The RouteViews Project: Update

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Background

- **RouteViews was first started in 1995**
- Now a growing network of 40+ collectors positioned strategically at Internet Exchange Points around the world
- RouteViews collaborates with the Center for Applied Internet Data Analysis (CAIDA) working with NSF grants that support Designing a Global Measurement Infrastructure to Improve Internet Security, GMI3S (OAC-2131987), and an Integrated Library for Advancing Network Data Science, ILANDS (CNS-2120399).
- RouteViews is supported with financial and in-kind donations by multiple organizations

- **RouteViews is based at the University of Oregon and operated by NSRC**
- NSRC supports the growth of global Internet infrastructure by providing engineering assistance, collaborative technical workshops, training, and other resources to university, research & education networks worldwide.
- NSRC is partially funded by the IRNC program of the NSF (OAC-2029309) and Google with other contributions from public and private organizations.
- The University of Oregon is a public research institution in Eugene, Oregon, USA founded in 1876.

RouteViews Team Members

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What is RouteViews

- A tool that allows Internet network operators to look at the BGP table from different backbones and locations around the world to troubleshoot and to assess:
  - Reachability, hijacks, bugs, peer visibility, mass withdrawals, RPKI status,…
- Operators who find it a valuable tool also peer to contribute to the value
- RouteViews operates collectors strategically positioned at IXPs around the world.
  - It also hosts a few multi-hop collectors at UO for those operators who are not present at IXPs.
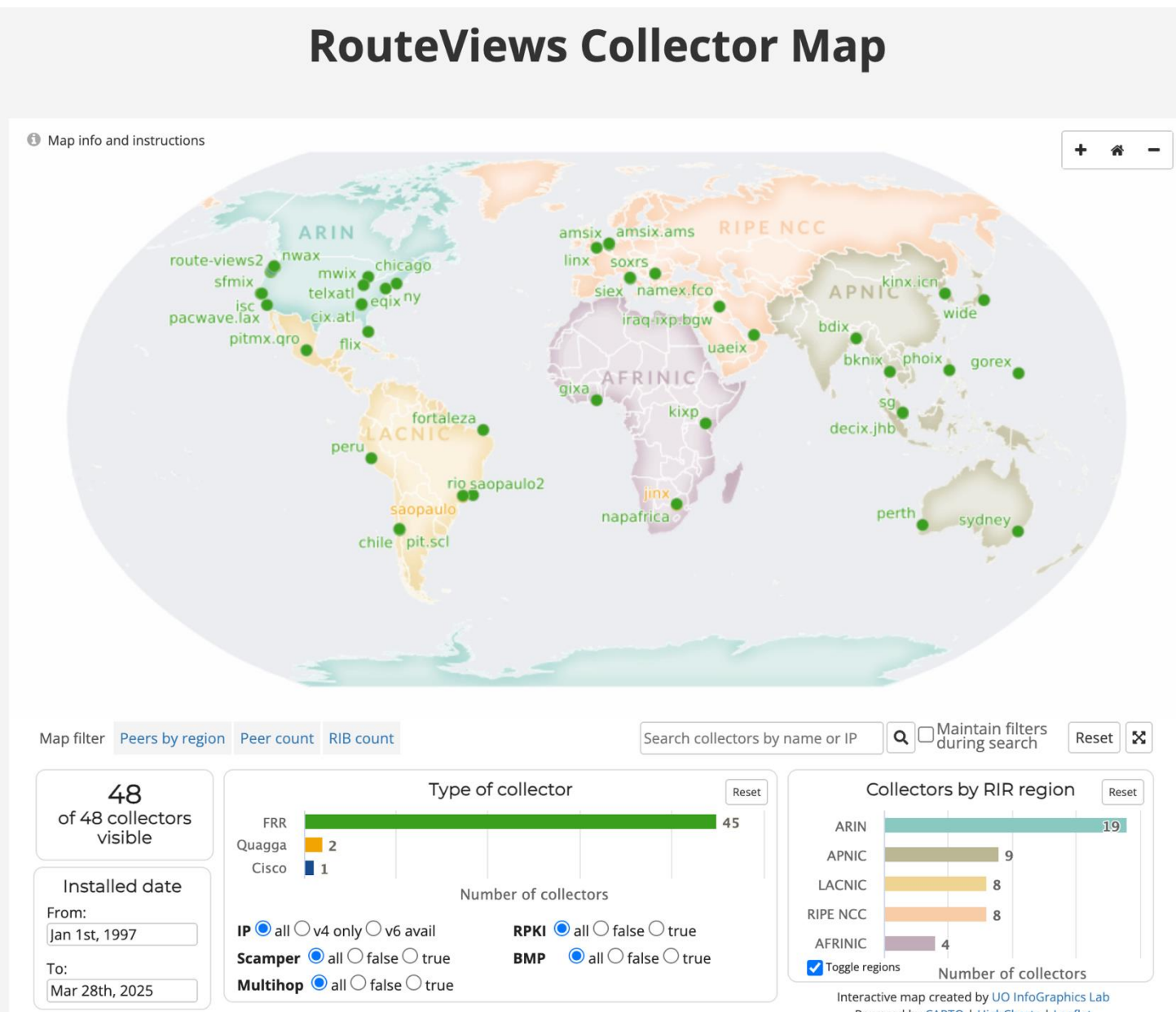
What is RouteViews

