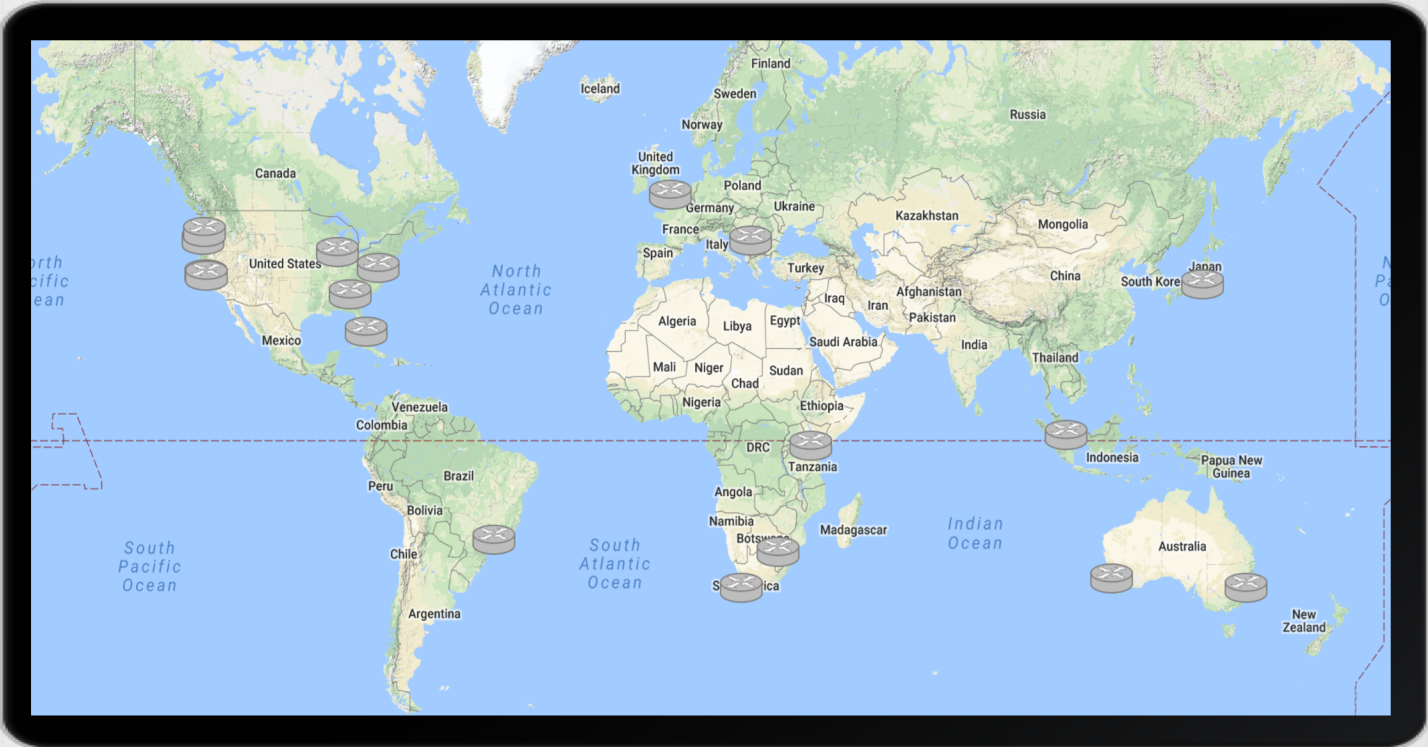


ENABLING RESEARCH THROUGH NEW AND INNOVATIVE INFRASTRUCTURE





FOOTPRINT



FOOTPRINT

COLLECTOR LOCATIONS

- ✓ Atlanta (digital realty)
- ✓ Chicago (equinx)
- ✓ Chile
- ✓ DC (eqix)
- ✓ Eugene (Multi-hop)
- ✓ Johannesburg (JINX, NAPAfrica)
- ✓ London (LINX)
- ✓ Miami (flix)
- ✓ Nairobi (kixp)
- ✓ Palo Alto (PAIX)
- ✓ Perth (WAIX)
- ✓ Portland (NWAX)
- ✓ Sao Paulo (IX.br x2)
- ✓ San Francisco (sfmix)
- ✓ Singapore (Equinix SG)
- ✓ Serbia (sox)
- ✓ Sydney (equinix)
- ✓ Tokyo (DIX-IE)
- ✓ Cape Town



ROUTEVIEWS

A collaborative router looking glass to share BGP views among network operators and researchers.



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NSRC

NSRC supports the growth of global Internet infrastructure by providing collaborative technical workshops, training, engineering assistance and other resources to Internet operators and their communities worldwide.

ROUTEVIEWS



UNIVERSITY OF OREGON



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UNIVERSITY OF OREGON

The University of Oregon is a public research university in Eugene, Oregon, USA founded in 1876. UO is renowned for its research prowess and commitment to teaching. Both NSRC and RouteViews are based at the UO.



PEERING STATS





PEERING STATS

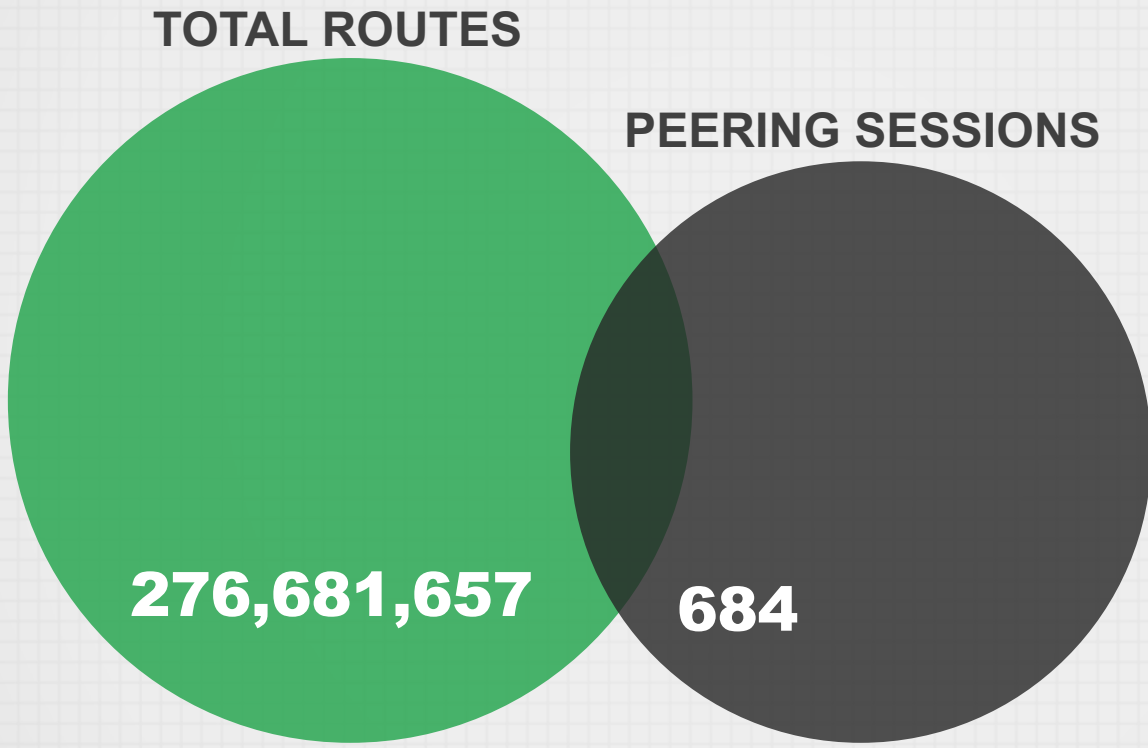
TOTAL ROUTES



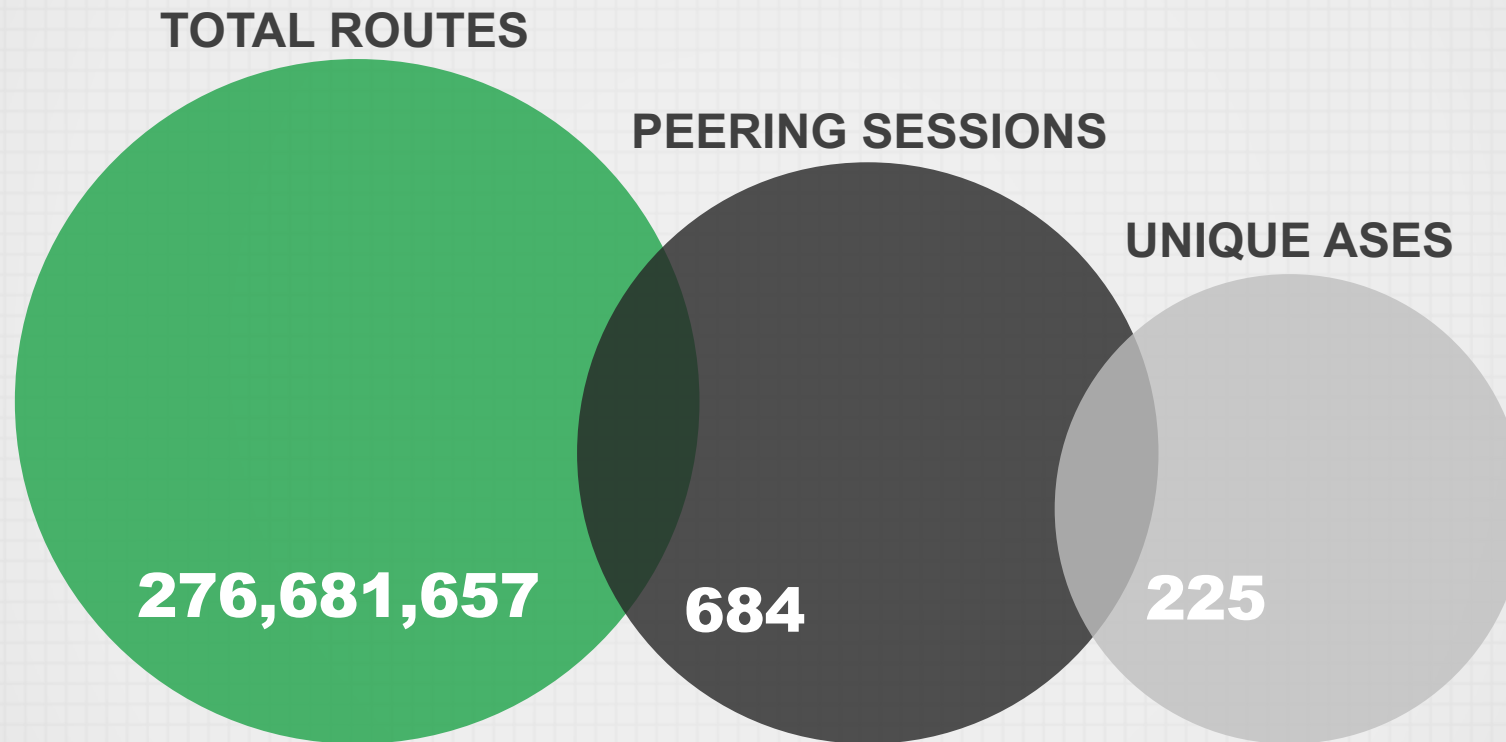
276,681,657



PEERING STATS



PEERING STATS



More peering information: routeviews.org/peers/peering-status.html

COLLECTORS

HARDWARE

Commodity

- 8-16 Cores
- 32G-64G Ram
- 400GB-1TB SSD
- 10 GB eth

Vendor

- ASR 1004

SOFTWARE

OpenSource

- Linux/Centos and...
- Quagga – bgpd
- FRR – bgpd
- Gobgpd

Vendor

- IOS XE

COLLECTORS OPERATIONS

MULTI-HOP

Pros

- If you can reach the collector, you can peer

Cons

- Peerings are subject to the routing anomalies that RouteViews seeks to observe and collect

INTERNET EXCHANGE

Pros

- Better positioned to address multi-hop issues
- Geographic diversity
- Peering diversity

COLLECTOR DATA

MRT

Multi-Threaded Routing Toolkit

- <https://tools.ietf.org/html/rfc6396>
- MRT provides a standard for parsing or dumping routing information to a binary file.
- RouteViews Dumps consist of BGP RIBs and UPDATES.
 - RIBs are dumped every 2 hours
 - UPDATES are dumped every 15 minutes

DATA ACCESS

- MRT files are bziped and rsynced back to <http://archive.routeviews.org/> regularly
- They can be accessed via, http, ftp and rsync.

MRT TOOLS

RIPE libBGPdump, UCLA BGP Parser, NTT BGPdump2, etc:



- <https://bitbucket.org/ripence/bgpdump/wiki/Home>
- <https://github.com/cawka/bgpparser>
- <https://github.com/yasuhiro-ohara-ntt/bgpdump2>
- <https://github.com/t2mune/mrtparse> (Python)
- <https://github.com/rfc1036/zebra-dump-parser> (Perl)

COLLECTOR ACCESSIBILITY

telnet://route-views*.routeviews.org

- No username necessary.
- Users are able to run show commands, e.g. show ip bgp x.x.x.x/x.

GOTCHAS

- Why not SSH?!
 - RouteViews data is publicly available. We've got nothing to hide.
- show ip route x.x.x.x next-hop is incorrect!
 - Remember, this is a collector. There's no data-plane, thus no true FIB.

USE CASES

OPERATIONS

- BGP is the backbone of the Global Routing Infrastructure.
- To ensure it's stability, it needs to be constantly monitored.
- RouteViews provides:
 - Command-Line/ Looking Glass
 - Prefix Visibility, Verify Convergence, Path Stability
 - Comparing Local/Regional/Global Views
 - Troubleshooting Reachability

USE CASES

RESEARCH

- BGP anomalies and dynamics are critical as well.
- RouteViews Provides:
 - Network Topology Monitoring
 - Route Leaks/Hi-Jacks (ex. <https://cyclops.cs.ucla.edu>)
 - Network Optimization
 - Growth, Aggregation, etc. In AS/V4/V6
 - Address Provenance
- ~500 research publications have used RouteViews data
- More info: <http://www.routeviews.org/routeviews/index.php/papers/>

BGP DATA DISTRIBUTION EVOLUTION

1st

Generation Characteristics (current)

- File-Based storage, MRT data format

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- File-Based storage, MRT data format
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- Manual retrieval, sequencing, and consolidation

BGP DATA DISTRIBUTION EVOLUTION

1st Generation Characteristics (current)

- File-Based storage, MRT data format
- Asynchronous
- Manual retrieval, sequencing, and consolidation
- No post-processing
- Centralized model

BGP DATA DISTRIBUTION EVOLUTION

2nd Generation Characteristics (future)

- “Message-based” data distribution, per-message timestamps, with meta-data

BGP DATA DISTRIBUTION EVOLUTION

2nd Generation Characteristics (future)

- “Message-based” data distribution, per-message timestamps, with meta-data
- Automated consolidating and sequencing

BGP DATA DISTRIBUTION EVOLUTION

2nd

Generation Characteristics (future)

- “Message-based” data distribution, per-message timestamps, with meta-data
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- Database storage and access

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- Real-time streaming telemetry

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2nd Generation Characteristics (future)

- “Message-based” data distribution, per-message timestamps, with meta-data
- Automated consolidating and sequencing
- Database storage and access
- RESTful interfaces
- Real-time streaming telemetry
- Middle-layer abstraction, multi-client access (facilitates analysis and services)

RESEACH OPPORTUNITIES

2nd Generation

By leveraging the 2nd generation characteristics of RouteViews BGP data distribution, new and novel approaches to BGP anomaly and dynamics analysis are possible.

RESEACH OPPORTUNITIES

2nd Generation

- Use RouteViews API data for ML supervised learning. Train models to detect:
 - Route leaking/hijacking
 - Infrastructure/peering outages
 - Internet censorship
 - Routing policy complexity
- Validate ML models against live BMP streams

NEXT STEPS **BMP & OpenBMP**

BMP

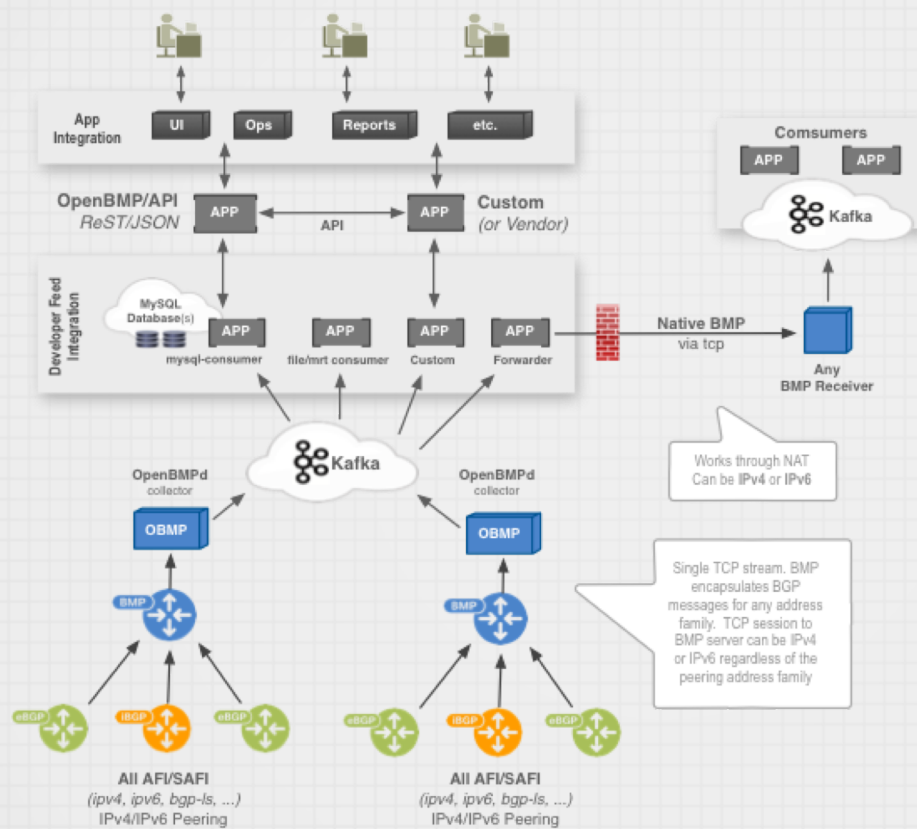
BGP Monitoring Protocol

- <https://tools.ietf.org/html/rfc7854>
- Available now – Cisco, Juniper, (FRR coming soon)
- In addition to MRT attributes BMPs adds
 - Start, Stop, Peer Up, Peer Down
 - Collector Identification
 - Statistics

NEXT STEPS **BMP & OpenBMP**

- BMP is the IETF standard for BGP monitoring
- OpenBMPd is OpenSource (part of the Linux Foundation)
 - Consolidates peers/collectors
 - Splits collector, peer and update messages into separate streams
- Apache Kafka comprises the message bus for openbmp
 - Addresses producer/consumer problems
 - Proven to Scale
 - Mature client API
 - Clients in 16 different programming languages.

OpenBMP ARCHITECTURE



<https://github.com/OpenBMP/openbmp/blob/master/docs/images/openbmp-flow.png>

BMP TOOLS



- <http://bgpstream.caida.org/>

Languages:

- <https://cwiki.apache.org/confluence/display/KAFKA/Clients>