RIPE Internet Measurements
Presentation of RIPE’s tools, methodologies and datasets

Vesna Manojlovic and Emile Aben | 17 June 2020 | IMV 2020
To Inform and Inspire
RIPE and the RIPE NCC
RIPE Community

- Started in 1989 by researchers in Europe
- Technical coordination of IP network
- Volunteers, no legal structure
- Open to everybody
  - Meetings
  - Working Groups
  - Mailing lists
- Collaboration and coordination
RIPE Working Groups

• Anyone can join the discussion
  - On mailing lists
  - At RIPE meetings (in-person and online)
  - Remote participation

• Read and/or subscribe
  - ripe.net/participate/ripe/wg

• Learning opportunities

• Please contribute!
The RIPE NCC

• Independent, not-for-profit, membership organisation
  - Funded by membership fees

• Distributing Internet resources as a Regional Internet Registry (RIR)
  - Policies decided by regional community
  - Through a neutral, impartial, open and transparent process

• Supporting the Internet through technical coordination
RIPE Database

- The RIPE Database contains registration information for networks in the RIPE NCC service region and related contact details.

- Some uses of the RIPE Database and its contents:
  - Providing accurate registration information of Internet number resources
  - Publishing routing policies by network operators
  - Facilitating coordination between network operators

- Uses the “whois” protocol, data is open
Regional Internet Registries (RIRs)
Get Involved

• RIPE meetings attendance support:
  - RACI programme, RIPE Fellowship, Diversity Task Force

• Other events organised by the RIPE NCC
  - Regional meetings, training courses, hackathons

• RIPE NCC’s Community support
  - NOG support, Community Projects Fund

• RIPE Labs
But What About Data?
We Collect a lot of Interesting Data!

- For the community, by the community
- For network operators
- Data collections:
  - RIPE Atlas: latencies and paths (how do packets experience the network)
  - RIPE RIS: control plane (BGP)
    - “where should packets be routed”
Why Do We Collect Data?

• It’s in our mission: “As a neutral source of information and knowledge, we actively contribute to a stable and innovative Internet.”

• To measure is to improve
Seeing your Network from the Outside

- RIPE Atlas is a global, open, distributed Internet measurement platform, operated by the RIPE NCC
  - Consisting of thousands of devices (probes, anchors, VM, software probes)
  - Actively measuring Internet connectivity in real time
  - Open data available to the operators and research community
  - Ping, traceroute, DNS, TLS, NTP
  - Supports IPv4 and IPv6
  - February 2020: we launched software probes
RIPE Atlas Data Interfaces

- Data files, APIs, CLI
- Widgets, tools, code
- atlas.ripe.net/docs

APIs Manuals and References

- APIs Manual
- API keys Manual
- API Resources Reference
- Streaming API Reference
- Built-in Measurements Reference
- RIPE Atlas Daily Data Dumps
Contact RIPE Atlas

- Website
  - atlas.ripe.net

- Articles and updates
  - labs.ripe.net/atlas

- Mailing list for active users
  - ripe-atlas@ripe.net

- Questions
  - atlas@ripe.net

- Twitter
  - @RIPE_NCC and #RIPEAtlas
RIPE RIS
RIPE Routing Information Service

• RIS collects BGP routing data
  - Since 1999
  - From multiple viewpoints
• ris.ripe.net
• ris-users@ripe.net
BGP: Internet Traffic Control

- BGP makes Interdomain routing work
- Border routers: routers that receive explicit routing information for all of the Internet
- How do we monitor this traffic control?
- Listen in on this chatter at interesting places in the Internet
RIPE RIS Data Interfaces

- Data Files
- Streaming
- Widgets / APIs in RIPEstat
RIPEstat: Multi-perspective on IPs

- RIPEstat is a web-based interface that provides everything you ever wanted to know about IPs, AS Numbers and related information for hostnames and countries in one place.
- stat.ripe.net
3rd Party Tools

