Developing a Holistic Internet Outage Measurement System

🗂️ Digital Vigilance
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A Holistic Approach to Investigating Internet Outages

Apply existing approach to new use case

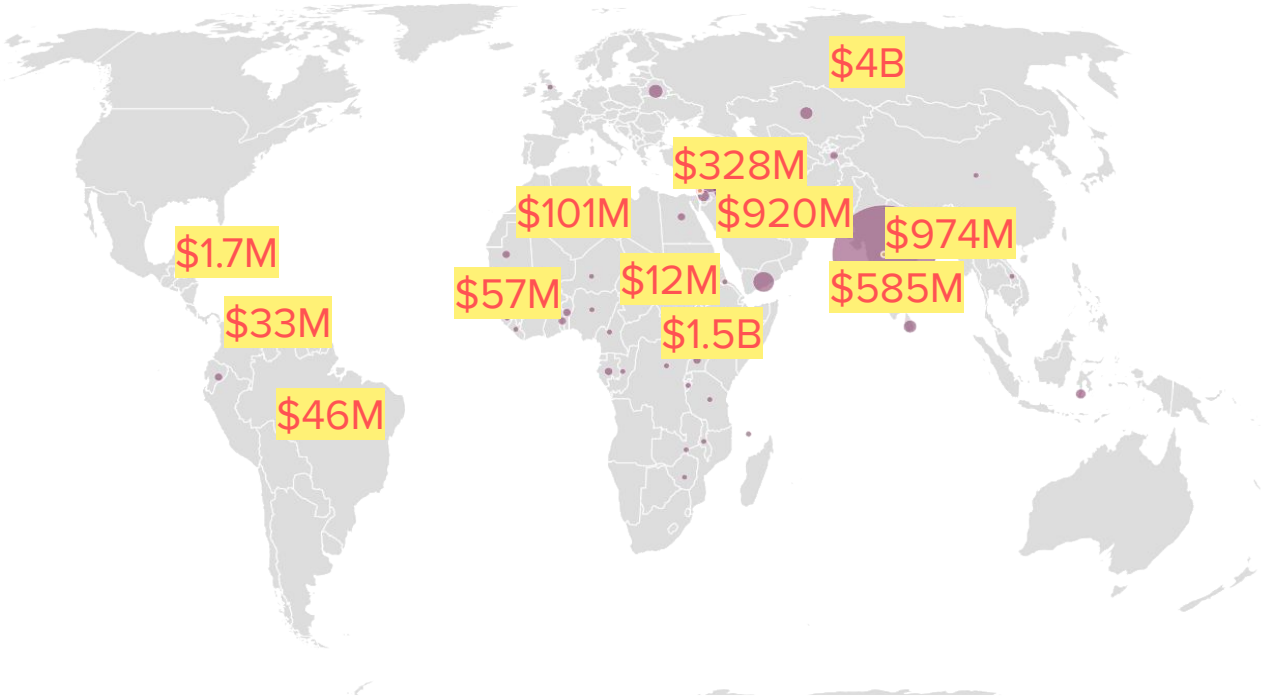
- Marx, R., et al. (2021) “Merge Those Metrics: Towards Holistic (Protocol) Logging.”
- Herbots, J., et al. (2023) “Vegvisir: A testing framework for HTTP/3 media streaming.”
- Vandersanden, M. (2023) “A Holistic Approach to Understand HTTP Adaptive Streaming.”

Supported by the Internet Society Pulse Fellowship

“… better understand the **availability**, **evolution**, and **resilience** of the Internet.”

