ROUTEVIEWS EVOLVES: Modernizing the BGP Collector for Today's Researcher
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A collaborative router looking glass to share BGP views among network operators and researchers.
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UNIVERSITY OF OREGON

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.
SPECIAL THANKS

JOHN KEMP
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KIMBERLY (KC) CLAFFY
LUCY LYNCH
HANS KUHN
JOEL JAEGGLI
JOHN HEASLEY
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
PEERING STATS
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TOTAL PREFIXES

314,486,083
PEERING STATS

TOTAL PREFIXES
314,486,083

PEERING SESSIONS
833
PEERING STATS

TOTAL PREFIXES: 314,486,083
PEERING SESSIONS: 833
AUTONOMOUS SYSTEMS: 239

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

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

Vendor
- ASR 1004

OpenSource
- Linux/Centos and…
- Quagga – bgpd
- FRR – bgpd

Vendor
- IOS XE
COLLECTORS OPERATIONS

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

Pros
- Better positioned to address multi-hop issues
- Geographic diversity
- Peering diversity
Multi-Threaded Routing Toolkit

- 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 bzipped 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:

- [Link 1](https://bitbucket.org/ripencc/bgpdump/wiki/Home)
- [Link 2](https://github.com/cawka/bgpparser)
- [Link 3](https://github.com/yasuhiro-ohara-ntt/bgpdump2)
- [Link 4](https://github.com/t2mune/mrtparse) (Python)
- [Link 5](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

- 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

- 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
BGP DATA DISTRIBUTION EVOLUTION

1st Generation Characteristics (current)
- File-Based storage, MRT data format
BGP DATA DISTRIBUTION EVOLUTION

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- Manual retrieval, sequencing, and consolidation
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Generation Characteristics (current)

- File-Based storage, MRT data format
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- Manual retrieval, sequencing, and consolidation
- No post-processing
BGP DATA DISTRIBUTION EVOLUTION

Generation Characteristics (current)

- File-Based storage, MRT data format
- Asynchronous
- Manual retrieval, sequencing, and consolidation
- No post-processing
- Centralized model
“Message-based” data distribution, per-message timestamps, with meta-data
BGP DATA DISTRIBUTION EVOLUTION

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

- “Message-based” data distribution, per-message timestamps, with meta-data
- Automated consolidating and sequencing
- Database storage and access
BGP DATA DISTRIBUTION EVOLUTION

- “Message-based” data distribution, per-message timestamps, with meta-data
- Automated consolidating and sequencing
- Database storage and access
- RESTful interfaces

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
BGP DATA DISTRIBUTION EVOLUTION

- "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)
**BGP DATA DISTRIBUTION EVOLUTION**

- "Message-based" data distribution, per-message timestamps, with meta-data
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- RESTful interfaces
- Real-time streaming telemetry
- Middle-layer abstraction, multi-client access (facilitates analysis and services)
- RPKI validation
NEXT STEPS COMMUNICATION

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

- Ensure RouteViews continues to meet the needs of the community.
- Comprised of research and industry members.
NEXT STEPS BMP & OpenBMP

BGP Monitoring Protocol

- 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

- [https://bgpstream.caida.org/](https://bgpstream.caida.org/)

Languages:

- [https://cwiki.apache.org/confluence/display/KAFKA/Clients](https://cwiki.apache.org/confluence/display/KAFKA/Clients)
By leveraging the 2nd generation characteristics of RouteViews BGP data distribution, new and novel approaches to BGP anomaly and dynamics analysis are possible.
RESEARCH OPPORTUNITIES

- 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
THANK YOU

Questions?