- **CAIDA IODA**
  - iodacaida.org

- **Internet Health Report**
  - ihr.iijlab.net/ihr

- **Artemis**
  - bgpartemis.org

- **BGP Alerter**
  - github.com/nttgin/BGPalerter
Measuring Websites

with RIPE Atlas
The Most Wanted Feature…

• By design, RIPE Atlas does not measure “application layer”
  - Operators are happy with transport/network layer
  - Ping, traceroute, DNS, TLS/SSL, NTP
• Users have been asking for HTTP measurements
• Due to ethical reasons, we decided:
  - to not target arbitrary websites with probes
  - that “standard” HTTP measurements are ONLY possible towards RIPE Atlas anchors
Ethical Reason: Protecting Hosts
Ethics in Tech

- Ethics in Network Measurements (RIPE Labs)
- Ethics in Technology (RIoT Summit, SHA2017)
**Workaround: Using a TCP Ping**

- **Traceroute (TCP) to the targeted web server**
  - Towards IP address: port 80
  - 3 packets; a packet size of zero
  - “maximum hops” = 64, initial time-to-live (TTL) = 64
  - Long enough for the first traceroute attempt to immediately reach the destination address

- **Mimics the behaviour of the TCP handshake**
  - That takes place when setting up an HTTP connection

- **This measures the same network delays!**
  - RTT turns out to be equivalent to HTTP connect times
**How to: Web UI**

- Go to Measurements
- Click on New msm
- Advanced options
- Add up to 1000 probes
- Choose one off
  - Or continuous / repeated
- Done!
  - You need to have credits
Credit System

• Running your own measurements cost credits
  - Ping = 10 credits, traceroute = 20, etc.
• Why? Fairness and to avoid overload
• Limits: daily spending and # of measurement results
• How to get credits?
  - Generated by hosting a probe / anchor
  - Transferred from another user
  - Reclaiming a gift voucher
How to: Command Line (CLI)

```bash
# ripe-atlas measure traceroute --target 82.94.235.165 --protocol TCP --size 1 --first-hop 64 --max-hops 64 --port 80
```

- "—size" should actually be 0 (will be fixed soon)
  - Please help us by fixing it yourself, make a pull request!

- CLI tools:
  - Source: [github.com/RIPE-NCC/ripe-atlas-tools/](https://github.com/RIPE-NCC/ripe-atlas-tools/)
  - Documentation: [ripe-atlas-tools.readthedocs.org](https://ripe-atlas-tools.readthedocs.org)
  - Included in many Linux/BSD distributions
Results

- Reachability Map
- Colour-coded for latency
- List of probes and latencies
- Download as JSON
Detailed Technical Information

- For 68% of the probe/destination pairs, median values differ by less than 1ms
- Interdecile ranges differ by less than 6ms
- When compared to RTT of 100 milliseconds, a difference in spread of 5-15ms may still be acceptable to assess network performance

- [https://labs.ripe.net/Members/wilhelm/measuring-your-web-server-reachability-with-tcp-ping](https://labs.ripe.net/Members/wilhelm/measuring-your-web-server-reachability-with-tcp-ping)
Internet Health
Routing and COVID-19

- Number of ASes with any type of origin change in BGP
  - No visible decrease in the number of changes
Routing and COVID-19

• Normal change pattern
• Periodic dips on Saturday and Sundays
• Stable BGP activity
• Operators take their responsibility and maintain their networks
• More on RIPE Labs
RIPE Atlas and COVID-19

- Internet Health Report during COVID-19
  - Network Delays in Times of Corona (RIPE Labs)
  - Network Delays During National Lockdowns (IHR)
- Internet is keeping up!
- Delays in some locations
Internet in Crimea (Study)

• Sociological fieldwork and Internet measurement
• Read the full study
Country Reports

- SEE Region Country Report, April 2020
- Germany Country Report, November 201
- Dutch Routing, August 2019
Outages
Visualisations
Outages at the Core: AMS-IX, Level 3