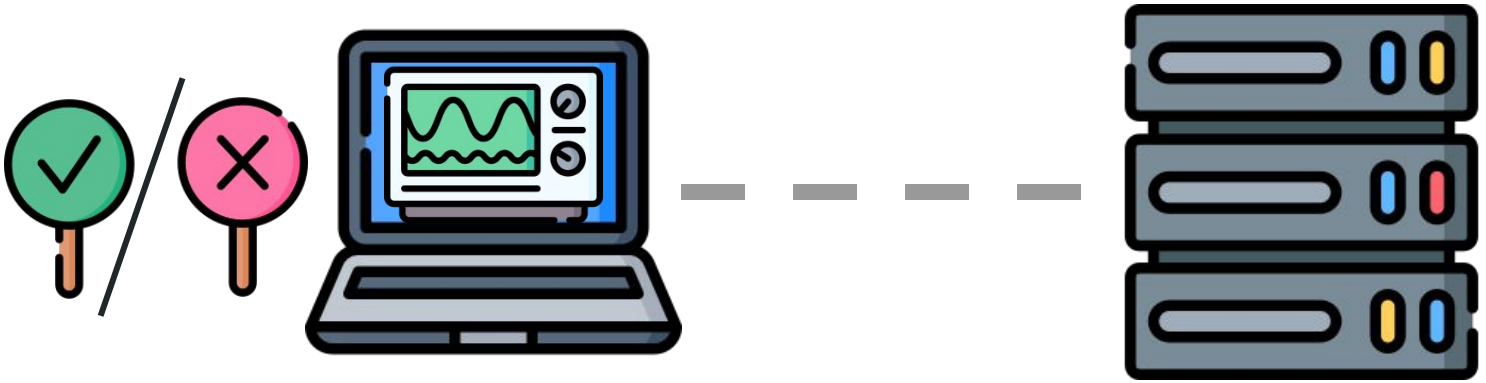
The **Internet** is **crucial infrastructure**, that experiences **frequent interruptions** with a worldwide **social** and **economic impact**

