# Identifying Interesting Outages

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## Introduction

Motivation: The Trinocular outage detection system collects a large amount of IPv4 /24 block outage data on a constant basis. 36M data points were collected in Q1 2019 alone, and there are nearly 660M points collected to date; however, we know little about this data. It is difficult to find important and interesting outages without a proper analytical tool.

Past Work: We previously developed an interactive map which displays geolocated outages. However, the average user may find the map difficult to navigate due to its minimal user interface.

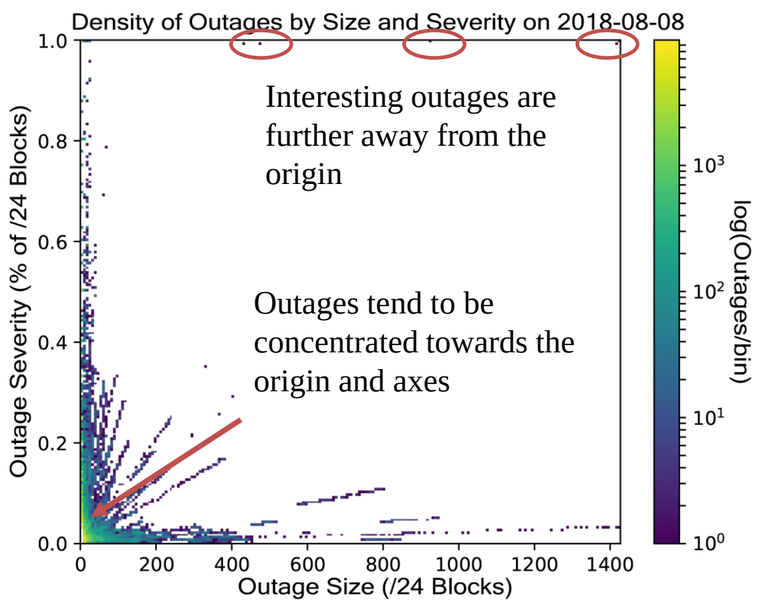
Approach: We propose two approaches: first, create a web-based tool that fetches outages based on selected parameters and provides links to outages on the interactive map; second, use the reporting tool in a proof-of-concept analysis with the goal of answering research questions. (E.g., what makes an outage interesting?)

## Outages: What is Interesting?

- We want to find and define interesting outages
  - Large, severe, and dynamic outages are more interesting than small, minor, and gradually changing outages
  - Dynamic outages are more likely to be an actual event than a static outage
  - A large outage of any severity is more interesting than a small outage with high severity, so we give size a larger weight
- We define interest as follows:

$$I = \Delta(size \cdot severity^2)$$

- Outage data is highly skewed, with many small events

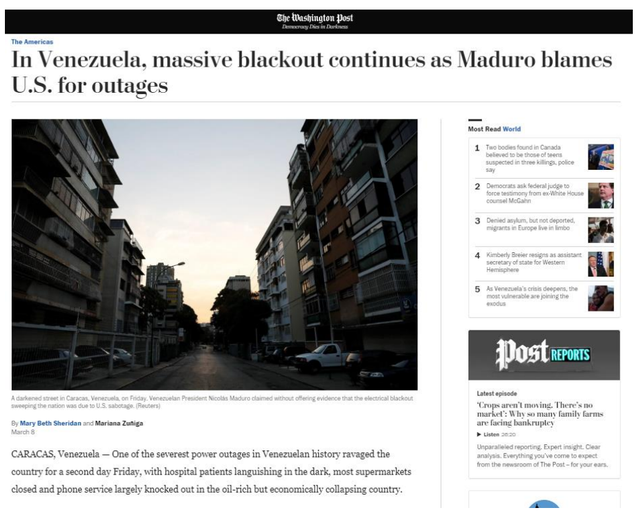



## Analyzing Outages We Find

- We completed analysis to test the tool's usefulness
  - Goal: find large, dynamic outages
  - Looked at data from 2019-03-03 to 2019-03-09
- Are there large outages?
  - Brazil on 2019-03-05 (3074 blocks), not dynamic
  - Venezuela on 2019-03-08 (1954 blocks), dynamic

