        Multi-Threaded Routing Toolkit (MRT) Routing Information Export Format
                    with BGP Additional Path Extensions

Abstract

   This document extends the Multi-threaded Routing Toolkit (MRT) export
   format for Border Gateway Protocol (BGP) routing information by
   supporting the advertisement of multiple paths in BGP extensions.

Status of This Memo

   This is an Internet Standards Track document.

   This document is a product of the Internet Engineering Task Force
   (IETF). It represents the consensus of the IETF community. It has
   received public review and has been approved for publication by the
   Internet Engineering Steering Group (IESG). Further information on
   Internet Standards is available in Section 2 of RFC 7841.

   Information about the current status of this document, any errata,
   and how to provide feedback on it may be obtained at
   http://www.rfc-editor.org/info/rfc8050.

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1. Introduction

   The MRT record format [RFC6396] was developed to provide researchers
   and engineers a means to encapsulate, export, and archive routing
   protocol transactions and RIB snapshots.

   The Advertisement of Multiple Paths in BGP [RFC7911] defines a BGP
   extension to allow the advertisement of multiple paths for the same
   address prefix without the new paths implicitly replacing any
   previous ones.

   This document contains an optional extension to the MRT format
   [RFC6396] and introduces additional definitions of MRT subtype fields
   to permit representation of multiple path advertisements [RFC7911].

2. Rationale

   MRT parsers are usually stateless. In order to parse BGP messages
   that contain data structures that depend on the capabilities
   negotiated during the BGP session setup, the MRT subtypes are
   utilized. The Advertisement of Multiple Paths [RFC7911] extension
   for BGP alters the encoding of the BGP Network Layer Reachability
   Information (NLRI) format for withdraws and announcements.
   Therefore, new BGP4MP/BGP4MP_ET subtypes as defined in [RFC6396] are
   required to signal to an MRT parser how to parse the NLRI.

   In Section 4.3 of the MRT specification [RFC6396], RIB subtypes are
   specified. Prefix length and prefix fields are encoded in the same
   manner as the BGP NLRI encoding. In order to support Path Identifier
   information as defined in [RFC7911], new subtypes need to be added.

   The following two sections define the required subtypes.

3. MRT Subtypes for Types BGP4MP/BGP4MP_ET

    This document defines the following new subtypes:

    o   BGP4MP_MESSAGE_ADDPATH

    o   BGP4MP_MESSAGE_AS4_ADDPATH

    o   BGP4MP_MESSAGE_LOCAL_ADDPATH

    o   BGP4MP_MESSAGE_AS4_LOCAL_ADDPATH

    The fields of these message types are identical to the equivalent
    non-additional-path versions specified in Section 4.4 of [RFC6396].
    These enhancements continue to encapsulate the entire BGP message in
    the BGP message field.

4. MRT Subtypes for Type TABLE_DUMP_V2

    This document defines the following new subtypes:

    o   RIB_IPV4_UNICAST_ADDPATH

    o   RIB_IPV4_MULTICAST_ADDPATH

    o   RIB_IPV6_UNICAST_ADDPATH

    o   RIB_IPV6_MULTICAST_ADDPATH

    o   RIB_GENERIC_ADDPATH

    The fields of these message types are identical to the equivalent
    non-additional-path versions specified in Section 4.3 of [RFC6396].
    However, for the case of the 4 AFI/SAFI-specific RIB subtypes, the
    existing RIB Entries field is redefined as detailed in the sections
    below.

4.1. AFI/SAFI-Specific RIB Subtypes

   In order to preserve the record compaction achieved by using the most
   common subtypes and allow multiple RIB Entries to be stored in a
   single TABLE_DUMP_V2 record, the existing RIB Entries field is
   redefined for use within the new AFI/SAFI-specific RIB subtypes
   defined by this document as follows:

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|         Peer Index            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                        Originated Time                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                        Path Identifier                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|       Attribute Length        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                   BGP Attributes... (variable)
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

