Using the RIPE Atlas API for Measuring IPv6 Reachability

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Overview

- Short intro to RIPE, RIPE NCC
- What is IPv6 & Getting IPv6
- What is RIPE Atlas
- How to use measurements
- IPv6-related RIPE Atlas use cases
- How to take part in the RIPE Atlas community
- Appendix 1: IPv6 documents
- Appendix 2: RIPEstat

RIPE and the RIPE NCC

RIPE

- Réseaux IP Européens
- Started in 1989

- Not a legal entity
- An open community - no official membership

- Makes polices

- Meets twice a year

- Work is done in various Working Groups on mailing lists

RIPE NCC

- RIPE Network Coordination Centre
- Started in 1992

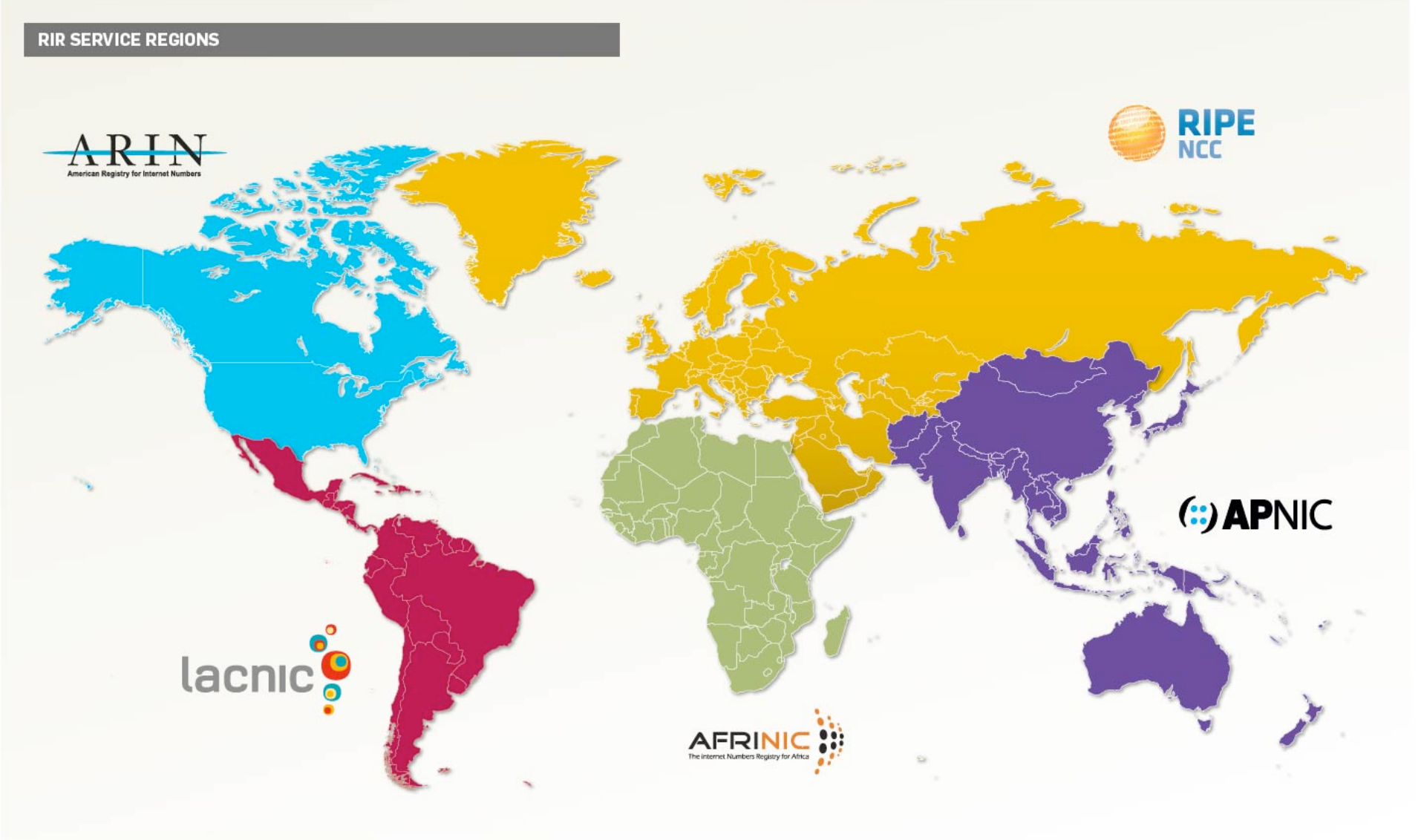
- Not-for-profit organisation
- Has members: Local Internet Registries (LIRs)

- Implements policies

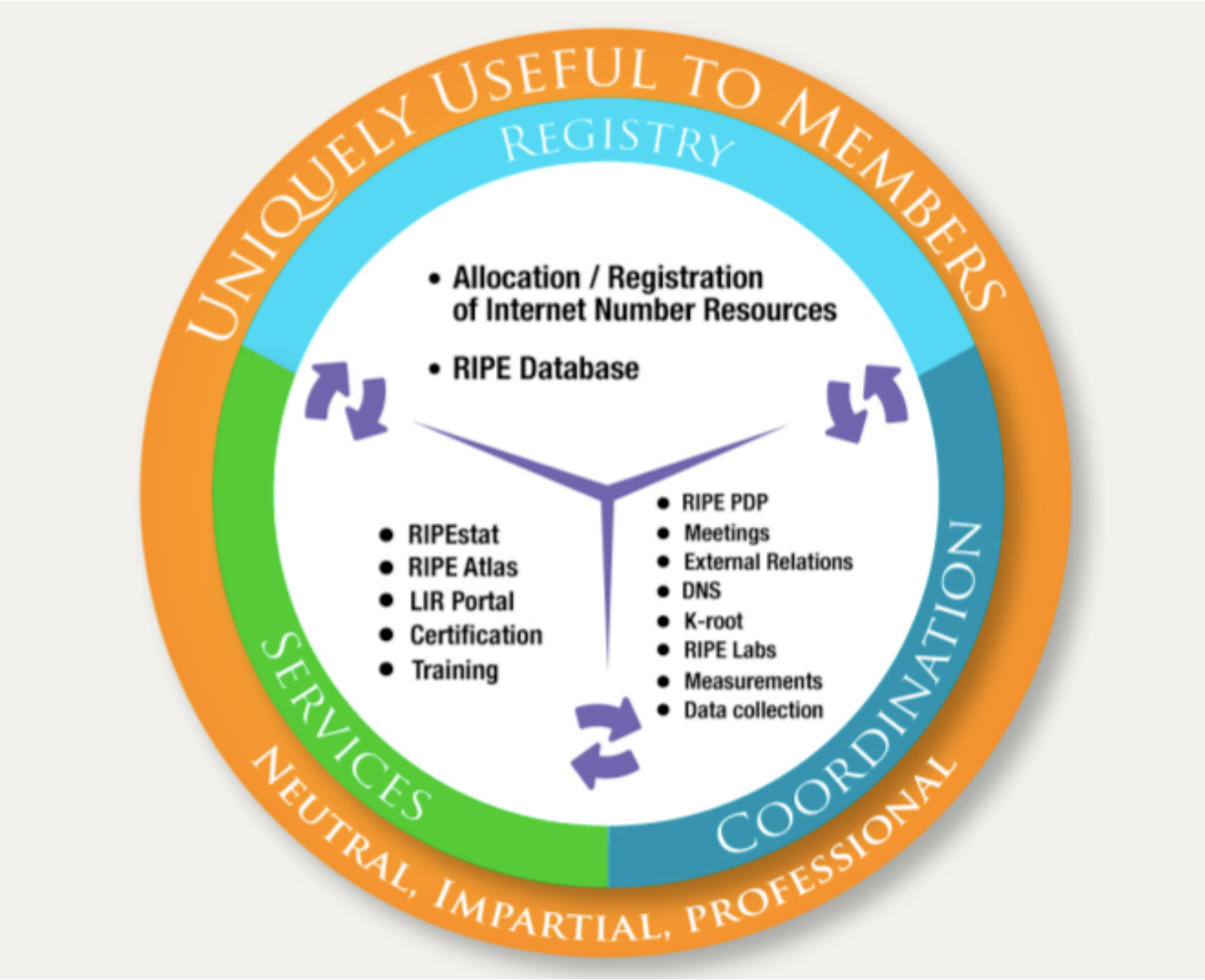
- Facilitates two RIPE Meetings each year

- Provides services to both members and non-members
- Governed by an Executive Board elected by the membership
  - Neutral, impartial, open, transparent

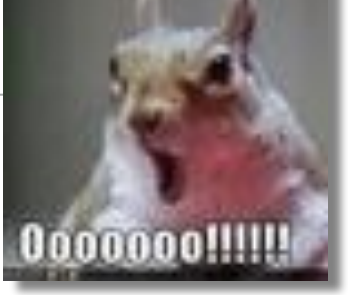
The Five RIRs



Not Only an RIR: RIPE NCC Services



Related Events in SEE Region



- Peering Forum, September 2014, Split, Croatia
  - http://www.peering-forum.eu/
- EURO-IX meeting, October 2014, Bucharest, Romania
  - https://euro-ix.net/events/51
- OpenFest, November 2014, Sofia
  - http://openfest.org/
- SEE4, April 2015, Belgrade, Serbia **(RIPE NCC regional meeting)**
  - http://www.ripe.net/see4

Increasing Academic Involvement: RACI

The RIPE Academic Cooperation Initiative (RACI)

RACI (the **RIPE Academic Cooperation Initiative**) will provide up to five students and researchers with complimentary tickets and transport to RIPE 69, and accommodation for the duration of the meeting.

RIPE 69 will take place from 3-7 November 2014 at the Novotel London West Hotel, London, United Kingdom.

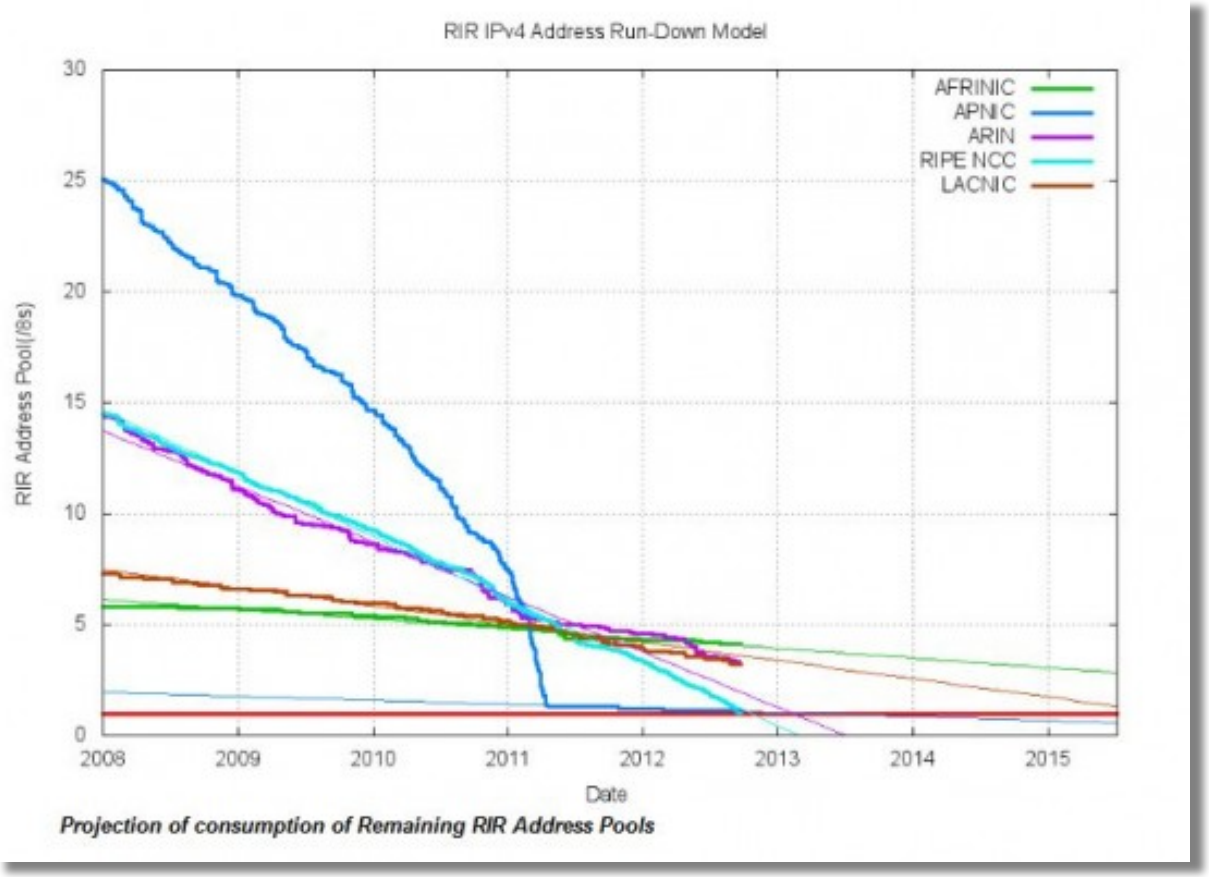
RACI applications are now open!
All applications received after 12 September 2014 will be considered for RACI at RIPE 70 in Amsterdam, to be held from 11-15 May 2015.