- Many free and commercial tools used by network engineers every day include data from RouteViews
  - CAIDA ASRANK
  - CAIDA BGP Reader
  - HE BGP Tools
  - Kentik Market Intelligence
  - Kentik BGP monitoring
  - Catchpoint
  - BGPMon
  - And many more

RouteViews Collector Map

http://www.routeviews.org/routeviews/index.php/map/

For network operators & researchers

USING ROUTEVIEWS

Using RouteViews

- Network Operators use the live data to analyse how their routes appear on the Global Routing System

- Researchers use the 27-year-old data archive to study trends, route hijacks, and changes such as:

  - Origin change

  - Next-hop change

  - New prefix / more specifics

  - New neighbours

  - Operator ASN appearing in a new transit path

  - Bogons

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Use Cases – peering negotiation

Understanding your prospects connectivity can be key to a good negotiation
- Who are the upstreams?
- Who are the peers?
- Who are the customers?

Let's have a look at AS2018 as an example

Connected Networks: Multihop Collector

```
route-views2.routeviews.org> sh bgp sum                    32 peers, multi-hop

IPv4 Unicast Summary (VRF default):
BGP router identifier 128.223.51.102, local AS number 6447 vrf-id 0
BGP table version 2376140
RIB entries 1842070, using 169 MiB of memory                Lots of full tables
Peers 32, using 644 KiB of memory

Neighbor         V       AS  MsgRcvd  MsgSent    TblVer  InQ OutQ  Up/Down  State/PfxRcd  PfxSnt Desc
12.0.1.63        4     7018   278377      377   2376140    0    0  06:14:18        938553       0 ATT
37.139.139.17    4    57866   281167      751   2376140    0    0  06:14:18        941733       0 Fusix
45.61.0.85       4    22652   430462      754   2376140    0    0  05:30:45        943602       0 FIBRENOIRE
62.115.128.137   4     1299  1145666      377   2376140    0    0  06:14:18        919817       0 Telia
64.71.137.241    4     6939   222621      376   2376140    0    0  06:14:18        961672       0 Hurricane Electric
77.39.192.30     4    20912   199676     2247   2376140    0    0  06:14:18        942334       0 PANSERVICE
87.121.64.4      4    57463   124693      375   2376140    0    0  06:13:35        483102       0 NETIXLTD
89.149.178.10    4     3257   301777      377   2376140    0    0  06:14:18        939075       0 Tiscali
91.218.184.60    4    49788   280255      376   2376140    0    0  06:14:18        943183       0 NEXTHOPNO
94.156.252.18    4    34224   365615      376   2376140    0    0  06:14:17        965856       0 NETERRA
105.16.0.247     4    37100   304500      746   2376140    0    0  06:11:16        942394       0 SEACOM
129.250.1.71     4     2914   267752      751   2376140    0    0  06:14:18        939523       0 NTT-A
137.164.16.84    4     2152   219827      376   2376140    0    0  06:14:18        941035       0 CENIC
140.192.8.16     4    20130   247609      751   2376140    0    0  06:14:18        964417       0 DEPAULEDU
144.228.241.130  4     1239     4442      377   2376140    0    0  06:14:17         45863       0 Sprint
147.28.7.1       4     3130      421      376   2376140    0    0  06:14:18            14       0 RGnet, LLC
```

