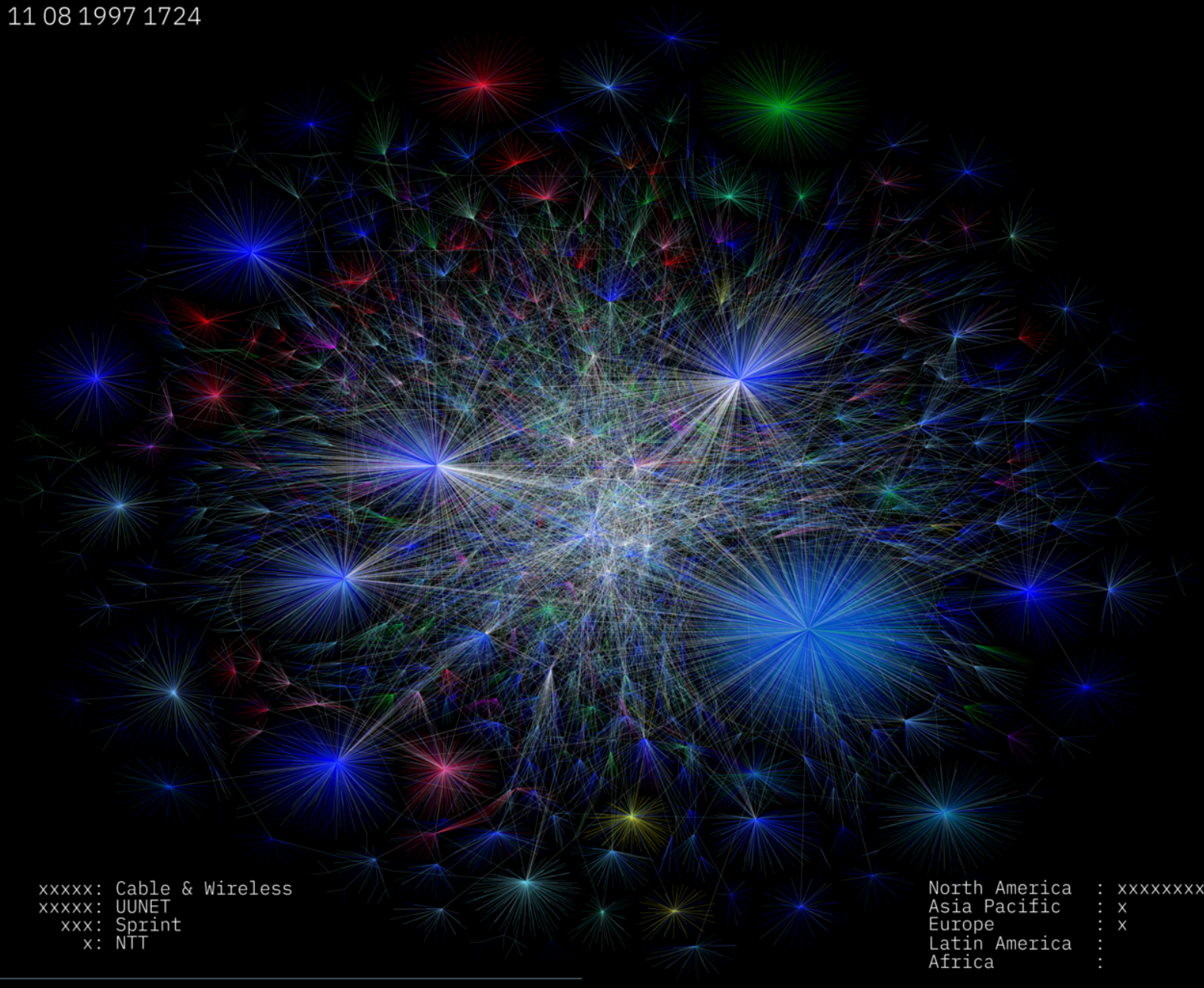
SHEDDING LIGHT IN THE DARK - THE IMPORTANCE OF INTERNET MEASUREMENTS

Franziska Lichtblau

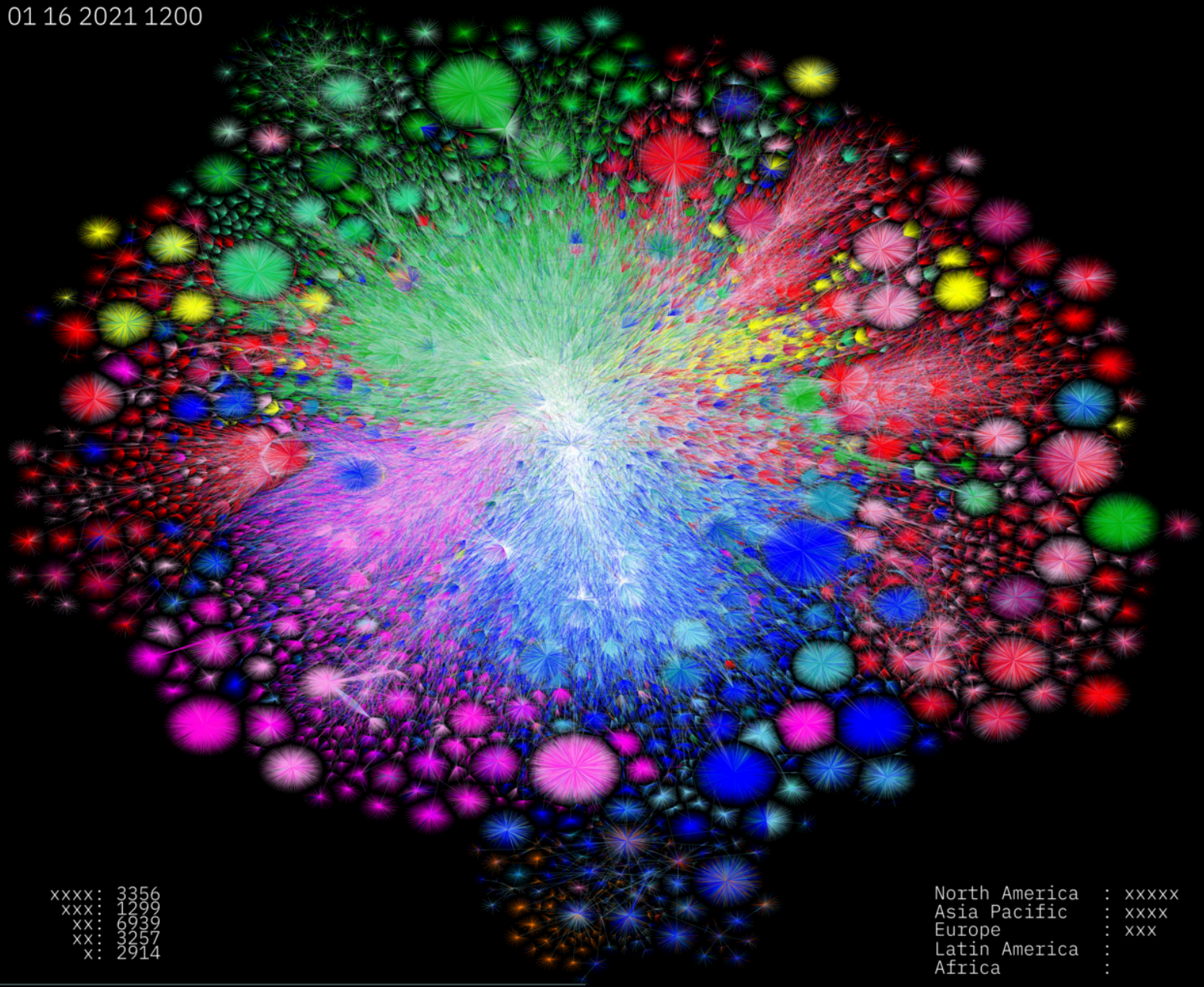
The Internet has shown an unprecedented growth over the last decades.

GLOBAL ROUTING TABLE 1997[1]



[1] *https://www.opte.org*

GLOBAL ROUTING TABLE 2021[2]



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THE INTERNET IS CRITICAL

Internet of Things

Event Organization

Ride Sharing

Highspeed Trading

Telephony

Remote Work

Industrial Automation

Online Banking

Goverment Services

Online Gaming

Streaming Services

Home Automation

News

This presentation

CHALLENGES IN THE MODERN INTERNET

Service availability

Global service coverage

Data integrity

Communication security

Reaction to new demands

INTERNET MEASUREMENT

Distributed system → no single source of truth

Constantly evolving

Multi-stakeholder model

Initial design does not focus on measurability

CHALLENGES IN INTERNET MEASUREMENT

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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Measuring the correct variables

Deploying adequate hardware

Dealing with personal data

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

Vantage points

TWO PERSPECTIVES

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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.

DATA PLANE VANTAGE POINTS IN MY PREVIOUS RESEARCH

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 *IPFIX* (IXPs) and *NetFlow* (ISP) and always kept on-premise.

