

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.



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RouteViews Team Members

Hans Kuhn



Nina Bargisen



Owen Conway



Philip Smith



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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.



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RouteViews Collector Map



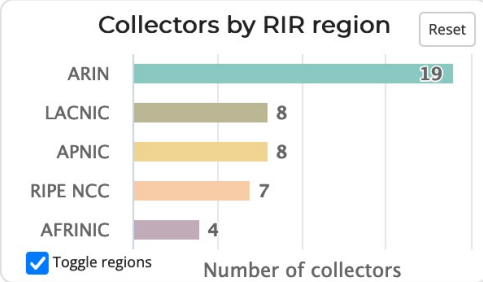
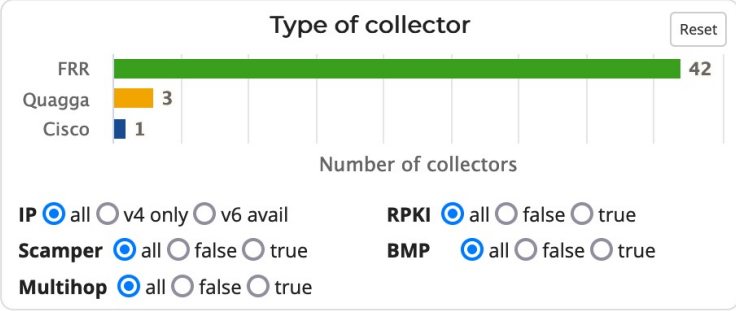
<http://www.routeviews.org/routeviews/index.php/map/>

Map filter **Peers by region** Peer count RIB count

Search collectors by name or IP Maintain filters during search

46
of 46 collectors visible

Installed date
From:
To:



Interactive map created by UO InfoGraphics Lab
Powered by CARTO | HighCharts | Leaflet

What's happening at RouteViews

ROUTEVIEWS NEWS



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RouteViews News

- Collectors:
 - The majority use FRR¹ (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 CIX-ATL, PacWave LAX, Iraq IX, PIT Mexico & Santiago, DE-CIX Johor Bahru
 - Several new locations offered; resources required to fulfil those offers

¹FRRouting 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)
- LookingGlass
 - **telnet** access is unsustainable
 - Aim to making LookingGlass default access for each collector
 - **telnet** 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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For network operators & researchers

USING ROUTEVIEWS



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Using RouteViews

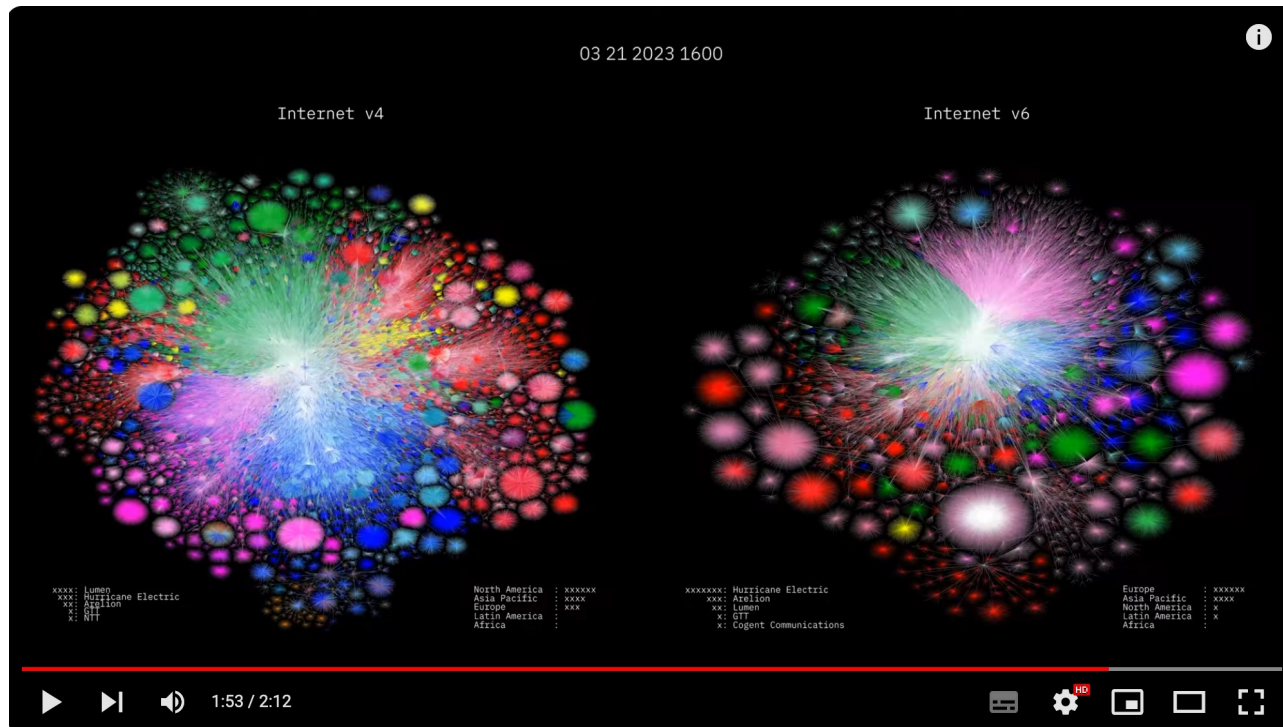
- Network Operators use the live data to analyse how their routes appear on the Global Routing System
- Researchers use the 27-year-old data archive to study trends, route hijacks, and changes such as:
 - Origin change
 - Next-hop change
 - New prefix / more specifics
 - New neighbours
 - Operator ASN appearing in a new transit path
 - Bogons



