End-to-end Pipeline for BMP Visualization

IETF 109, Livio Sgier
System Goals

- Investigate BMP capabilities in the context of a MPLS VPN L3 lab network
- Build end-to-end pipeline
- Correlation on **VPN level** and in **time** between **control** (BMP) and **forwarding** plane (IPFIX)
  - Enable root cause analysis, (real time) performance monitoring
Border Gateway Protocol (BGP)

Border Gateway Protocol - UPDATE Message
- Marker: fFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
- Length: 79
- Type: UPDATE Message (2)
- Withdrawn Routes Length: 0
- Total Path Attribute Length: 51
- Path attributes
  - Path Attribute - ORIGIN: IGP
  - Path Attribute - AS_PATH: 65539 65536 65537
  - Path Attribute - NEXT_HOP: 192.0.2.171
  - Path Attribute - COMMUNITIES: 64496:299 64496:1001
- Network Layer Reachability Information (NLRI)
  - 203.0.113.252/31

RIB Entry: Prefix with attached attributes
BGP Monitoring Protocol (BMP)

- Access to Adj-RIB-In [RFC 7854]

Enabled use cases:
→ Access to incoming BGP updates
BGP Monitoring Protocol (BMP)

- Access to Adj-RIB-In [RFC 7854]
- Access to Adj-RIB-Out [RFC 8671]

Enabled use cases:
- Access to outgoing BGP updates
BGP Monitoring Protocol (BMP)

- Access to Adj-RIB-In [RFC 7854]
- Access to Adj-RIB-Out [RFC 8671]
- Access to Loc-RIB [draft]

Enabled use cases:
- Access to BGP updates **installed** in local RIB
BGP Monitoring Protocol (BMP)

- Access to Adj-RIB-In [RFC 7854]
- Access to Adj-RIB-Out [RFC 8671]
- Access to Loc-RIB [draft]
- Route Monitoring Path Marking [draft]

Enabled use cases:
→ Access to **how** BGP updates are installed in the local RIB
BGP Monitoring Protocol (BMP)

- Access to Adj-RIB-In [RFC 7854]
- Access to Adj-RIB-Out [RFC 8671]
- Access to Loc-RIB [draft]
- Route Monitoring Path Marking [draft]
- Route Policy and Attr. Tracing [draft]

Enabled use cases:
- Information about triggered route policies
Lab Network Type

- MPLS/BGP IP Virtual Private Networks [RFC 4364]
- Common architecture for ISPs: Enabling **multiple VPNs** over same physical infrastructure
- Entities: Customer Edge (CE), Provider Edge (PE), Provider Core (P)
- Virtual routing and forwarding (VRF) instances per VPN to isolate routing tables
- New address family: **VPNv4/6** (Route Distinguisher + IPv4/6, e.g., 0:64499:6:203.0.113.10/32)
End-to-end Pipeline Design: Export & Collection

Which RIBs?
Which address families?

Collect IPFIX and BMP → correlate & enrich
End-to-end Pipeline Design: Processing & Storage

- High-performance message broker.
- Time-series, column-oriented database.

Split BMP into separate message types.

Router

BGP/IP

BGP/IP

BGP/IP

Collector
(pmacct)

BGP/IP

BMP/IPFIX

BMP/IPFIX

BMP/IPFIX

Kafka

Druid

BMP/IPFIX

BMP/IP

IPFIX
End-to-end Pipeline Design: Visualization

Diagram:
- Router (BGP/IP) to Collector (pmacct) (BGP/IP) to Kafka (BMP/IPFIX) to Druid (BMP/IPFIX) to NodeJS (socket.io) to Web Front-end
- Druid (API) to NodeJS

- Handle requests between front-end and Druid/Routers
- Interactive UI with filters and resulting graphs
Visualization/Web Front End

- **Goals**
  - Support **exploratory** and **real time** queries for **Route Monitoring**, **Peering**, **Route Policy**
  - **Correlation** on **VPN level** and in **time** between control- and forwarding-plane
    → Make cause and effect visible across planes

<table>
<thead>
<tr>
<th>Peering</th>
<th>Route Monitor</th>
<th>Route Policy &amp; Attr. Tracing</th>
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<tbody>
<tr>
<td></td>
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<td>Real Time</td>
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<td>Explore</td>
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**Control Plane**

- Std. Community: 64497:1
- RIB Selection: Pre-policy Adj-RIB-In
- Initialize: 2020-10-25T10:00:00.000Z
- Start: 2020-10-25T10:00:00.000Z
- End: 2020-10-25T11:00:00.000Z

**Data Plane**

- Std. Community: 64497:1
- Peer Src IP: 192.0.2.53
- Start: 2020-10-25T10:00:00.000Z
- End: 2020-10-25T11:00:00.000Z

Visualization: Example Query (1)

“For **VPN A**, show me the **Adj-RIB-In Pre-Policy** and its **correlation** to the **forwarding plane** before and after enabling an interface on a **VPN level**.”
Visualization: Example Query (2)

“For re-enabled prefix X on VPN A, show a live view of Adj-RIB-Out and all triggered route policies”