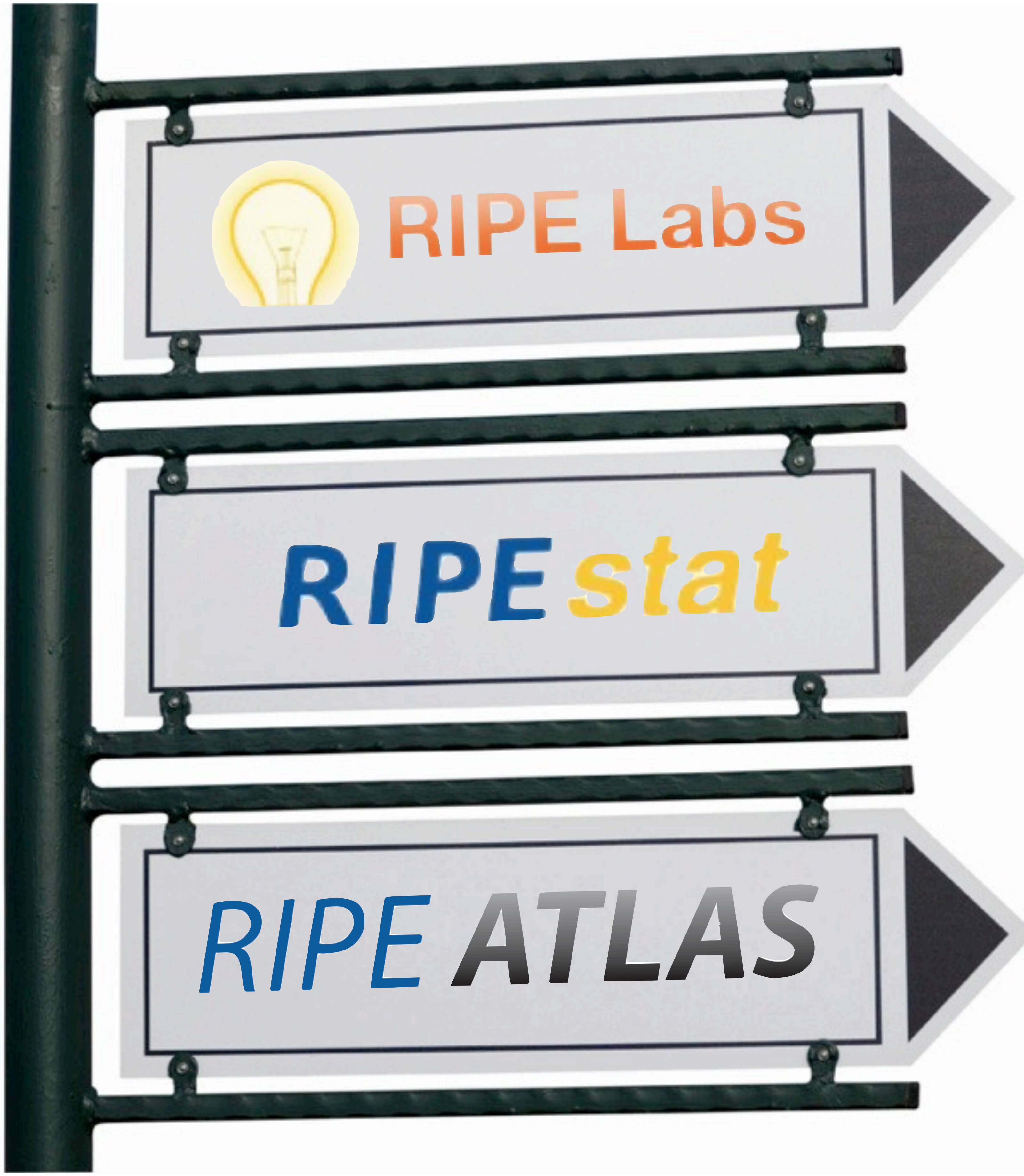
Network Data for Better Internet Policy

Daniel Karrenberg
Chief Scientist, RIPE NCC

Who is talking: Daniel Karrenberg

- **1980s**: helped build Internet in Europe
  - GUUG, EUUG, EUnet, Ebone, IXes, RIPE, ...
- **1990s**: helped build RIPE NCC
  - 1st CEO: 1992-2000
- **2000s**: Chief Scientist & Public Service
  - Trustee of the Internet Society, IETF, ...
- **2010s**: Chief Scientist
  - Interests: Internet measurements, stability, trust & identity in the Internet, ...


RIPE Labs
RIPEstat
RIPE ATLAS



Stories

General Statistics

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IPv4 Address Space Growth per Country

Emile Aben — Feb 06, 2012 04:10 PM
Contributors: Rene Wilhelm

Filed under: allocation, statistics, ipv4

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With the depletion of the IPv4 free pool in the APNIC region and the imminent IPv4 free pool run out in the RIPE NCC's service region, it is interesting to look at IPv4 allocation rates per country to see where free pool run out has and will have the most consequences, in terms of curtailing growth of IPv4 address usage. In this article, we try to visualise where "the pressure is on" the most.

