matthias Wichtlhuber, Juan Tapado, Narseo Vallina-Rodriguez, Oliver Hohlfeld, Georgios Smaragdakis

IMC 2020

# THE LOCKDOWN EFFECT: IMPLICATIONS OF THE COVID-19 PANDEMIC ON INTERNET TRAFFIC

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euronews.

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

*The New York Times*

## ***Working From Home: How Coronavirus Could Affect the Workplace***

**INSIDE**  
HIGHER ED

**Will Shift to Remote Teaching Be Boon or Bane for Online Learning?**

 REUTERS

**Under lockdown, Italy's social and family life goes virtual**

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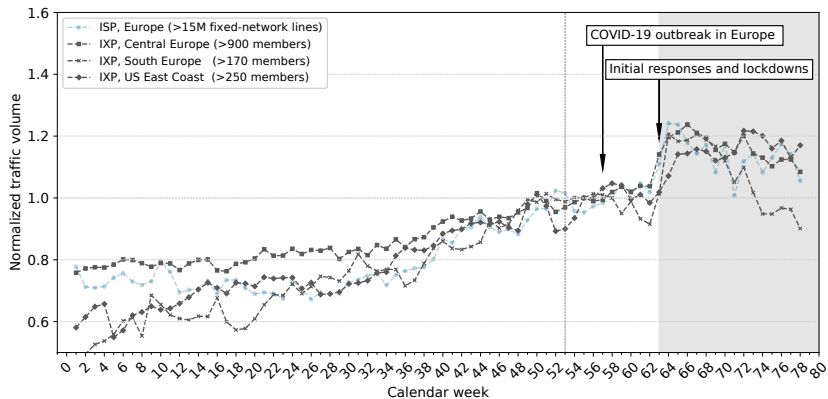
**Under lockdown, Italy's social and family life goes virtual**

The Internet is essential in all these efforts, but how did it react?



Once the lockdown started the ISP saw an **increase in traffic** which normally spans over multiple months.

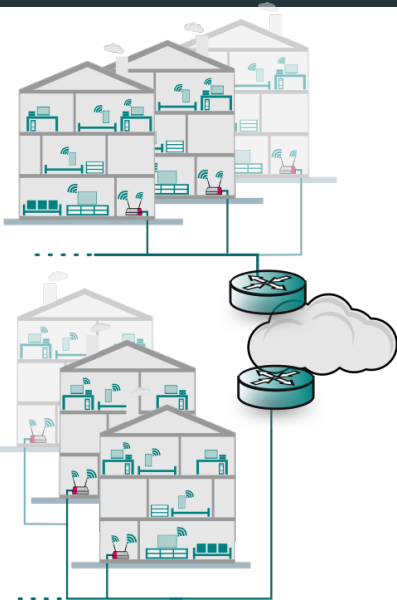
# TRAFFIC CHANGES JANUARY 2019 TO JUNE 2020