CC	Outages?
BE	✅
NL	✅
DE	✅
CN	✅
IN	✅
US	✅
…	✅

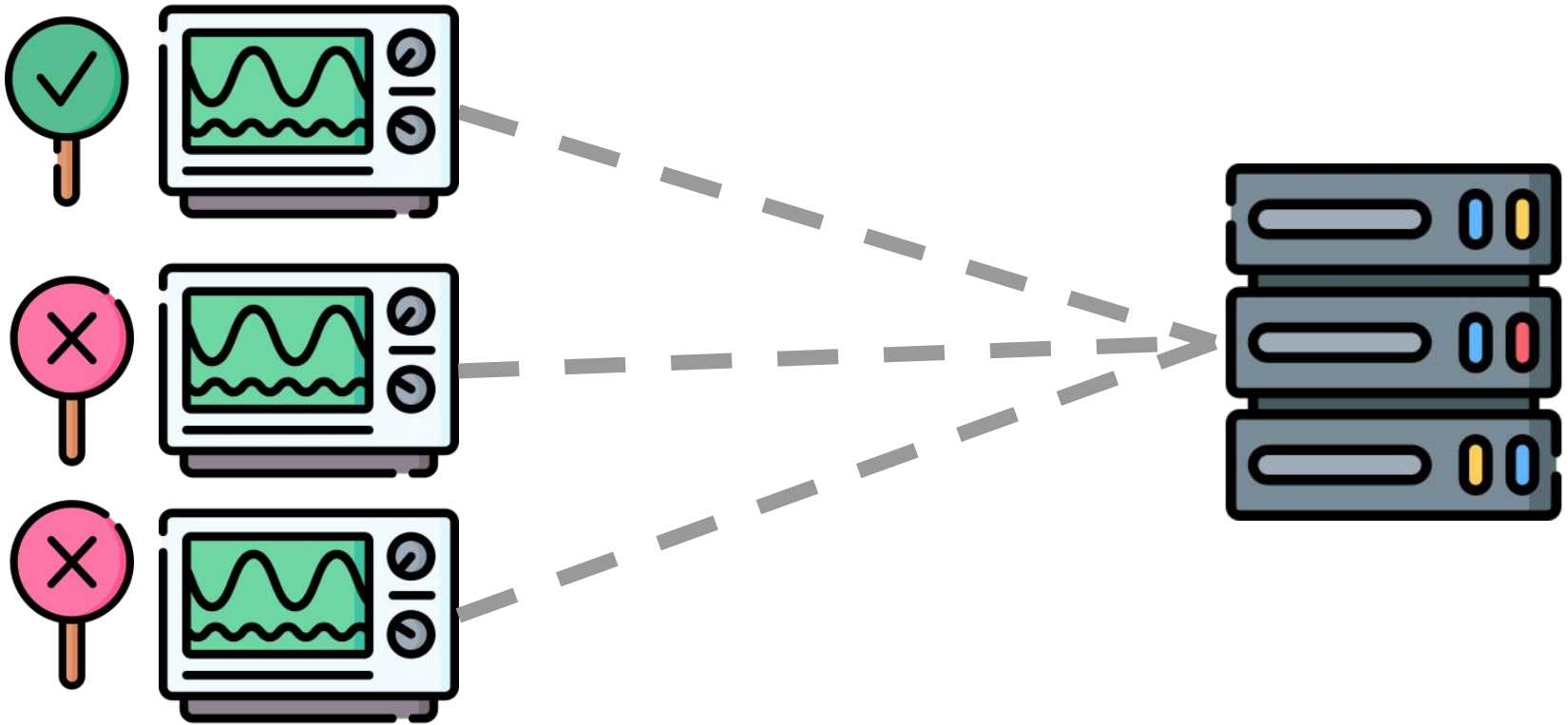


Sources: Samuel Woodhams & Simon Migliano: Internet Shutdowns 2023 Data Sheet
Pulse Internet Society: Global Internet Shutdowns

Check the pulse



Many measurements, many varying results



Holistic Knowledge Base

RIPE Atlas

Measures
- connectivity
- reachability
- performance

IODA

Measures
- connectivity
- reachability
- performance

Tracks outages

CloudFlare Radar

Measures
- performance
- usage

Tracks outages

OONI

Measures
- connectivity
- reachability
- performance

Tracks censorship

Holistic Knowledge Base

Measures
- connectivity
- reachability
- performance
- usage

Tracks outages and censorship

Leverages the **diverse characteristics** of the various data sources

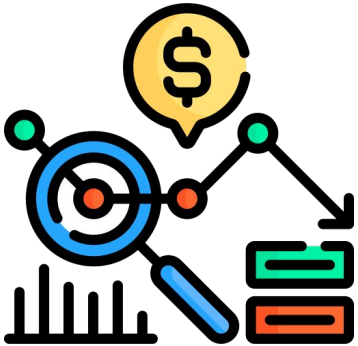
Goals of a holistic system

1. **Inform**

Present a clear view of the aggregated data

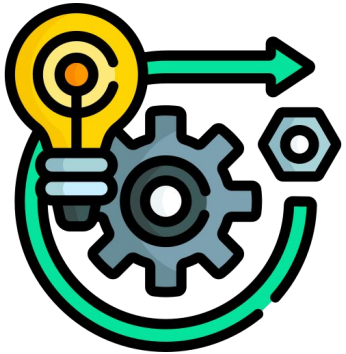
2. **Aid analysis**

Facilitate a manual analysis process, allow valuable insights into the data



3. **Take action**

Automate the analysis process, react to outage events



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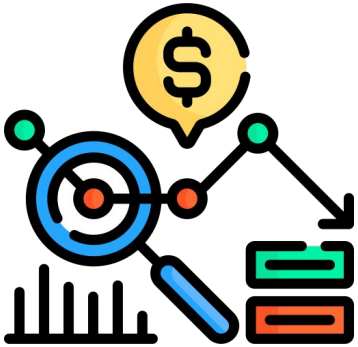
Current Focus



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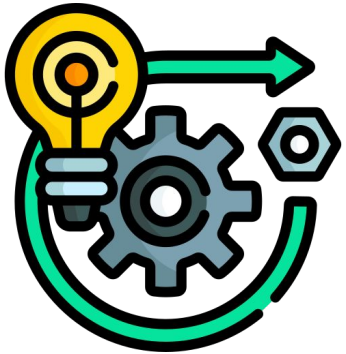