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

DATA PLANE DATA SANITATION

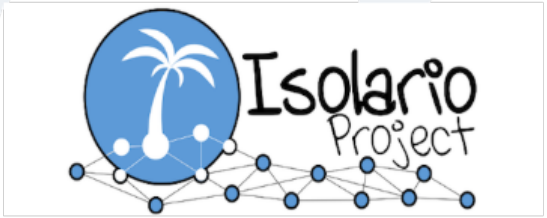
Very vantage point specific $\rightarrow$ relies on specifics about the traffic collection and physical infrastructure which can introduce artifacts:

- 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

CONTROL PLANE DATA SANITATION

Every BGP speaker is responsible for their announcements

↓

many unexpected artifacts in the wild:

Every BGP speaker is responsible for their announcements

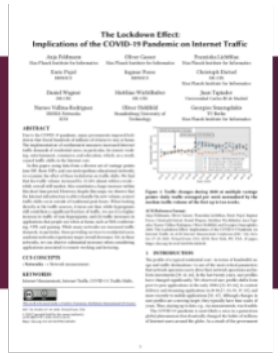
↓

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 Poese, Christoph Dietzel, Daniel Wagner, Matthias Wichtlhuber, Juan Tapiador, Narseo Vallina-Rodriguez, Oliver Hohlfeld, Georgios Smaragdakis

IMC 2020

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

COVID-19 AND THE INTERNET

euronews.

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

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INSIDE HIGHER ED

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

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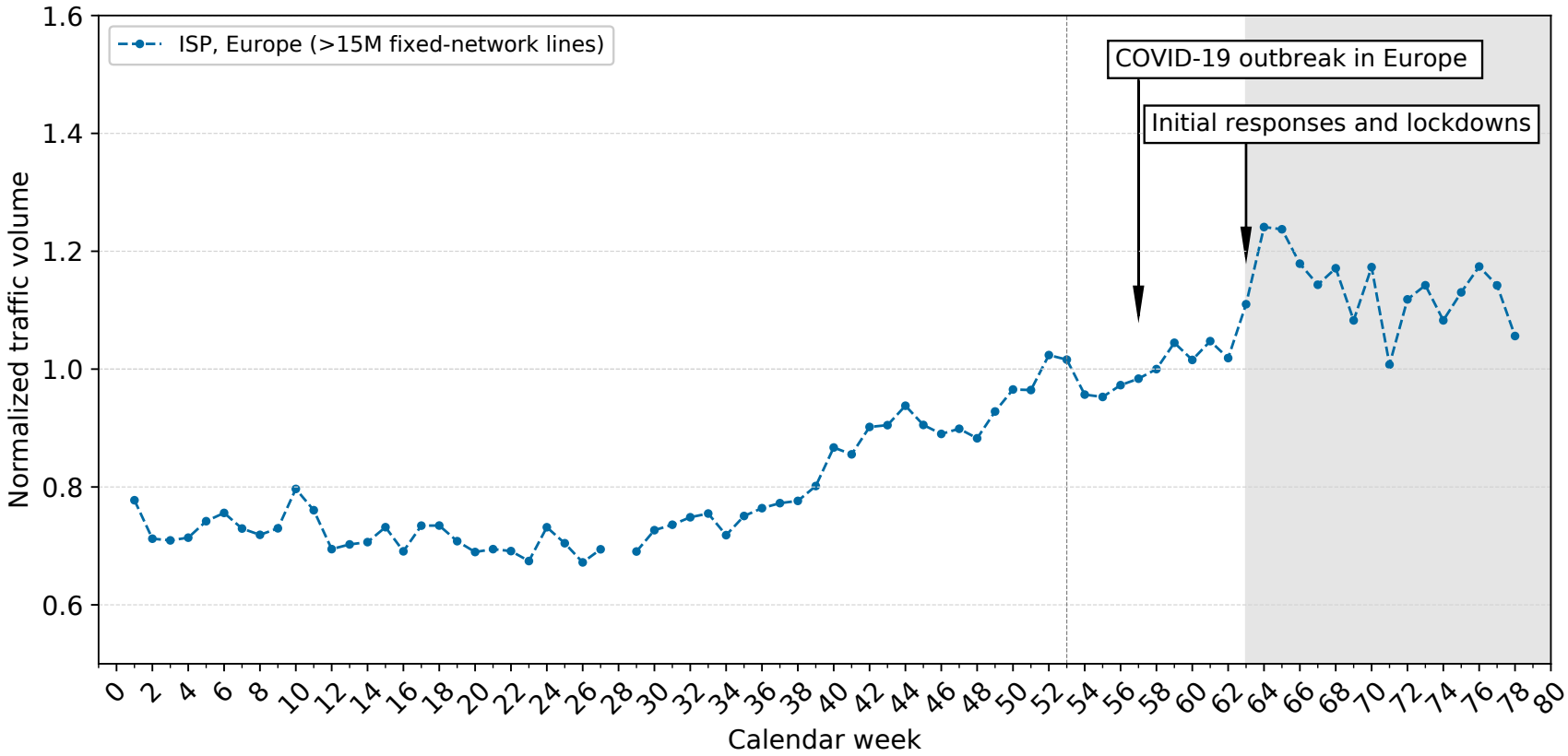
The Internet is essential in all these efforts, but how did it react?

TRAFFIC CHANGES JANUARY 2019 TO JUNE 2020



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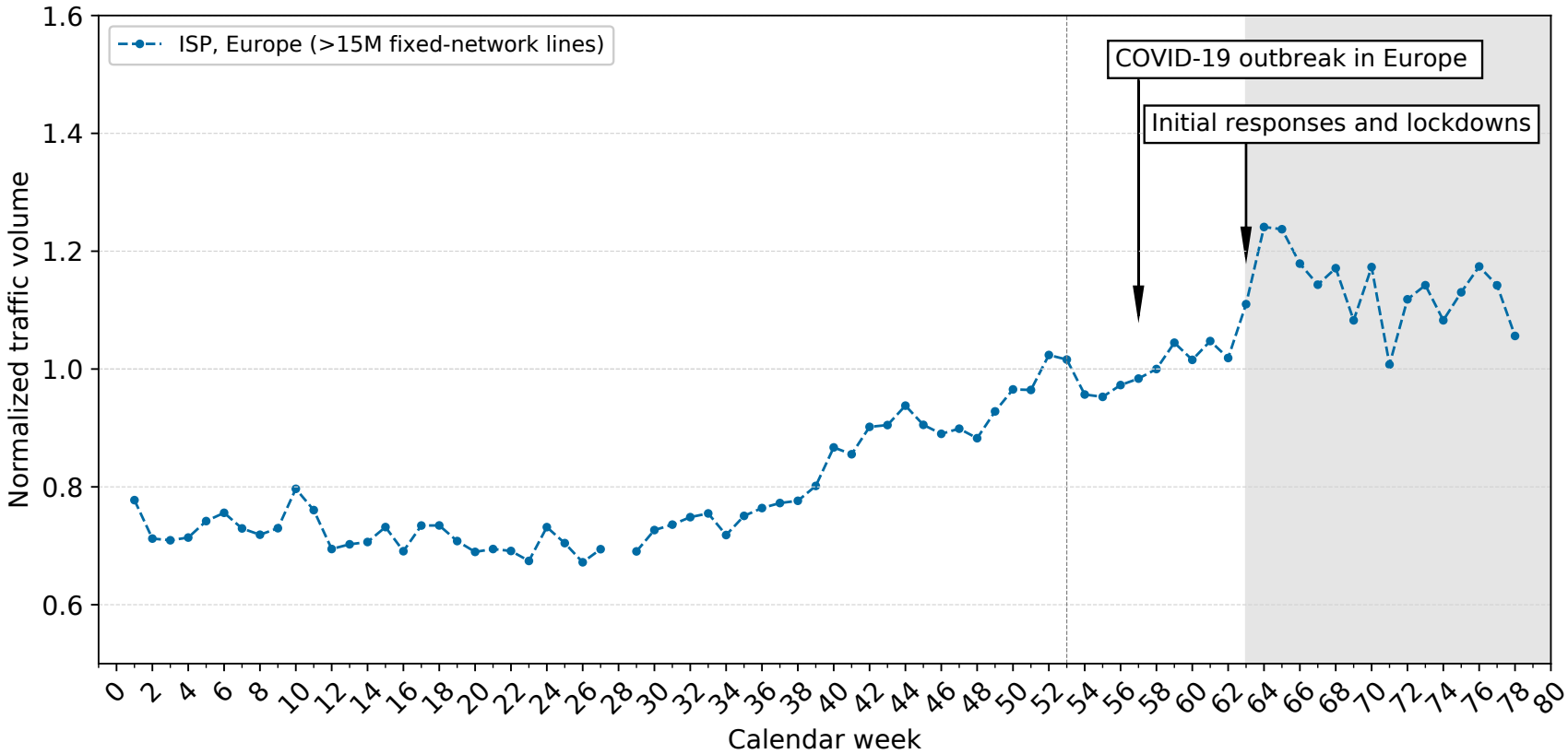

Once the lockdown started the ISP saw an increase in traffic which normally spans over multiple months.