### Studying the Venezuelan Outage on 2019-03-08

- Are outages in a specific ISP?
  - Yes: CANTV, a Venezuelan state-run ISP
- Can we determine root causes?
  - Yes: we found documentation of power outages


The Washington Post
Democracy Dies in Darkness

The Americas

In Venezuela, massive blackout continues as Maduro blames U.S. for outages

A darkened street in Caracas, Venezuela, on Friday. Venezuelan President Nicolás Maduro claimed without offering evidence that the electrical blackout sweeping the nation was due to U.S. sabotage. (Reuters)

By Mary Beth Sheridan and Mariana Zuñiga
March 8

CARACAS, Venezuela — One of the severest power outages in Venezuelan history ravaged the country for a second day Friday, with hospital patients languishing in the dark, most supermarkets closed and phone service largely knocked out in the oil-rich but economically collapsing country.

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## Outage Reports

- Backend program fetches list of outages from database
- Website displays outages based on search parameters:
  - Report type (size, severity, interest metric, historical)
  - Start date
  - Search duration
  - Region
- The report links to pre-existing outage map
  - The size of the circle corresponds to outage size
  - The color of the circle corresponds to outage severity

### Report by Size (Number of IPv4 /24 Blocks)

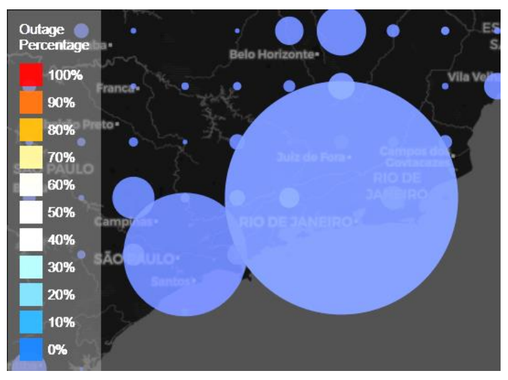
Size | 2019-03-03 | 1 Week | search

Top 10 outage(s) by size on 2019-03-03 00:00:00 for 7 days:

| Rank | Location | Coordinates | Time | Blocks Out | Blocks in Grid | Percent Out |
|---|---|---|---|---|---|---|
| 1 | Duque de Caxias, Rio de Janeiro, BR | (-22.75, -43.25) | 2019-03-05 09:51:00 | 3074 | 48111 | 6.39 |
| 2 | Caraballeda, Vargas, VE | (10.75, -66.75) | 2019-03-08 11:00:00 | 1954 | 1991 | 98.14 |
| 3 | Kawaguchi, Saitama, JP | (35.75, 139.75) | 2019-03-07 21:37:00 | 1404 | 109164 | 1.29 |
| 4 | Qalyub, Muhafazat al Qalyubiyah, EG | (30.25, 31.25) | 2019-03-08 05:08:00 | 1074 | 8172 | 13.14 |
| 5 | Saint Marys, Kansas, US | (37.75, -97.75) | 2019-03-07 23:27:00 | 995 | 131809 | 0.75 |
| 6 | Zhengzhou, Henan Sheng, CN | (34.75, 113.75) | 2019-03-03 17:09:00 | 980 | 67436 | 1.45 |
| 7 | Amouguer, Meknes-Tafilalet, MA | (32.25, -4.75) | 2019-03-08 07:53:00 | 975 | 21967 | 4.44 |
| 8 | Santa Maria de Ipire, Guarico, VE | (8.25, -65.75) | 2019-03-08 11:00:00 | 922 | 1252 | 73.64 |
| 9 | Salavan, Salavan, LA | (16.25, 106.25) | 2019-03-04 23:02:00 | 820 | 20386 | 4.02 |
| 10 | Shahr-e Qods, Tehran, IR | (35.75, 51.25) | 2019-03-09 06:48:00 | 726 | 16598 | 4.37 |

