

Measuring the Internet during Novel Coronavirus to Evaluate Quarantine

<https://ant.isi.edu/minceq>

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2020-05-29

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MINCEQ is supported by NSF/CISE as a RAPID response to COVID-19 as award NSF-2028279.



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How Is the World Reacting to COVID-19?

- Wuhan
 - quarantine 2020-01-23 to -04-08
- the United States:
 - response varies by state
 - all declared state of emergency by 2020-03-16
 - stay-at-home varies, most by Mid-March or early April
- the rest of the world
 - many reports

See Which States and Cities Have Told Residents to Stay at Home

By Sarah Marshall, Denise Lu and Vanessa Buntin | Updated March 23, 2020

All 50 States Are Now Reopening. But at What Cost?

By Sarah Marshall and Amy Harris | Updated May 29, 2020 | Updated May 29, 2020 10:07 a.m. ET

In Connecticut, shops that had been boarded during the steepest push of the constraining pandemic were closed to full-staff on Wednesday to signal a return to business.

In Kentucky, gift shops crested open their doors.

And across Alaska, restaurants, bars and gyms, which have been open to small numbers of customers for weeks, were getting ready to re-open up to full capacity. "It will all be specific. One-fifty quarantine announced," that day it was prior to the virus."

The United States has crossed an uneasy threshold with all 50 states beginning to reopen in some way, two months after the coronavirus first cut the country into lockdowns. But there are caveats: In some states, bars are deciding to open up, with some forgoing for others.

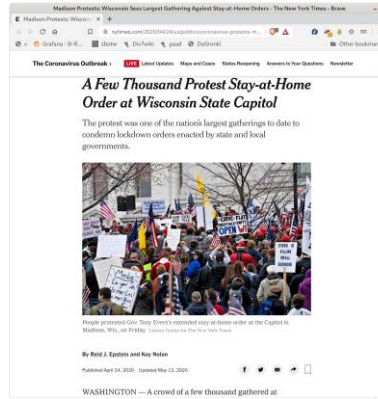
The reopening comes in full re-opened on business — or at least open to outdoor spaces like beaches and state parks — reflect the intense political and societal pressure vying on the nation's governors, even as epidemiologists remain cautious and warn of a second wave of cases.



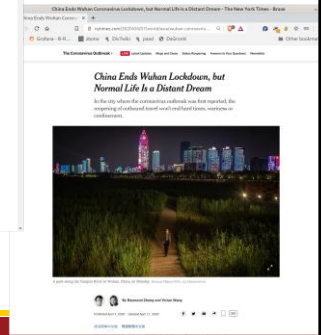
Reactions Vary: What is *Really* Happening?

- many different reactions
- timing varies
- compliance often uncertain

• can we evaluate response centrally?
globally?



uncertainty over what is happening on the ground, domestically and abroad



Our Prior Work: Examining the IPv4 Internet



Since 2006, we regularly scan the Internet (IPv4, like 192.200.1.2, but *.*.*.*)

<https://ant.isi.edu/address/browse/>

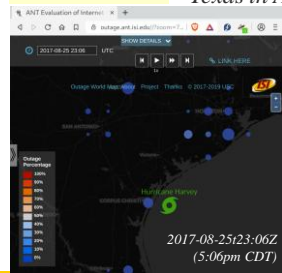
(map as of June 2019)

Since 2014 we have been tracking Internet outages

<https://outage.ant.isi.edu/>

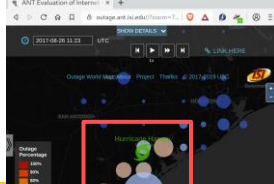
(data from Hurricane Harvey hitting Texas in August 2017)

before landfall: few outages



Harvey Landfall: 2017-08-26:03:00Z (10pm CDT)

serious outages (red circles), N. of Corpus Christi



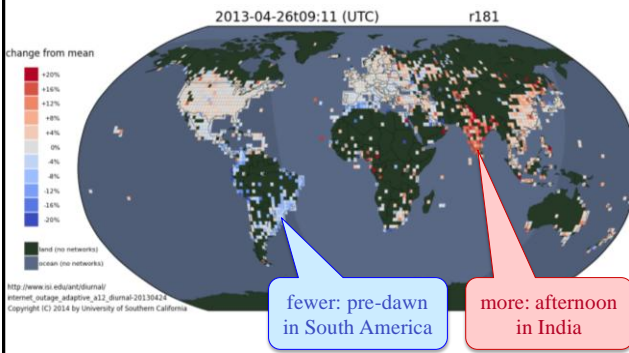
2017-08-26 11:56Z (5:56am CDT)

