            Shortest Path Bridging, MAC mode Support over EVPN
                       draft-ietf-l2vpn-spbm-evpn-00

Abstract

   This document describes how Ethernet Shortest Path Bridging MAC mode
   (802.1aq) can be combined with EVPN in a way that interworks with
   PBB-PEs as described in the PBB-EVPN solution. This is achieved via
   operational isolation of each Ethernet network subtending an EVPN
   core while supporting full interworking between the different
   variations of Ethernet networks.

Status of this Memo

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1. Introduction

This document describes how Ethernet Shortest Path Bridging MAC mode (802.1aq) along with PBB-PEs and PBBNs (802.1ah) can be supported by EVPN such that each island is operationally isolated while providing full L2 connectivity between them. Each island can use its own control plane instance and multi-pathing design, be it multiple ECT sets, or multiple spanning trees.

The intention is to permit both past, current and emerging future versions of Ethernet to be seamlessly integrated to permit large scale, geographically diverse numbers of Ethernet end systems to be fully supported with EVPN as the unifying agent.

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1.2. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC2119 [RFC2119].

2. Conventions used in this document

2.1. Terminology

BEB: Backbone Edge Bridge
B-MAC: Backbone MAC Address
B-VID: Backbone VLAN ID
CE: Customer Edge
DF: Designated Forwarder
ESI: Ethernet Segment Identifier
EVPN: Ethernet VPN
IB-BEB: A BEB that has both an I-component (customer layer VLAN aware bridge) and a B-component (backbone layer VLAN aware bridge)
ISIS-SPB: IS-IS as extended for SPB
I-SID: I-Component Service ID
NLRI: Network Layer Reachability Information
PBBN: Provider Backbone Bridged Network

        PBB-PE: Co located 802.1ah BEB and EVPN PE
        PE: provider edge
        SPB: Shortest path bridging
        SPBM: Shortest path bridging MAC mode
        SPBM-PE: Co-located 802.1aq SPBM<->EVPN interworking function and
        EVPN PE

3. Changes since previous version

  1) Comments received during call for WG adoption resolved.

