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**Support for Adj-RIB-Out in BGP Monitoring Protocol (BMP)
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Abstract

The BGP Monitoring Protocol (BMP) defines access to only the Adj-RIB-In Routing Information Bases (RIBs). This document updates the BGP Monitoring Protocol (BMP) [RFC 7854](#) by adding access to the Adj-RIB-Out RIBs. It adds a new flag to the peer header to distinguish Adj-RIB-In and Adj-RIB-Out.

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Table of Contents

1.	Introduction	2
2.	Terminology	3
3.	Definitions	3
4.	Per-Peer Header	4
5.	Adj-RIB-Out	4
5.1.	Post-Policy	4
5.2.	Pre-Policy	5
6.	BMP Messages	5
6.1.	Route Monitoring and Route Mirroring	5
6.2.	Statistics Report	5
6.3.	Peer Down and Up Notifications	6
6.3.1.	Peer Up Information	6
7.	Other Considerations	6
7.1.	Peer and Update Groups	7
8.	Security Considerations	7
9.	IANA Considerations	7
9.1.	BMP Peer Flags	7
9.2.	BMP Statistics Types	8
9.3.	Peer Up Information TLV	8
10.	References	8
10.1.	Normative References	8
10.2.	URIs	9
	Acknowledgements	9
	Contributors	9
	Authors' Addresses	10

[1.](#) Introduction

BGP Monitoring Protocol (BMP) defines monitoring of the received (e.g., Adj-RIB-In) Routing Information Bases (RIBs) per peer. The Adj-RIB-In pre-policy conveys to a BMP receiver all RIB data before any policy has been applied. The Adj-RIB-In post-policy conveys to a BMP receiver all RIB data after policy filters and/or modifications have been applied. An example of pre-policy verses post-policy is when an inbound policy applies attribute modification or filters. Pre-policy would contain information prior to the inbound policy changes or filters of data. Post policy would convey the changed data or would not contain the filtered data.

Monitoring the received updates that the router received before any policy has been applied is the primary level of monitoring for most use-cases. Inbound policy validation and auditing is the primary use-case for enabling post-policy monitoring.

In order for a BMP receiver to receive any BGP data, the BMP sender (e.g., router) needs to have an established BGP peering session and actively be receiving updates for an Adj-RIB-In.

Being able to only monitor the Adj-RIB-In puts a restriction on what data is available to BMP receivers via BMP senders (e.g., routers). This is an issue when the receiving end of the BGP peer is not enabled for BMP or when it is not accessible for administrative reasons. For example, a service provider advertises prefixes to a customer, but the service provider cannot see what it advertises via BMP. Asking the customer to enable BMP and monitoring of the Adj-RIB-In is not feasible.

BGP Monitoring Protocol (BMP) [RFC 7854](#) [[RFC7854](#)] only defines Adj-RIB-In being sent to BMP receivers. This document updates [section 4.2](#) [[RFC7854](#)] per-peer header by adding a new flag to distinguish Adj-RIB-In verses Adj-RIB-Out. BMP senders use the new flag to send either Adj-RIB-In or Adj-RIB-Out.

Adding Adj-RIB-Out provides the ability for a BMP sender to send to BMP receivers what it advertises to BGP peers, which can be used for outbound policy validation and to monitor routes that were advertised.

2. Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [BCP 14 RFC 2119](#) [[RFC2119](#)] [RFC 8174](#) [[RFC8174](#)] when, and only when, they appear in all capitals, as shown here.

3. Definitions

- o Adj-RIB-Out: As defined in [[RFC4271](#)], "The Adj-RIBs-Out contains the routes for advertisement to specific peers by means of the local speaker's UPDATE messages."
- o Pre-Policy Adj-RIB-Out: The result before applying the outbound policy to an Adj-RIB-Out. This normally would match what is in the local RIB.

- o Post-Policy Adj-RIB-Out: The result of applying outbound policy to an Adj-RIB-Out. This MUST be what is actually sent to the peer.