2011 was an interesting year for IP address allocation. Geoff Huston has a good overview of trends and analysis. The major milestones were the allocation of the last five IPv4 /8 blocks from the IANA to the Regional Internet Registries (RIRs) and the APNIC region reaching their final /8.

In this short article we look a bit closer at the growth in 2011 of IPv4 address space allocated or assigned to organisations on a country level, and what this might tell us for 2012. The underlying assumption of this analysis is that growth rates for 2011 will be a rough estimate for the desired growth rates in 2012 (but as usual, results from the past are no guarantee for the future). Where large pools of allocated and assigned address space already exist, there is more room for improving efficient utilisation of these resources. The main difference between 2011 and 2012 is that APNIC will be allocating from their final /8 and the RIPE NCC will possibly hit this milestone as well. All RIRs have special policies in place for their last /8, which restrict the amount of address space each organisation can get.

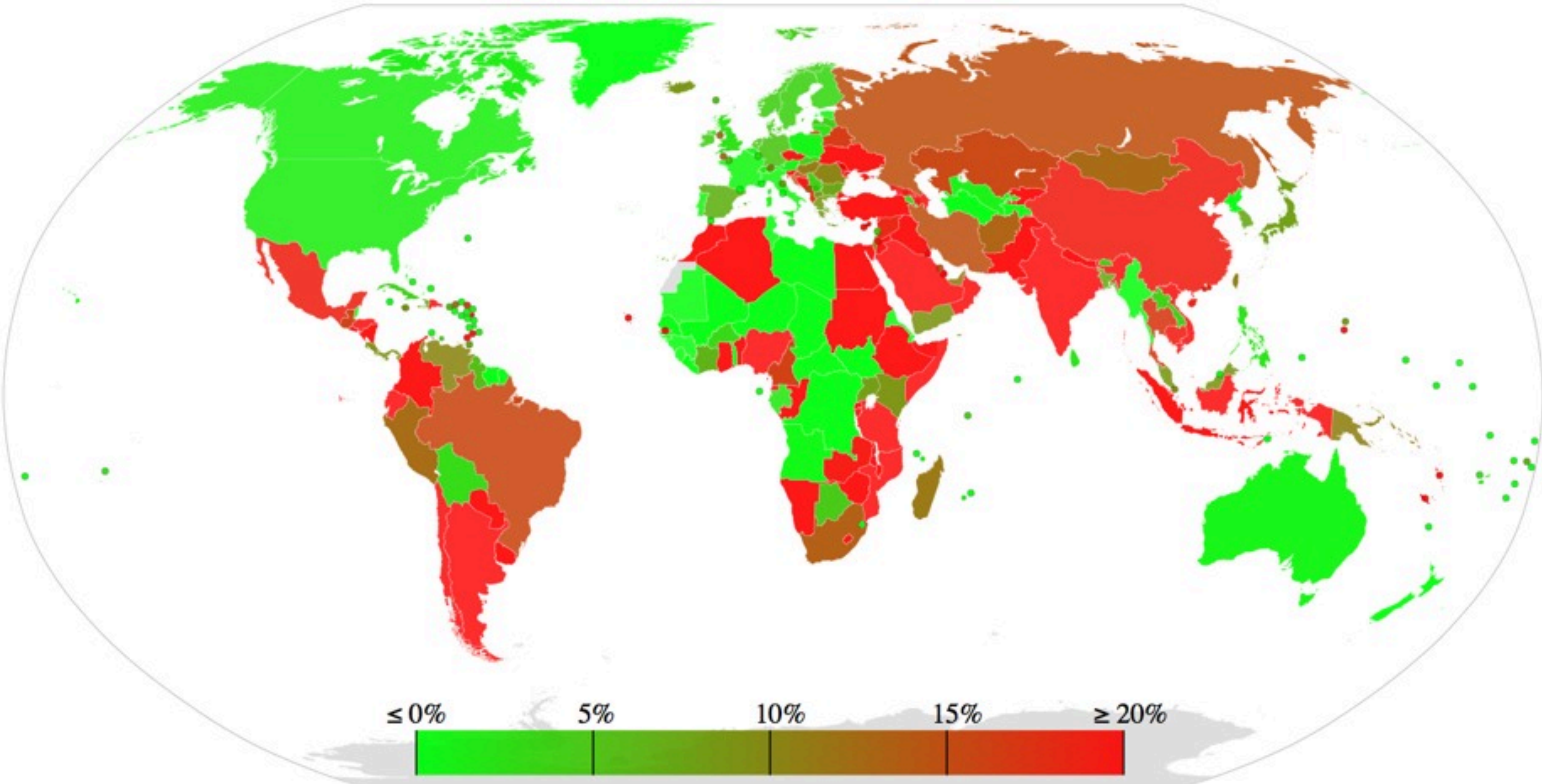
Figure 1 shows how much the IPv4 address pool handed out from the RIRs to organisations in specific countries has grown from 1 Jan 2011 to 1 Jan 2012.

Figure 1: Growth of IPv4 address pool handed out from the RIRs to entities in specific countries. Countries are coloured by growth, going from bright green (0% or less) to bright red (20% or more).

