

# **RouteViews Evolves: Modernizing the BGP Collector for Today's Researcher**



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The group is currently led by the network engineering team at the University of Oregon, with some assistance from the Network Startup Resource Center (NSRC) group.

## 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.

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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.

# FOOTPRINT



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## COLLECTOR LOCATIONS

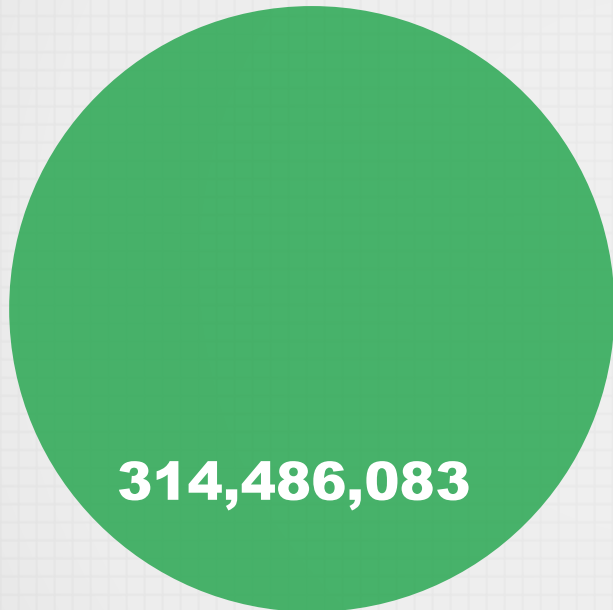
- ✓ Atlanta (digital realty)
- ✓ Chicago (equinx)
- ✓ Chile
- ✓ DC (eqix)
- ✓ Eugene (Multi-hop)
- ✓ Johannesburg (JINX, NAPAfrica)
- ✓ London (LINX)
- ✓ Miami (flix)
- ✓ Nairobi (kixp)
- ✓ Palo Alto (PAIX)
- ✓ Perth (WAIX)
- ✓ Portland (NWAX)
- ✓ Sao Paulo (IX.br x4)
- ✓ San Francisco (sfmix)
- ✓ Singapore (Equinix SG)
- ✓ Serbia (sox)
- ✓ Sydney (equinix)
- ✓ Tokyo (DIX-IE)
- ✓ Cape Town