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Connected networks: Multihop Collector

```
route-views3.routeviews.org# sh ip bg regexp _2018$
BGP table version is 12697779, local router ID is 128.223.51.108, vrf id 0
Default local pref 100, local AS 6447
Status codes:  s suppressed, d damped, h history, * valid, > best, = multipath,
            i internal, r RIB-failure, S Stale, R Removed
Nexthop codes: @NNN nexthop's vrf id, < announce-nh-self
Origin codes:  i - IGP, e - EGP, ? - incomplete
RPKI validation codes: V valid, I invalid, N Not found


    Network        Next Hop         Metric LocPrf Weight Path
N*  41.74.144.0/22  195.239.77.236                0 3216 2018 i
N*              109.233.62.1                 0 29479 50304 2018 i
N*              195.239.252.124              0 3216 2018 i
N*              104.251.122.1                0 14315 2914 20080 2018 i
N*              158.106.197.135              0 46450 2914 20080 2018 i
N*              202.150.221.33               0 38001 2914 20080 2018 i
N*              89.149.178.10        10      0 3257 174 2018 2018 i
N*              190.15.124.18                0 61568 2018 i
N*              163.253.3.22                 0 11537 2018 i
N*              205.171.200.245      0       0 209 3356 2914 20080 2018 i
N*              67.219.192.5                 0 19653 2914 20080 2018 i
N*              203.62.187.103               0 9268 4764 3356 2914 20080 2018 i
N*              210.5.41.225                 0 45352 2018 i
N*              64.71.137.241                0 6939 2018 i
N*              203.62.187.102               0 9268 4764 3356 2914 20080 2018 i
N*=             94.101.60.146                0 39120 2018 i
N*>             89.21.210.85                 0 39120 2018 i
```

Connected ASNs

Prepends indicate upstream

Tier 1 network

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Downstreams: Local Collector

```
route-views.napafrica.routeviews.org# sh ip bgp regexp  ^2018(_.+)+$
BGP table version is 250650352, local router ID is 196.60.9.68, vrf id 0
Default local pref 100, local AS 6447
Status codes:  s suppressed, d damped, h history, * valid, > best, = multipath,
            i internal, r RIB-failure, S Stale, R Removed
Nexthop codes: @NNN nexthop's vrf id, < announce-nh-self
Origin codes:  i - IGP, e - EGP, ? - incomplete
RPKI validation codes: V valid, I invalid, N Not found


   Network        Next Hop        Metric LocPrf Weight Path
N*> 137.158.0.0/16   196.60.8.216                 0 2018 36982 i
N*> 143.160.0.0/24   196.60.8.216                 0 2018 8094 i
N*> 143.160.240.0/20 196.60.8.216                 0 2018 8094 i
N*> 146.182.0.0/16   196.60.8.216                 0 2018 37501 i
N*> 146.182.0.0/17   196.60.8.216                 0 2018 37501 i
N*> 146.182.128.0/17 196.60.8.216                 0 2018 37501 i
N*> 146.231.0.0/16   196.60.8.216                 0 2018 37520 i
V*> 154.114.25.0/24  196.60.8.216                 0 2018 36982 i
V*> 154.115.0.0/24   196.60.8.216                 0 2018 6149 i
V*> 154.115.112.0/20 196.60.8.216                 0 2018 36982 i
N*> 192.42.99.0/24   196.60.8.216                 0 2018 37520 i
N*> 196.6.221.0/24   196.60.8.216                 0 2018 8094 i
V*> 196.21.40.0/24   196.60.8.216                 0 2018 37501 i
V*> 196.21.158.0/24  196.60.8.216                 0 2018 37501 i
V*> 196.21.159.0/24  196.60.8.216                 0 2018 37501 i
V*> 196.21.164.0/22  196.60.8.216                 0 2018 8094 i
```

downstream ASNs

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Make life easier for your NOC