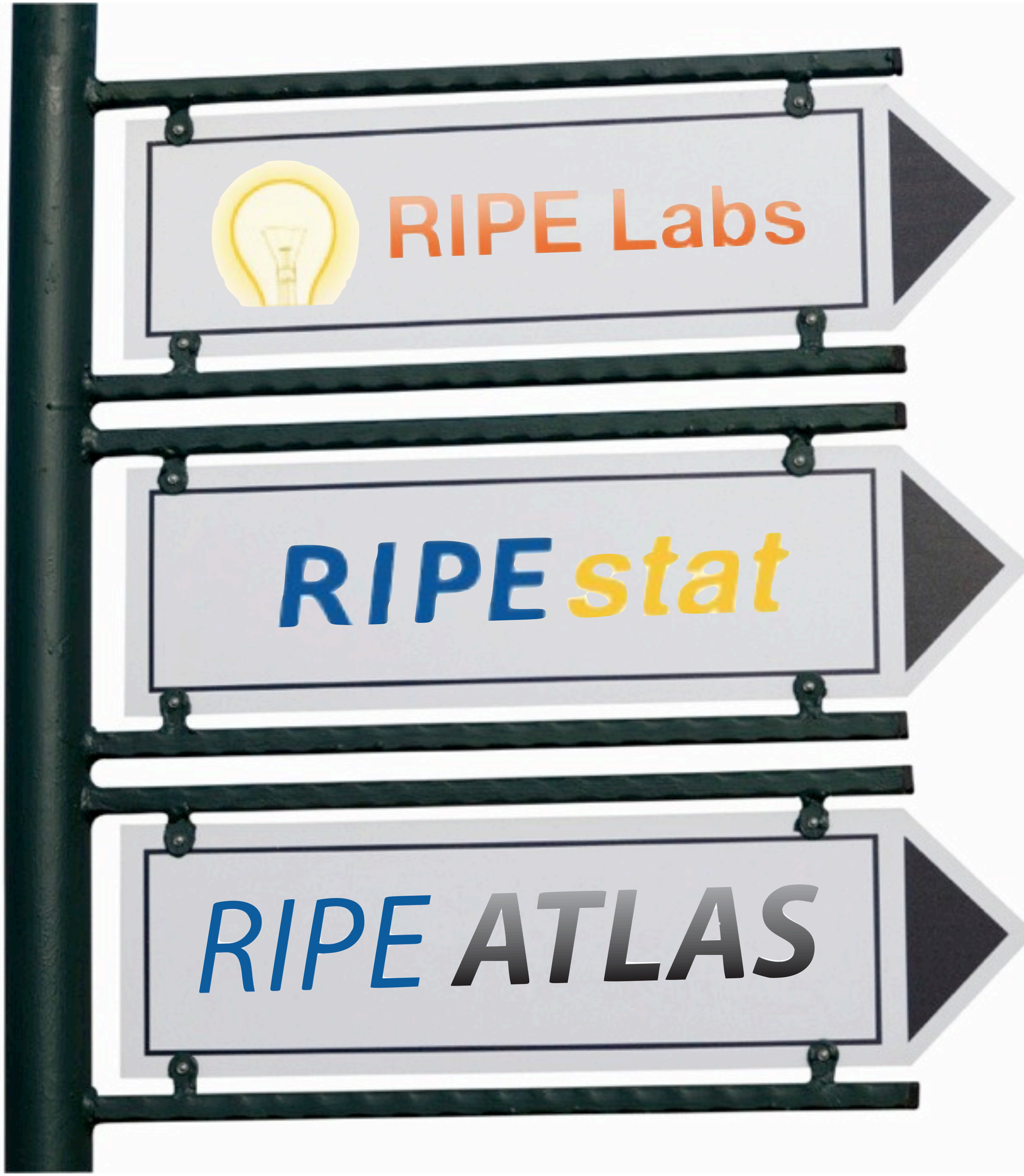
All of the RIR regions (you can find a map of the RIR service regions on the RIPE NCC web site) tell a different story:

- IPv6 RIPEness - the Sequel
- Interesting Graph - IPv6 Ripeness Movie
- Interesting Graph - IPv6 and RIPE 60
- Slight Increase in DNS Resolvers Doing P...
- Interesting Graph - Decrease in 6to4?
- A Look at DNS Priming Queries to K-root
- Measuring IPv6 at Web Clients and Cachin...
- Measuring IPv6 at Web Clients and Cachin...
- Measuring IPv6 at Web Clients and Cachin...
- 2009 - The year before IPv6 took off?
- REX and Ukrtelecom
- Interesting Graphs - Priming Queries to ...
- Interesting Graph - IPv6 performance
- Interesting Graph - Networks with IPv6 o...
- IPv6 RIPEness - The List of 4-star LIRs
- 6to4 - How Bad is it Really?
- RIPE Atlas - the iPad Drawing
- 6to4 - Why is it so Bad?

RIPE Labs: Example



Growth of IPv4 Address Space Allocations in 2011



Specific (IP/ASN)

Real-Time / History

RIPEstat Data Sources

http://stat.ripe.net

RIPE NCC data

- Number Registry (RIPE DB)
- Routing Registry (RIPE DB)
- Active Measuring (Atlas, TTM)
- BGP Routing (RIS)
- ...