IPV4 Map of Internet Address Space Use. (C) 2007-2017 USC/Information Sciences Institute. www.isi.edu/ant/address-usage. John Heidemann from layout suggested by Rasmus Møller. Thanks: Yuri Izrael, orthodoxy, John Heidemann, Yuri Izrael, Ramesh Govindan, Christos Papadopoulos, Joseph Bannister, Stuart Lancaster. Internet address census. 355w.201902.8. Taken June 2019. This shows the results of pings of about 3 billion IP addresses, with color indicating the reply: as hit/miss; unallocated; cyan hatched; reserved

The Dynamic Internet

insight: can see the Internet sleep?

=> can see the Internet
work-from-home!



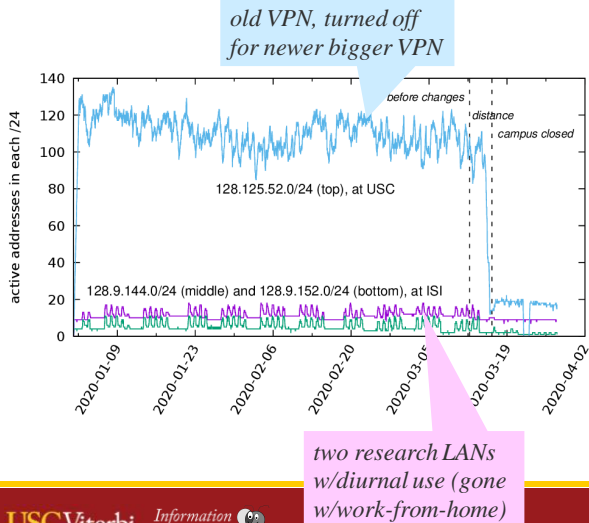
animation:

<https://ant.isi.edu/diurnal/>

Mining Our Outage Data

- reuse existing Trinocular scanning for outages
 - ICMP echo requests
 - to some addresses in 5M blocks
 - every 11 minutes
- re-analyze to track address use
- will compare to regional traffic data
 - from FRGP (IXP in Colorado)
- pros:
 - broad coverage: >5M /24s
 - timely: 24x7 every 11 minutes
 - global coverage
- cons:
 - *not designed for virus hunting*
 - scanning rate varies per block
 - more probes when negative response
⇒ must remember prior state
 - only see public, non-firewalled IPv4
⇒ likely less sensitive in U.S.

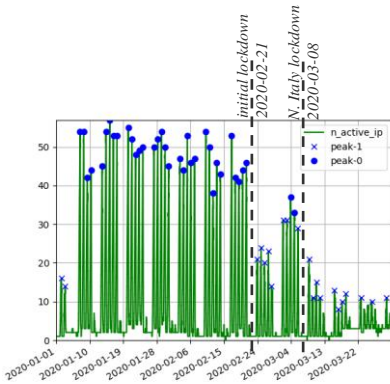
Early Results at USC



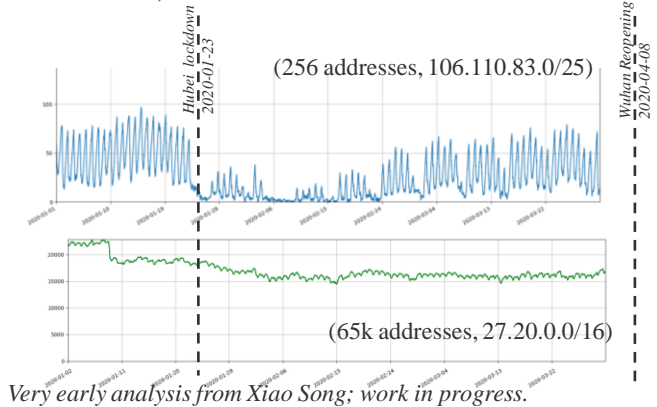
- data of 3 networks at USC and ISI
- talked to network operators about ground truth
- => confirms we can see changes due to COVID-19 WFH

Early Results from the World

Milan, Italy (149.132.172.0/24)



Wuhan, China



Open Questions and Next Steps

- algorithm to automate finding changes?
- how much does coverage vary?
- comparing to traffic data
 - early results in “Do You See Me Now?...” by Mirkovic et al, IEEE TMA 2017
 - can we do similar w/Corona?
- updates at <https://ant.isi.edu/blog> or contact me at johnh @ isi.edu