https://ripe69.ripe.net/programme/raci/

IPv6: Why & What

Ran-out of IPv4

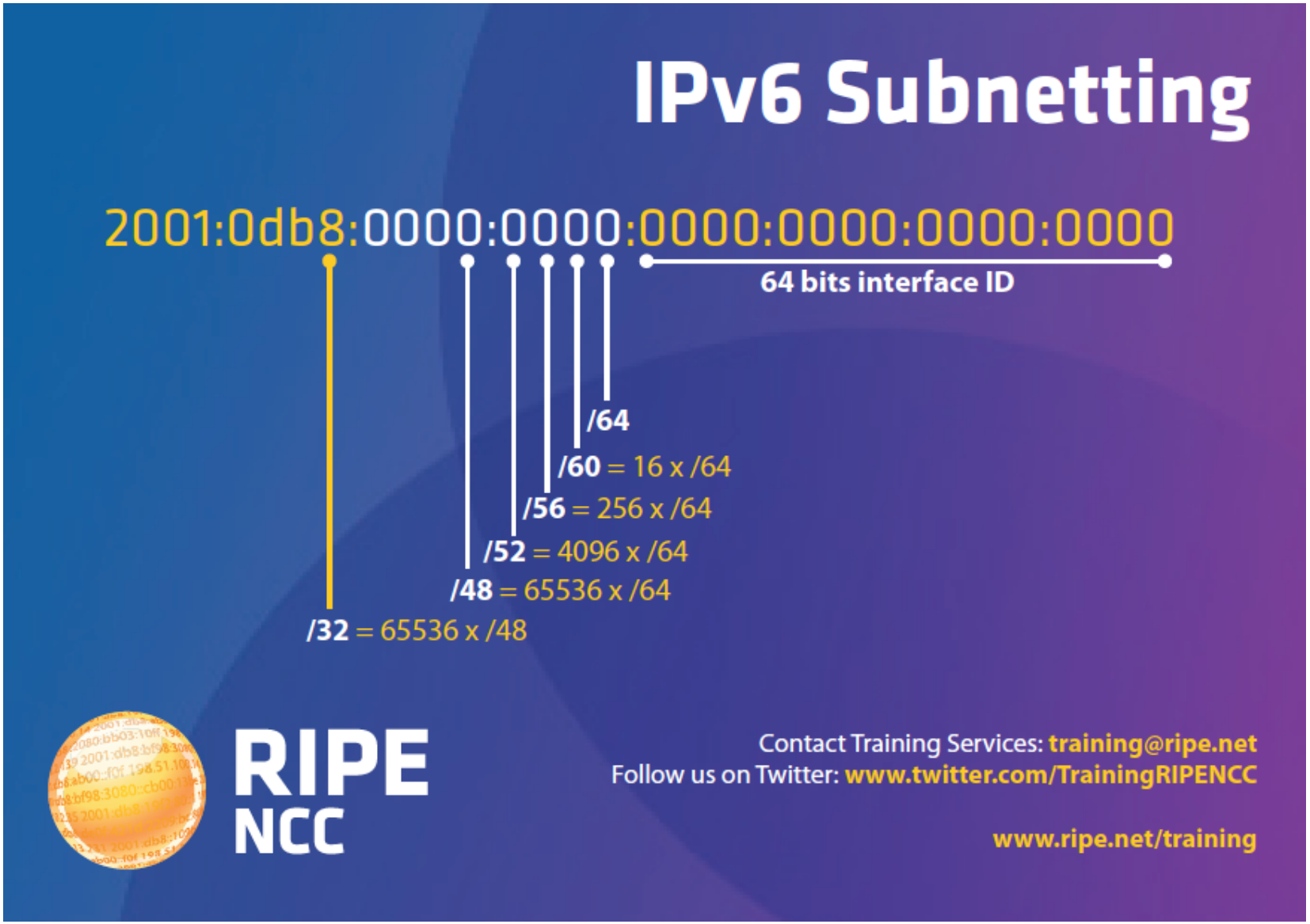
- RIPE NCC is currently giving out IPv4 space from the “Last /8”
- Only to LIRs
- Only one /22 (1024 IP addresses) per member (LIR)



IPv6 Address Basics

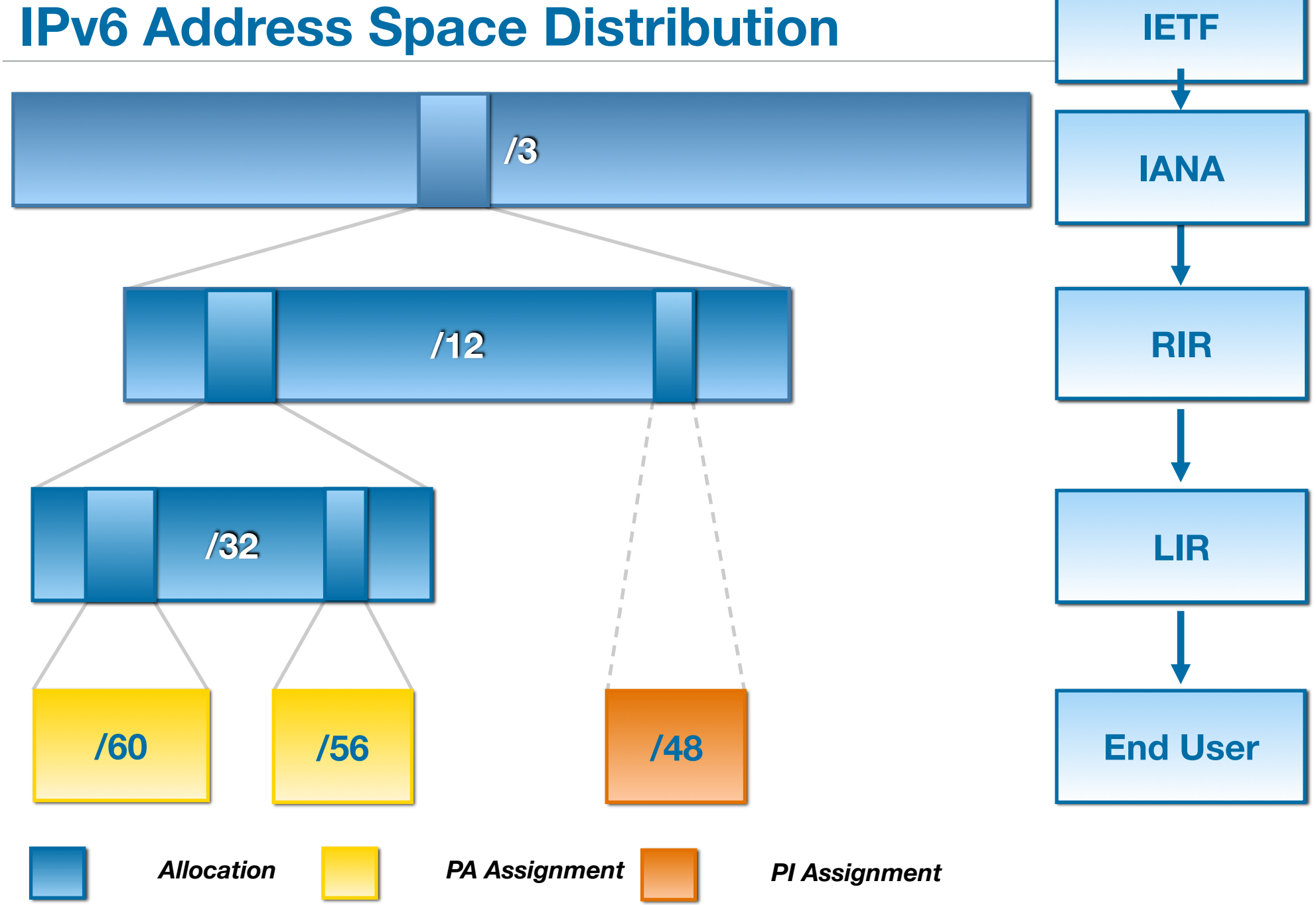
- Longer addresses, larger address space
- IPv6 address has 128 bits
  - Written in hexadecimal, using **:** as a separator
- For example: 2001:**0**db8:**00**3e:ef11:**0000:0000**:c100:**00**4d
  - shortened to: 2001:db8:3e:ef11::c100:4d
- Each interface can have multiple addresses:
  - link-local: fe80::bae8:56ff:fe1d:138
  - “private” (ULA): fc00::/7
  - 6to4 tunnel: 2002::/16
  - public: 2000::/3 (e.g. 2001:470:26:200:bae8:56ff:fe1d:138)
- ***NOT* BACKWARDS COMPATIBLE WITH IPv4!!!**
  - translation technologies needed

IPv6 Subnetting



Getting IPv6

IPv6 Address Space Distribution



Getting IPv6 from the RIPE NCC

- To qualify for an allocation an organisation must:
  - Be an LIR
  - Have a plan for making assignments within two years
  - Minimum allocation size is /32

- To qualify for a PI assignment an organisation must:
  - Meet the contractual requirements for PI resources
    - LIRs must demonstrate special routing requirements
  - PI space cannot be used for sub-assignments
  - Minimum assignment size is /48

Getting IPv6 Otherwise

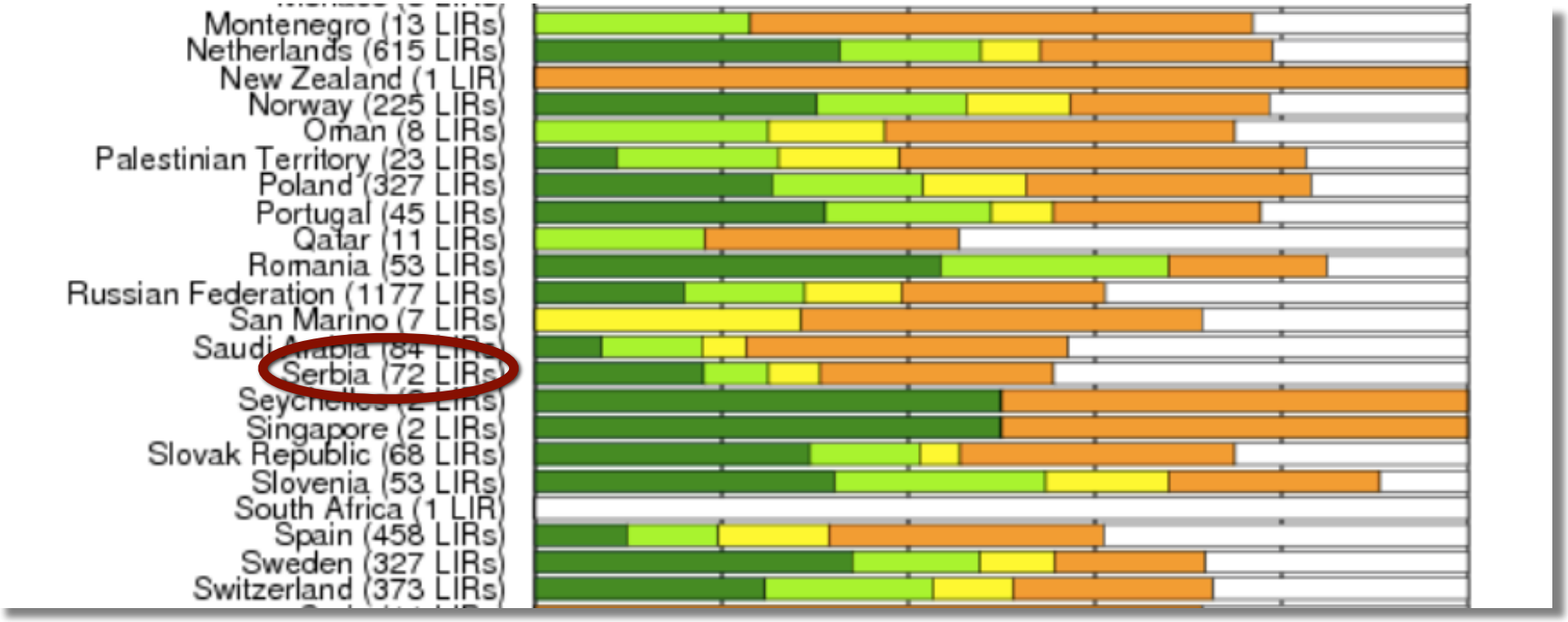
- For local network, use “private” IPv6 space (ULA)
  - FC00::/8 and FD00::/8
  - http://tools.ietf.org/html/rfc4193, http://tools.ietf.org/html/rfc5375
- For learning/testing/transition, use tunnels
  - SixXS: https://www.sixxs.net/
  - Hurricane Electric https://www.tunnelbroker.net/
- For small SOHO, ask your upstream ISP
  - No, you are not the first one to ask...
  - Ask for a sub-allocation if you are a business
  - Ask for /48 is you are a home user