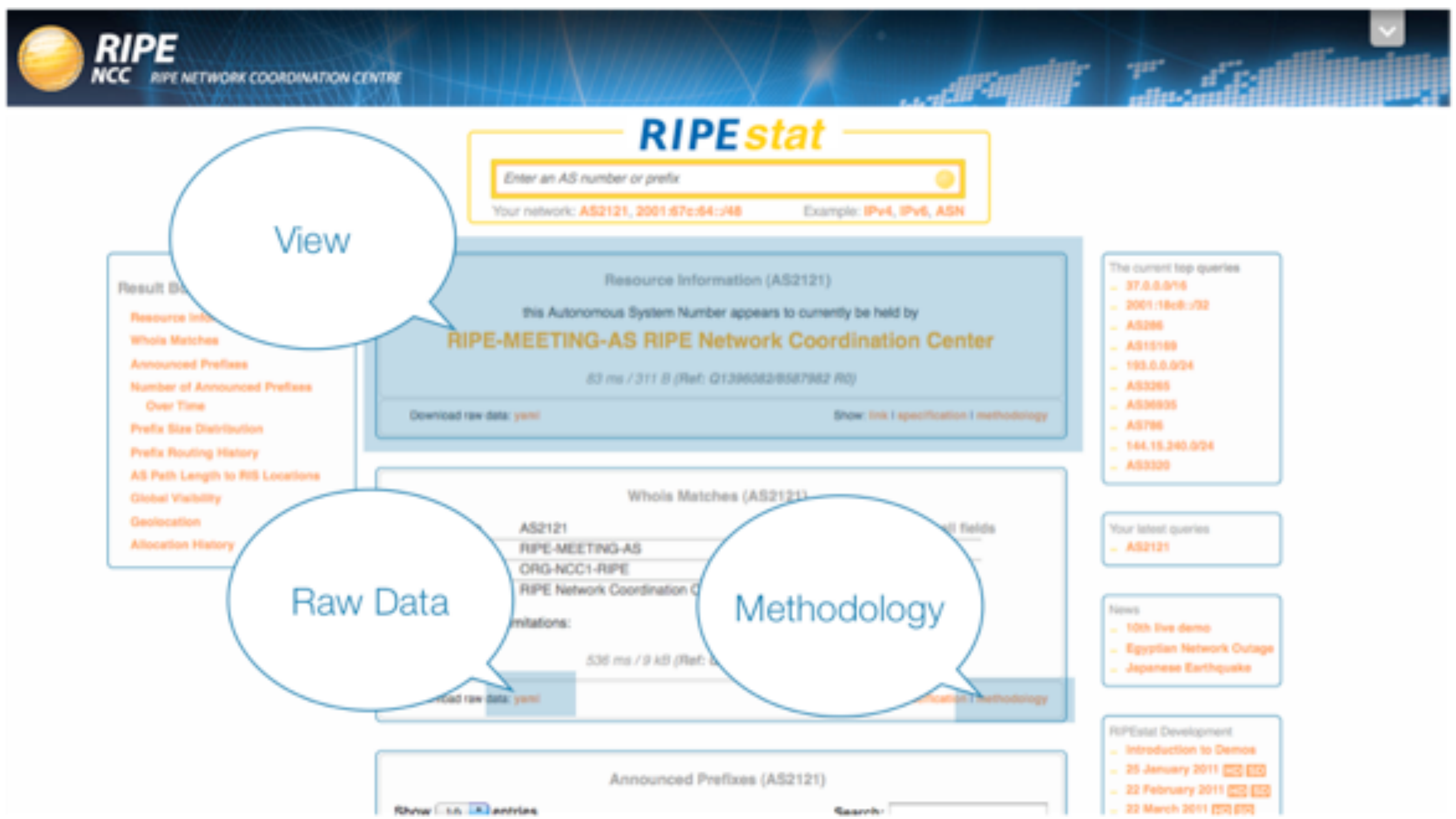
3rd party data

- Blacklist Data
- Geo Location Data

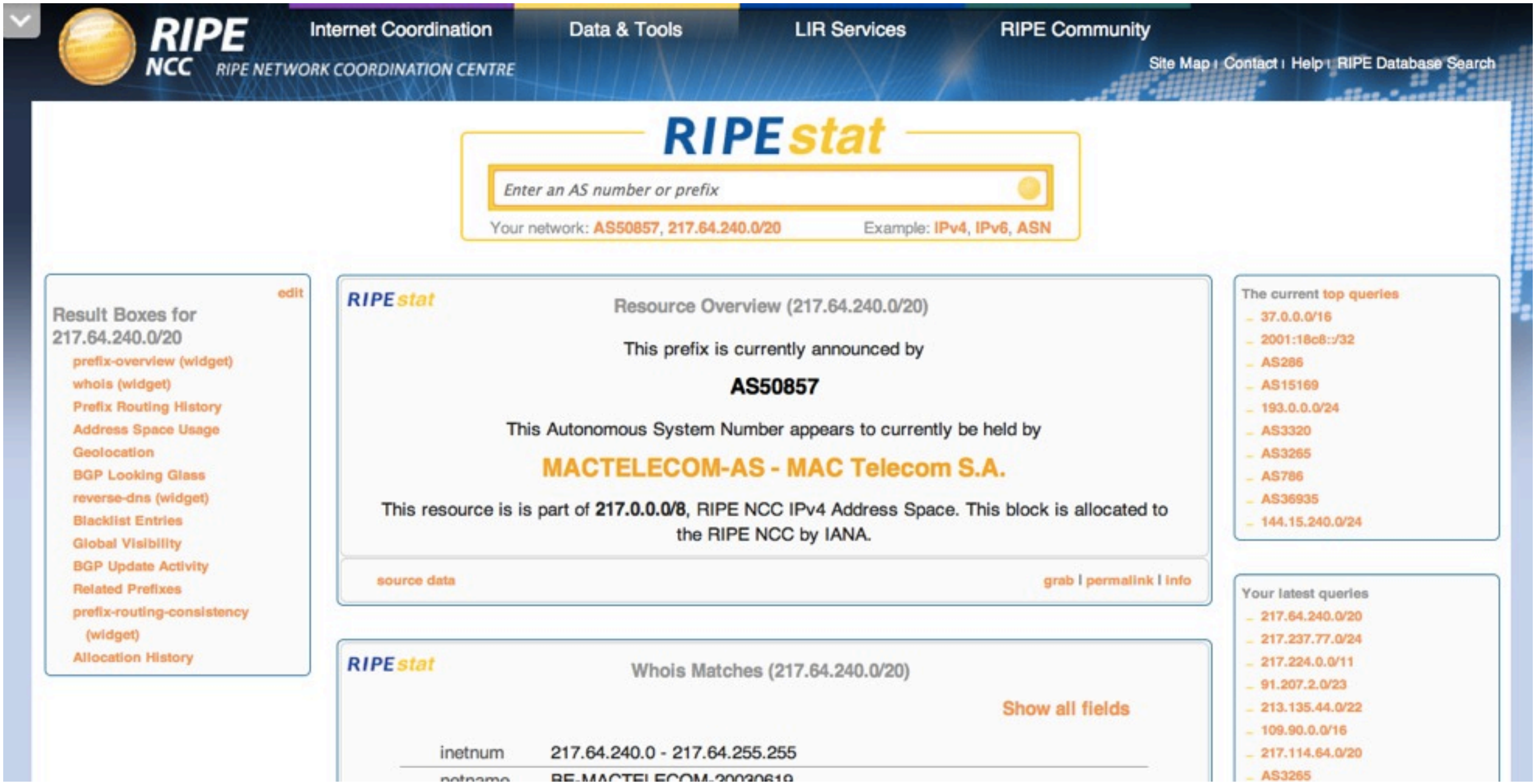
?

RIPEstat: The RIPE NCC Information Toolbox

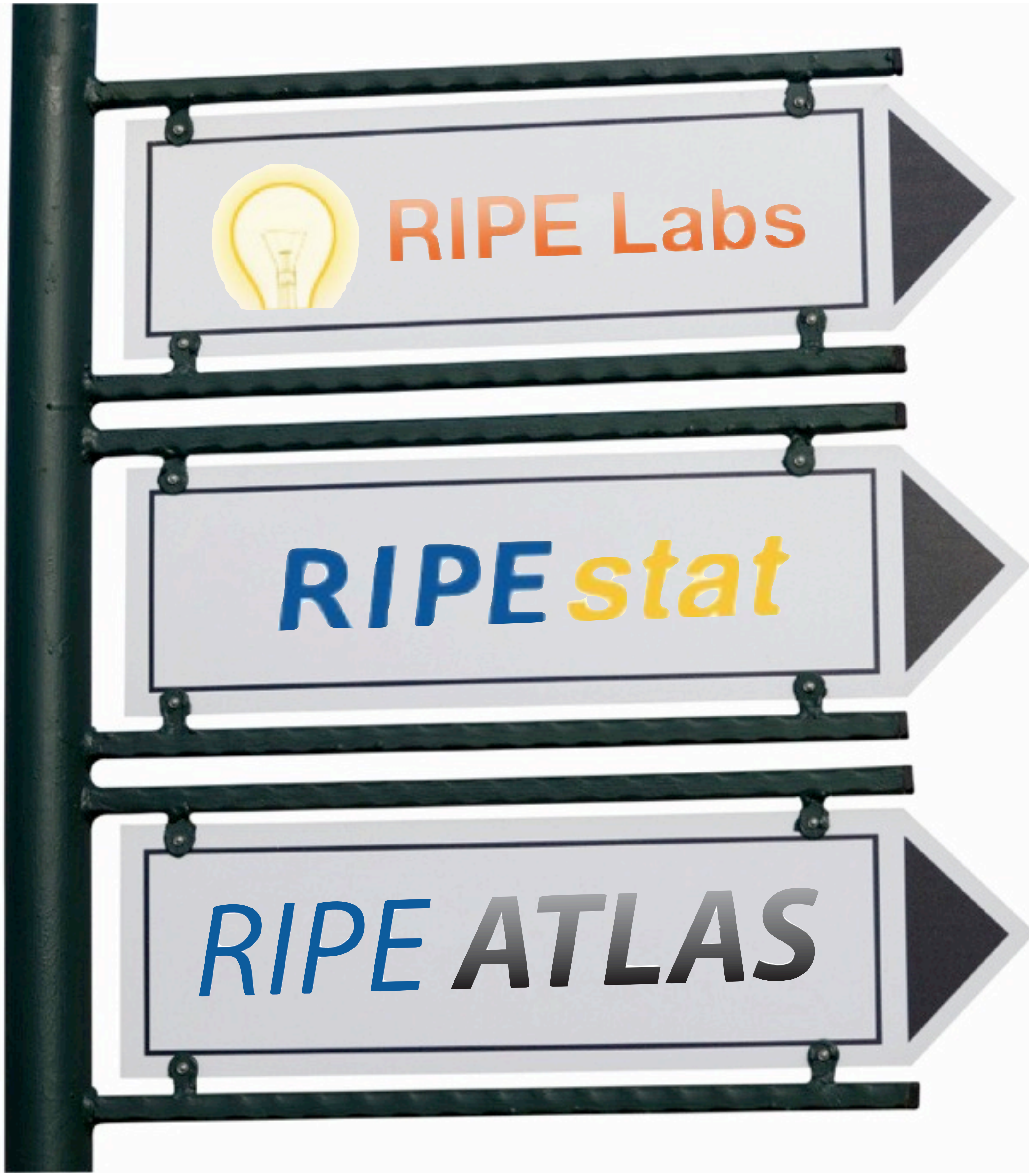
- Modular and extendable toolbox
  - Graphical interface
  - One-Stop Shop for Information about IPs & ASNs