Before holistic system

Heterogeneous interfaces

IODA

Query: from, until, entity_code

Result: start, duration, location, datasource

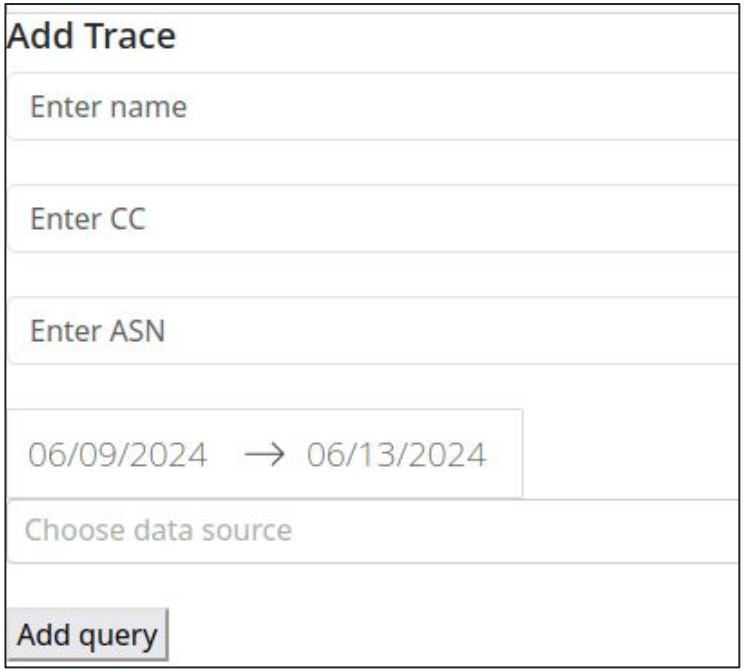
Cloudflare

Query: dateStart, dateEnd, location