4. Solution Overview

The EVPN solution for 802.1aq SPBM incorporates control plane
interworking in the PE to map ISIS-SPB [RFC6329] information elements
into the EVPN NLRI information and vice versa. This requires each PE to
act both as an EVPN BGP speaker and as an ISIS-SPB edge node. Associated
with this are procedures for configuring the forwarding operations of
the PE such that an arbitrary number of EVPN subtending SPBM islands may
be interconnected without any topological or multipathing dependencies.
This model also permits PBB-PEs as defined in 0to be seamlessly
communicate with the SPB islands.

```
                         +--------------+
                         |              |
                         |              |
        +-----+    +----+ |              | +----+   +---+
        |     |-----|SPBM| |              | |PBB |---|CE2|
        |SPBM |     |PE1 | |   IP/MPLS    | |PE1 |   +---+
+---+ |NTWK1|     +----+ |   Network    | +----+
|CE1|-|     |         |              |          |
+---+ |     |    +----+ |              |          |
        |     |-----|SPBM| |              | +----+   +-----+
        +-----+     |PE2 | |              | |SPBM|   |SPBM | +---+
                    +----+ |              | |PE3 |---|NTWK2|-|CE3|
                         +--------------+ +----+   +-----+ +---+
```
        Figure 1: PBB and SPBM EVPN Network
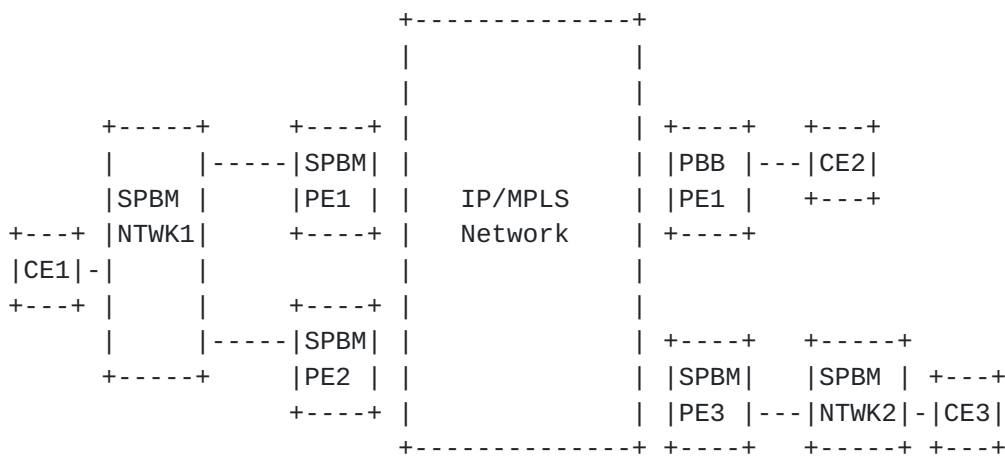
Each EVPN is identified by a route target. The route target identifies the set of SPBM islands and PBB-PEs that are allowed to communicate. Each SPBM island is administered to have an associated Ethernet Segment ID (ESI) associated with it. This manifests itself as a set of Ethernet segments, where each ESI is unique within the route target.
BGP acts as a common repository of the I-SID attachment points for the set of subtending PEs/SPBM islands. This is in the form of B-MAC address/I-SID/Tx-Rx-attribute tuples. BGP filters leaking I-SID information into each SPBM island on the basis of locally registered interest. If an SPBM island has no BEBs registering interest in an I-SID, information about that I-SID from other SPBM islands, PBB-PEs or PBBNs will not be leaked into the local ISIS-SPB routing system.
For each B-VID in an SPBM island, a single SPBM-PE is elected the designated forwarder for the B-VID. An SPBM-PE may be a DF for more than one B-VID. This is described further in section 4.2. The SPBM-PE originates IS-IS advertisements as if it were an IB-BEB that proxies for the other SPBM islands and PBB PEs in the EVPN defined by the route target, but the PE typically will not actually host any I-components.
An SPBM-PE that is a DF for a B-VID strips the B-VID tag information from frames relayed towards the EVPN. The DF also inserts the appropriate B-VID tag information into frames relayed towards the SPBM island on the basis of the local I-SID/B-VID bindings advertised in ISIS-SPB.

5. Elements of Procedure

5.1. PE Configuration

At SPBM island commissioning a PE is configured with:

1) The route target for the service instance. Where a route target is defined as identifying the set of SPBM islands, PBBNs and PBB-PEs to be interconnected by the EVPN.

2) The unique ESI for the SPBM island. Mechanisms for deriving a unique ESI for the SPBM island are for further study.

And the following is configured as part of commissioning an ISIS-SPB node:

1) A Shortest Path Source ID (SPSourceID) used for algorithmic construction of multicast DA addresses. Note this is required for SPBM BEBs independent of the EVPN operation.

   2) The set of VLANs (identified by B-VIDs) used in the SPBM island
      and multi-pathing algorithm IDs to use. The set of B-VIDs and
      multi-pathing algorithms used may be different in different
      domains and the B-VID itself is removed for frames carried over
      the IP/MPLS network.

   A type-1 Route Distinguisher for the node can be auto-derived. This
   will be described in a future version of the document.

5.2. DF Election

   PEs self appoint in the role of DF for a B-VID for a given SPBM
   island. The procedure used is as per section 9.5 of [EVPN]
   "Designated Forwarder election".
   A PE that assumes the role of DF for a given DF is responsible for
   originating specific information into BGP from ISIS-SPB and vice
   versa. A PE that ceases to perform the role of DF for a given B-VID
   is responsible for withdrawing the associated information from BGP
   and ISIS-SPB respectively. The actual information exchanged is
   outlined in the following sections.

5.3. Control plane interworking ISIS-SPB to EVPN

   When a PE receives an SPBM service identifier and unicast address
   sub-TLV as part of an ISIS-SPB MT capability TLV it checks if it is
   the DF for the B-VID in the sub-TLV.

   If it is the DF, and there is new or changed information then a MAC
   advertisement route NLRI is created for each new I-SID in the sub-
   TLV.