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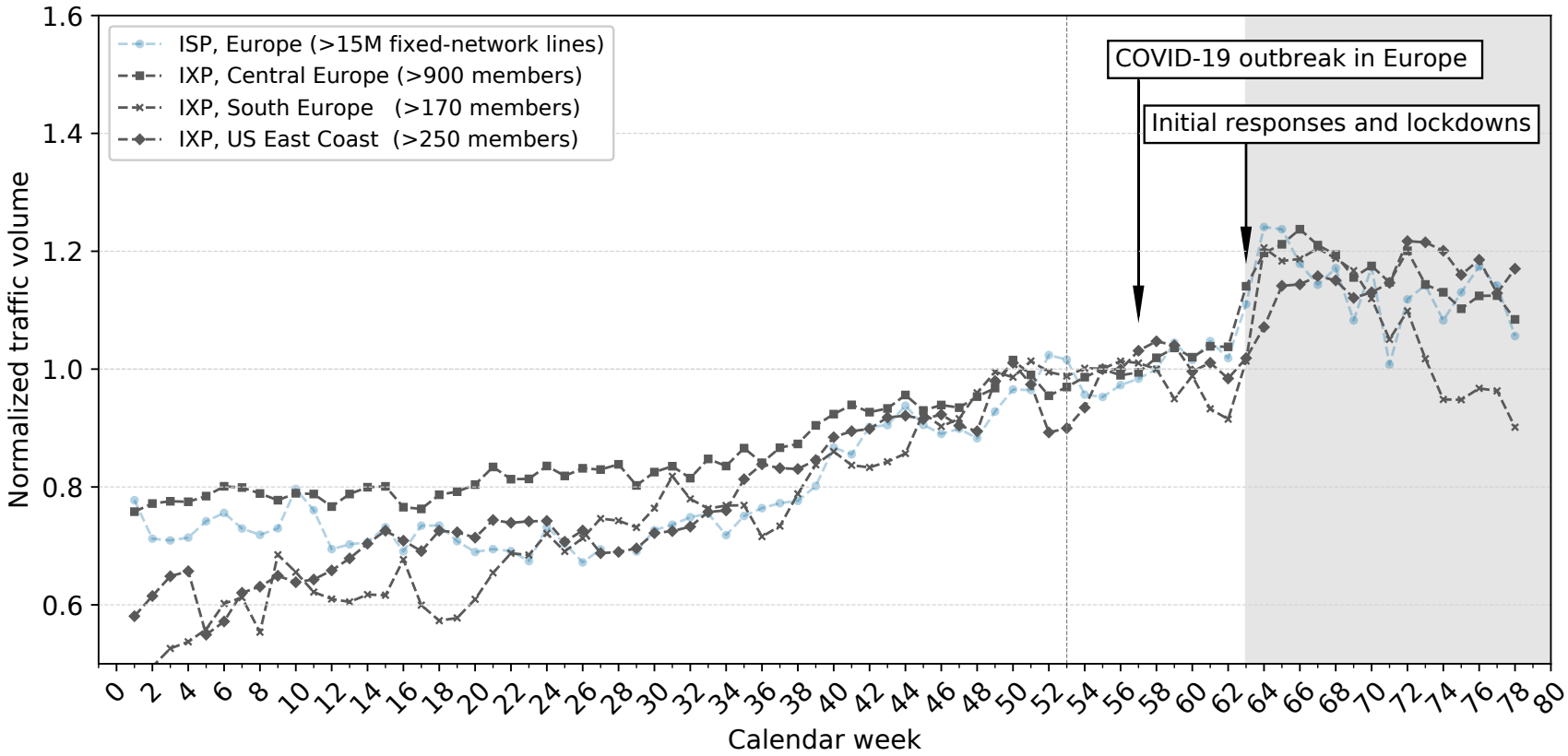

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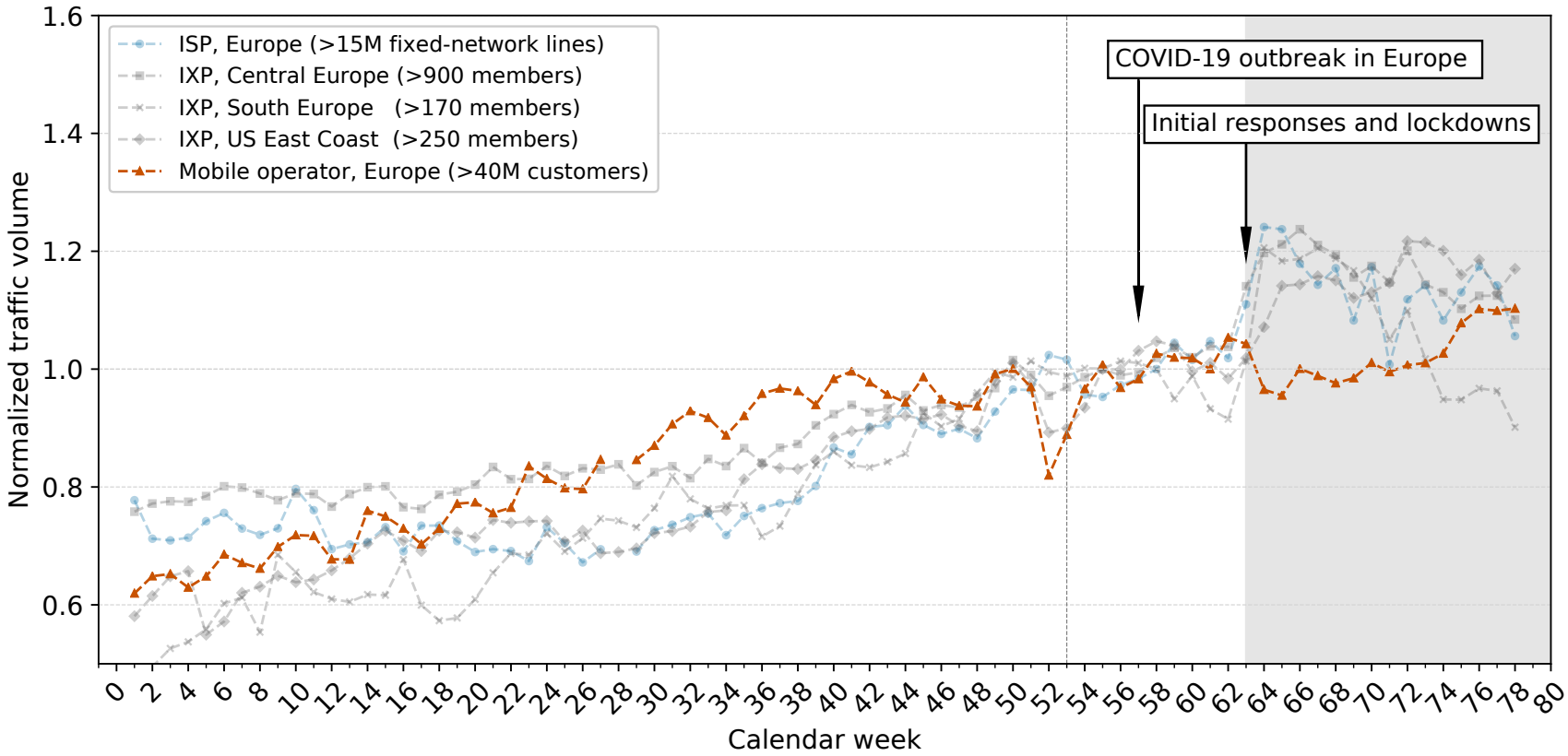