- Does the Internet Route Around Damage? A Case Study Using RIPE Atlas

Vesna Manojlovic and Emile Aben | 17 June 2020 | IMV 2020
Croatian Earthquake, March 2020

- After the Quake in Croatia

Vesna Manojlovic and Emile Aben | 17 June 2020 | IMV 2020
Earthquake in Nepal, April 2016

- Using RIPE Atlas and RIPEstat to detect network outage events
Country Events: .TR, .KP, .IR

- The Internet in North Korea - Hanging by a Single Thread?
- Iran and K-root: The Rest of the Story
- A RIPE Atlas View of Internet Meddling in Turkey
Power Outage in Amsterdam

- Amsterdam Power Outage as Seen by RIPE Atlas
- RIPE Atlas Hackathon 2015 Discomo Team Visualises Netherlands Power Outage
TWC, ASM-IX and Facebook Outages

- The AMS-IX Outage as Seen with RIPE Atlas
- #facebookdown? What Internet Measurement Data Shows
- Time Warner Cable Outage
Natural Disasters: Haiyan, Sandy, Pam

- RIPE Atlas: Hurricane Sandy and How the Internet Routes Around Damage
- Typhoon Haiyan - What we see in RIPEstat and RIPE Atlas
- Cyclone Pam and the Internet in Vanuatu
DNS Related

RIPE Atlas Measurements
Maps Based on DNS Measurements

- DNS Root Instances
- Comparative DNS Root RTT
- Root Server Performance
DNSMON

- From anchors to ccTLDs
- An Updated DNS Monitoring Service
DomainMon

- Like “DNSMON”, but
  - From probes
  - To second-level domains
- RIPE Atlas: DomainMON is Here
User Measurements Visualisations

- List of probes: sortable by RTT
- Map: colour-coded by RTT
- LatencyMON: compare multiple latency trends
Additional System and Global DNS Measurements

- Measuring random domains
- Measuring popular domains
  - New RIPE Atlas Root Zone DNS Measurements
- Instead of setting-up your own measurements, use the existing data!
DNS Measurements Analysis

- DNS Censorship (DNS Lies) As Seen By RIPE Atlas (Stéphane Bortzmeyer)
- Orange Blacklisting: A Case for Measuring Censorship (Stéphane Bortzmeyer, Oct 2016)
- Operator Level DNS Hijacking (Babak Farrokhi, Jul 2016)
- Dissecting DNS Defenses During DDoS Attacks (Giovane Moura, May 2018)
DNS Measurements Hackathon, April 2017

• Results of the DNS Measurements Hackathon

• DNS resolver hijack tester
  - Out of 6,700 probes, 113 were “suspicious” or “being weird”,

• DNS Fingerprinting to identify hijacked resolvers
  - Top-5 countries were: VN, MG, IQ, ID and KR

• Data sets for researchers, Dec 2018
IXP Country Jedi
Does Internet Traffic Stay in a Country?

• Internet traffic paths (traceroutes) between RIPE Atlas probes in the same country to answer the following questions:
  - Do the paths take out-of-country detours?
  - Do we see Internet Exchange Points in the paths?

• **Probe to probe**
• **User to user**
IPv4 paths: Hungary, Bosnia, Finland
Slovenia, Bosnia, Serbia

IXP IPs: YES, out-of-country IPs: NO
IXP IPs: NO, out-of-country IPs: NO
IXP IPs: YES, out-of-country IPs: YES
IXP IPs: NO, out-of-country IPs: YES
Questions

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Feedback

• What would you want to do with this data?
• What is missing?
• What could be easier?
Get Involved

- Use RIPE Atlas and RIS for your purposes: data analysis, network troubleshooting, investigative journalism
- Do scientific research and add your paper to the Wikipedia page
- Contribute to the code and community tools
- Add multi-lingual content / documentation on GitHub
- Sponsor a hackathon!
- Host a RIPE Atlas anchor or a (SW) probe
- Write a RIPE Labs article
With Great Power

Comes

Great Responsibility