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

# WHY IS THE ISP A GOOD VP TO OBSERVE THE EFFECT OF COVID-19?

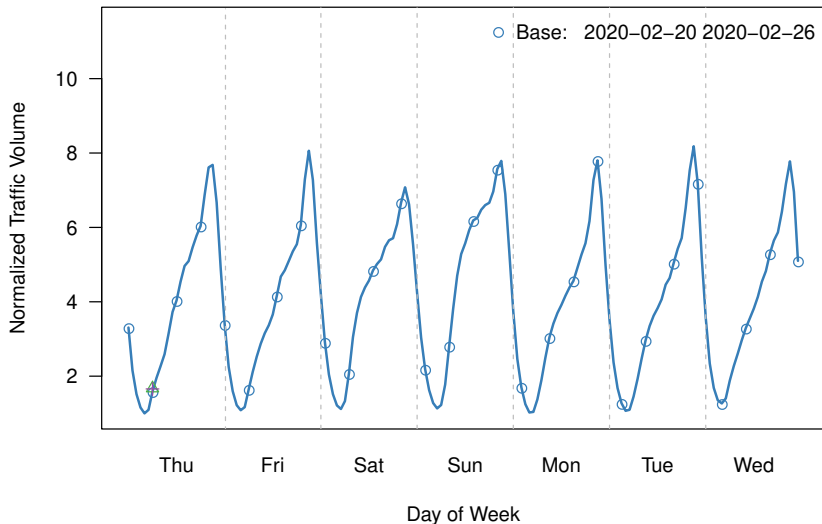


- Large customer base in central Europe
- Tier-1 ISP: cross-cut through society
- Possibility to filter for subscriber lines
  - End-user view
  - Small business view
- Operates in the same region as the IXP: Augments view<sup>a</sup>

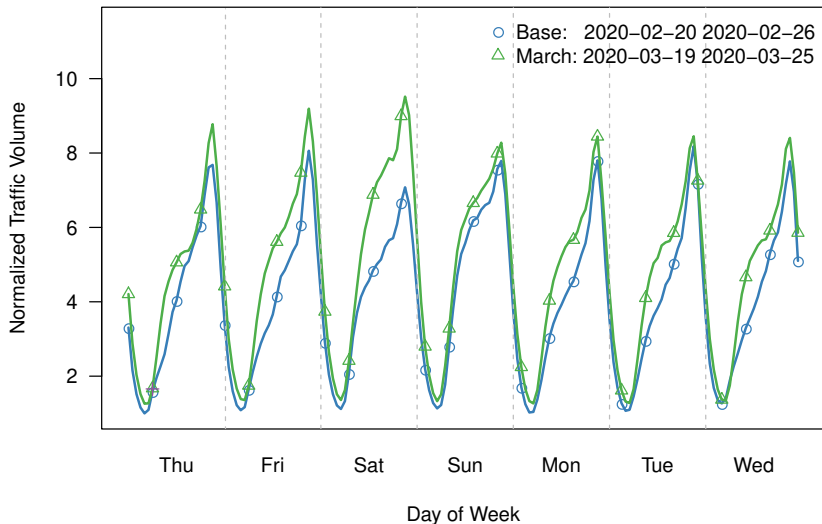
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<sup>a</sup> This presentation is limited to the ISP perspective on COVID-19. More details are provided in the IMC'20 paper.