Often customers and peers contact your noc with routing issues.
Announcing your routes to RouteViews, helps your engineers to
see your network from the rest of the Internet.

Example: You want to balance traffic between your upstreams
but the deaggregation scheme is not working

Make life easier for your NOC

upstream

route-views3.routeviews.org# sh ip bg 220.239.64.0
BGP routing table entry for 220.239.64.0/20, version 10370995
Paths: (1 available, best #1, table default)
  Not advertised to any peer
  38001 7473 4804 4804
    202.150.221.33 from 202.150.221.33 (10.11.33.29)
      Origin IGP, valid, external, best (First path received), rpki validation-state: invalid
      Community: 38001:100 38001:3003 38001:8003
      Last update: Sun Nov 10 14:28:09 2024
route-views3.routeviews.org#

RPKI state

Make life easier for your NOC

```
route-views3.routeviews.org# sh ip bg 220.239.64.0/19
BGP routing table entry for 220.239.64.0/19, version 9454097
Paths: (25 available, best #24, table default)
  Not advertised to any peer
  9268 4764 1221 7474 4804, (aggregated by 4804 198.142.65.160)
  203.62.187.103 from 203.62.187.103 (203.62.187.103)
    Origin IGP, valid, external, atomic-aggregate, rpki validation-state: valid
    Community: 0:2011 9268:2124
    Last update: Mon Nov  4 04:04:03 2024
  9268 4764 1221 7474 4804, (aggregated by 4804 198.142.65.160)
  203.62.187.102 from 203.62.187.102 (203.62.187.102)
    Origin IGP, valid, external, atomic-aggregate, rpki validation-state: valid
    Community: 0:2011 9268:2124
    Last update: Mon Nov  4 02:34:28 2024
route-views3.routeviews.org#
```

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Make life easier for your NOC

Ups – we forgot to create new ROAs so networks are dropping
the covering prefix

Go fix

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For Peering Coordinators

PEERING WITH ROUTEVIEWS

RouteViews Peering Policy

General requirements:

- Peer must operate stable equipment - RouteViews will shutdown BGP sessions that disturb the stability of the RouteViews platform
- Peer must have a routable ASN
- Peer must not be a hobby network
- Peer's full view of the global routing table is preferred
- Routes should be aggregated as much as possible (no longer than /24 for IPv4 and /48 for IPv6)
- Peer must be present with up-to-date information in PeeringDB - including the NOC email address
- Peer must filter RFC6890 space
- RouteViews does not accept addpath-RX or TX
- Peers must not send default routes

IXP peering:

- We happily accept everyone's routes from the route servers.
- We will set up bilateral sessions with anyone who meets the general requirements and will send us their full table.
- We will peer at all mutual exchanges if requested.

Multihop peering:

- We will accept multihop peers who are not on any mutual IXPs.
- Peers must provide their full view of the Internet as they see it.
- We accept two sessions for redundancy; more than two sessions can be set up if the feeds are sufficiently different.

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Why a selective Policy?

- Balance operational OH, scale and information from the data

- Hobby Networks

- Full View of the Internet

- What makes a peering interesting?