Result: startDate, endDate, asns, dataSource

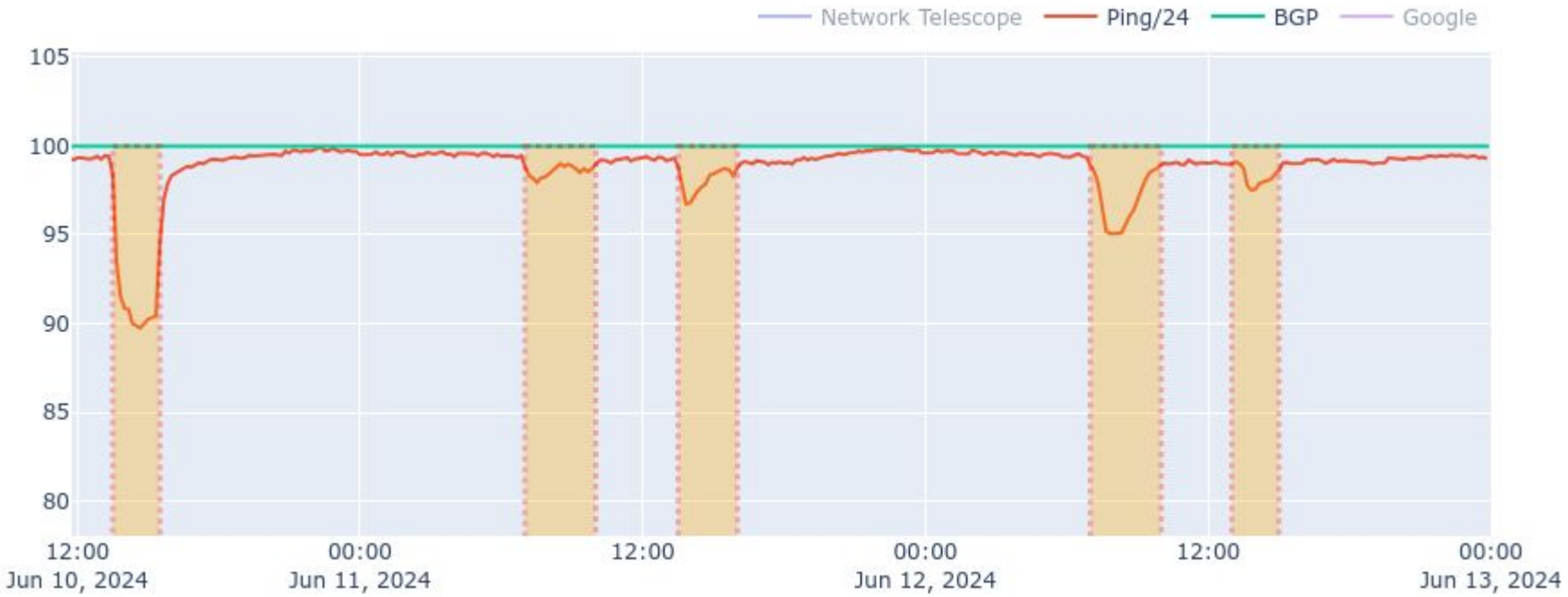
Holistic system

Homogenous interfaces

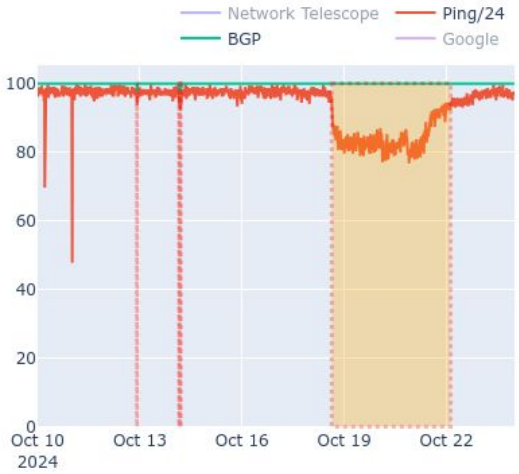


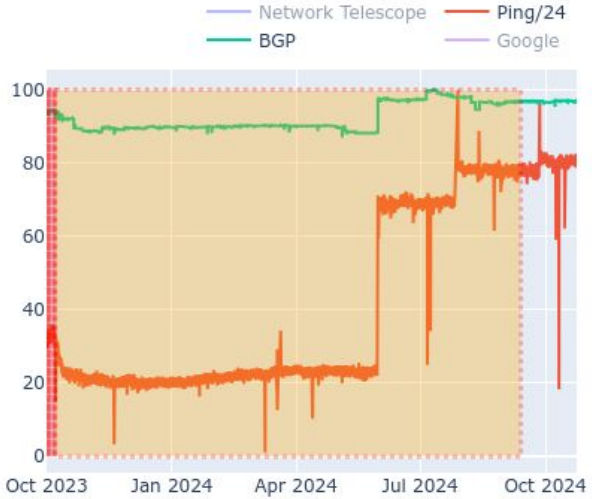