   - the Route Distinguisher is set to that of the PE.

   - the ESI is that of the SPBM island.

   - the Ethernet tag ID contains the I-SID (including the Tx/Rx
     attributes). The encoding of I-SID information is as per figure 2.

```
     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
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |T|R| Reserved  |                  I-SID                       |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 2: I-SID encoding in the Ethernet tag-ID field

- the MAC address is copied from the sub-TLV

- an locally assigned MPLS label

Similarly in the scenario where a PE became elected DF for a B-VID in an operating network, the IS-IS database would be processed in order to construct the NLRI information associated with the new role of the PE.

If the BGP database has NLRI information for the I-SID, and this is the first instance of registration of interest in the I-SID from the SPB island, the NLRI information with that tag is processed to construct an updated set of SPBM service identifier and unicast address sub-TLVs to be advertised by the PE.

The ISIS-SPB information is also used to keep current a local table indexed by I-SID to indicate the associated B-VID for processing of frames received from EVPN. When an I-SID is associated with more than one B-VID, only one entry is allowed in the table. Rules for preventing this are out of scope of this memo.

5.4. Control plane interworking EVPN to ISIS-SPB

When a PE receives a BGP NLRI that is new information, it checks if it is the elected DF to communicate this information into ISIS-SPB by checking if the I-SID in the Ethernet Tag ID locally maps to the B-VID it is an elected DF for. Note that if no BEBs in the SPB island have advertised any interest in the I-SID, it will not be associated with any B-VID locally, and therefore not of interest. If the I-SID is of local interest to the SPBM island and the PE is the DF for the B-VID that that I-SID is locally mapped to, a SPBM service identifier and unicast address sub-TLV is constructed/updated for advertisement into ISIS-SPB.

The NLRI information advertised into ISIS-SPB is also used to locally populate a forwarding table indexed by B-MAC+I-SID that points to the label stack to impose on the SPBM frame. The bottom label being that offered in the NLRI.

5.5. Data plane Interworking 802.1aq SPBM island or PBB-PE to EVPN

When an PE receives a frame from the SPBM island in a B-VID for which it is a DF, it looks up the B-MAC/I-SID information to determine the label stack to be added to the frame for forwarding in the EVPN. The

PE strips the B-VID information from the frame, adds the label
information to the frame and forwards the resulting MPLS packet.

5.6. Data plane Interworking EVPN to 802.1aq SPBM island

When a PE receives a packet from the EVPN it may infer the B-VID to
overwrite in the SPBM frame from the I-SID or by other means (such as
via the bottom label in the MPLS stack).

If the frame has a local multicast DA, it overwrites the SPsourceID
in the frame with the local SPsourceID.

5.7. Data plane interworking EVPN to 802.1ah PBB-PE

A PBB-PE actually has no subtending PBBN nor concept of B-VID so no
frame processing is required.

A PBB-PE is required to accept SPBM encoded multicast DAs as if they
were 802.1ah encoded multicast DAs. The only information of interest
being that it is a multicast frame, and the I-SID encoded in the
lower 24 bits.

5.8. Multicast Support

Refer to "mLDP extensions for integrating EVPN and multicast"[mLDP].

6. Other Aspects

6.1. Flow Ordering

When per I-SID multicast is implemented via PE replication, a stable
network will preserve frame ordering between known unicast and
broadcast/unknown/multicast traffic (e.g. race conditions will not
exist). This cannot be guaranteed when multicast is used in the EVPN.

6.2. Transit

Any PE that does not need to participate in the tandem calculations
at the B-MAC layer may use the IS-IS overload bit to exclude SPBM
tandem paths and behave as pure interworking platform.

7. Acknowledgements

The authors would like to thank Peter Ashwood-Smith, Martin Julien
and Janos Farkas for their detailed review of this draft.

8. Security Considerations

For a future version of this document.

9. IANA Considerations

For a future version of this document.

10. References

10.1. Normative References

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[RFC6329] Fedyk et.al. "IS-IS Extensions Supporting IEEE 802.1aq
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10.2. Informative References

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