Results found in 0.002 seconds

Size shows how many people are affected by an outage




Screenshot of Brazilian outage

### Report by Severity (Percentage of IPv4 /24 Blocks)

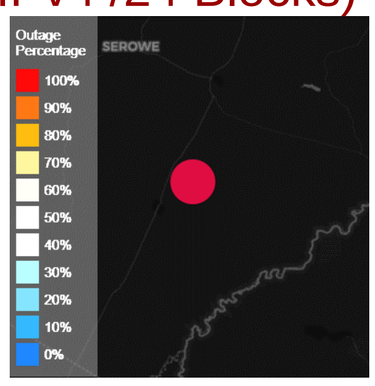
Severity | 2019-03-03 | 1 Week | search

Top 10 outage(s) by severity on 2019-03-03 00:00:00 for 7 days:

| Rank | Location | Coordinates | Time | Blocks Out | Blocks in Grid | Percent Out |
|---|---|---|---|---|---|---|
| 1 | Lephalale, Limpopo, ZA | (-23.75, 27.75) | 2019-03-05 12:14:00 | 7 | 7 | 100.0 |
| 2 | Vilhena, Rondonia, BR | (-13.25, -60.75) | 2019-03-05 23:47:00 | 8 | 8 | 100.0 |
| 3 | 'Ain el Hadjar, Saida, DZ | (34.75, 0.25) | 2019-03-06 01:15:00 | 6 | 6 | 100.0 |
| 4 | Tiaret, Tiaret, DZ | (35.25, 1.25) | 2019-03-06 01:15:00 | 8 | 8 | 100.0 |
| 5 | Sidi Aissa, Wilaya de M'Sila, DZ | (35.75, 3.75) | 2019-03-06 01:15:00 | 7 | 7 | 100.0 |
| 6 | Hidalgo del Parral, Chihuahua, MX | (27.25, -105.75) | 2019-03-07 08:14:00 | 8 | 8 | 100.0 |
| 7 | Santa Cruz de Bucaral, Falcon, VE | (10.75, -69.25) | 2019-03-07 21:15:00 | 6 | 6 | 100.0 |
| 8 | San Luis, Falcon, VE | (11.25, -69.75) | 2019-03-07 21:15:00 | 23 | 23 | 100.0 |
| 9 | Higuerote, Miranda, VE | (10.75, -66.25) | 2019-03-07 21:26:00 | 12 | 12 | 100.0 |
| 10 | Piritu, Portuguesa, VE | (9.25, -69.25) | 2019-03-07 21:26:00 | 13 | 13 | 100.0 |

Results found in 47.666 seconds

Severity measures what fraction of networks in a grid cell have problems




Screenshot of South African outage

### Report by Interest

Interest | 2019-03-03 | 1 Week | search

Top 10 outage(s) by interest on 2019-03-03 00:00:00 for 7 days:

| Rank | Location | Coordinates | Time | Blocks Out | Blocks in Grid | Percent Out |
|---|---|---|---|---|---|---|
| 1 | Duque de Caxias, Rio de Janeiro, BR | (-22.75, -43.25) | 2019-03-05 09:51:00 | 3074 | 48111 | 6.39 |
| 2 | Caraballeda, Vargas, VE | (10.75, -66.75) | 2019-03-08 11:00:00 | 1954 | 1991 | 98.14 |
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| 8 | Amouguer, Meknes-Tafilalet, MA | (32.25, -4.75) | 2019-03-08 07:53:00 | 975 | 21967 | 4.44 |
| 9 | Bejuma, Carabobo, VE | (10.25, -68.25) | 2019-03-08 08:59:00 | 615 | 626 | 98.24 |
| 10 | Salavan, Salavan, LA | (16.25, 106.25) | 2019-03-04 23:02:00 | 820 | 20386 | 4.02 |

Results found in 0.001 seconds

Interest combines size and severity to look for changes that affect both many people and most of the people in one location.




Screenshot of Venezuelan outage

## Conclusions

- Website makes outage information more accessible to the general public
- The tool helps streaming finding interesting outages
- The tool is being used to analyze outage causes

**Check it out for yourself: https://outage.ant.isi.edu and https://outage.ant.isi.edu/report**

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