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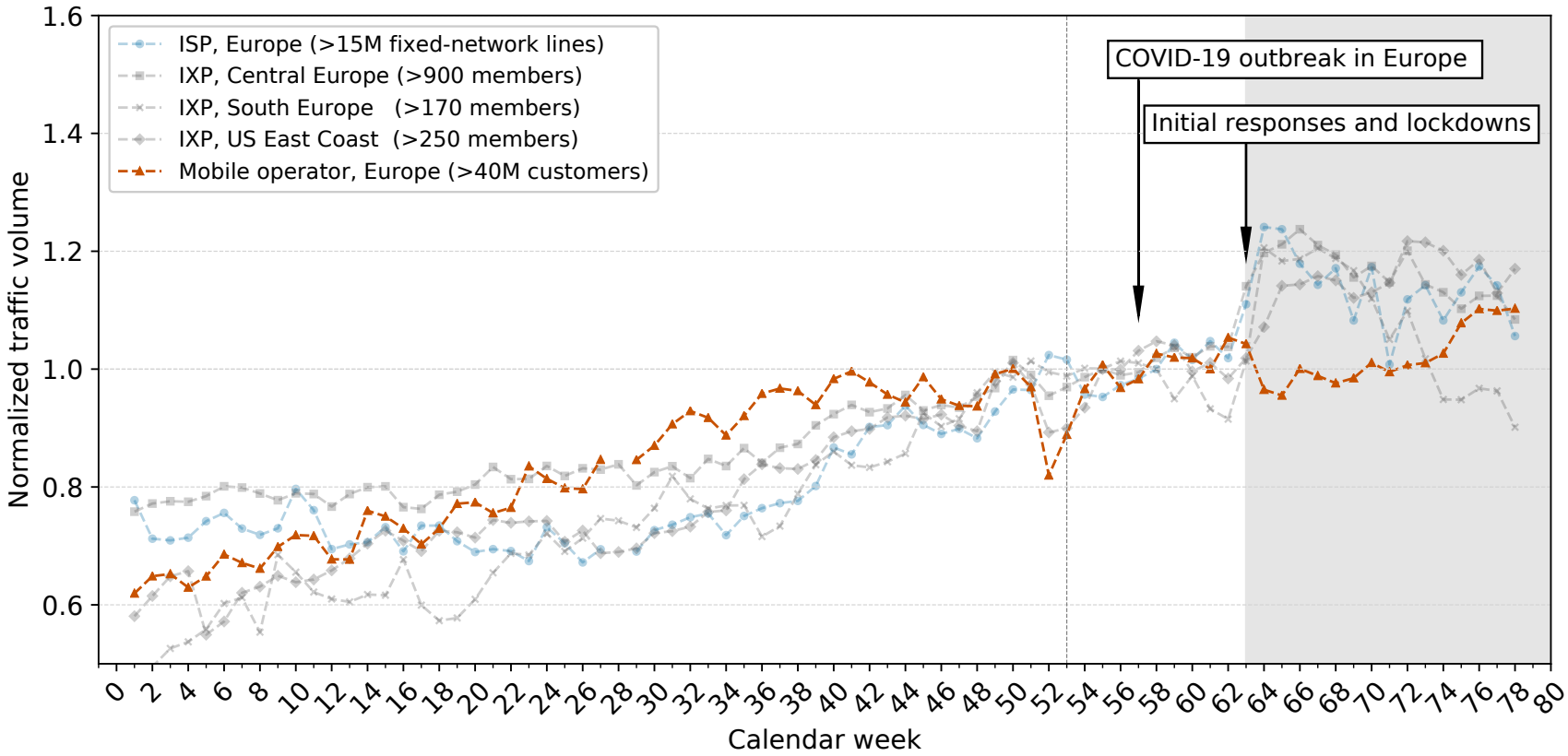


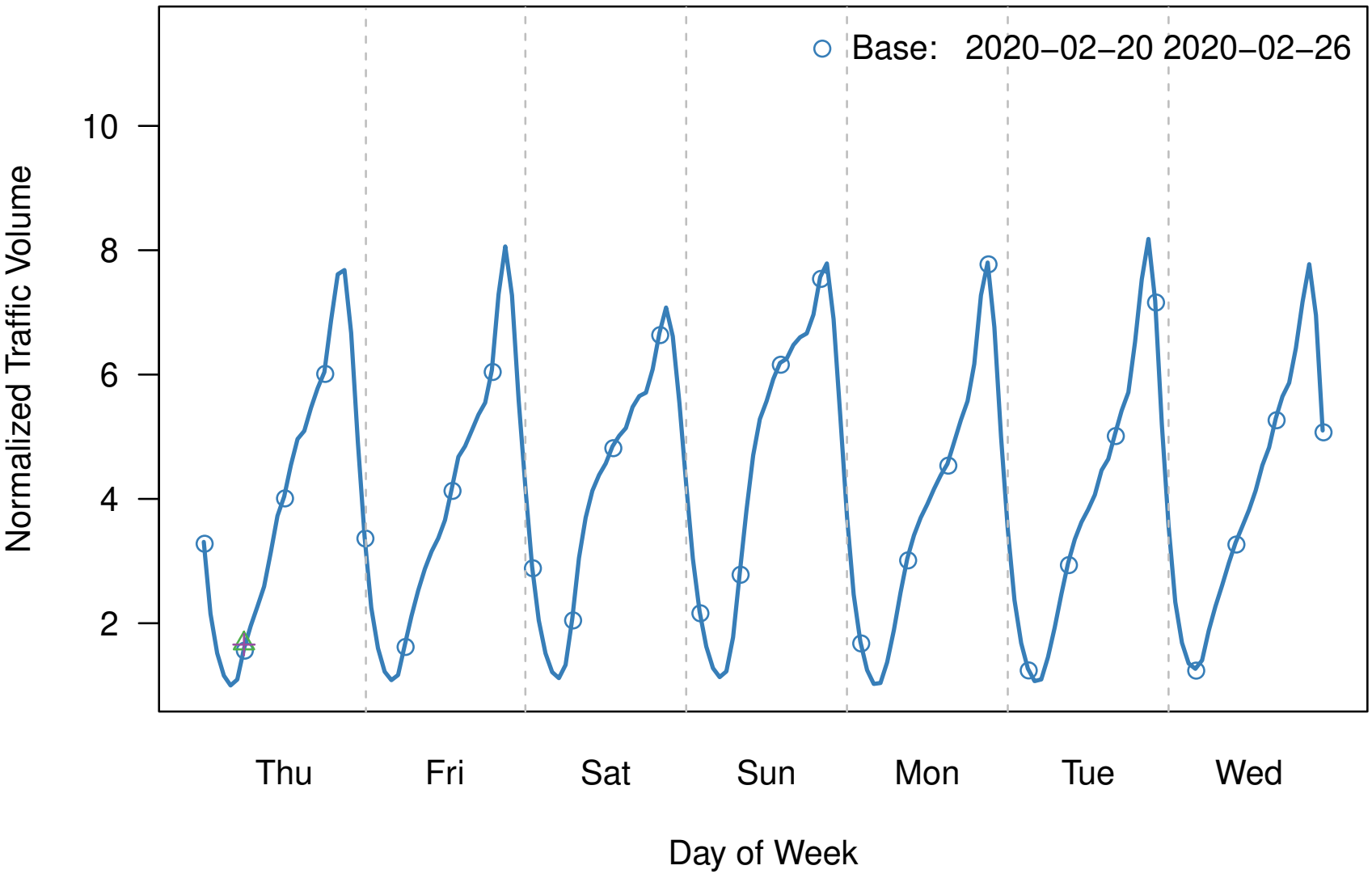
Once the lockdown started mobile traffic decreased measurably and increases with the first relaxations in mid April.

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[a]

[a] This presentation is limited to the ISP perspective on COVID-19. More details are provided in the IMC'20 paper.

ISP TRAFFIC VOLUME DEVELOPMENT IN THE FIRST COVID WAVE (2020)



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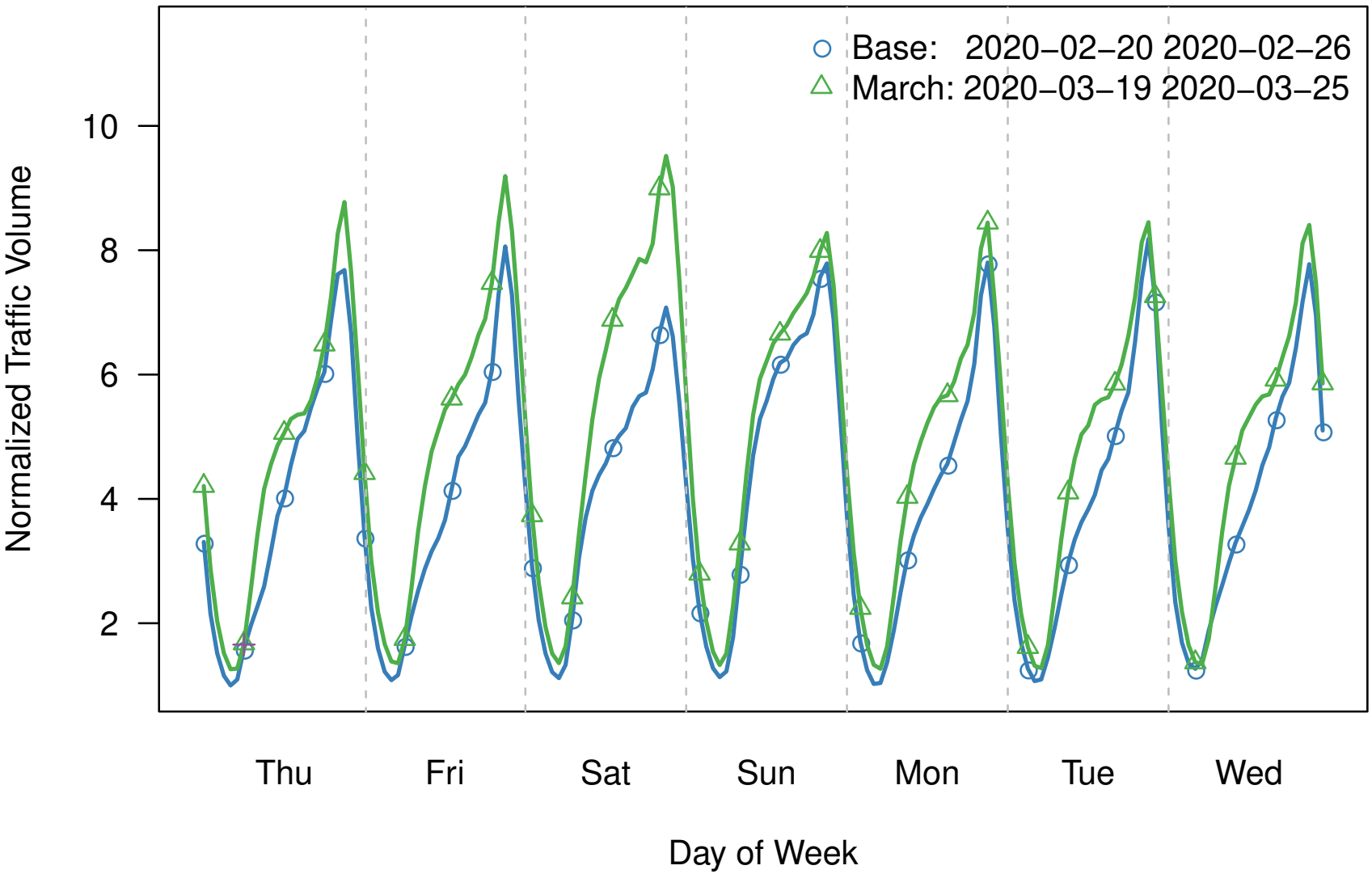

