



# IHR: Monitoring Internet Health at Scale

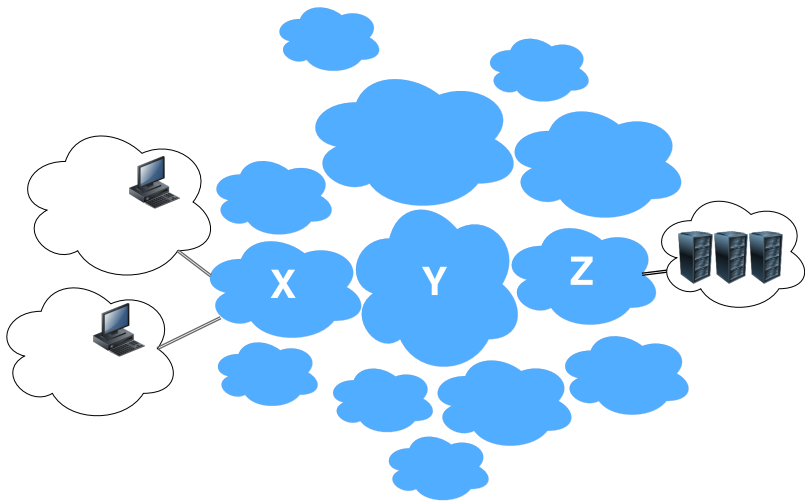
<https://ihr.iijlab.net>

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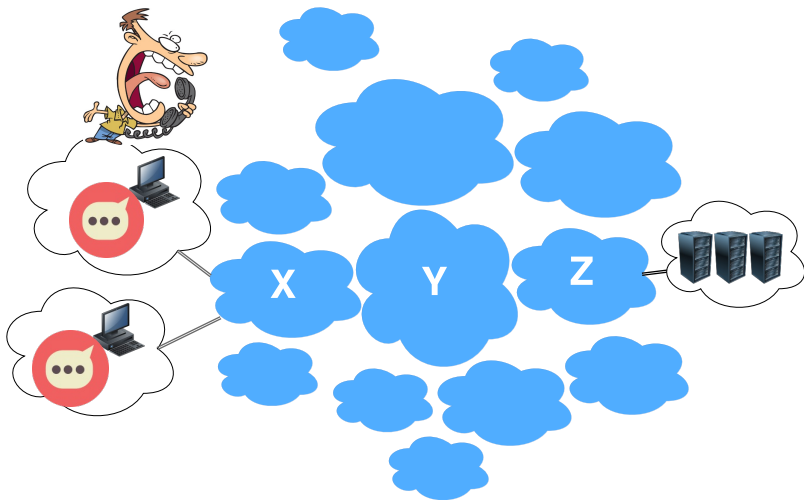
**Romain Fontugne**

IIJ Research Lab

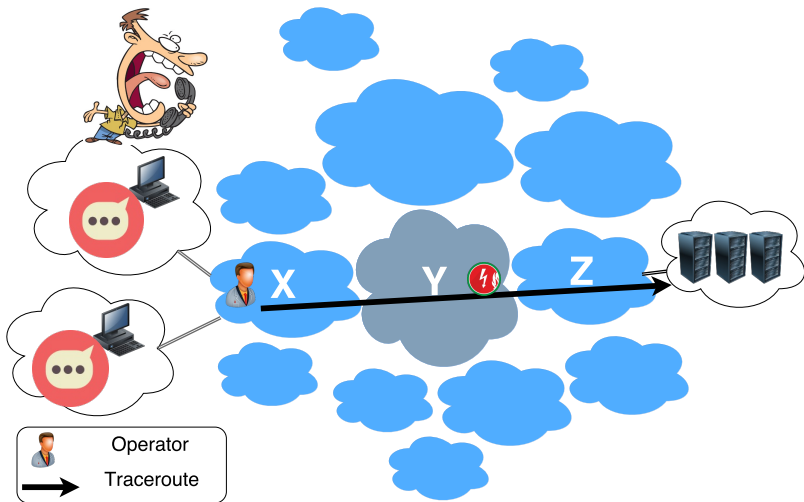
# Internet: a network of networks



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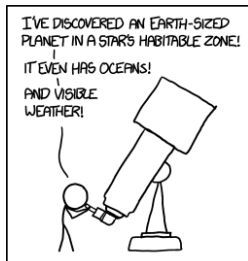
# Internet Health Report?

## Goal: Monitor Internet's Health

- Automatically pinpoint connectivity issues

## Main Challenges:

- Internet is huge
  - Over 60k autonomous systems
  - Billions of connected devices
- Constantly evolving
- Limited views on remote networks



TO MESS WITH AN ASTRONOMER, PUT A MIRROR IN THE PATH OF THEIR TELESCOPE.