IPv6 Security Considerations

- Everybody can claim to be a router
  - Use RA Guard to filter unauthorised RAs (RFC 6105)

- SEcure Neighbor Discovery (SEND) - RFC3971
  - Neighbor solicitation/advertisement spoofing
  - DoS attack
  - Router solicitation and advertisement attacks
  - No implementations (yet)

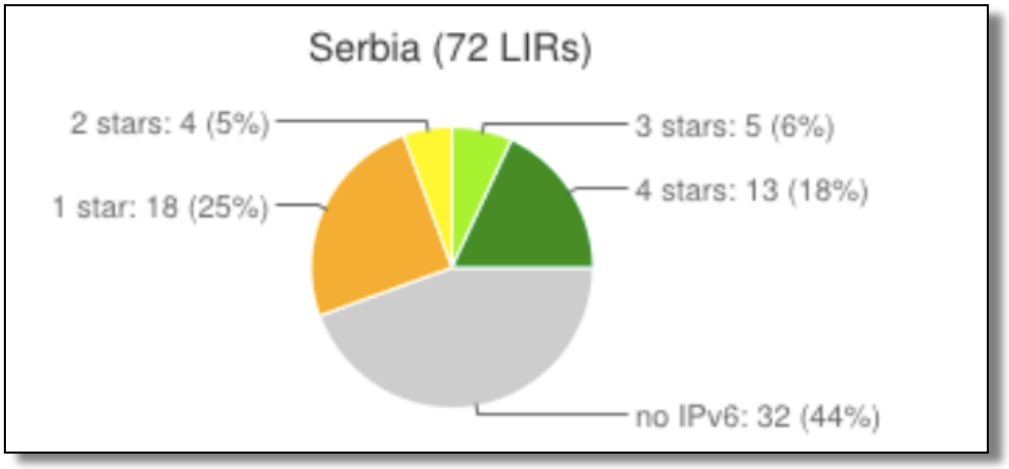
- Measure of IPv6 readiness for LIRs
  - allocation; reverse DNS; route6 object in RR; BGP seen in RIS



- 4 stars == free T-shirt!

IPv6 RIPEness in Serbia

- 4 star: http://ipv6ripeness.ripe.net/4star/RS.html



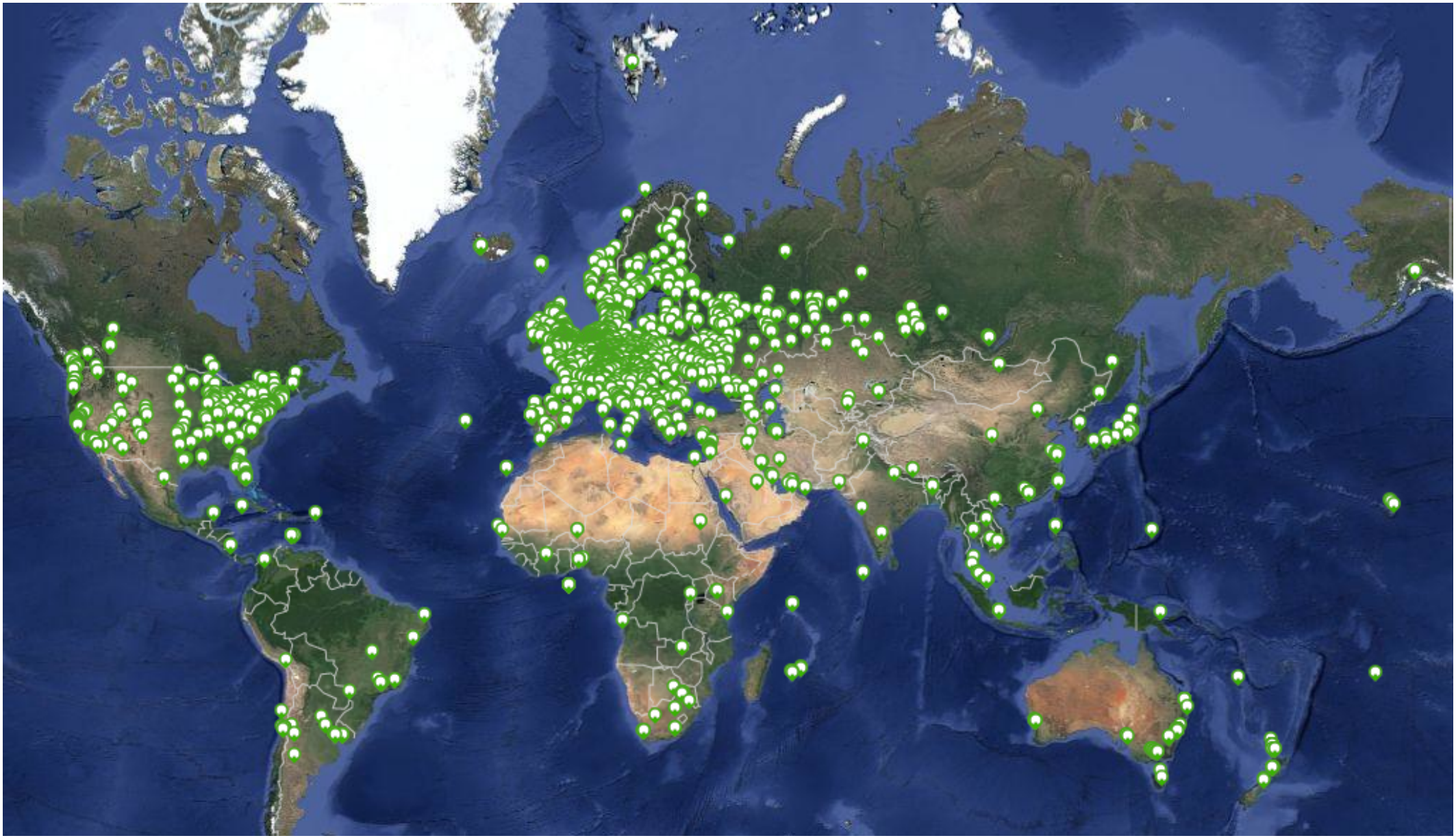
- 5 star: http://ipv6ripeness.ripe.net/5star/RS.html

Access (last 6 months)	Access (last month)	Content	LIR
7.8 %	8.2 %	15.5 %	Akademska mreza Republike Srbije - AMRES
		41.1 %	Drustvo za telekomunikacije Verat d.o.o, Bulevar Vojvode Misica 37
		100.0 %	Vip mobile d.o.o.


:db8:abc
03:10ff 198.
b8:bf98:3080:
198.51.100.14
80::cb00:13be
b8:19f2:80::1
21d:2209:bc:80
001:db8::109
fof 198.51
001:db

RIPE Atlas

RIPE Atlas Probe Deployment



RIPE Atlas Basics

- RIPE Atlas is a global active measurements platform
- Goal is to provide the view of the Internet reachability
- Small hardware probes are hosted by volunteers
- Built-in measurements are run towards root-name servers from all probes
  - visualized as **Internet Traffic Maps**
  - data is publicly available for analysis

Internet Traffic Maps

Maps – RIPE Atlas — RIPE

https://atlas.ripe.net/results/maps/

RIPE Atlas Home • About RIPE Atlas • Get Involved • Results • Login

- Internet Maps
- Coverage & Statistics
- Analyses & Use Cases
- Graphs
- RIPE Atlas Anchors

You are here: Home > Data & Tools > RIPE Atlas > Results > Inte

RIPE Atlas - Map Visualisations

DNS root instances

Shows, for each probe, which root DNS server instance the probe ends up querying, when they ask a particular root server. In other words, it shows the "gravitational radius" for root DNS server instances.

Comparative DNS Root RTT

Shows a comparison of response time for DNS SOA queries to all the root DNS servers. For each probe, a marker shows the "best" root server with colour identifying the related minimum response time.

DNS root server TCP/UDP performances

This map shows the reply time to the SOA query of a particular root DNS server, over the selected transport protocol (UDP, TCP or comparison of the two) for each probe.

RTT to fixed destinations

Shows the colour coding for the RTT value for the particular destination for each probe. The minimum / average / maximum values are based on standard "ping" measurements.

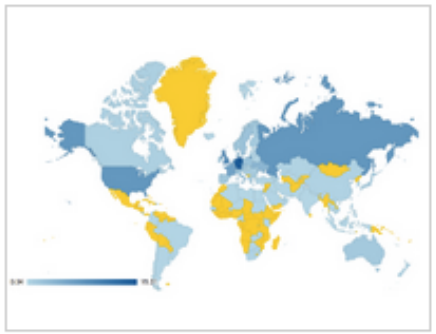
Reachability of fixed destinations

Shows if the particular fixed destination is reachable or not from each probe. Red markers indicate that the specific destination for these probes are unreachable and green reachable.

RIPE Atlas network extent

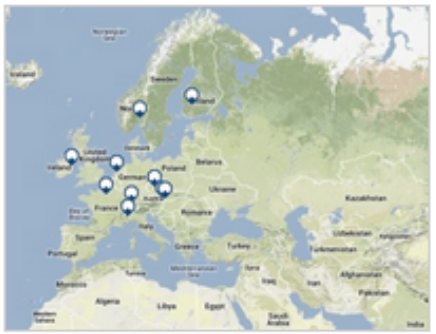
Shows the extent of the RIPE Atlas network, with all active and inactive probes.

Percentage of probes per country



Shows the distribution of probes in the world using colouring to highlight the most populated countries. Only up probes are taken into account.

RIPE Atlas anchor locations



Shows the location of RIPE Atlas anchors.

RIPE Atlas Early September 2014

- 6,600+ active probes
  - 2,050+ probes do IPv6
- 17,500+ registered users (3,000 active monthly)
- Four types of customised measurements available to probe hosts: **ping, traceroute, DNS, SSL**
  - And of course, ping6 and traceroute6 :-)

RIPE Atlas Participation and Benefits

- Anyone can become a RIPE Atlas probe host

- Major personal and operational benefit:
  - See your network from the outside!
  - Have ~6,500 external vantage points to do customised measurements towards the destination of your choice

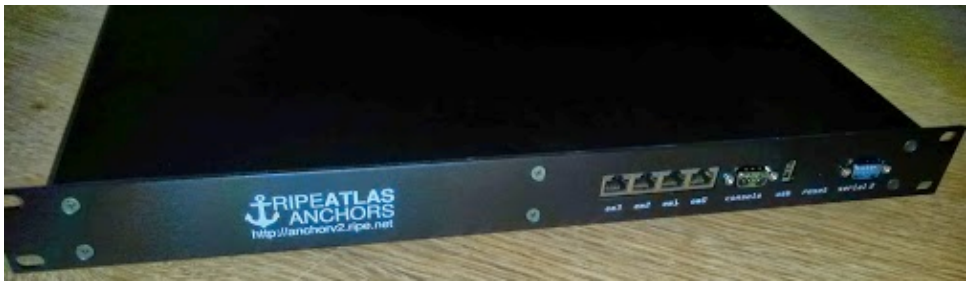
- Data of built-in measurements available to everyone
  - Maps, data from public probes, API to download raw data

Measurement Devices

- v1 & v2: Lantronix XPort Pro

- v3: TP-Link TL-MR3020 powered from USB port
  - Does not work as a wireless router!

- RIPE Atlas anchor: Soekris net6501-70

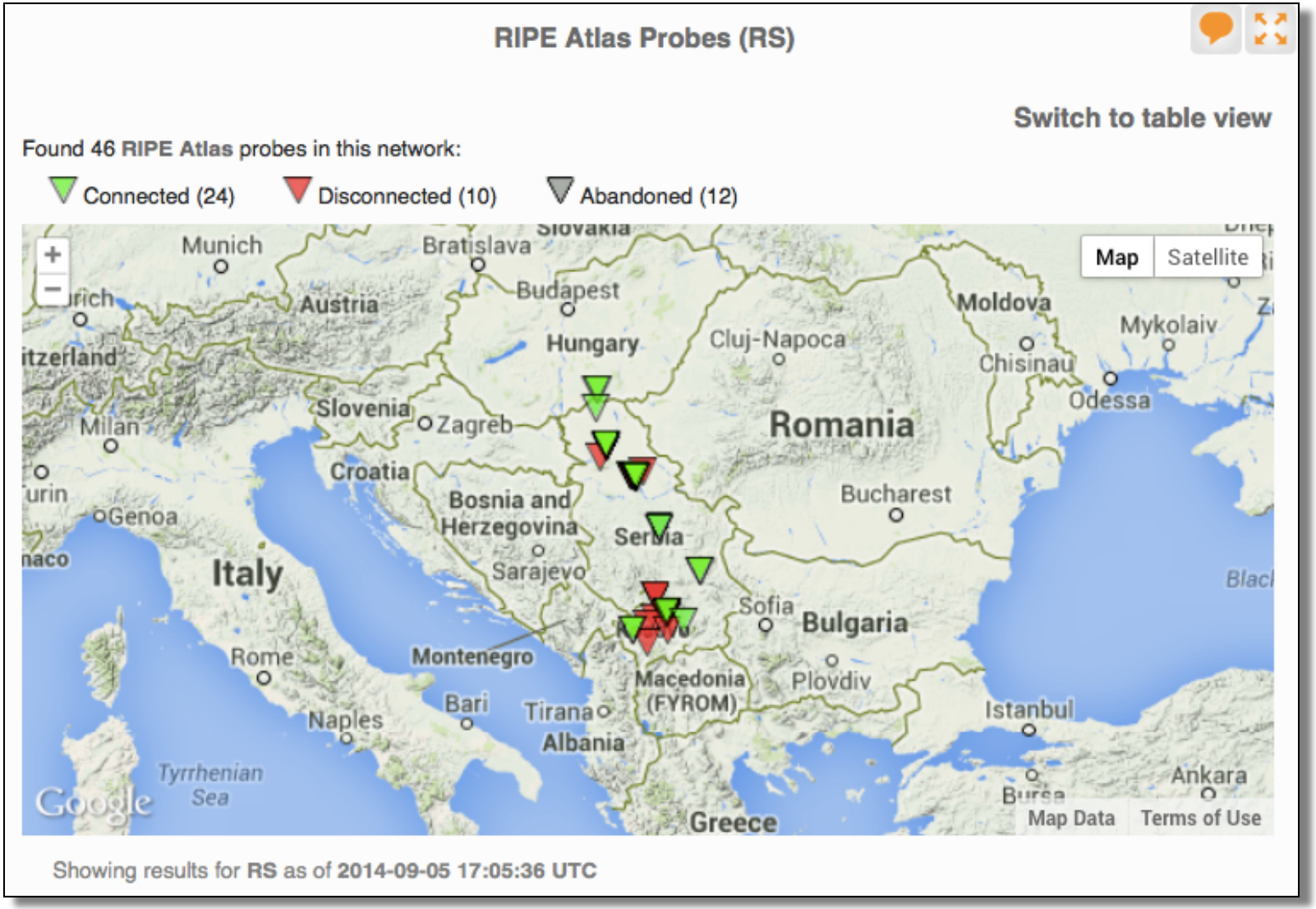


RIPE Atlas Anchors

- Anchors: well-known targets and powerful probes
  - Regional baseline & “future history”
- 73 anchors installed
- Anchoring measurements
- Measurements between anchors
- 200 probes targeting each anchor with measurements
- Each probe measures four to five anchors
- Apply: https://atlas.ripe.net/about/anchors/

- **The only RIPE Atlas anchor in Balkans is hosted by SOX, Belgrade!**

Probes per country, in RIPEstat



Naming&Shaming: Probes at BalCCon2013

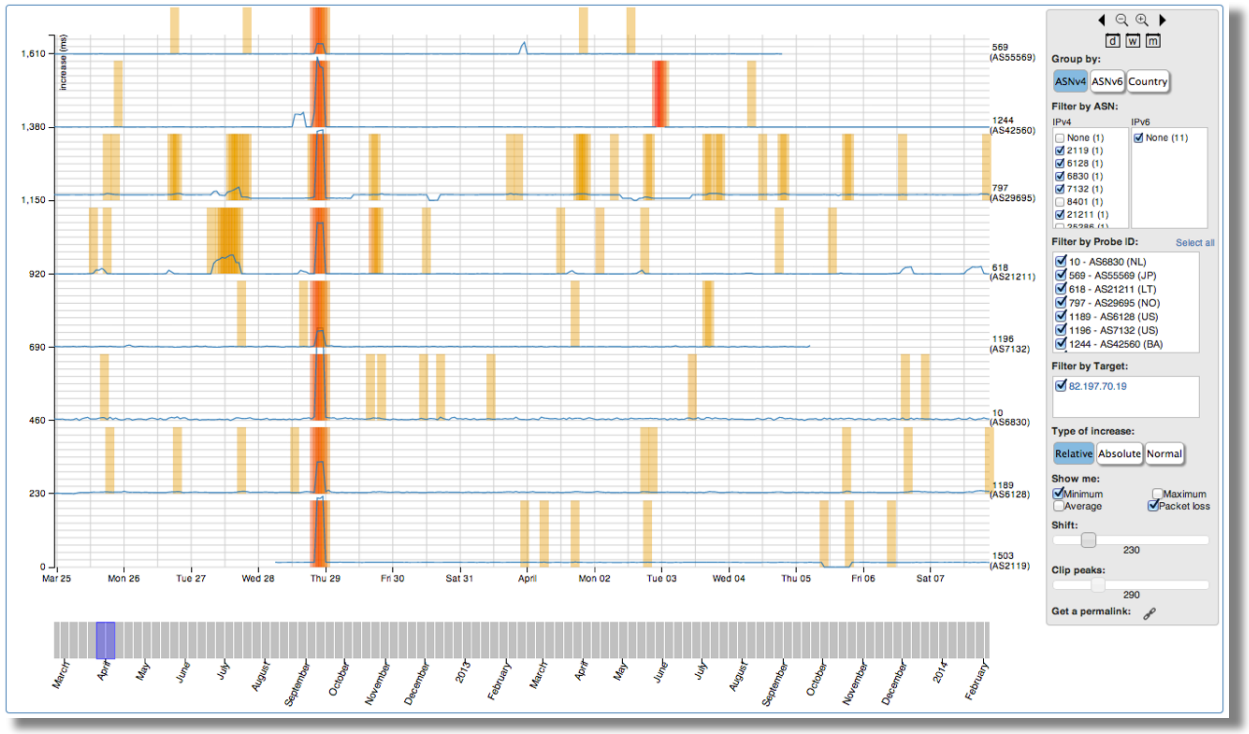
Veljko	Handed out	2013-07-26	OHM 201	Balccon 2013	?
Gabriel	Handed out	2013-07-26	OHM 2013	OHM2013	
Moki	Handed out	2013-07-26	OHM 201	Balccon 2013, will write an article about privacy aspects	?
Igor	Handed out	2013-07-26	OHM 201	Balccon 2013	?
Madis	Handed out	2013-07-26	OHM 2013	OHM2013	
Nikola	Handed out	2013-07-26	OHM 201	Balccon, 2013	?
Mihajlo	Handed out	2013-07-26	OHM 201	Balcon 2013	?
Silvan	Handed out	2013-07-26	OHM 201	BalCCon 2013, hackerspace.si probe (which space?!)	?
Marco	Handed out	2013-07-26	OHM 2013	OHM2013	
Jason	Handed out	2013-07-26	OHM 2013	Iceland! // OHM2013	
Hacklab01	Handed out	2013-07-26	OHM 201	Balccon 2013 Zagreb	?
Haklab Beograd	Online, not hosted	2013-07-26	OHM 201	Balccon 2013, Haklab Beograd	?

RIPE Atlas New Features

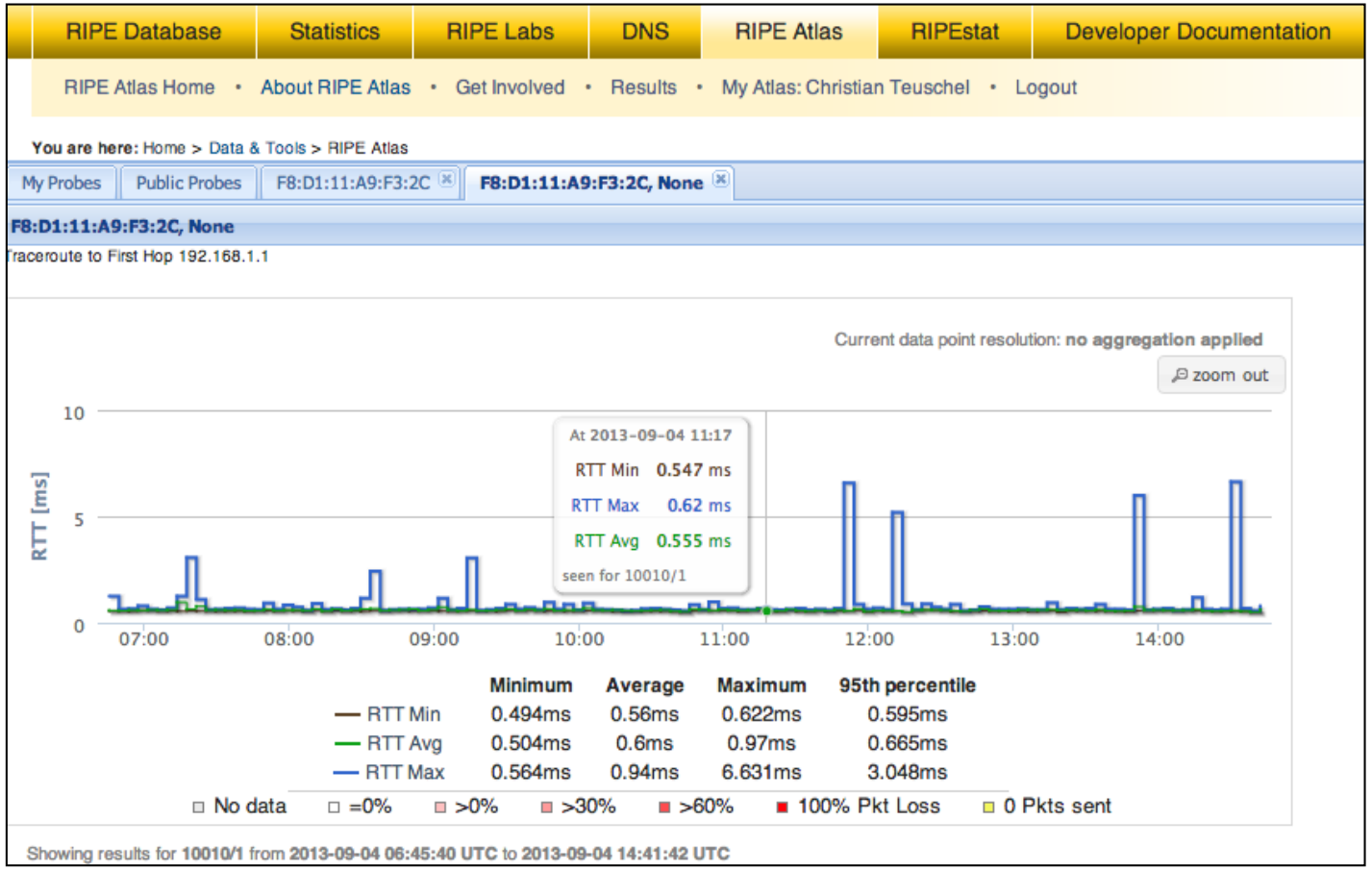
- Seismograph
  - Multiple ping measurements in one view
  - Stacked chart and interactive control panel
  - Based on RIPEstat widget framework
- Zoomable ping graph
  - Replacing multiple RRDs graphs: zoom in/out in time, in the same graph, without loss of detail
  - Easier visualisation of an event's details
  - Selection of RTT class (max, min, average)
- Latest results API
  - https://atlas.ripe.net/docs/measurement-latest-api/

Seizmograph

- Powerful Anchors Mesh Visualization
- https://labs.ripe.net/Members/massimo_candela/seismograph-user-guide

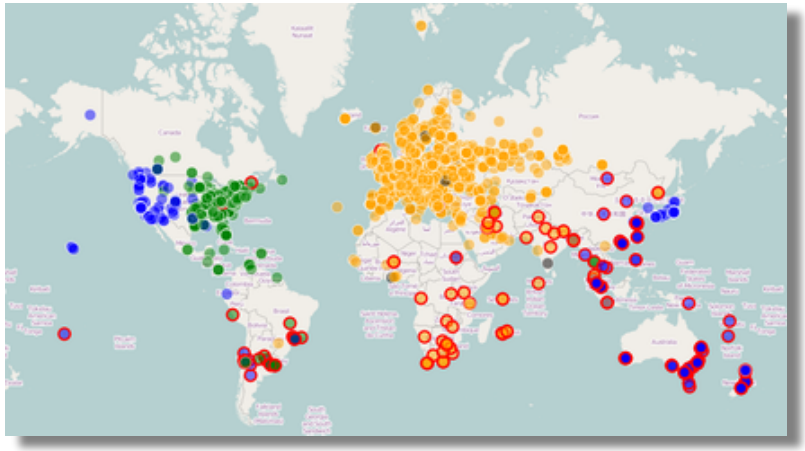


Zoomable Ping Graph

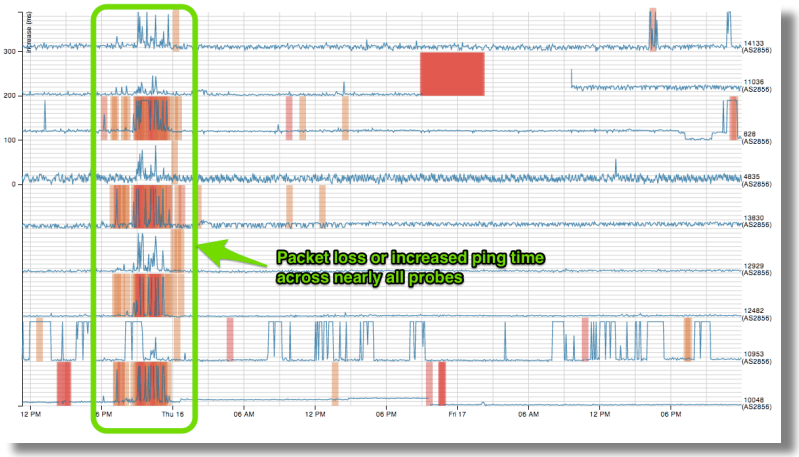


New Success Stories

- Helped Wikimedia to identified ways to decrease latency and improve performance
  - https://labs.ripe.net/Members/emileaben/how-ripe-atlas-helped-wikipedia-users



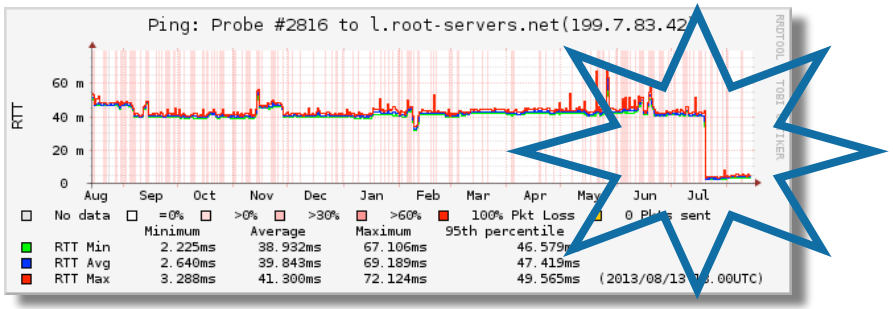
- Investigating problems of slow servers
  - http://engineering.freeagent.com/2014/01/24/atlas-probes/



- TimeWarnerCable outage
  - https://labs.ripe.net/Members/emileaben/time-warner-cable-outage

Older Use Cases

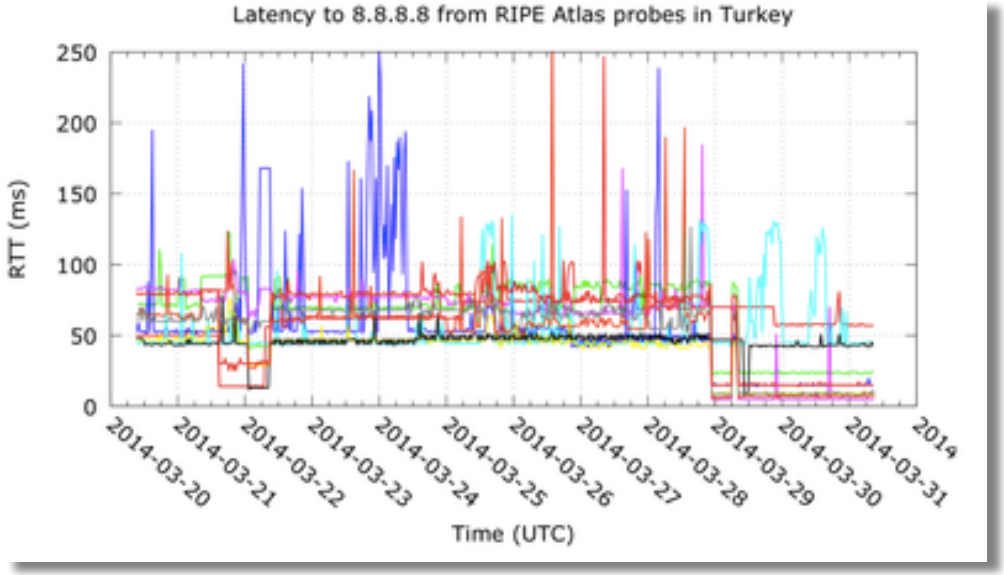
- IXP: Measuring the effect of installing L-root in Belgrade / SOX



- DNS: Looking for most popular instances of .FR anycast servers

Name server instance	Nr. of probes connecting to instance	Percentage
dns.th2.nic.fr	173	36%
dns.fra.nic.fr	173	36%
dns.lon.nic.fr	47	10%
dns.lyn2.nic.fr	29	6%
dns.lyn1.nic.fr	25	5%
dns.bru.nic.fr	19	4%
dns.ix1.nic.fr	18	4%

- Events: Measuring Internet outage in Turkey



Security Aspects

- Probes have hardwired trust material (registration server addresses / keys)
- The probes don't have any open ports; they only initiate connections - this works fine with NATs, too
- Measurements are scheduled by centralised "command servers" via reverse ssh tunnels
- Probes don't listen to local traffic; there are no passive measurements running
- Measurement source code published
- Reported vulnerabilities: https://atlas.ripe.net/docs/security/

At Hackerspaces

RIPE Atlas

42 Hackerspaces with a RIPE Atlas Probe

To ask for a probe: atlas.ripe.net/apply

To add a probe to your hackerspace: edit the page of your hackerspace on this wiki; at the bottom add "equipment" your hackerspace on this map!

For more info, see Project description "RIPE Atlas probes at hackerspaces" and the workshop at 29c3

- http://hackerspaces.org/wiki/RIPE_Atlas

How to Use Measurements

User-Defined Measurements

- Probe hosts and RIPE NCC members perform customised measurements using the targets and frequency of their choice

- API available for creating measurements
  - https://atlas.ripe.net/docs/measurement-creation-api/

- REST APIs for analysing measurements, too
  - https://labs.ripe.net/Members/wilhelm/ripe-atlas-code-for-analysis-and-statistics-reporting

Web UI: How to Schedule a Measurement

- Log in to atlas.ripe.net
- Go to “My Atlas” → “My Measurements”
- Choose “New Measurement” or “One-off”
  - Most measurements are periodic & last a long time
  - Choose type, target, frequency, # of probes, region...
  - You will spend credits (next slides)
- To see results: “My Measurements”
- More details: https://atlas.ripe.net/doc/udm

Credit System

- By hosting a probe, you earn credits as a reward for making your probe available to others
  - Hosts earn 21,600 credits per day, as long as the probe is connected
- To perform customised measurements, you spend credits
  - Use them to perform measurements from your probe towards any target
  - Ping costs 10 credits, traceroute costs 20, etc.
  - Daily limit applies

Credit System (continued)

- Credit system introduced to ensure fairness and protect system from overload
- To use the API, you need keys that identify users:
    - https://atlas.ripe.net/atlas/keys
- Extra credits can be earned by:
    - Being a RIPE NCC member
    - Hosting a RIPE Atlas anchor
    - Sponsoring multiple probes
- More details: https://atlas.ripe.net/doc/credits

Status Checks: Creating Alerts in “Icinga”

1. Create a RIPE Atlas ping measurement
   - You can use up to 1,024 probes
2. URL: https://atlas.ripe.net/api/v1/status-checks/MEAUSRMNT_ID/
3. Come back later to see whether anything has changed
4. Define your alerts accordingly

- Icinga:
  - Make use of the built-in check_http plugin
- Documentation and examples:
  - https://atlas.ripe.net/docs/status-checks/

Hands-on Tutorials by the Community

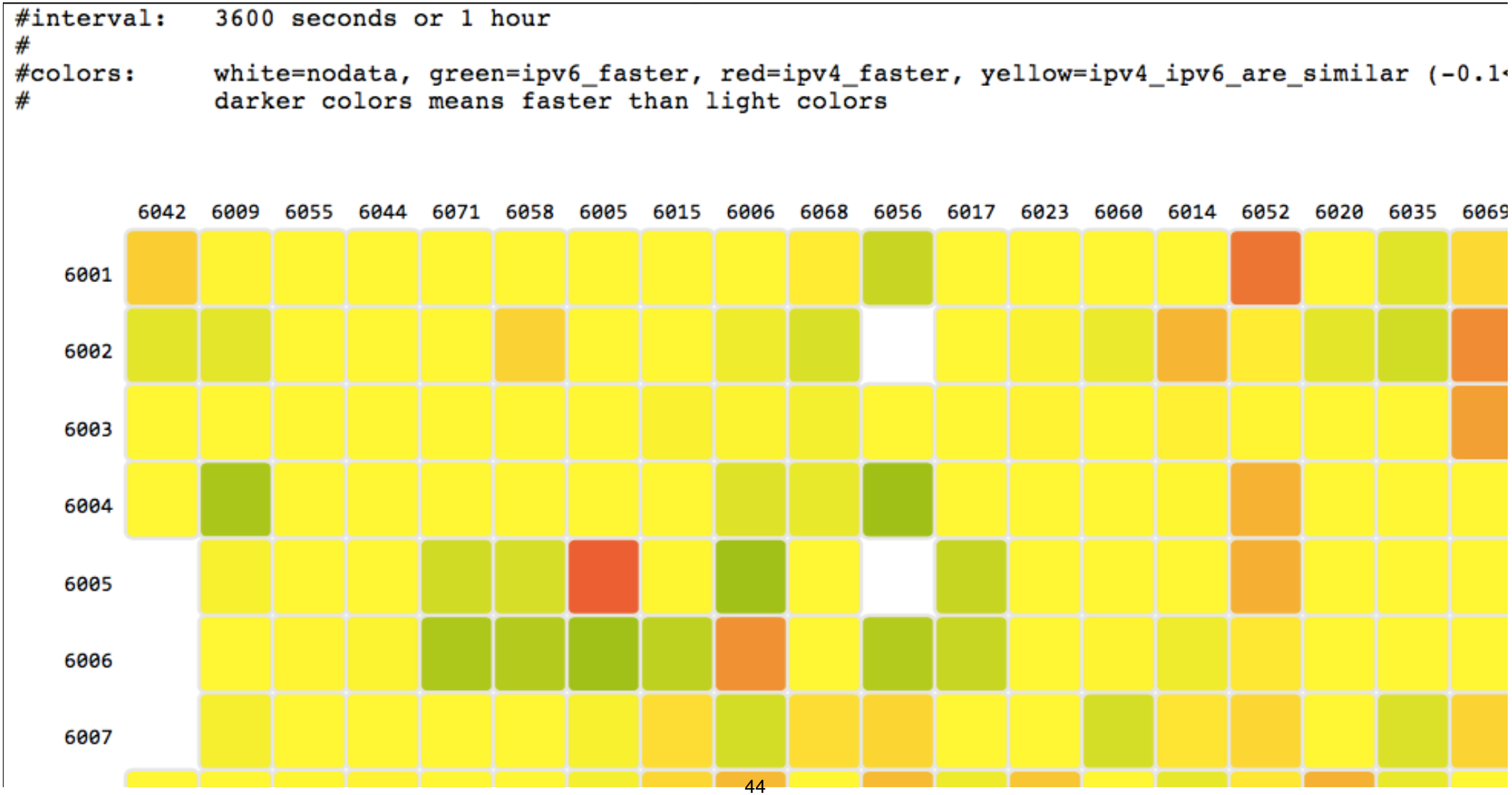
- Nikolay Melnikov, Hands-on: RIPE Atlas, AIMS 2013
  - http://cnds.eecs.jacobs-university.de/users/nmelnikov/aims2013-ripe-atlas.html

- Stéphane Bortzmeyer, Creating and Analysing RIPE Atlas Measurements, RIPE67
  - https://ripe67.ripe.net/presentations/153-ripe-atlas-udm-api-1.pdf

IPv6 Use Cases

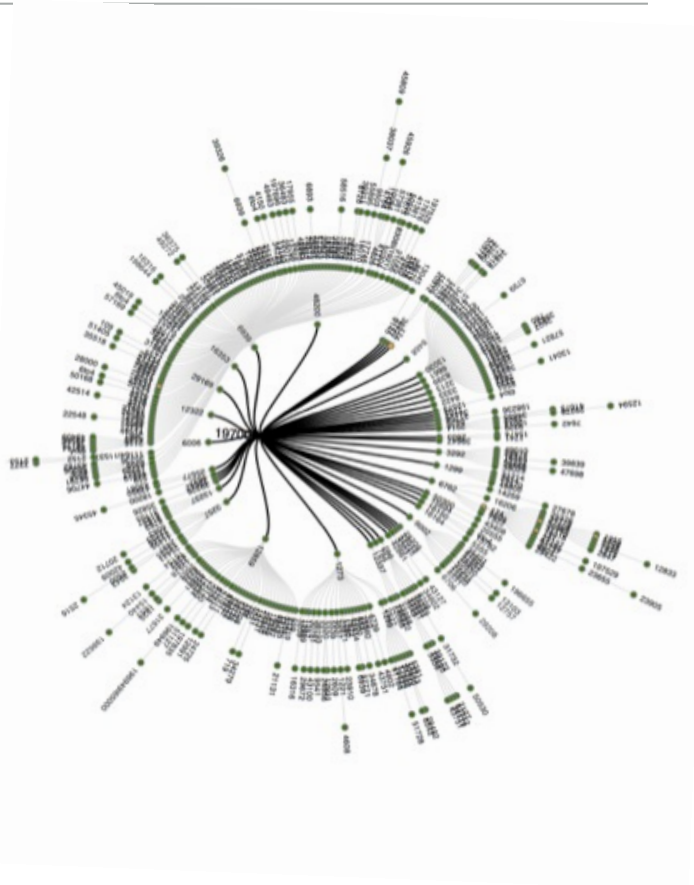
Anchors IPv4/IPv6 Performance

- In Beta: matrix view of Anchors mesh
- Interactive, gives more details on click



RIPE Atlas IPv6 traceroute Visualisation

- Only for RIPE NCC members! (LIRs)
- Via the LIR Portal
- Using 1,000 RIPE Atlas probes
- Visualising:
  - Completed paths
  - Unsuccessful paths
  - Clickable hops (ASNs)



- https://labs.ripe.net/Members/becha/test-your-ipv6-reachability-using-ripe-atlas
- https://labs.ripe.net/Members/emileaben/visualise-your-ipv6-connectivity-using-ripe-atlas

Reachability Testing

Global Reachability Measurements

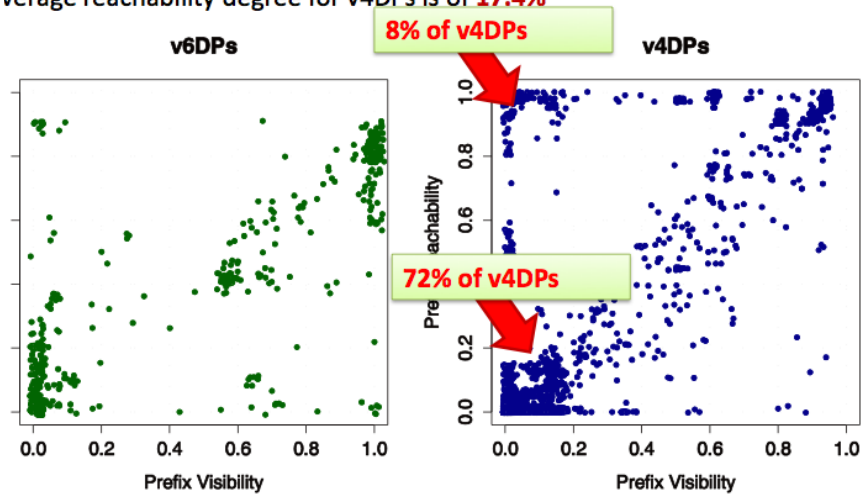
- We test the reachability of the globally-defined v6DPs using ***100 active probes*** within the RIPE Atlas platform

RIPE68@Warsaw 12

Results

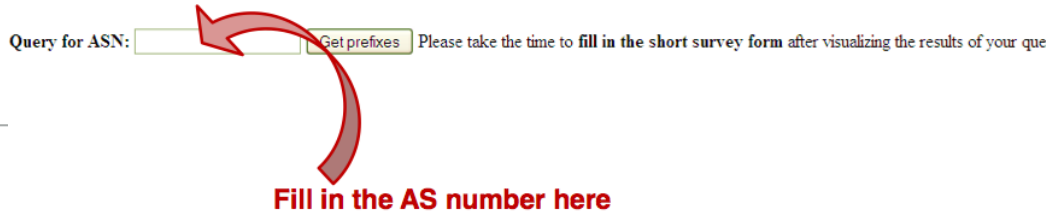
verage reachability degree for a v6DP is of **46.5%**

verage reachability degree for v4DPs is of **17.4%**



Help us to help you!

- Go to **visibility.it.uc3m.es**
- Check if the prefixes of an AS are LVPs/DPs– monitor the global visibility of your prefixes!
- … and tell us why the prefixes discovered have limited visibility in the first place: intended/unintended behaviour?



https://ripe68.ripe.net/presentations/226-Understanding_the_Reachability_of_IPv6_Limited_Visibility_Prefixes.pdf

IPv6 and RIPE Atlas: Reachability Testing

- Using RIPE Atlas to perform worldwide traces to measure round-trip times and other route measurements
  - We identified routes that can be optimised and sent to other POPs with much better response times
  - We also identified routes that can be optimised by changing the transit provider for the same POP
  - https://labs.ripe.net/Members/becha/world-ipv6-launch-ripe-atlas-use-cases

- The success rate with IPv6-only domain names is much lower (~60%) than with "mixed" (both IPv4 and IPv6) domain names (~96%)
  - https://labs.ripe.net/Members/stephane_bortzmeyer/how-many-ripe-atlas-probes-can-resolve-ipv6-only-domain-names

IPv6 and RIPE Atlas: Filtering

- Is there BGP route filtering based on prefix size in IPv6?
  - We saw roughly 1% out of ~500 RIPE Atlas probes that can't reach a destination in an IPv6 /48 prefix (without a covering shorter prefix) out of IPv6 PA space
  - Likely due to filtering
    - https://labs.ripe.net/Members/emileaben/ripe-atlas-a-case-study-of-ipv6-48-filtering
- Is the DNS filtering of AAAA causing unexpected problems?
  - https://labs.ripe.net/Members/emileaben/ripe-atlas-case-study-of-aaaa-filtering

IPv6 and RIPE Atlas: Packet Size and PMTU

- What happens when users try to send large packets over the Internet? Above a certain size, these packets will have to be fragmented, which might cause problems
- 9% of RIPE Atlas probes have problems with fragmentation in IPv4, and 10% of probes have fragmentation problems in IPv6
- https://labs.ripe.net/Members/emileaben/ripe-atlas-packet-size-matters
- http://www.nlnetlabs.nl/downloads/publications/pmtu-black-holes-msc-thesis.pdf

IPv6 and RIPE Atlas: Troubleshooting (1)

- Performing traceroute6 to DNS name that does not have IPv6 helped troubleshoot IPv6 at Vienna University!
  - Most probes reported “name resolution failed”
  - “One probe, 13255 resolved wsww2.cc.univie.ac.at to 2001:6f8:114e:3::c099:aec4, which is interesting because c099:aec4 is exactly equal to the IPv4 address of wsww2.cc.univie.ac.at. So I suspect that this probe is behind a resolver that does DNS64.” (allowing this user-defined measurement was a RIPE Atlas bug ;-))

IPv6 and RIPE Atlas: Troubleshooting (2)

- “It is quite common in the IPv6 world to have devices that believe they are connected to the IPv6 Internet while they are not”
  - “When you use RIPE Atlas to measure the connectivity of an IPv6 device, 90% success is the maximal reachability you'll get.”
  - https://labs.ripe.net/Members/stephane_bortzmeyer/how-many-atlas-probes-believe-they-have-ipv6-but-are-wrong

Tips for Writing IPv6-capable Applications

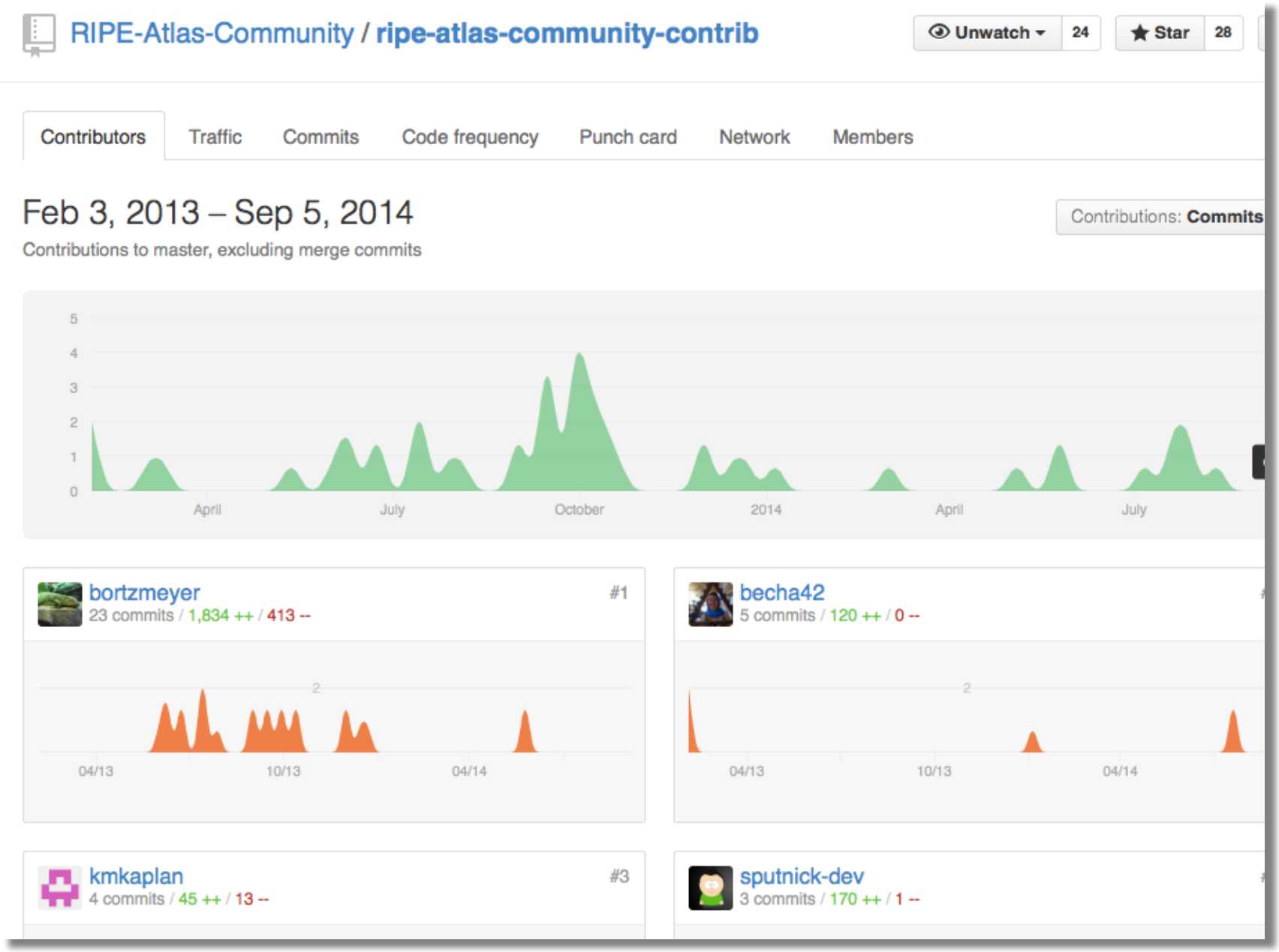
- Application Aspects of IPv6 Transition: http://tools.ietf.org/html/rfc4038
- Porting applications to IPv6:
  - http://gsyc.escet.urjc.es/~eva/IPv6-web/ipv6.html
  - http://www.euchinagrid.org/IPv6/IPv6_presentation/Introduction_to_IPv6_programming.pdf
- Ecdysis: open-source implementation of a NAT64 gateway:
  - http://ecdysis.viagenie.ca/

- **A Recommendation for IPv6 Address Text Representation**
  - http://tools.ietf.org/html/rfc5952

- IETF WGs - Behave: Standardising NATs and protocol translators
  - https://www.ietf.org/dyn/wg/charter/behave-charter.htm

How to Take Part in the RIPE Atlas Community

Contribute to the Community GitHub



Also on GitHub

- https://github.com/RIPE-Atlas-Community

- Measurements source code
  - https://labs.ripe.net/Members/philip_homburg/ripe-atlas-measurements-source-code
  - https://github.com/RIPE-Atlas-Community/RIPE-Atlas-probe-fw-code-4520

- Links to other contributions

- Plus Rumy! http://rubygems.org/gems/ripe-atlas

Become a RIPE Atlas Ambassador

- If you want to...
  - Help distribute probes
  - Give workshops, tutorials, and promote RIPE Atlas
- To become an ambassador:
  - Get in touch; we'll ship you some probes
  - https://www.ripe.net/mailman/listinfo/ripe-atlas-ambassadors
- Become a sponsor:
  - https://atlas.ripe.net/get-involved/community/#!tab-sponsors
- 2014:

Microsoft

Annenberg School for Communication University of Pennsylvania

AS34288 CONNECTING EDUCATION TO THE WORLD

Previous Sponsors

RIPE Atlas Contact Information

https://atlas.ripe.net

- Get a probe: **https://atlas.ripe.net/apply**
- Mailing list for active users: **ripe-atlas@ripe.net**
- Articles and updates on RIPE Labs: **https://labs.ripe.net/atlas**

- Questions: **atlas@ripe.net**
- Twitter: **@RIPE_Atlas** and **#RIPEAtlas**

Questions?

Appendix 1: IPv6 Documents

RIPE NCC IPv6 Training Courses

- Basic and advanced:
  - http://www.ripe.net/training/ipv6/
  - http://www.ripe.net/lir-services/training/courses/advanced-ipv6
- http://www.ripe.net/lir-services/training/material/ripe-ncc-training-material#IPV6
- http://www.ripe.net/lir-services/resource-management/allocations-and-assignments/request-ipv6/ipv6-subnetting-card

RIPE Document: ripe-554

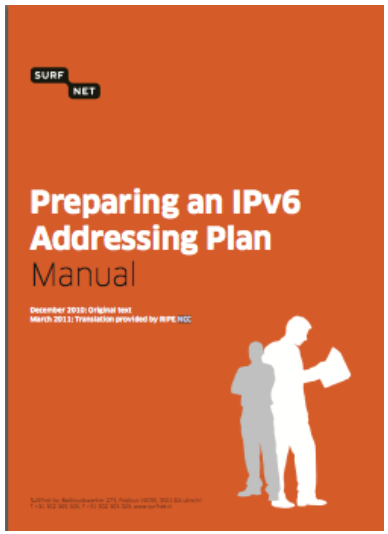
- “Requirements for IPv6 in ICT Equipment”
  - http://www.ripe.net/ripe/docs/ripe-554.html

- Best Current Practice describing what to ask for when requesting IPv6 support
- Useful for tenders and RFPs

- Originated by the Slovenian government
  - Adopted by various others (Germany, Sweden)

What to do with a /48?

- Organisations have no idea how to handle 65,536 subnets!
- Manual for preparing an IPv6 addressing plan
  - https://www.ripe.net/lir-services/training/material/IPv6-for-LIRs-Training-Course/IPv6_addr_plan4.pdf



Moar Links

Websites

- http://www.getipv6.info/
- http://www.ipv6actnow.org
- http://datatracker.ietf.org/wg/v6ops/

Mailing lists

- http://lists.cluenet.de/mailman/listinfo/ipv6-ops
- http://www.ripe.net/mailman/listinfo/ipv6-wg

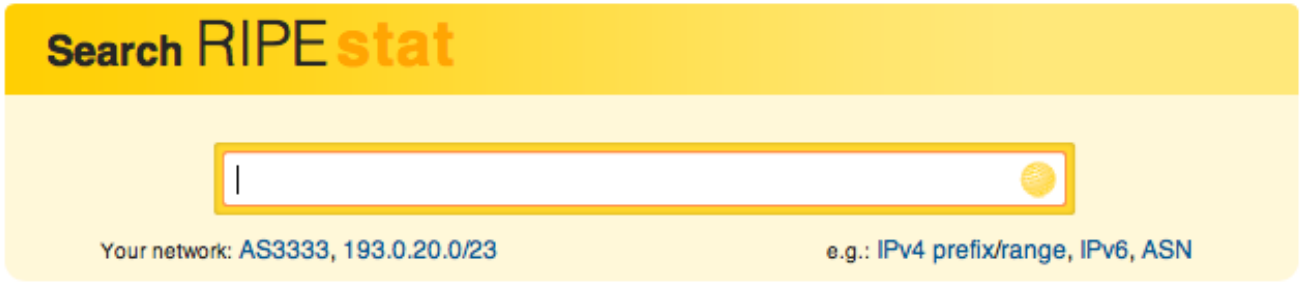
Appendix 2: RIPEstat

https://stat.ripe.net

RIPEstat Introduction

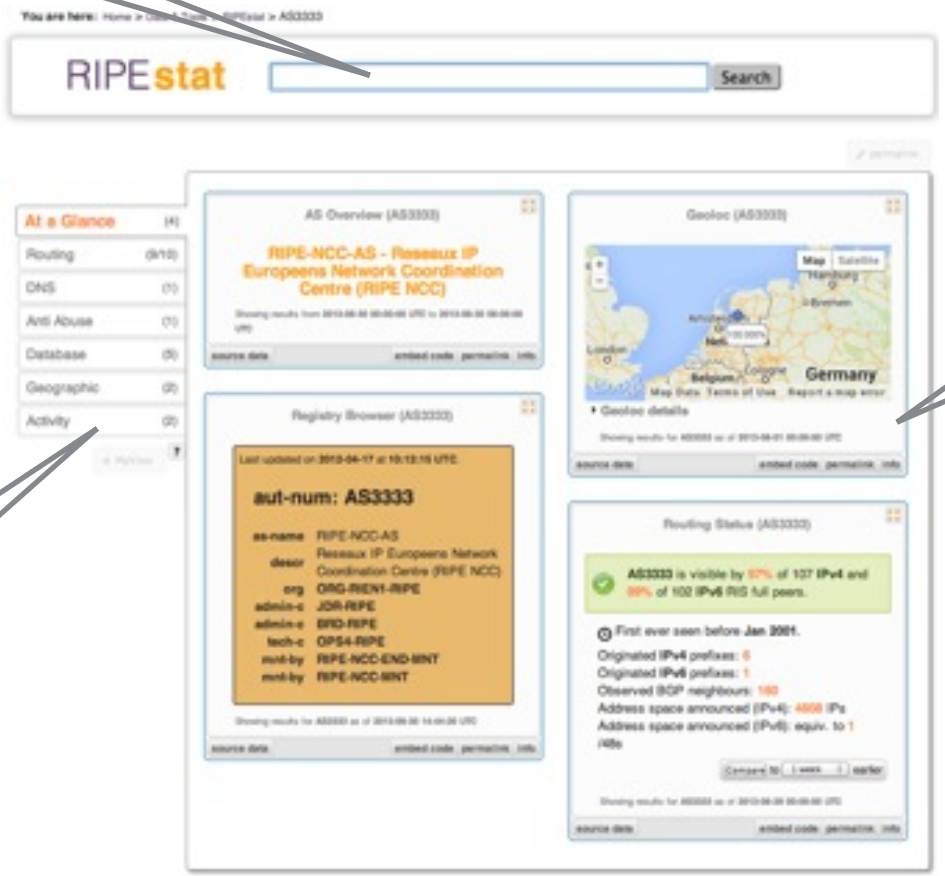
RIPEstat is a “one-stop shop” for information about Internet number resources

- RIPE NCC: registration data and RIPE Database, routing (RIS), reverse DNS, RIPE Atlas measurements
- External sources: IRR, RIRs, geolocation, blacklists, M-Lab network activity



Web Interface: Query Results Page

Search box



Widgets

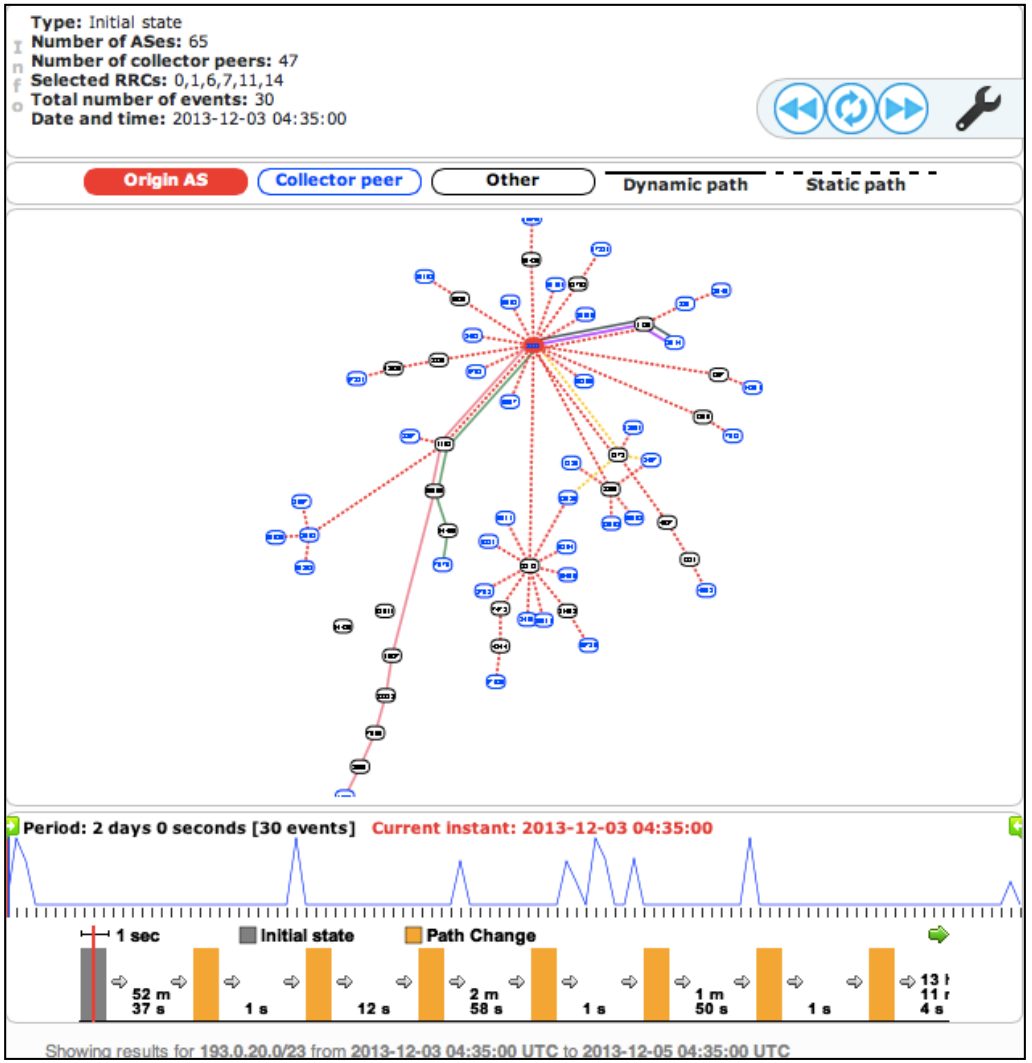
Widgets grouped into thematic tabs

RIPEstat Data and Interfaces

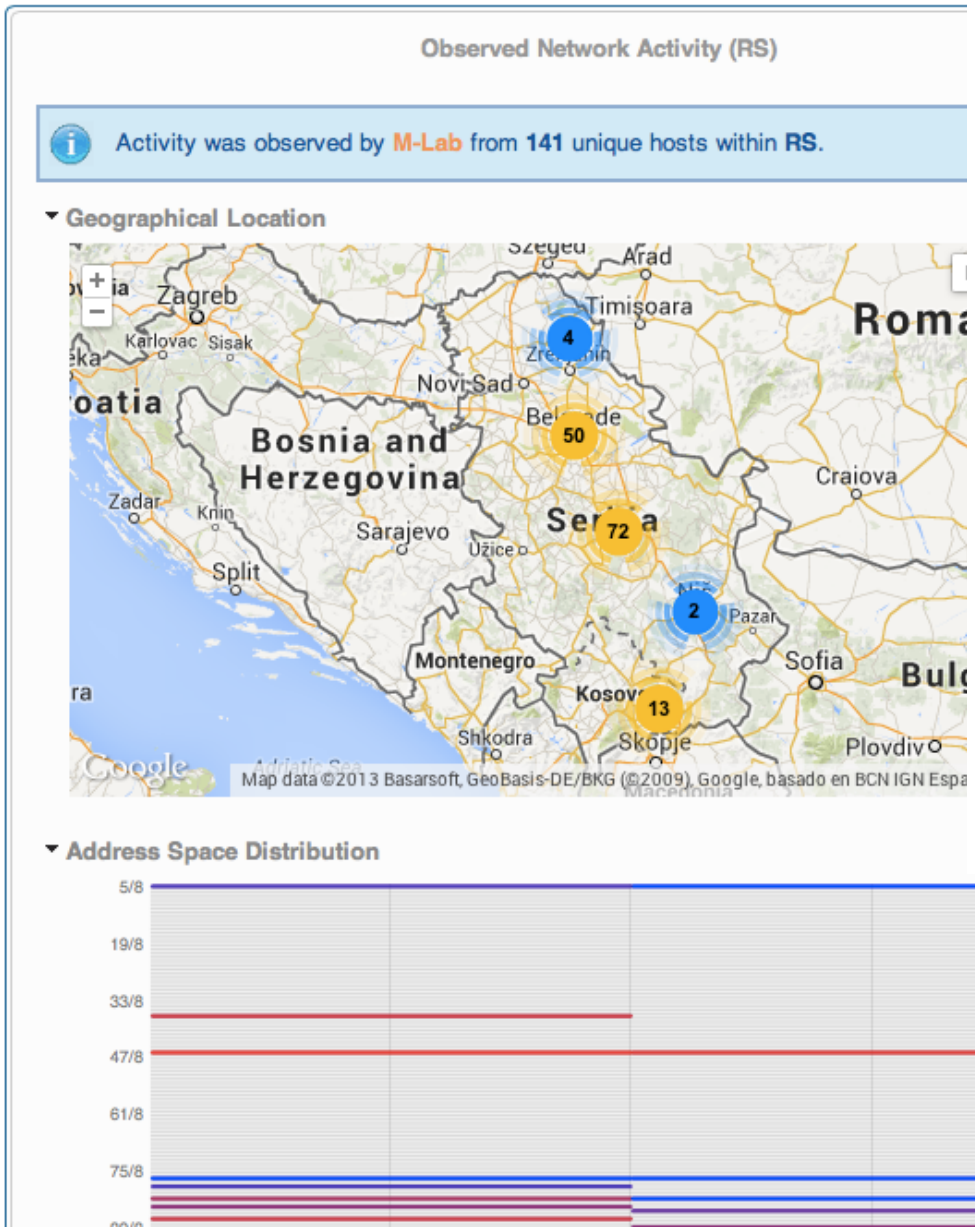
- Search by: IPv4, IPv6 address/prefix, AS Number, hostname, country, keywords (new)
- Web, widgets, data API, text service, mobile app
- Other features:
  - BGPlay2
  - Abuse Finder
  - Customisable “My Views”
  - History view for RIPE NCC members/LIRs
  - Embed widgets on your site

BGPlay is Back!