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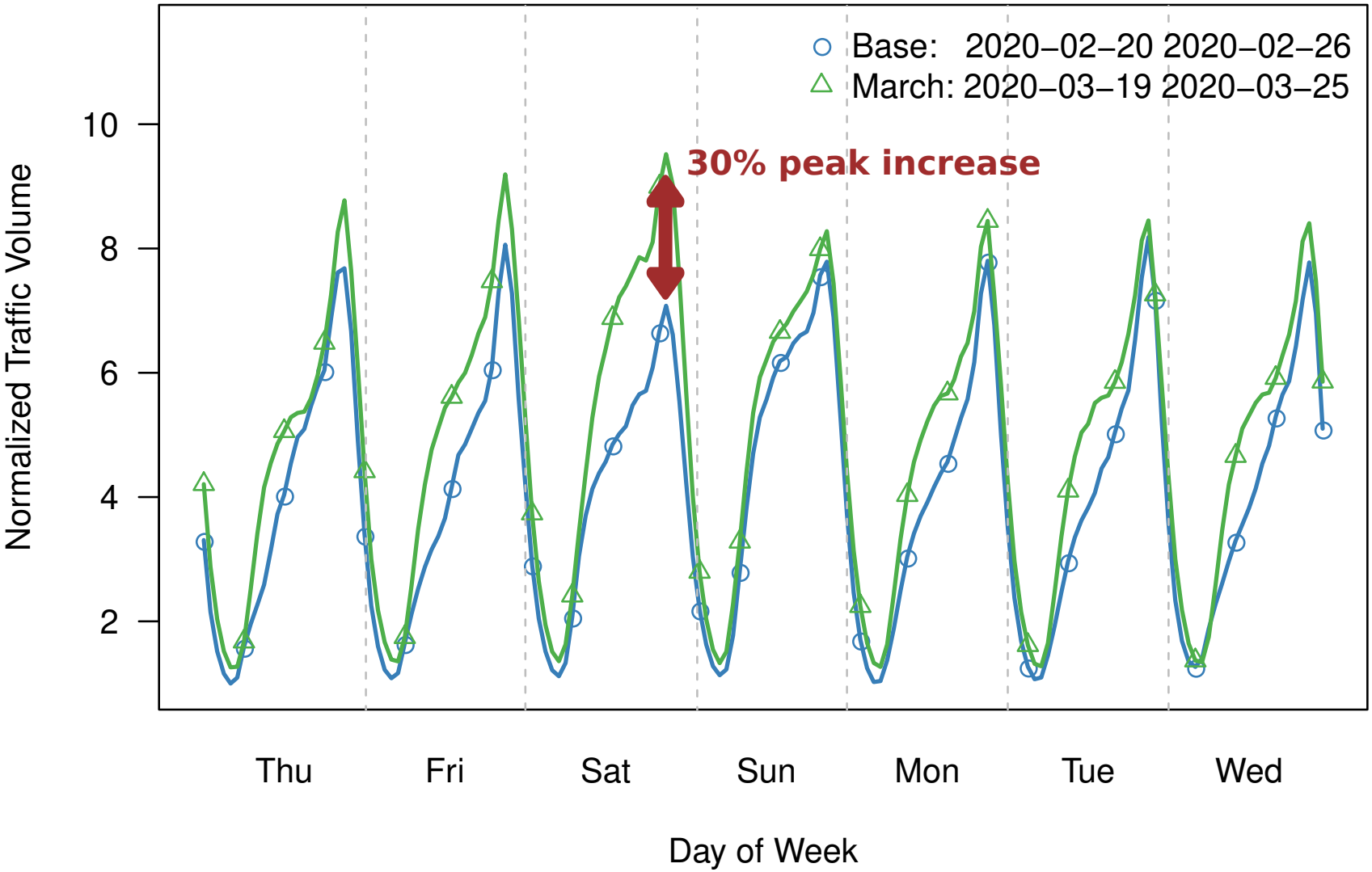
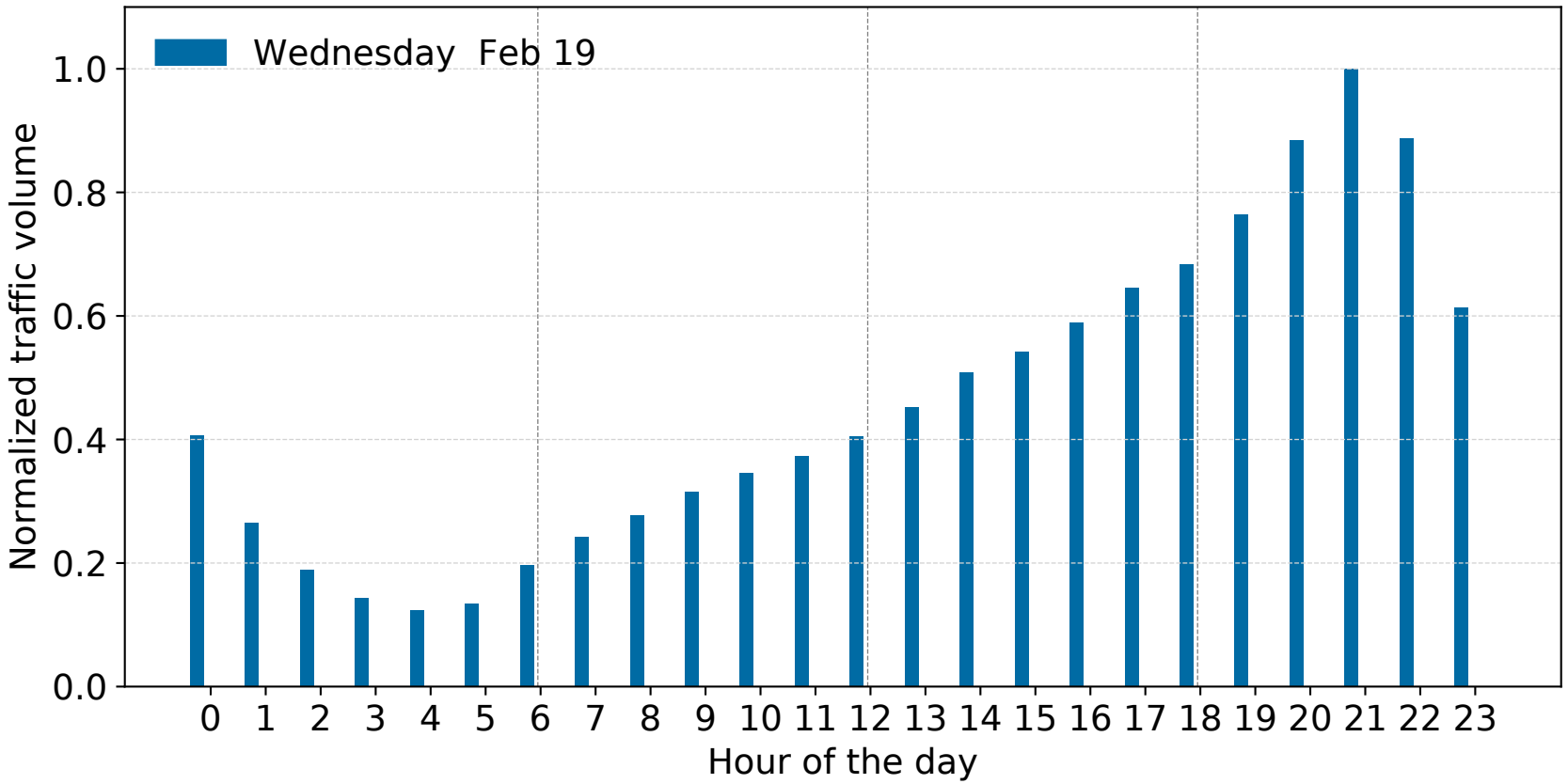


LOCKDOWN: CHANGE IN WORKDAY VS. WEEKEND PATTERN (ISP)



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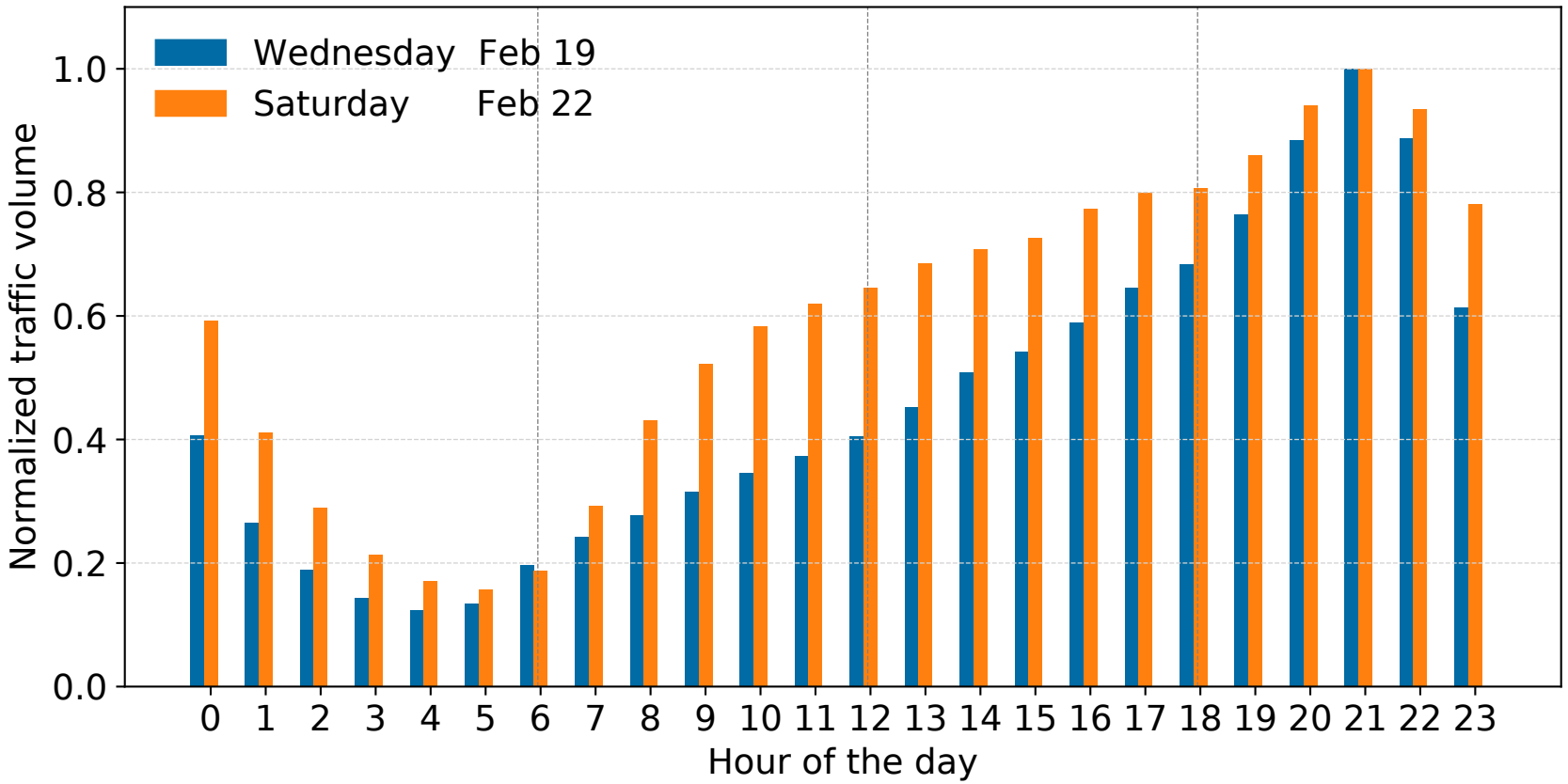

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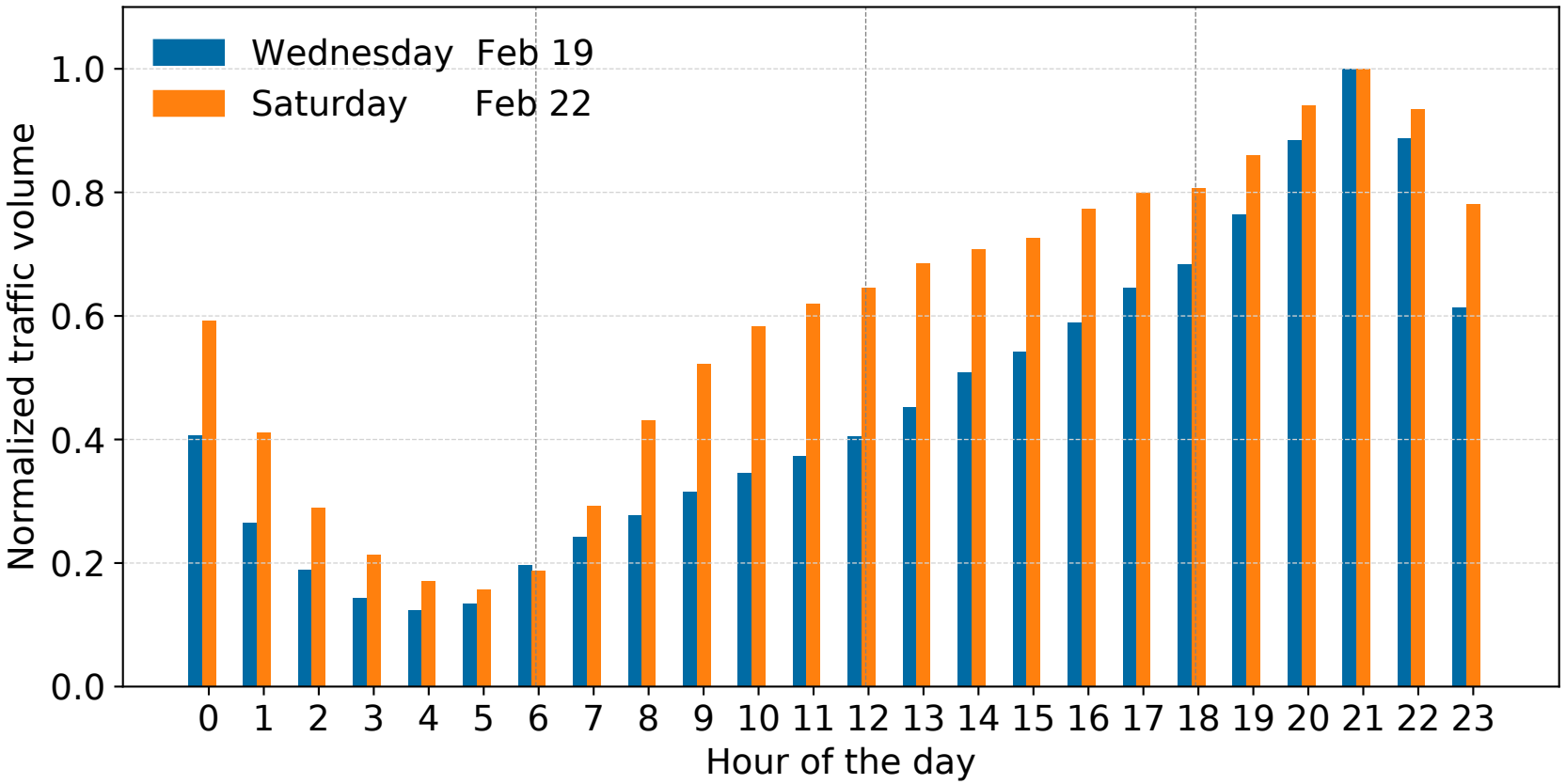