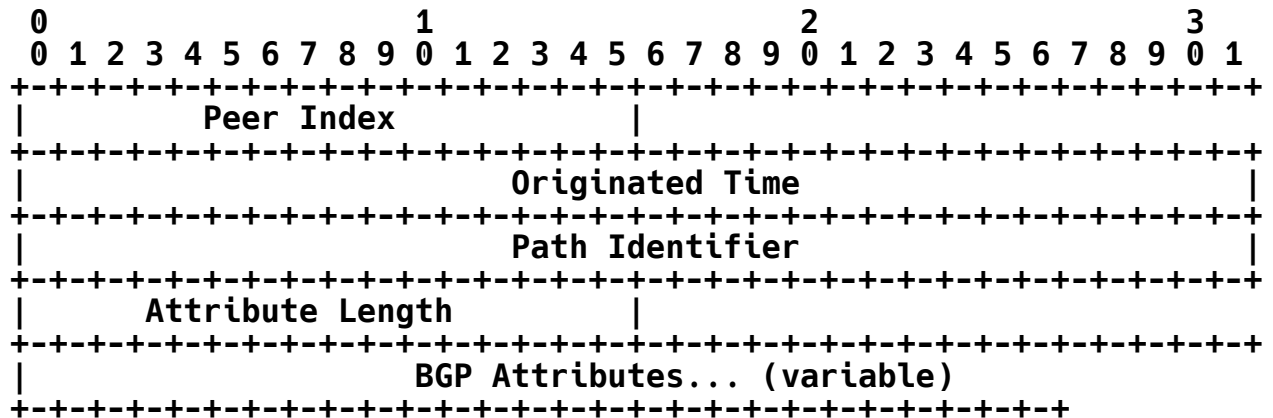   Figure 1: RIB Entries for AFI/SAFI-Specific RIB Subtypes with
                          Support for Additional Paths

   This adds a field to the RIB Entries record to store the Path
   Identifier when used with the RIB_IPV4_UNICAST_ADDPATH,
   RIB_IPV4_MULTICAST_ADDPATH, RIB_IPV6_UNICAST_ADDPATH, and
   RIB_IPV6_MULTICAST_ADDPATH subtypes.

4.2. RIB_GENERIC_ADDPATH Subtype

   The fields of this subtype are identical to the equivalent non-
   additional-path versions specified in Section 4.3.3 of [RFC6396].
   These fields continue to encapsulate the raw and additional-path-
   enabled AFI/SAFI/NLRI in the record, and the raw attributes in the
   RIB Entries.

   For clarity, the RIB Entries in this subtype are not redefined.

5. IANA Considerations

   IANA has assigned the subtype codes defined below in the "Multi-
   threaded Routing Toolkit (MRT)" registry
   <https://www.iana.org/assignments/mrt>.

5.1. BGP4MP/BGP4MP_ET Subtype Codes

   The following have been registered in the "BGP4MP Subtype Codes" and
   "BGP4MP_ET Subtype Codes" registries:

      8 BGP4MP_MESSAGE_ADDPATH (RFC 8050)

      9 BGP4MP_MESSAGE_AS4_ADDPATH (RFC 8050)

      10 BGP4MP_MESSAGE_LOCAL_ADDPATH (RFC 8050)

      11 BGP4MP_MESSAGE_AS4_LOCAL_ADDPATH (RFC 8050)

5.2. TABLE_DUMP_V2 Subtype Codes

   The following have been registered in the "TABLE_DUMP_V2 Subtype
   Codes" registry:

      8 RIB_IPV4_UNICAST_ADDPATH (RFC 8050)

      9 RIB_IPV4_MULTICAST_ADDPATH (RFC 8050)

      10 RIB_IPV6_UNICAST_ADDPATH (RFC 8050)

      11 RIB_IPV6_MULTICAST_ADDPATH (RFC 8050)

      12 RIB_GENERIC_ADDPATH (RFC 8050)

6. Security Considerations

   It is not believed that this document adds any additional security
   considerations. However, the security considerations of [RFC6396]
   are equally applicable to this document, because this document
   permits the export of more detailed routing data.

   An organization that uses the MRT format to store their BGP routing
   information should be aware that supporting these extensions permits
   more detailed network path information to be stored and should
   consider the implications of this within their environment.

An organization that peers with public BGP collectors and enables the
capability for additional paths on a peering session should be aware
that it is exporting not only its best paths, but potentially other
paths within its networks. The BGP peer should consider any and all
implications of exposing this additional data.

7. Normative References

   [RFC6396] Blunk, L., Karir, M., and C. Labovitz, "Multi-Threaded
              Routing Toolkit (MRT) Routing Information Export Format",
              RFC 6396, DOI 10.17487/RFC6396, October 2011,
              <http://www.rfc-editor.org/info/rfc6396>.

   [RFC7911] Walton, D., Retana, A., Chen, E., and J. Scudder,
              "Advertisement of Multiple Paths in BGP", RFC 7911,
              DOI 10.17487/RFC7911, July 2016,
              <http://www.rfc-editor.org/info/rfc7911>.

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