- The most popular visualisation tool has been revamped and implemented in a state-of-the-art web interface
- The most famous incident: YouTube hijacked by Pakistan Telecom
- https://www.ripe.net/internet-coordination/news/industry-developments/youtube-hijacking-a-ripe-ncc-ris-case-study
- Video: http://www.youtube.com/watch?v=IzLPKuAOe50



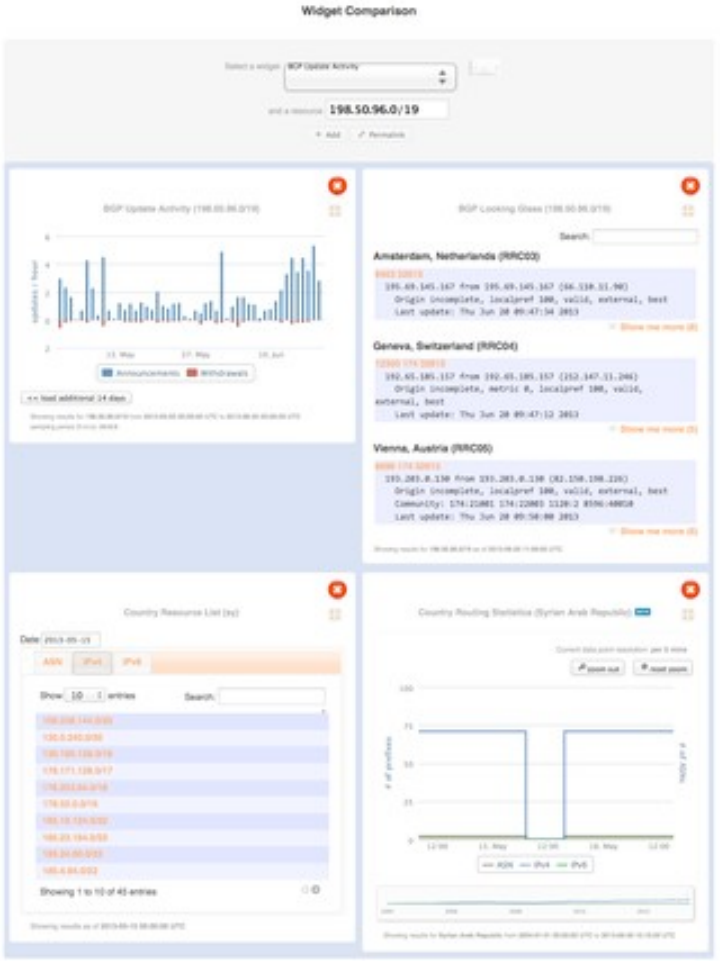
M-Labs Data for Serbia



Use Cases for Comparing Multple Widgets

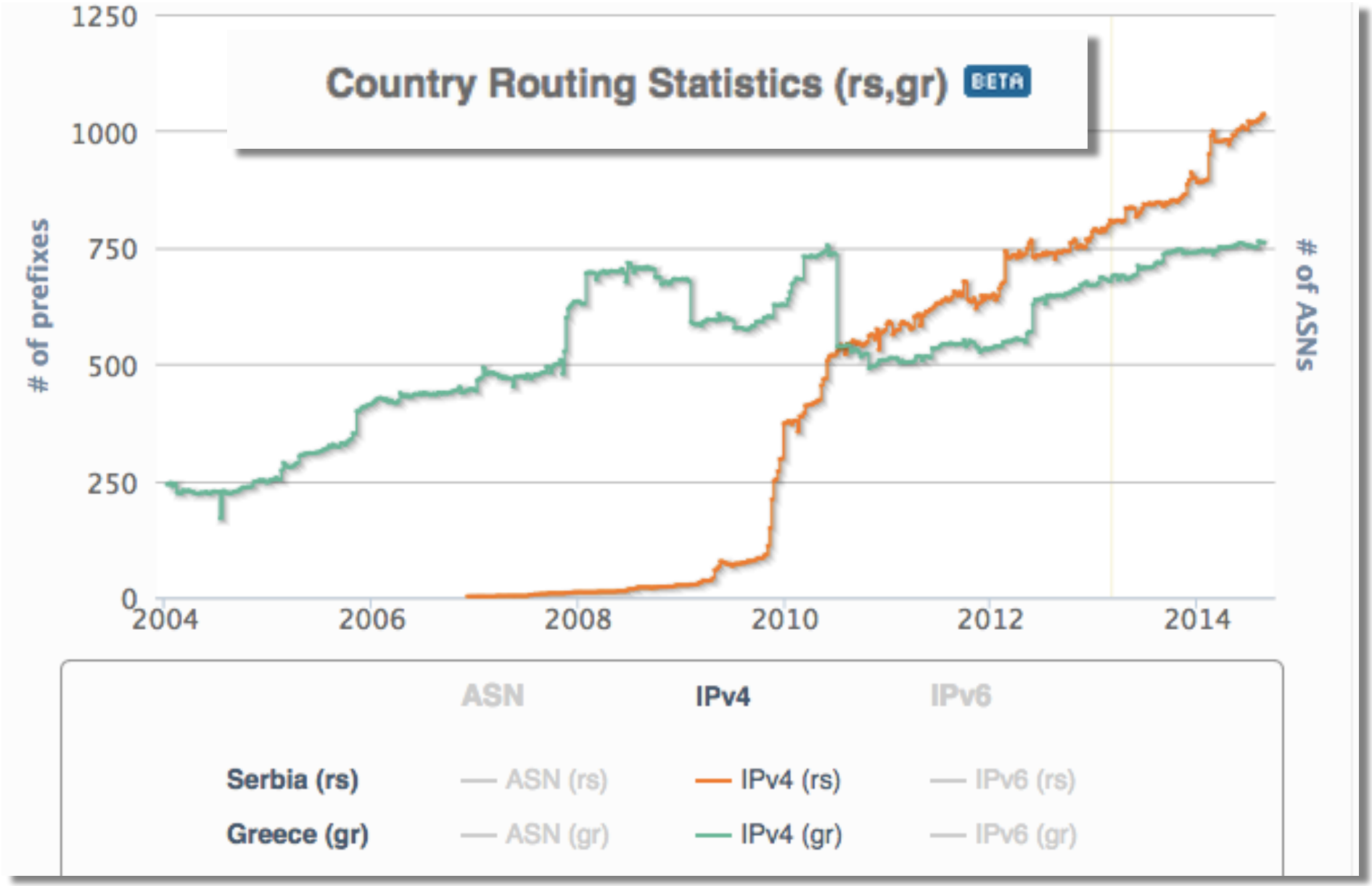
- Making peering decisions

- Country Outage

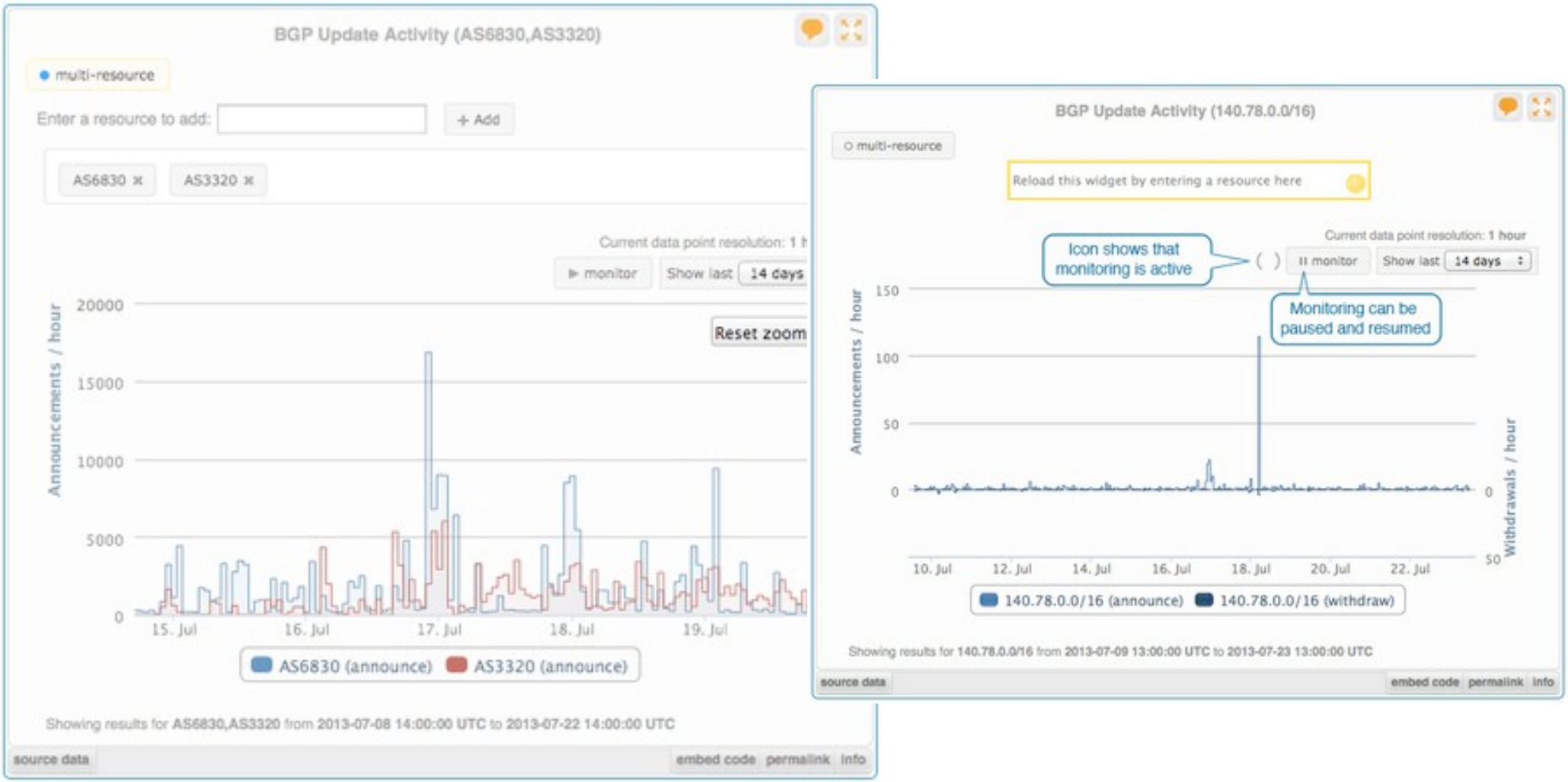


https://labs.ripe.net/Members/suzanne_taylor_muzzin/ripestats-multiple-widget-and-resource-comparison

In-widget Comparison: Serbia and Greece



BGP Comparison and Monitoring



RIPEstat Plans for the Future

- Migrate RIS Dashboard features into RIPEstat
- Add notable events to BGPlay2
- Improve back-end stability to enable resilience of current services and scale for future growth
- Increase data quality and consistency
- Tell us your feature requests:
  - **http://roadmap.ripe.net/ripe-stat/**