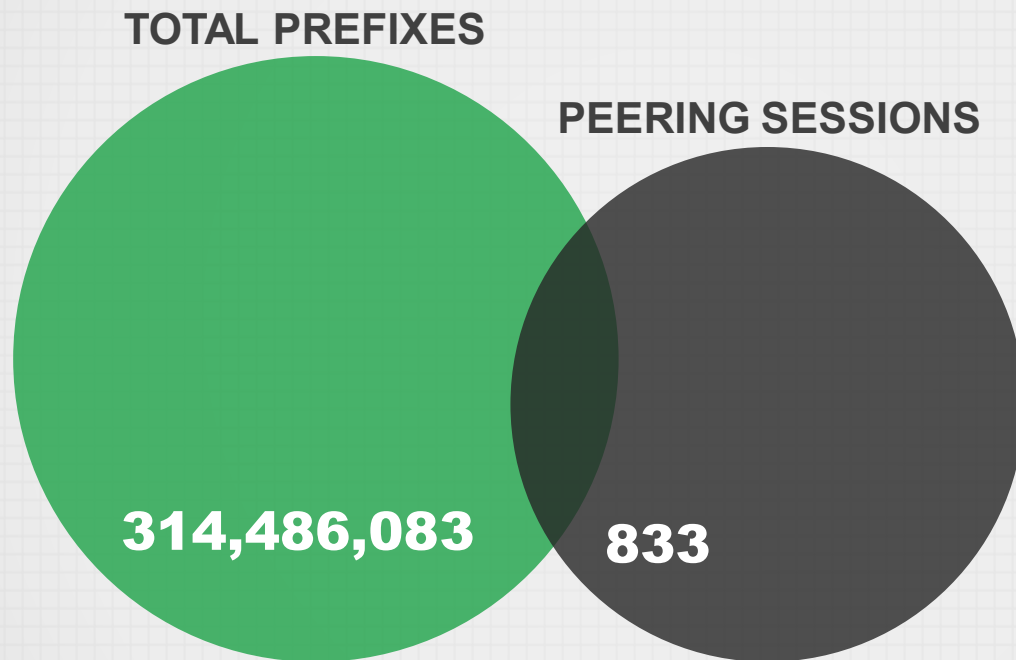
# PEERING STATS

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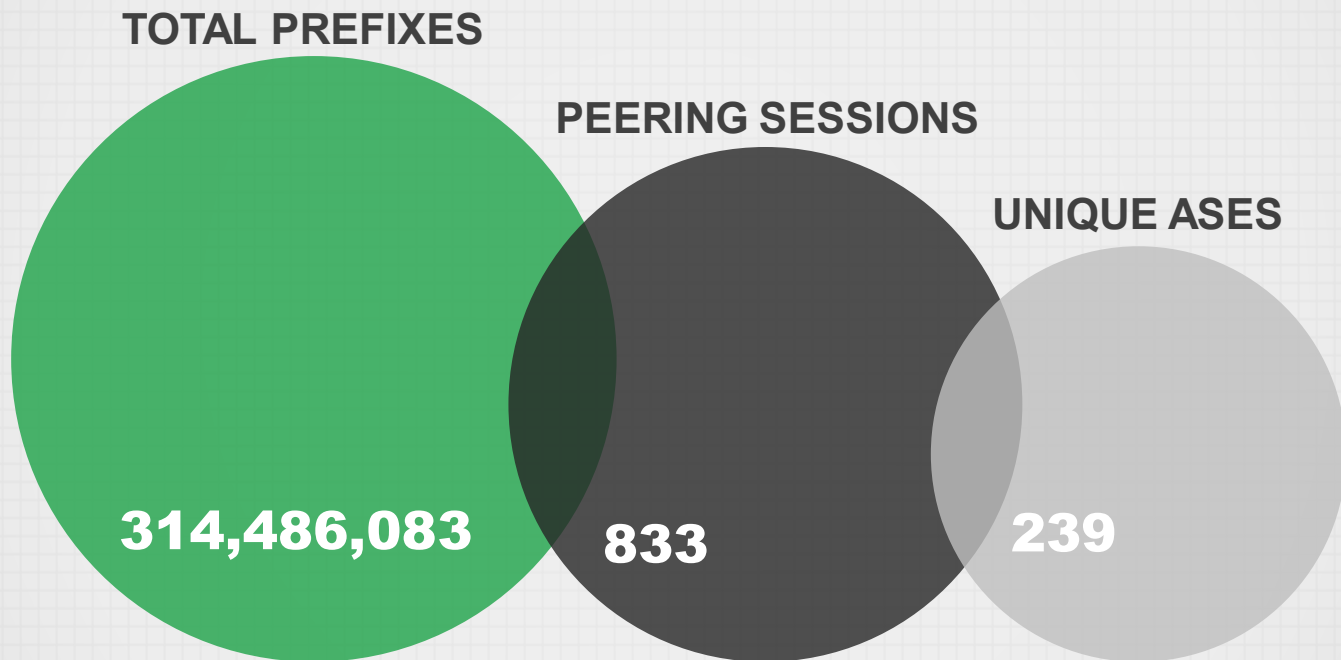
TOTAL PREFIXES



# PEERING STATS



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More peering information: [routeviews.org/peers/peering-status.html](https://routeviews.org/peers/peering-status.html)

# COLLECTORS

## HARDWARE

### Commodity

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

### Vendor

- ASR 1004

## SOFTWARE

### OpenSource

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

### 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/ripenc/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.
  - We use ssh for host management.
- 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. Artemis, Cyclops)
  - 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

1<sup>st</sup>

## Generation Characteristics (current)

- File-Based storage, MRT data format

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## Generation Characteristics (current)

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

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

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



# RESEACH OPPORTUNITIES

2<sup>nd</sup>

Generation

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

# RESEACH OPPORTUNITIES

2<sup>nd</sup>

Generation

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

# NEXT STEPS **Communication**

## User List

- Better communications for those who are interested.
  - Maintenance.
  - Outages.
  - Collector announcements.

# NEXT STEPS Governance

## Steering Committee

- Ensure RouteViews continues to meet the needs of the community.
- Comprised of research and industry members.

# NEXT STEPS **BMP & OpenBMP**

## BMP

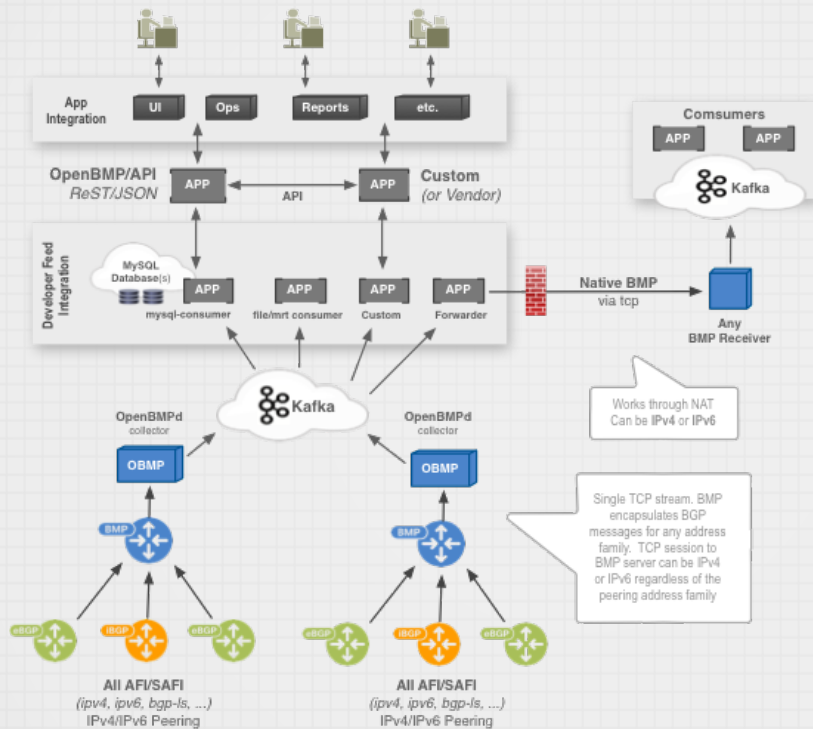
### **BGP Monitoring Protocol**

- <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
  - Can be easily extended to meet future needs.

# 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>



**THANK YOU**

Questions?