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RouteViews Impact



Barrett Lyon:

<https://www.youtube.com/watch?v=vo5gIK9czIE>



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Use Cases – 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  
Peers 32, using 644 KiB of memory
```

Lots of full tables

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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Use Cases – Weird Announcements

```
route-views7.routeviews.org> sh ip bgp 45.181.4.0/24
BGP routing table entry for 45.181.4.0/24, version 54948963
Paths: (8 available, best #2, table default)
  Not advertised to any peer
```

```
...
924 835 16735 53062 262698 269289
  185.121.168.42 from 185.121.168.42 (10.20.30.40)
    Origin IGP, valid, external, best (Older Path), rpki validation-state: not found
    Community: 835:11103 924:90 924:601 924:690 16735:111 16735:7000 16735:7203 16735:53062 24115:16735 24115:24115 24115:65023
    53062:10020 53062:10021 53062:30004 53062:30007 53062:30009 53062:30011 53062:30013 53062:30045 53062:30049 53062:30058
    53062:30091 53062:30092 53062:30105 53062:30114 53062:30115 53062:30117 53062:30122 53062:30130 53062:30136 53062:30152
    53062:30156 53062:30161 53062:30168 53062:30182 53062:30183 53062:30184 53062:30185 53062:30186 53062:30187 53062:30188
    53062:30191 53062:30198 53062:30200 53062:30203 53062:30208 53062:30217 53062:30222 53062:30228 53062:30232 53062:30235
    53062:30239 53062:30244 53062:30250 53062:30255 53062:30263 53062:30274 53062:30278 53062:30287 53062:30291 53062:30296
    53062:30301 53062:30305 53062:30317 53062:30328 53062:30344 53062:30355 53062:30357 53062:30369
    Large Community: 924:1:90 924:600:90 924:601:101 24115:1000:2 24115:1001:1 24115:1002:1 24115:1003:26 24115:1004:16735
    53062:11:3692 53062:12:81 53062:13:48
    Last update: Thu Jun 20 04:03:53 2024
37989 18106 263444 262316 269289 269289 269289 269289 269289 269289 269289 269289 269289 269289 269289 269289 269289 269289
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  203.123.48.6 from 203.123.48.6 (203.123.48.6)
    Origin IGP, valid, external, rpki validation-state: not found
    Community: 13538:2000
    Last update: Sun Jun 16 10:17:30 2024
```

What is AS53062 trying to achieve with all these communities??

What is AS269289 trying to achieve by prepending 101 times??



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Use Cases – Invalid ROAs