## IHR: Three main components

- Delay/forwarding anomaly detection
- Outages detection
- AS dependencies monitoring

## Contributions

- Results publicly available:  
<https://ihr.iijlab.net>
- Open source code:  
<https://github.com/InternetHealthReport>

# Delay/Forwarding anomalies

## RIPE Atlas measurement platform

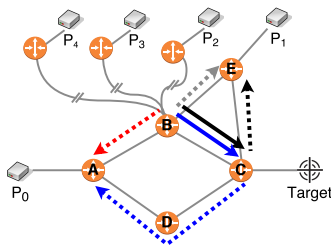
- About 10k devices world-wide
- Doing pings, traceroutes, DNS queries, ...

## Approach

- Monitor in-network delays
- Model packet forwarding
- Report anomalies

## Examples

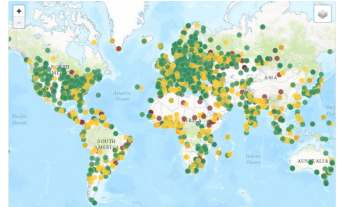
- Congestion in Level(3)
- Packets wandering in Cogent



# Outage detection

## Disco

- Monitor RIPE Atlas disconnections
- Identify burst of disconnections
- Report the corresponding network or geo area



## Example

- June 2018: National exams in Iraq

Probes disconnection



Disconnections / minute



Burst modeling





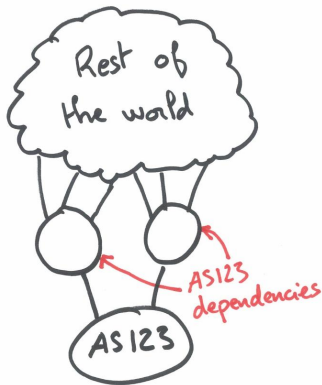
# AS dependency

## Monitoring AS Dependency

- A network's connectivity depends on other networks
- Dependency changes may reveal routing anomalies
- Help operators to plan and assess infrastructure deployments

## Example

- Tokyo Institute of Technology
- 2/28: DDoS attack against Github



## Internet Health Report

- Monitor connectivity issues
- Delay, disconnection and routing anomalies
- <https://ihr.ijlab.net>
- [romain@ij.ad.jp](mailto:romain@ij.ad.jp)

## References

- A. Shah et al. "Disco: Fast, good, and cheap outage detection", TMA'17.
- R. Fontugne et al. "Pinpointing Delay and Forwarding Anomalies Using Large-Scale Traceroute Measurements", IMC'17.
- R. Fontugne et al. "The (thin) Bridges of AS Connectivity: Measuring Dependency using AS Hegemony", PAM'18.

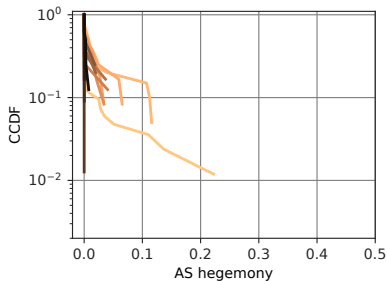


# Online Results: Examples in 2018

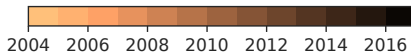
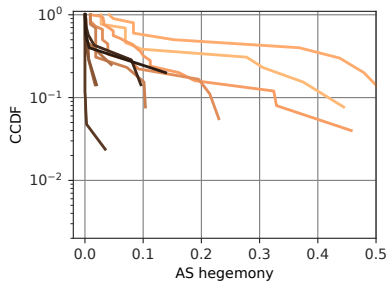
**Internet Health Report:** <https://ihr.iiijlab.net>

- DoS attack
  - Attack against Github on Feb. 28th
  - Attacks during Russian elections Mar. 18th
- Outage
  - Power outage in northern Brazil, Mar. 21st
  - DECIX outage, Apr. 4th
  - The fall of Bitcanal (*the Hijack factory*), July
- BGP leak
  - Leak from CloudFlare, Jul. 1st
- Censorship
  - Country-level bottlenecks: Iran, China, Pakistan, ...
  - CrimeaCom in 2013 vs. CrimeaCom in 2018
  - Exams in Iraq, June
  - Protests in Iraq, Jul. 14-15th

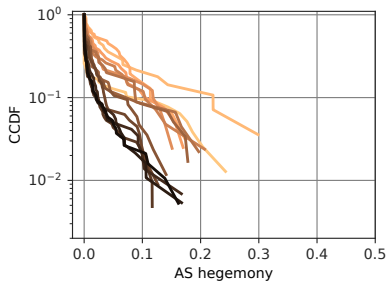
IPv4 local graph:



IPv6 local graph:



IPv4 local graph:



IPv6 local graph:

