ROUTEVIEWS

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

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RouteViews was founded at the University of Oregon's Advanced Network Technology Center (ANTC) in 1995. Data archives began in 1997 and amount to 22TBs (compressed) today.

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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 and Google with other contributions from public and private organizations.

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The University of Oregon is a public research institution 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.

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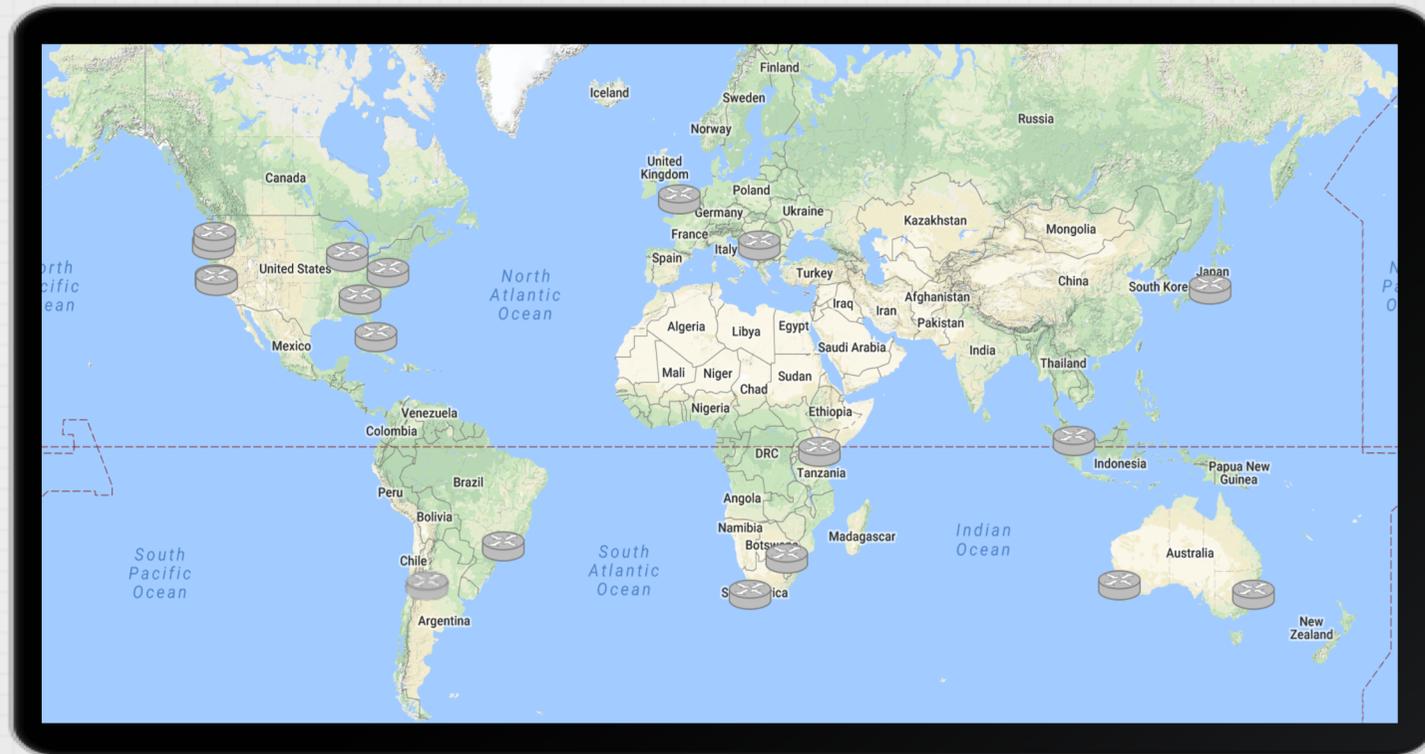
FOOTPRINT

FOOTPRINT

COLLECTOR LOCATIONS

- Atlanta (digital realty)
- Chicago (equinix)
- 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

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PEERING STATS

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PEERING STATS

TOTAL PREFIXES

314,486,083

PEERING STATS

TOTAL PREFIXES

PEERING SESSIONS

314,486,083

833

PEERING STATS

TOTAL PREFIXES

PEERING SESSIONS

AUTONOMOUS SYSTEMS

314,486,083

833

239
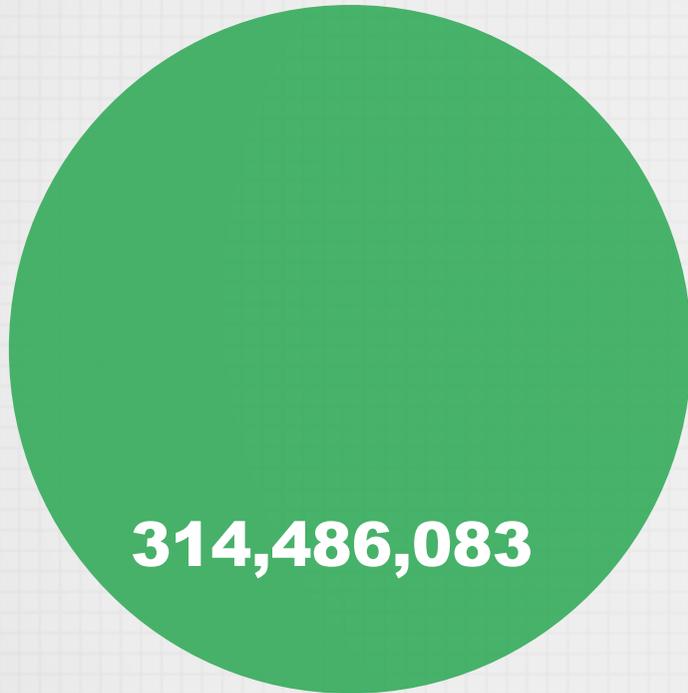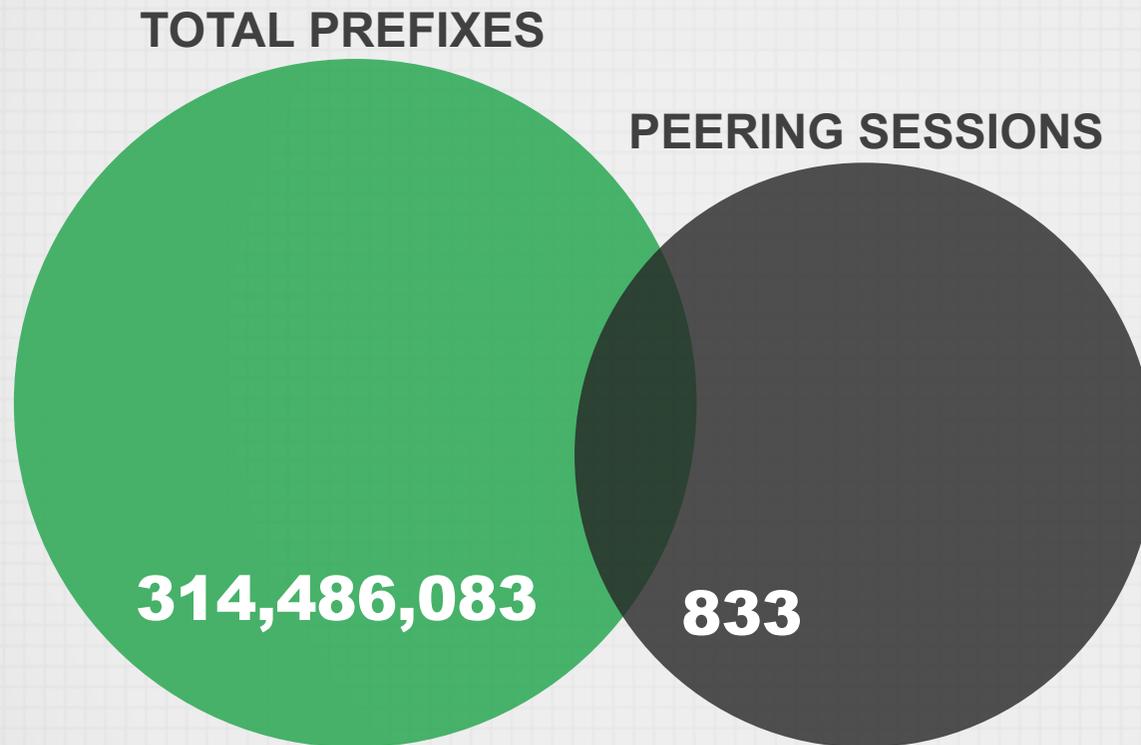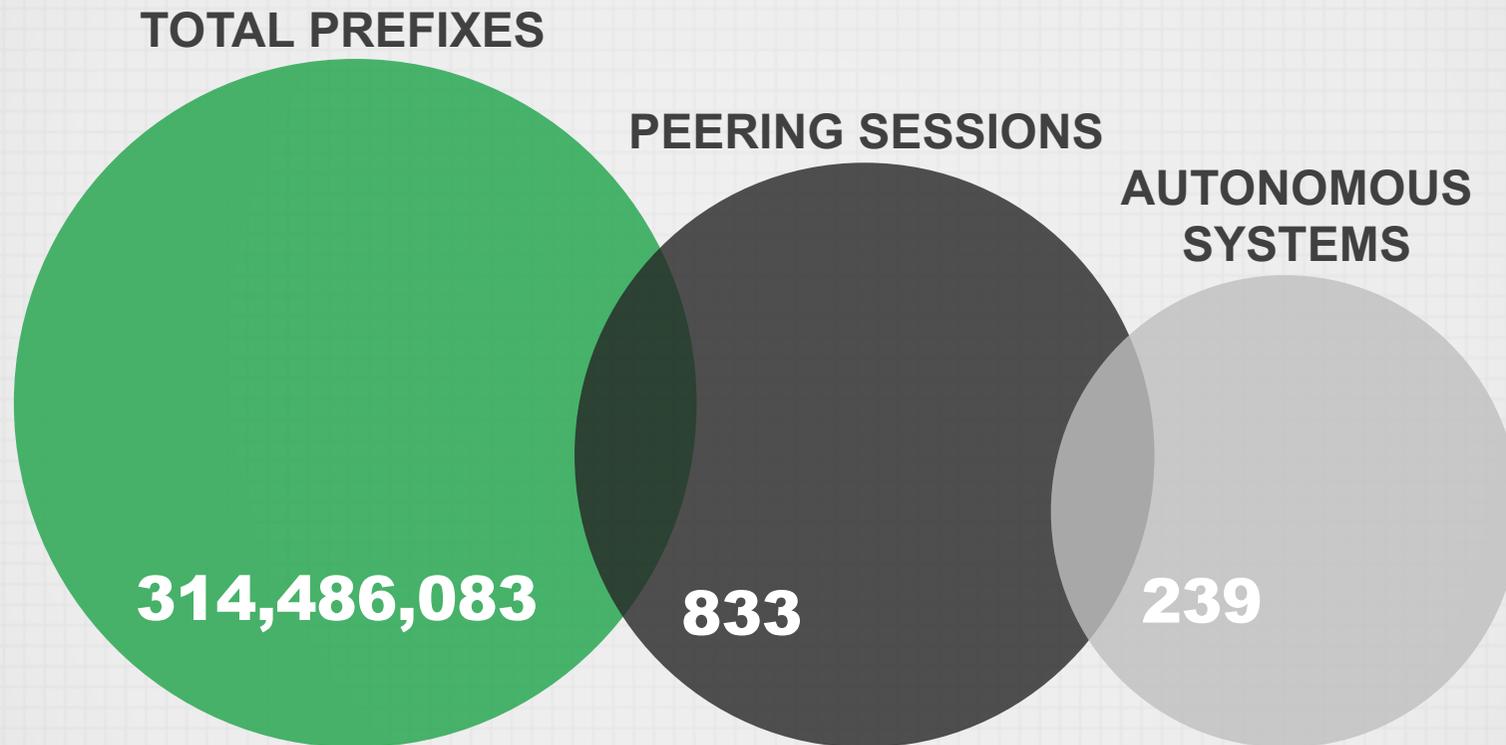
More peering information: www.routeviews.org/peers/peering-status.html