```
route-views.phoix.routeviews.org> sh ip bgp rpki invalid
BGP table version is 14686437, local router ID is 198.32.172.137, 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
I*>	1.6.168.0/24	198.32.172.156	0		0	142271 9304 6453 4755 9583 ?
I*>	1.6.169.0/24	198.32.172.156	0		0	142271 9304 6453 4755 9583 i
I*>	1.6.183.0/24	198.32.172.156	0		0	142271 9304 6453 4755 9583 i
I*>	1.6.219.0/24	198.32.172.156	0		0	142271 9304 6453 4755 9583 137130 i
I*>	1.6.247.0/24	198.32.172.156	0		0	142271 9304 6453 4755 9583 i
I*>	1.7.178.0/24	198.32.172.156	0		0	142271 9304 6453 4755 9583 137130 i
I*>	1.7.191.0/24	198.32.172.156	0		0	142271 9304 6453 4755 9583 137130 i
I*>	1.7.205.0/24	198.32.172.156	0		0	142271 9304 6453 4755 9583 140202 i
I*>	1.7.228.0/24	198.32.172.156	0		0	142271 9304 6453 4755 9583 137130 i
I*>	1.44.160.0/23	198.32.172.156	0		0	142271 9304 7473 7474 ?
	...					



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Use Cases – Valid ROAs

```
route-views.phoix.routeviews.org> sh ip bgp rpki valid
BGP table version is 14686899, local router ID is 198.32.172.137, 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
V*> 1.0.0.0/24	198.32.172.170			0	150000 150000 150000 150000 150000 18233 135607 13335 i
V* 1.0.4.0/22	198.32.172.170			0	150000 150000 150000 150000 150000 18233 135607 7545 2764 38803 i
V*>	198.32.172.156	0		0	142271 135607 7545 2764 38803 i
V* 1.0.5.0/24	198.32.172.170			0	150000 150000 150000 150000 150000 18233 135607 7545 2764 38803 i
V*>	198.32.172.156	0		0	142271 135607 7545 2764 38803 i
V* 1.0.64.0/18	198.32.172.170			0	150000 150000 150000 150000 150000 18233 135607 174 2497 7670 18144 i
V*>	198.32.172.156	0		0	142271 174 2519 7670 18144 i
V*> 1.1.1.0/24	198.32.172.170			0	150000 150000 150000 150000 150000 18233 135607 13335 i
V* 1.6.0.0/22	198.32.172.170			0	150000 150000 150000 150000 150000 18233 135607 9583 i
V*>	198.32.172.156	0		0	142271 135607 9583 i
V* 1.6.1.0/24	198.32.172.170			0	150000 150000 150000 150000 150000 18233 135607 9583 i
V*>	198.32.172.156	0		0	142271 135607 9583 i
V* 1.6.2.0/24	198.32.172.170			0	150000 150000 150000 150000 150000 18233 135607 9583 i
V*>	198.32.172.156	0		0	142271 135607 9583 i
...					



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For Peering Coordinators

PEERING WITH ROUTEVIEWS



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Peering with RouteViews

- RouteViews has an Open peering policy
 - PeeringDB: <https://www.peeringdb.com/asn/6447>
- We require all peers to have a PeeringDB entry
 - Our tools build peering options (for IXP based collectors) and configurations from PeeringDB
- Peering:
 - Over IPv4 (for IPv4 prefixes) and IPv6 (for IPv6 prefixes)
 - We want to receive the entire BGP table (if operationally possible)
 - Please do not use “add-path” or send us bogon routes
 - We do not send you any prefixes (please don’t ask)



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Peering with RouteViews

- Present in multiple IXP locations?
 - It can be interesting to peer; we will assess based on available capacity
- Will we peer with everyone?
 - If you peer with IXP Route Servers, you will be peering with AS6447
 - Bi-lateral peerings we are more selective about
 - Multi-hop peerings we are more selective about
 - We are interested in new, interesting, diverse peers all around the world



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For potential hosts of collectors

HOSTING ROUTEVIEWS



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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)
 - 100GB 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)



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Collector Software

- Ubuntu 22.04 is RouteViews standard OS
 - We require a minimal Ubuntu Server install
 - Our deployment scripts do the rest
 - (We will likely use Ubuntu 24.04 once we validate it with our deployment tools)
- Routing daemon we install is FRR
 - MRT¹ used for BGP RIBs (archived every 2 hours) and for BGP updates (archived every 15 minutes)

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



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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 😊



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How you can help

SUPPORTING ROUTE VIEWS



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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



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Thank you!