Holistic system

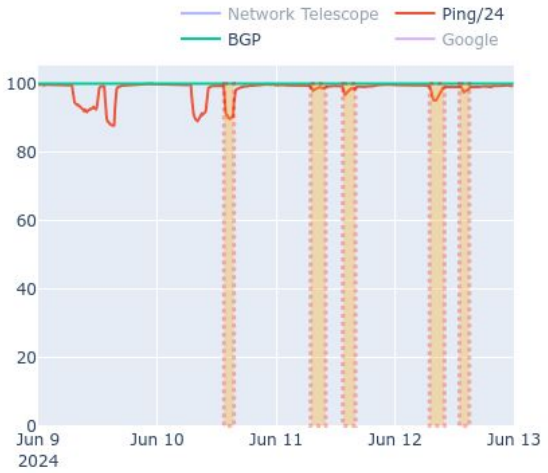
Preliminary findings: outages are mostly partial



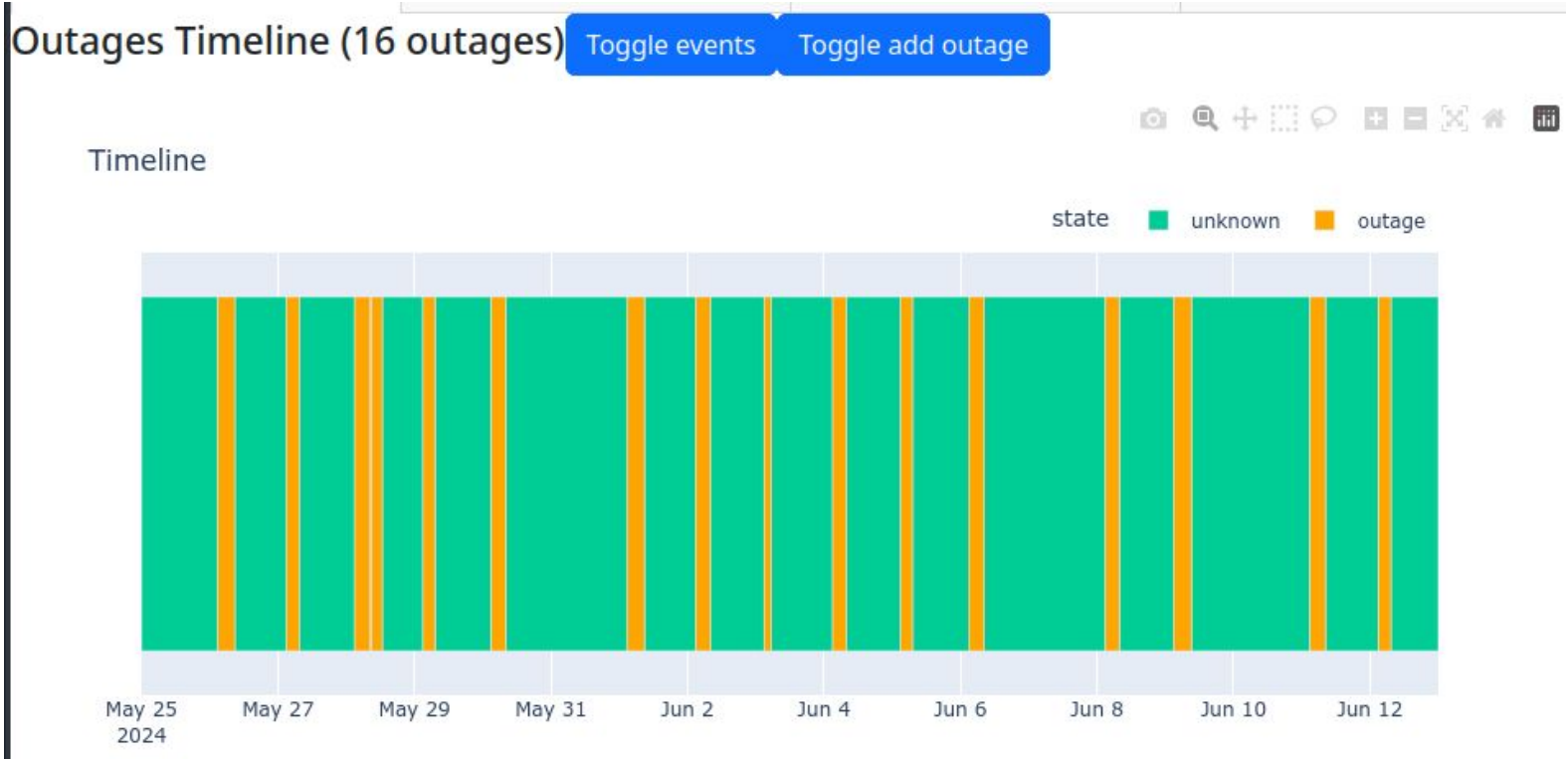
Preliminary findings: different kinds of outages