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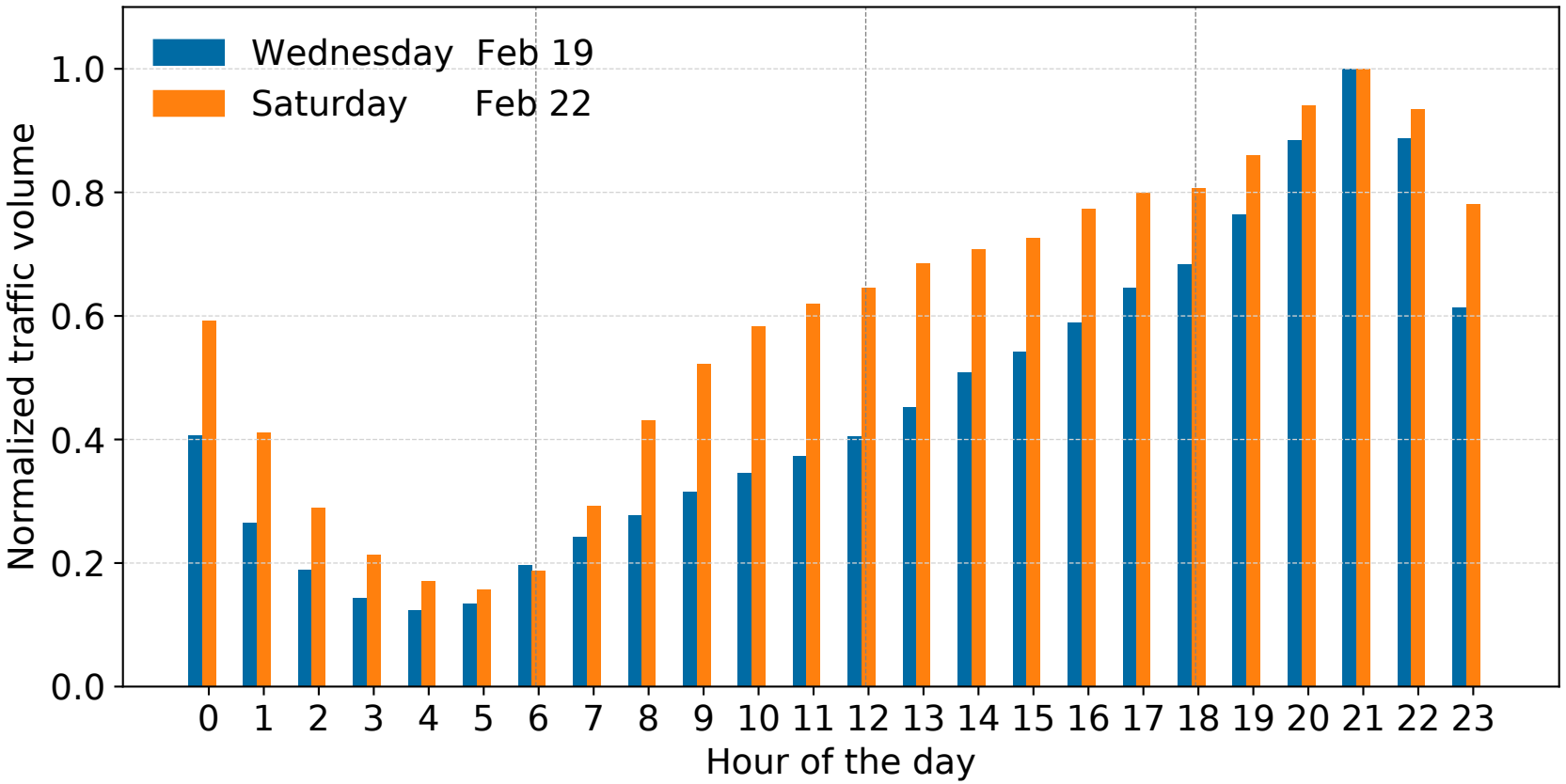

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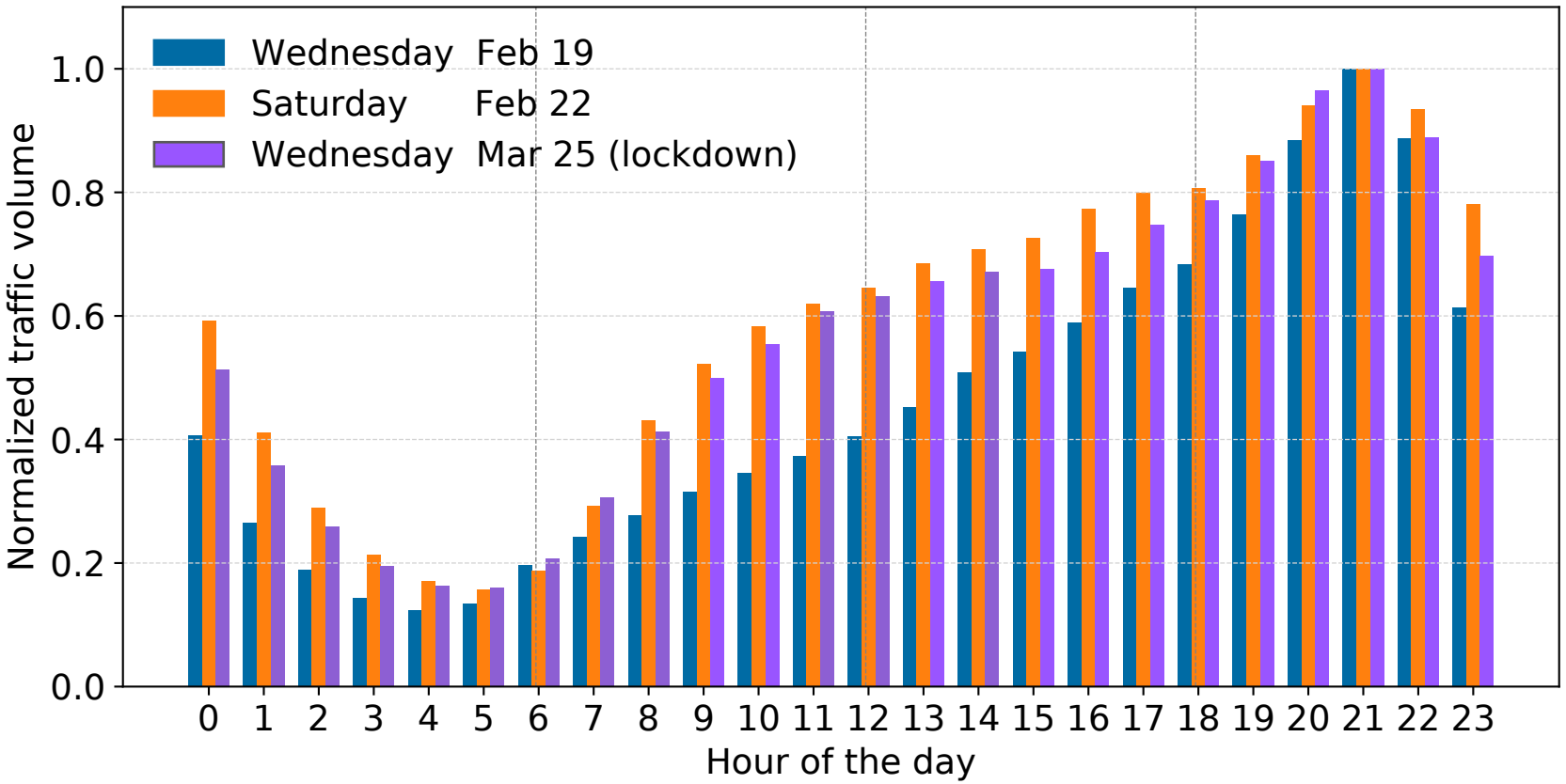

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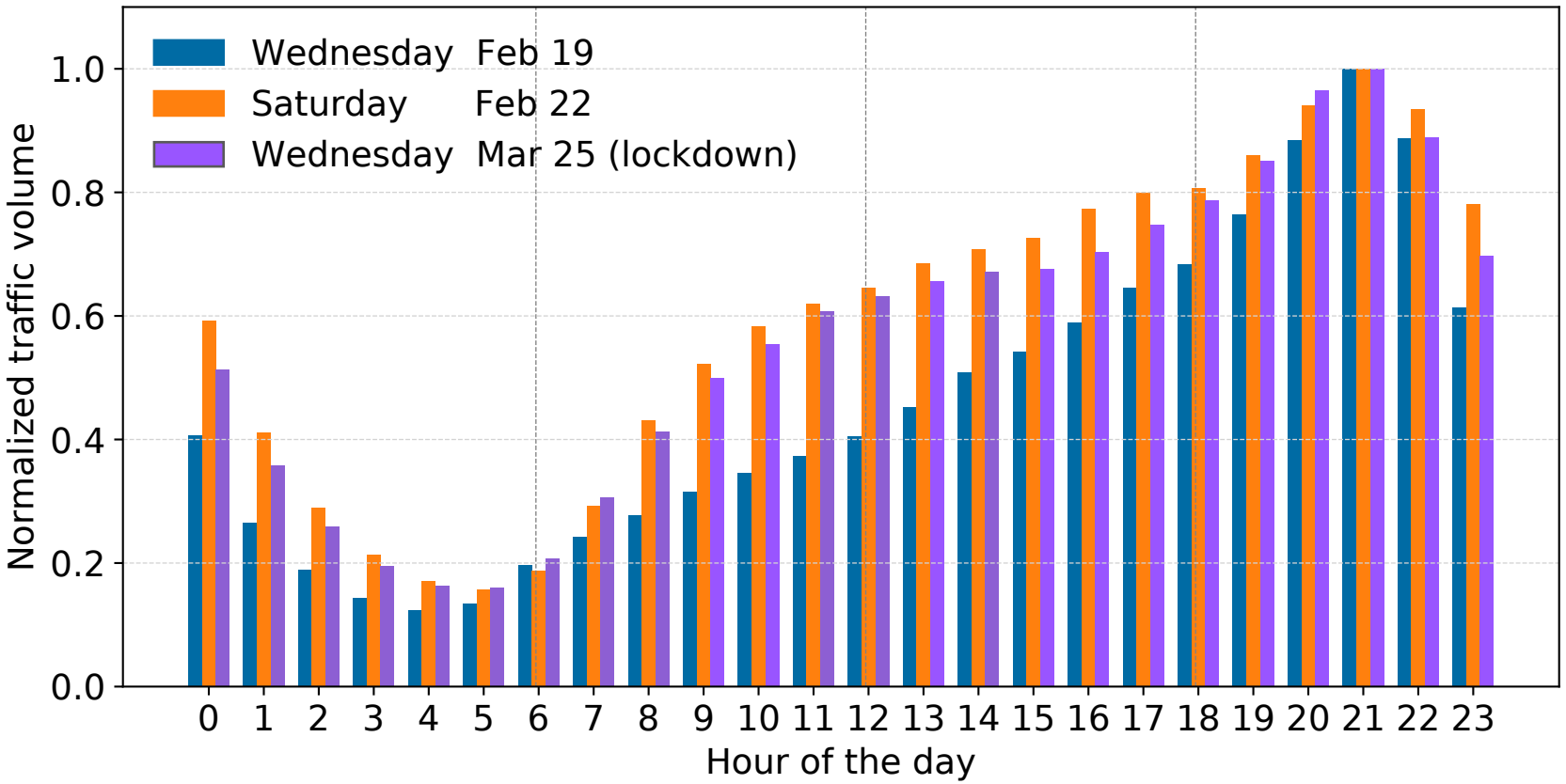