4. Per-Peer Header

The per-peer header has the same structure and flags as defined in [section 4.2 \[RFC7854\]](#) with the following 0 flag addition:

```

      0 1 2 3 4 5 6 7
      +---+---+---+---+
      |V|L|A|0| Resv |
      +---+---+---+---+

```

- o The 0 flag indicates Adj-RIB-In if set to 0 and Adj-RIB-Out if set to 1.

The existing flags are defined in [section 4.2 \[RFC7854\]](#) and the remaining bits are reserved for future use. They SHOULD be transmitted as 0 and their values MUST be ignored on receipt.

The following fields in the Per-Peer Header are redefined:

- o Peer Address: The remote IP address associated with the TCP session over which the encapsulated PDU is sent.
- o Peer AS: The Autonomous System number of the peer from which the encapsulated PDU was sent.
- o Peer BGP ID: The BGP Identifier of the peer from which the encapsulated PDU was sent.
- o Timestamp: The time when the encapsulated routes were advertised (one may also think of this as the time when they were installed in the Adj-RIB-Out), expressed in seconds and microseconds since midnight (zero hour), January 1, 1970 (UTC). If zero, the time is unavailable. Precision of the timestamp is implementation-dependent.

5. Adj-RIB-Out

5.1. Post-Policy

The primary use-case in monitoring Adj-RIB-Out is to monitor the updates transmitted to a BGP peer after outbound policy has been applied. These updates reflect the result after modifications and filters have been applied (e.g., Adj-RIB-Out Post-Policy). Some attributes are set when the BGP message is transmitted, such as next-hop. Adj-RIB-Out Post-Policy MUST convey what is actually

transmitted to the peer, next-hop and any attributes set during transmission should also be set and transmitted to the BMP receiver.

The L flag MUST be set to 1 to indicate post-policy.

5.2. Pre-Policy

Similarly to Adj-RIB-In policy validation, pre-policy Adj-RIB-Out can be used to validate and audit outbound policies. For example, a comparison between pre-policy and post-policy can be used to validate the outbound policy.

Depending on BGP peering session type (IBGP, IBGP route reflector client, EBGP, BGP confederations, Route Server Client) the candidate routes that make up the Pre-Policy Adj-RIB-Out do not contain all local-rib routes. Pre-Policy Adj-RIB-Out conveys only routes that are available based on the peering type. Post-Policy represents the filtered/changed routes from the available routes.

Some attributes are set only during transmission of the BGP message, i.e., Post-Policy. It is common that next-hop may be null, loopback, or similar during this phase. All mandatory attributes, such as next-hop, MUST be either ZERO or have an empty length if they are unknown at the Pre-Policy phase completion. The BMP receiver will treat zero or empty mandatory attributes as self-originated.

The L flag MUST be set to 0 to indicate pre-policy.

6. BMP Messages

Many BMP messages have a per-peer header but some are not applicable to Adj-RIB-In or Adj-RIB-Out monitoring, such as peer up and down notifications. Unless otherwise defined, the O flag should be set to 0 in the per-peer header in BMP messages.

6.1. Route Monitoring and Route Mirroring

The O flag MUST be set accordingly to indicate if the route monitor or route mirroring message conveys Adj-RIB-In or Adj-RIB-Out.

6.2. Statistics Report

The Statistics report message has a Stat Type field to indicate the statistic carried in the Stat Data field. Statistics report messages are not specific to Adj-RIB-In or Adj-RIB-Out and MUST have the O flag set to zero. The O flag SHOULD be ignored by the BMP receiver.

The following new statistic types are added:

- o Stat Type = 14: (64-bit Gauge) Number of routes in Adj-RIBs-Out Pre-Policy.
- o Stat Type = 15: (64-bit Gauge) Number of routes in Adj-RIBs-Out Post-Policy.
- o Stat Type = 16: Number of routes in per-AFI/SAFI Adj-RIB-Out Pre-Policy. The value is structured as: 2-byte Address Family Identifier (AFI), 1-byte Subsequent Address Family Identifier (SAFI), followed by a 64-bit Gauge.
- o Stat Type = 17: Number of routes in per-AFI/SAFI Adj-RIB-Out Post-Policy. The value is structured as: 2-byte Address Family Identifier (AFI), 1-byte Subsequent Address Family Identifier (SAFI), followed by a 64-bit Gauge.