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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

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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

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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

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DATA ACCESS

- MRT files are bzipped and rsynced back to http://archive.routeviews.org/ regularly

- They can be accessed via, http, ftp and rsync.

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MRT TOOLS

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

- https://bitbucket.org/ripencc/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)
- https://github.com/CAIDA/libparsebgp
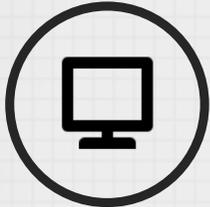
COLLECTOR ACCESSIBILITY

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.

- 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.

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USE CASES

- BGP is the backbone of the Global Routing Infrastructure.
- To ensure its 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

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USE CASES

- BGP anomalies and dynamics are critical as well.
- RouteViews Provides:
  - Network Topology Monitoring
  - Route Leaks/Hijacks (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/

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BGP DATA DISTRIBUTION EVOLUTION

1st **Generation Characteristics (current)**

- File-Based storage, MRT data format

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- Asynchronous
- Manual retrieval, sequencing, and consolidation

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- No post-processing

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

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BGP DATA DISTRIBUTION EVOLUTION

2nd Generation Characteristics (future)

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

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BGP DATA DISTRIBUTION EVOLUTION

2nd **Generation Characteristics (future)**

- "Message-based" data distribution, per-message timestamps, with meta-data
- Automated consolidating and sequencing
- Database storage and access

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- Real-time streaming telemetry
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- RPKI validation

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NEXT STEPS COMMUNICATION

User List

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

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NEXT STEPS GOVERNANCE

Steering Committee

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

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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, BMP adds
  - Start, Stop, Peer Up, Peer Down
  - Collector Identification
  - Statistics

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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

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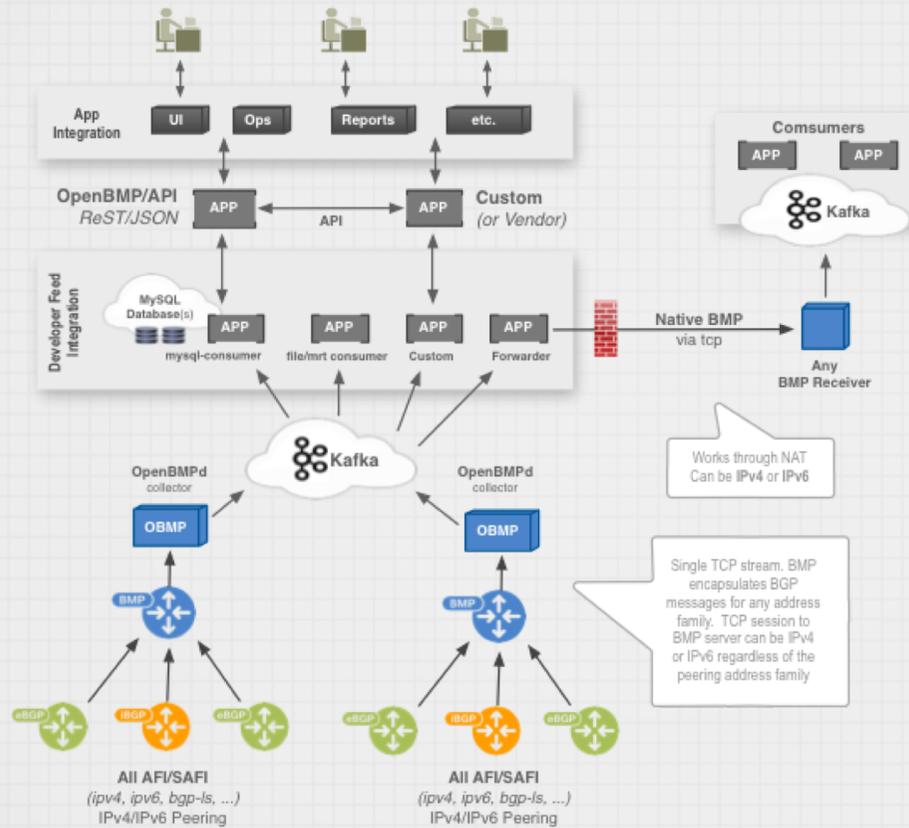
BMP TOOLS

An open-source software framework for live and historical BGP data analysis
- https://bgpstream.caida.org/

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

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RESEARCH 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.

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RESEARCH OPPORTUNITIES

(2nd) **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

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THANK YOU

Questions?

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