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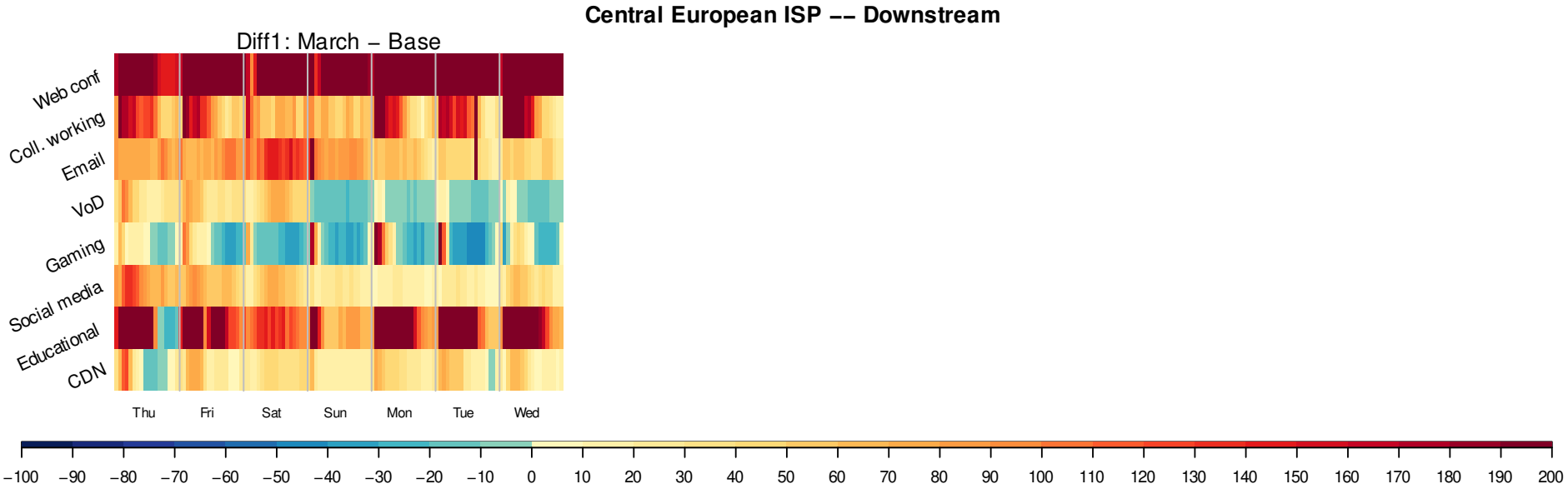
- During pandemic: Workdays look more like weekends.

CHANGES IN APPLICATION CLASSES: CENTRAL EUROPEAN ISP



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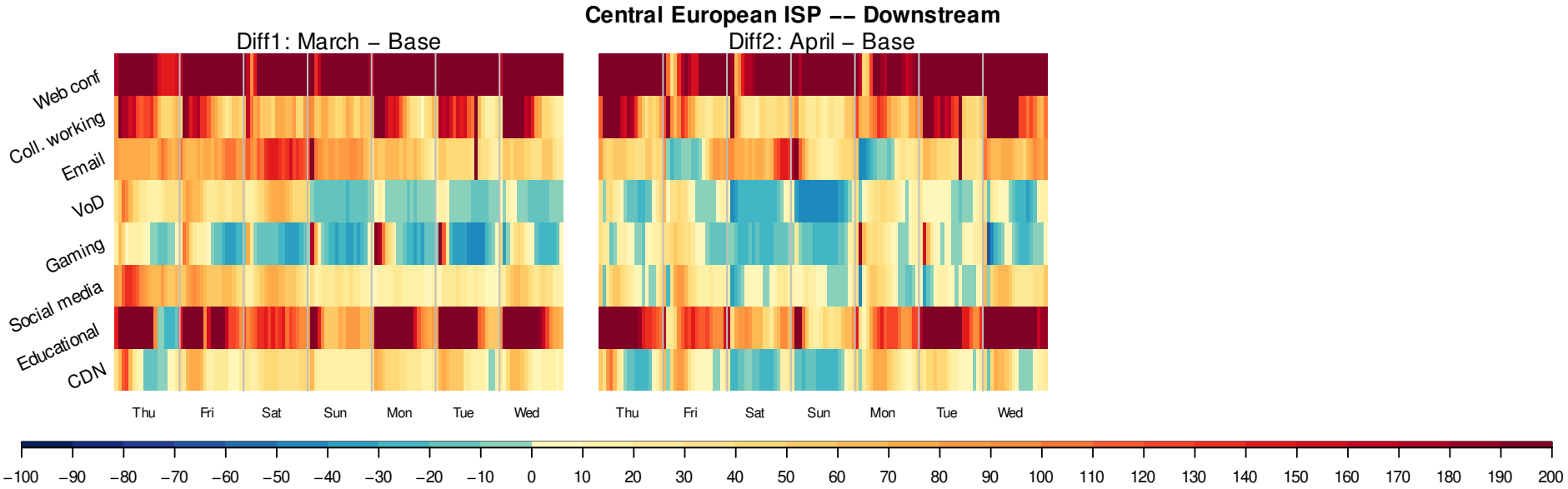

March & April:

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

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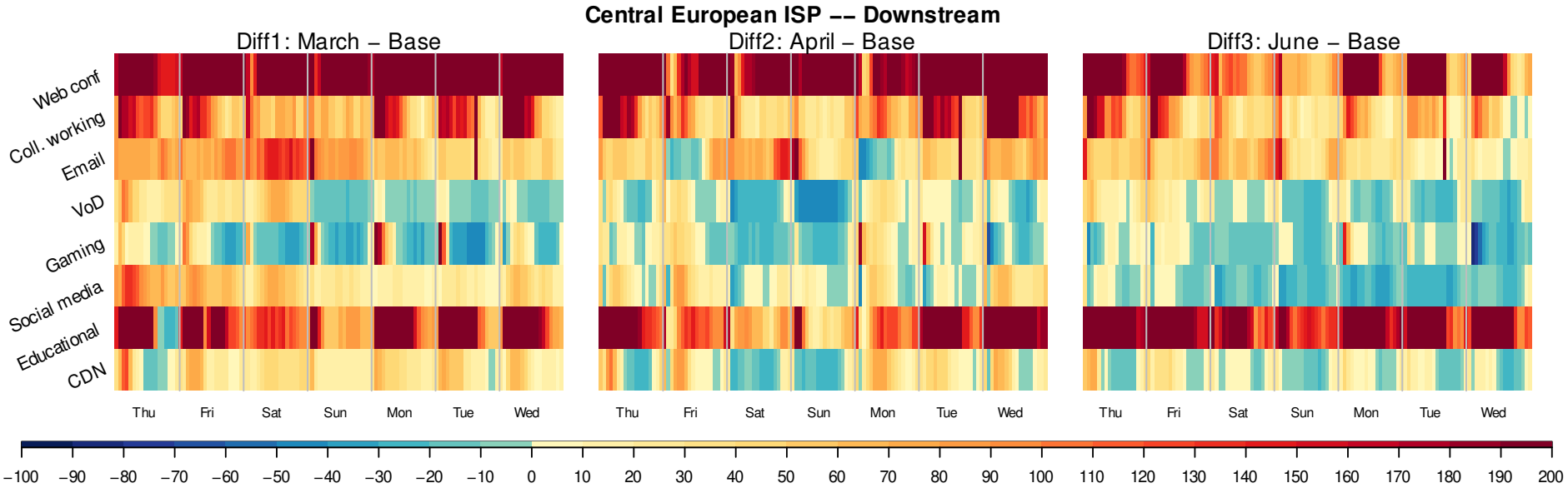

March & April:

- 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

PEOPLE CHANGE → TRAFFIC CHANGES

- Changes in people's lives lead to new traffic patterns

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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 usually provision for ≈30% increase per year

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