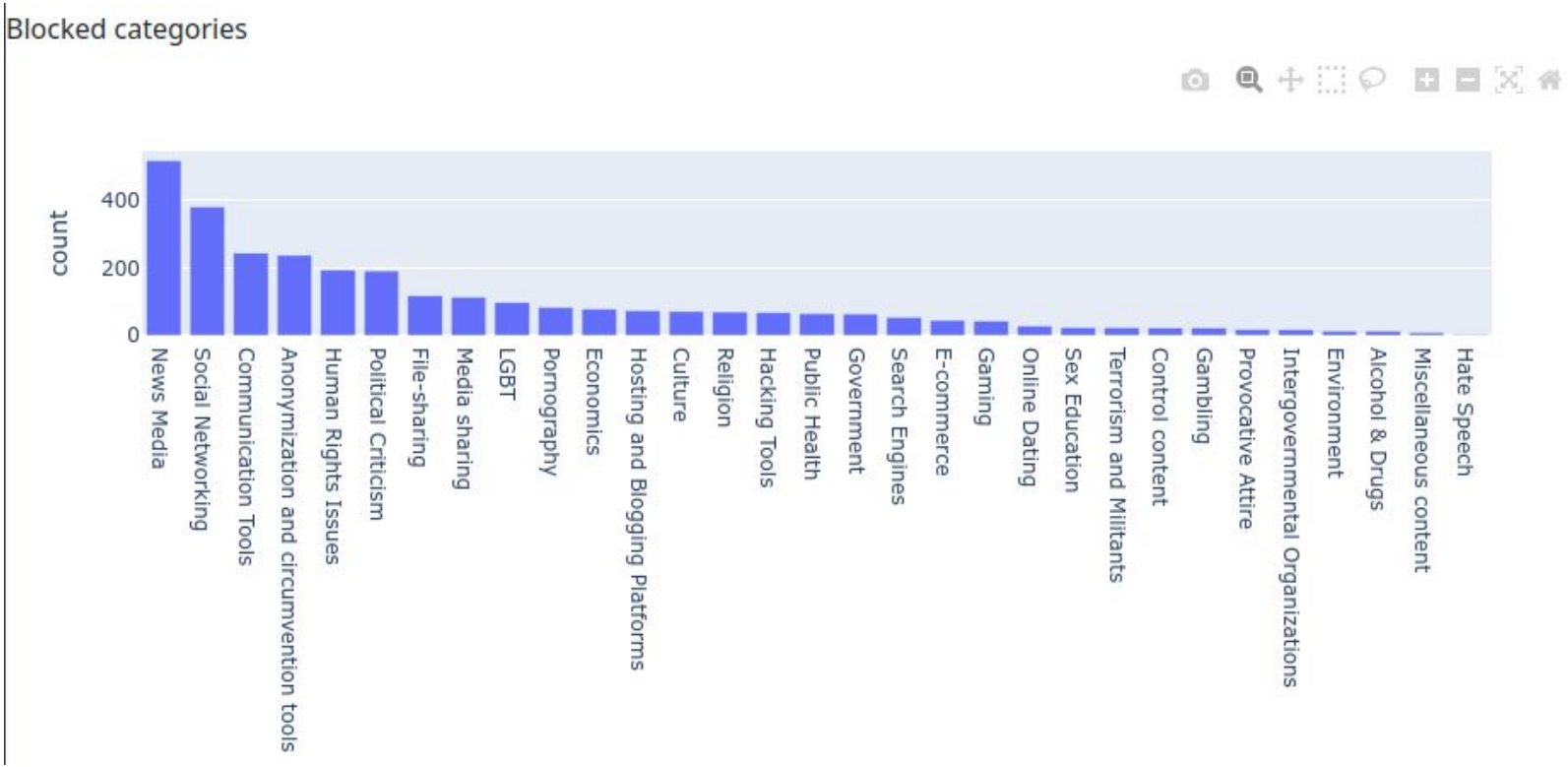




Preliminary findings: shutdowns have a predictable time and duration

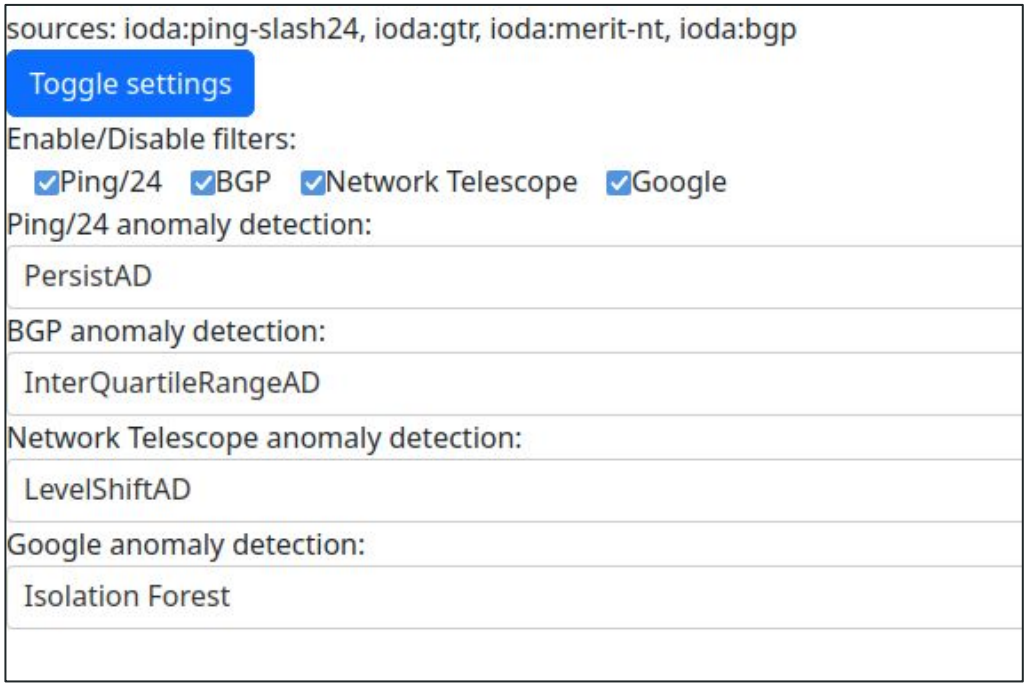


Preliminary findings: shutdowns target specific categories



Anomaly detection for Internet measurements

Integrated anomaly detection for any data source



Next steps

- Additional (real-time) **data**
- **Machine learning**
  - Identify outage periods
  - Find root causes
- Improve **assistance** and **automation** features

The topic sparks **engagement in students**.

Holistic approach

- combining diverse data sources
- providing homogenous interfaces

Investigating Internet outages

- identify outage periods
- assist and automate the analysis process

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