  - Networks in regions where we have limited visibility

  - Networks demonstrating new interconnection patterns

  - Networks using innovative routing practices

  - Networks that help us understand emerging market dynamics

  Or maybe something we haven't thought about yet

What's happening at RouteViews

ROUTEVIEWS NEWS

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RouteViews News

- Collectors:
  - The majority use FRR[1] (either version 9.1 or 10)
  - One Cisco ASR1004 and one (still) using Quagga
  - Moving collectors from metal to VMs (easier deployment & management)
- Location update:
  - Recent additions include DE-CIX Johor Bahru, NAMEX, Interlan
  - Several new locations offered; resources required to fulfil those offers

[1]FRRouting Project: https://frrouting.org/

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RouteViews Development Projects

- API
  - Allow programmatic access to live RouteViews data
  - (our collectors currently allow telnet access, which 1000s of automated scripts hammer on a daily basis)
  - A BETA version is available at api.routeviews.org

- LookingGlass
  - telnet access is unsustainable
  - Aim to making LookingGlass default access for each collector
    - telnet will remain available on one collector for legacy

- BMP
  - Live feed from collectors for BGP data consumers

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RouteViews Behind the Scenes Projects

Months of ongoing effort:

- Upgrading archive infrastructure and storage
  - RouteViews stores BGP data from 1997 – around 50 TBytes (compressed)

- Tooling
  - Automation tools for managing the whole infrastructure and deploying new peers

- Collector OS (from CentOS to Ubuntu)
  - CentOS end-of-life – half the collectors still running CentOS

- FRR performance
  - Standardising on two latest releases, upgrading from old releases
  - "Badly behaving peers" (aka slow peers)

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RouteViews Future Planning

- Collectors & hosts in new locations outside North America
  - Large IXPs with dense interconnection
  - Unique or specialist environments (eg R&E exchanges)
- Scalable and diverse archiving
- Improved community support
  - Running this infrastructure costs money!
  - We hugely appreciate our generous supporters
    - https://www.routeviews.org/routeviews/index.php/supporters/
- Your suggestions are very welcome! 🙏

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https://www.flexoptix.net

For potential hosts of collectors

HOSTING ROUTEVIEWS

Hosting RouteViews

- RouteViews is interested in new locations
  - Especially in regions or economies we have no collector
  - Where there are IXPs with large numbers of peers (>100)
- Hosting a RouteViews collector
  - Hosts can be IXPs themselves
  - Hosts can be members of IXPs
  - Hosts sponsor the IXP port and the (~10Mbps) transit required
  - Hosts sponsor the VM needed for the collector
    - Physical hardware is less preferred due to being harder to manage
    - VMs sometimes may not be possible due to operational requirements

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Collector Specifications

- Virtual Machine:
    - 16GB RAM min (prefer 32GB)
    - 200GB disk
    - 4 vCPUs
    - 1 transit interface (management and public CLI access, low traffic)
    - 1 peering interface on the IX

- Physical Hardware:
    - 32GB – 64GB RAM
    - 400GB – 1TB SSD
    - 4+ CPUs
    - Ethernet port for transit interface (1Gbps is enough)
    - Ethernet port for IX peering (10Gbps is the standard now)

Collector Software

- Ubuntu 24.04 is RouteViews standard OS
  - We require a minimal Ubuntu Server install
  - Our deployment scripts do the rest
- Routing daemon we install is FRR
  - MRT[1] used for BGP RIBs (archived every 2 hours) and BGP updates (archived every 15 minutes)

[1] Multi-Threaded Routing Toolkit: https://datatracker.ietf.org/doc/html/rfc6396

Collector Host

- Acknowledged on RouteViews website as a sponsor
- Contact details kept up to date with RouteViews team
  - An up-to-date PeeringDB entry helps 😀

How you can help

SUPPORTING ROUTEVIEWS

Supporting RouteViews

- The project was started in 1995 because network operators wished to see what their BGP announcements looked like from an external viewpoint
  - Thousands of network operators & researchers all around the world now rely on RouteViews
  - Many everyday tools we all rely on use RouteViews data
- Please consider supporting RouteViews:
  - By peering with one of our collectors
  - By publicly acknowledging the value of the information we have collected
  - In any other way that helps keep this community service going

Thank you!