RIPEstat



RIPE NCC
RIPE NETWORK COORDINATION CENTRE
Internet Coordination
Data & Tools
LIR Services
RIPE Community
Site Map | Contact | Help | RIPE Database Search
RIPEstat
Enter an AS number or prefix
Your network: AS50857, 217.64.240.0/20
Example: IPv4, IPv6, ASN
edit
Result Boxes for 217.64.240.0/20
prefix-overview (widget)
whois (widget)
Prefix Routing History
Address Space Usage
Geolocation
BGP Looking Glass
reverse-dns (widget)
Blacklist Entries
Global Visibility
BGP Update Activity
Related Prefixes
prefix-routing-consistency (widget)
Allocation History
RIPEstat
Resource Overview (217.64.240.0/20)
This prefix is currently announced by
AS50857
This Autonomous System Number appears to currently be held by
MACTELECOM-AS - MAC Telecom S.A.
This resource is is part of 217.0.0.0/8, RIPE NCC IPv4 Address Space. This block is allocated to the RIPE NCC by IANA.
source data
grab | permalink | info
RIPEstat
Whois Matches (217.64.240.0/20)
Show all fields
inetnum 217.64.240.0 - 217.64.255.255
The current top queries
37.0.0.0/16
2001:18c8::/32
AS286
AS15169
193.0.0.0/24
AS3320
AS3265
AS786
AS36935
144.15.240.0/24
Your latest queries
217.64.240.0/20
217.237.77.0/24
217.224.0.0/11
91.207.2.0/23
213.135.44.0/22
109.90.0.0/16
217.114.64.0/20
AS3265



State of the Net

Big Picture & Individual Measurements

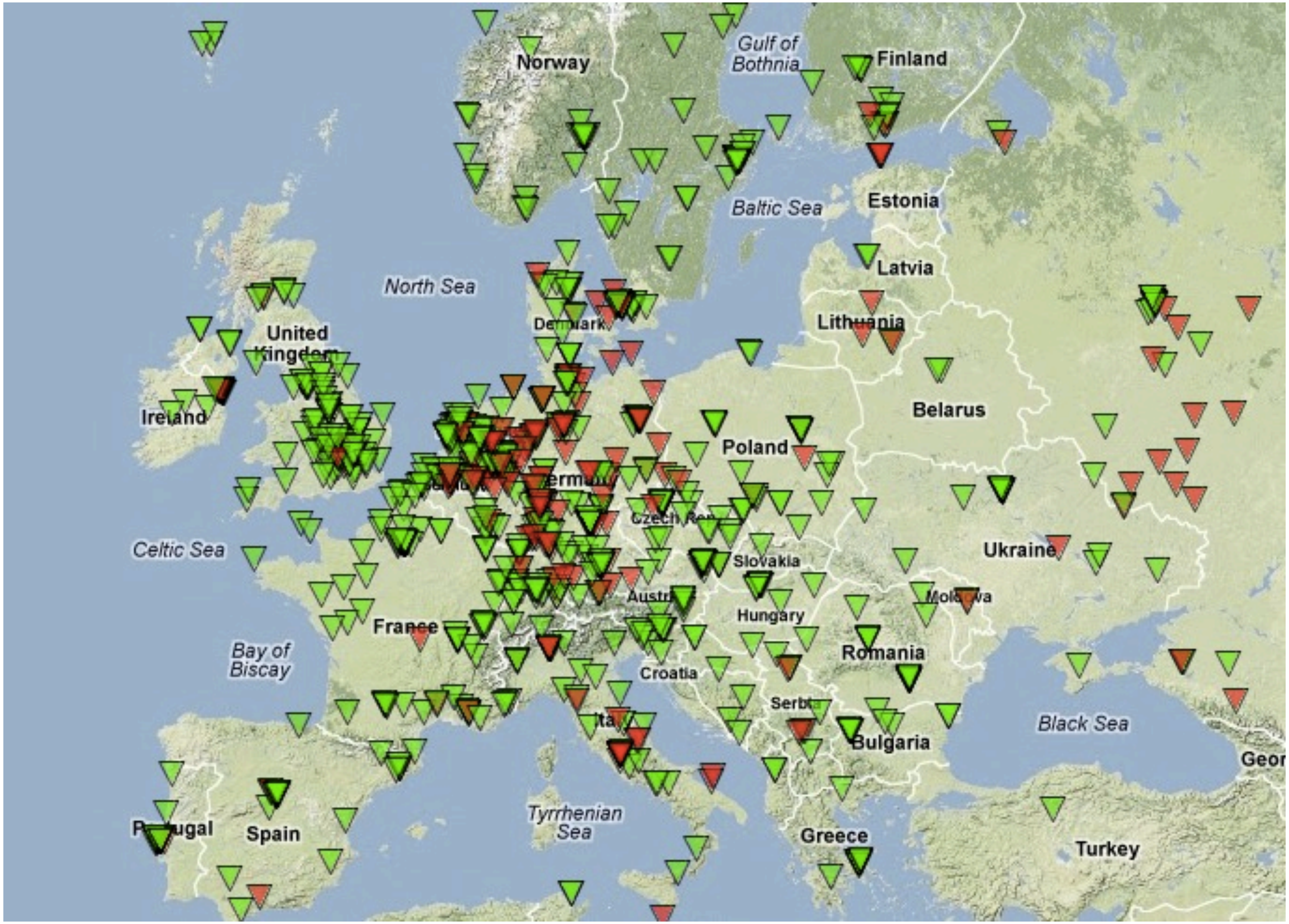
RIPE Atlas

- A network of active probes measuring the Internet infrastructure in real-time
- Started in 2010;
  currently more than 1300 probes online

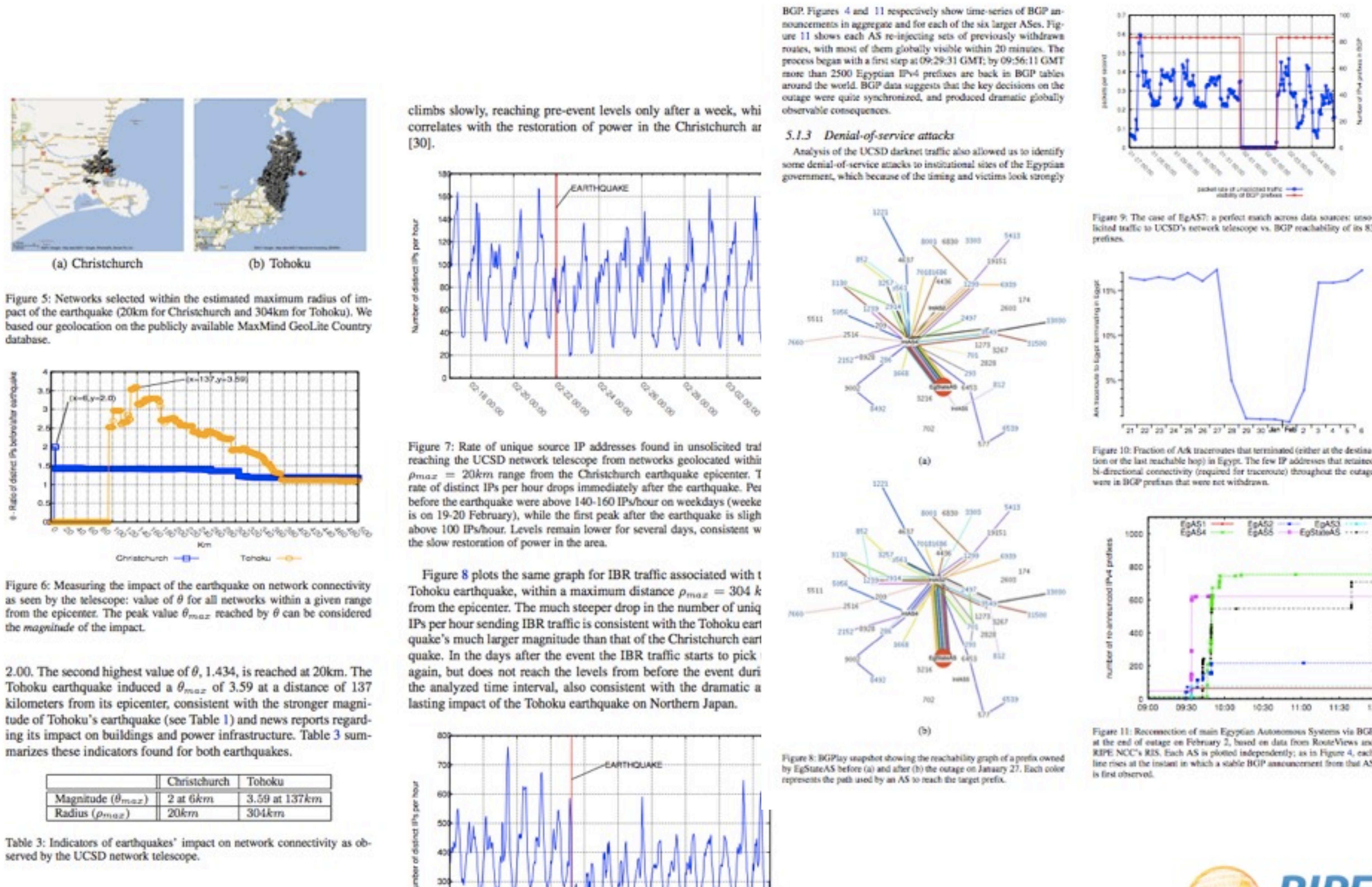
RIPE Atlas

- Network built based on hosts and sponsors
  - Probes can be hosted by ISPs, Internet Exchange Points, individuals...
- User Benefits
  - Worldwide network for active measurements
  - Measure your network/services from the outside
- Community benefits
  - Situational awareness
  - Wealth of data

Example: Reachability of 128.0.0.0/16



Network Events / Academic Papers



(a) Christchurch (b) Tohoku

Figure 5: Networks selected within the estimated maximum radius of impact of the earthquake (20km for Christchurch and 304km for Tohoku). We based our geolocation on the publicly available MaxMind GeoLite Country database.

Figure 6: Measuring the impact of the earthquake on network connectivity as seen by the telescope: value of θ for all networks within a given range from the epicenter. The peak value θ_{max} reached by θ can be considered the *magnitude* of the impact.

2.00. The second highest value of θ, 1.434, is reached at 20km. The Tohoku earthquake induced a θ_{max} of 3.59 at a distance of 137 kilometers from its epicenter, consistent with the stronger magnitude of Tohoku's earthquake (see Table 1) and news reports regarding its impact on buildings and power infrastructure. Table 3 summarizes these indicators found for both earthquakes.

	Christchurch	Tohoku
Magnitude (θ_{max})	2 at $6km$	3.59 at $137km$
Radius (ρ_{max})	$20km$	$304km$

Table 3: Indicators of earthquakes' impact on network connectivity as observed by the UCSD network telescope.

climbs slowly, reaching pre-event levels only after a week, whi correlates with the restoration of power in the Christchurch ar [30].

Figure 7: Rate of unique source IP addresses found in unsolicited traf reaching the UCSD network telescope from networks geolocated withi $\rho_{max} = 20km$ range from the Christchurch earthquake epicenter. T rate of distinct IPs per hour drops immediately after the earthquake. Pe before the earthquake were above 140-160 IPs/hour on weekdays (weeke is on 19-20 February), while the first peak after the earthquake is sligh above 100 IPs/hour. Levels remain lower for several days, consistent w the slow restoration of power in the area.

Figure 8 plots the same graph for IBR traffic associated with t Tohoku earthquake, within a maximum distance $\rho_{max} = 304\ k$ from the epicenter. The much steeper drop in the number of uniq IPs per hour sending IBR traffic is consistent with the Tohoku eart quake's much larger magnitude than that of the Christchurch eart quake. In the days after the event the IBR traffic starts to pick again, but does not reach the levels from before the event duri the analyzed time interval, also consistent with the dramatic a lasting impact of the Tohoku earthquake on Northern Japan.

BGP. Figures 4 and 11 respectively show time-series of BGP announcements in aggregate and for each of the six larger ASes. Figure 11 shows each AS re-injecting sets of previously withdrawn routes, with most of them globally visible within 20 minutes. The process began with a first step at 09:29:31 GMT; by 09:56:11 GMT more than 2500 Egyptian IPv4 prefixes are back in BGP tables around the world. BGP data suggests that the key decisions on the outage were quite synchronized, and produced dramatic globally observable consequences.

5.1.3 Denial-of-service attacks

Analysis of the UCSD darknet traffic also allowed us to identify some denial-of-service attacks to institutional sites of the Egyptian government, which because of the timing and victims look strongly

(a)

(b)

Figure 8: BGPlay snapshot showing the reachability graph of a prefix owned by EgStateAS before (a) and after (b) the outage on January 27. Each color represents the path used by an AS to reach the target prefix.

Figure 9: The case of EgAS7: a perfect match across data sources: unsolicited traffic to UCSD's network telescope vs. BGP reachability of its 83 prefixes.

Figure 10: Fraction of Ark traceroutes that terminated (either at the destination or the last reachable hop) in Egypt. The few IP addresses that retained bi-directional connectivity (required for traceroute) throughout the outage were in BGP prefixes that were not withdrawn.

Figure 11: Reconnection of main Egyptian Autonomous Systems via BGP at the end of outage on February 2, based on data from RouteViews and RIPE NCC's RIS. Each AS is plotted independently; as in Figure 4, each line rises at the instant in which a stable BGP announcement from that AS is first observed.

How Is This Relevant to Government?

- Law enforcement
  - RIPEstat can bring together relevant data for a given Internet number resource
- Better intelligence on issues like the recent case concerning DigiNotar fraudulent certificates

- What We're NOT Doing
  - Last-mile, consumer broadband measurements

How Can We Help You?

- What are YOU interested in?
  - These are active projects open to community input
- Talk to us about what you would like to see!

Questions?