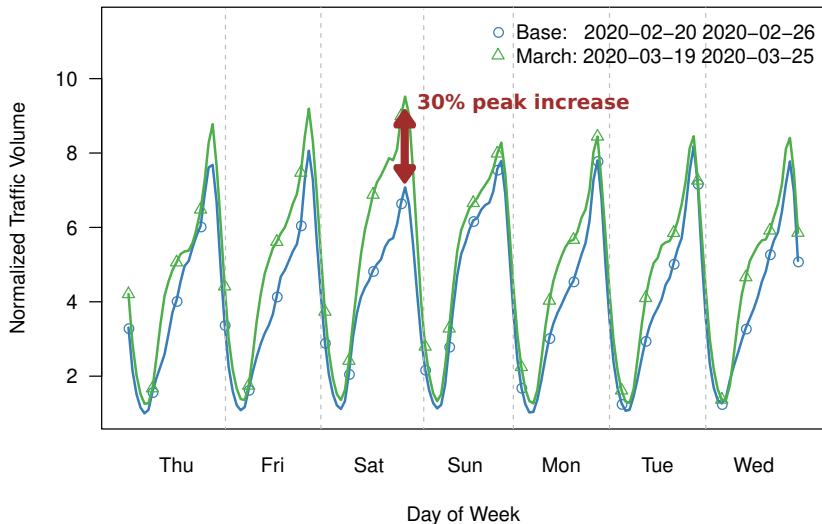
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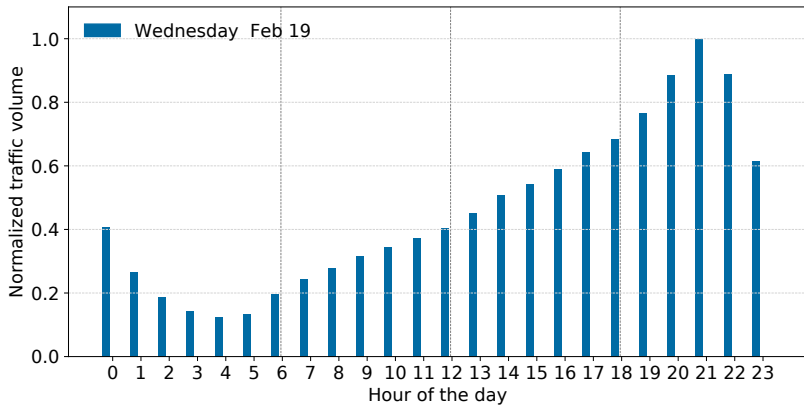
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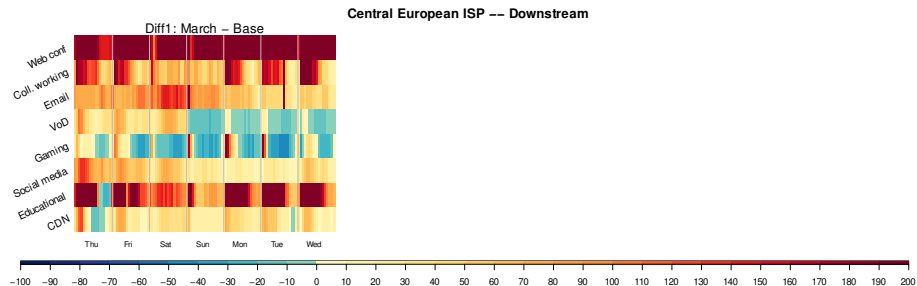
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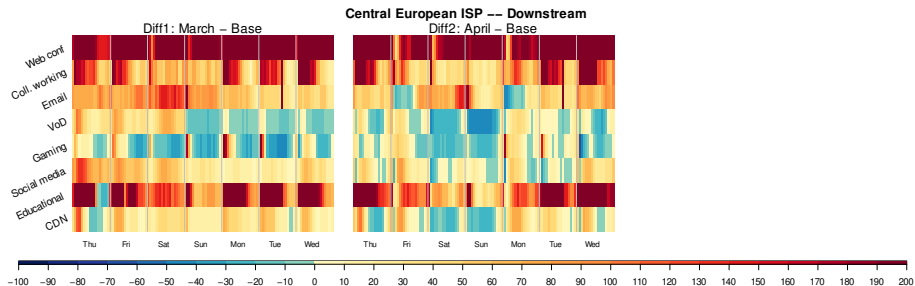
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  - Workday: Strong increase in evening hours
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- During pandemic: Workdays look more like weekends.

# CHANGES IN APPLICATION CLASSES: CENTRAL EUROPEAN ISP



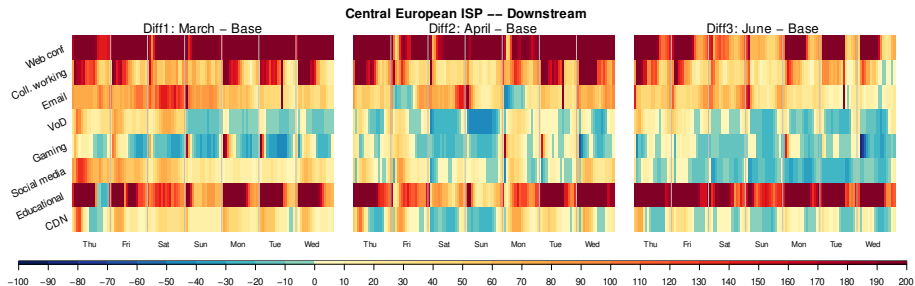
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- Large increase in **web conferencing**, **collaborative working**, and **educational traffic**

## June:

- **Web conferencing** still growing, but more focused on **working hours**
- Moderate growth in **collaborative working**

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We find that the impact of the COVID-19 pandemic is directly reflected in changes to Internet traffic patterns.

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Networks can accommodate sudden changes in demand if they're planned with spare capacity and quick reaction times.