6.3. Peer Down and Up Notifications

Peer Up and Down notifications convey BGP peering session state to BMP receivers. The state is independent of whether or not route monitoring or route mirroring messages will be sent for Adj-RIB-In, Adj-RIB-Out, or both. BMP receiver implementations SHOULD ignore the 0 flag in Peer Up and Down notifications. BMP receiver implementations MUST use the per-peer header 0 flag in route monitoring and mirroring messages to identify if the message is for Adj-RIB-In or Adj-RIB-Out.

6.3.1. Peer Up Information

The following Peer Up message Information TLV type is added:

- o Type = 4: Admin Label. The Information field contains a free-form UTF-8 string whose length is given by the Information Length field. The value is administratively assigned. There is no requirement to terminate the string with null or any other character.

Multiple admin labels can be included in the Peer Up notification. When multiple admin labels are included the BMP receiver MUST preserve their order.

The TLV is optional.

7. Other Considerations

[7.1.1.](#) Peer and Update Groups

Peer and update groups are used to group updates shared by many peers. This is a level of efficiency in implementations, not a true representation of what is conveyed to a peer in either Pre-Policy or Post-Policy.

One of the use-cases to monitor Adj-RIB-Out Post-Policy is to validate and continually ensure the egress updates match what is expected. For example, wholesale peers should never have routes with community X:Y sent to them. In this use-case, there may be hundreds of wholesale peers but a single peer could have represented the group.

From a BMP perspective, this should be simple to include a group name in the Peer Up, but it is more complex than that. BGP implementations have evolved to provide comprehensive and structured policy grouping, such as session, AFI/SAFI, and template-based based group policy inheritances.

This level of structure and inheritance of policies does not provide a simple peer group name or ID, such as wholesale peer.

Instead of requiring a group name to be used, a new administrative label informational TLV ([Section 6.3.1](#)) is added to the Peer Up message. These labels have administrative scope relevance. For example, labels "type=wholesale" and "region=west" could be used to monitor expected policies.

Configuration and assignment of labels to peers is BGP implementation specific.

[8.](#) Security Considerations

It is not believed that this document adds any additional security considerations.

[9.](#) IANA Considerations

This document requests that IANA assign the following new parameters to the BMP parameters name space [[1](#)].

[9.1.](#) BMP Peer Flags

This document defines the following per-peer header flags ([Section 4](#)):

- o Flag 3 as 0 flag: The 0 flag indicates Adj-RIB-In if set to 0 and Adj-RIB-Out if set to 1.

9.2. BMP Statistics Types

This document defines four statistic types for statistics reporting ([Section 6.2](#)):

- o Stat Type = 14: (64-bit Gauge) Number of routes in Adj-RIBs-Out Pre-Policy.
- o Stat Type = 15: (64-bit Gauge) Number of routes in Adj-RIBs-Out Post-Policy.
- o Stat Type = 16: Number of routes in per-AFI/SAFI Adj-RIB-Out Pre-Policy. The value is structured as: 2-byte Address Family Identifier (AFI), 1-byte Subsequent Address Family Identifier (SAFI), followed by a 64-bit Gauge.
- o Stat Type = 17: Number of routes in per-AFI/SAFI Adj-RIB-Out Post-Policy. The value is structured as: 2-byte Address Family Identifier (AFI), 1-byte Subsequent Address Family Identifier (SAFI), followed by a 64-bit Gauge.

9.3. Peer Up Information TLV

This document defines the following BMP Peer Up Information TLV types ([Section 6.3.1](#)):

- o Type = 4: Admin Label. The Information field contains a free-form UTF-8 string whose length is given by the Information Length field. The value is administratively given by the Information Length field. The value is administratively assigned. There is no requirement to terminate the string with null or any other character.

10. References

10.1. Normative References

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[10.2.](#) URIs

- [1] <https://www.iana.org/assignments/bmp-parameters/bmp-parameters.xhtml>

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