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Shortest Path Bridging, MAC mode Support over EVPN
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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.

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[draft-ietf-l2vpn-spbm-evpn-01](#)

April 2014

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Table of Contents

1.	Introduction.....	3
1.1.	Authors.....	3
1.2.	Requirements Language.....	3
2.	Conventions used in this document.....	3
2.1.	Terminology.....	3
3.	Changes since previous version.....	4
4.	Solution Overview.....	4
5.	Elements of Procedure.....	5
5.1.	PE Configuration.....	5
5.2.	DF Election.....	6
5.3.	Control plane interworking ISIS-SPB to EVPN.....	6
5.4.	Control plane interworking EVPN to ISIS-SPB.....	7
5.5.	Data plane Interworking 802.1aq SPBM island or PBB-PE to EVPN.....	7
5.6.	Data plane Interworking EVPN to 802.1aq SPBM island.....	8
5.7.	Data plane interworking EVPN to 802.1ah PBB-PE.....	8
5.8.	Multicast Support.....	8
6.	Other Aspects.....	8
6.1.	Flow Ordering.....	8
6.2.	Transit.....	8
7.	Acknowledgements.....	8
8.	Security Considerations.....	9
9.	IANA Considerations.....	9
10.	References.....	9
10.1.	Normative References.....	9
10.2.	Informative References.....	9
11.	Authors' Addresses.....	10

Internet-Draft

[draft-ietf-l2vpn-spbm-evpn-01](#)

April 2014

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 0 to be seamlessly communicate with the SPB islands.

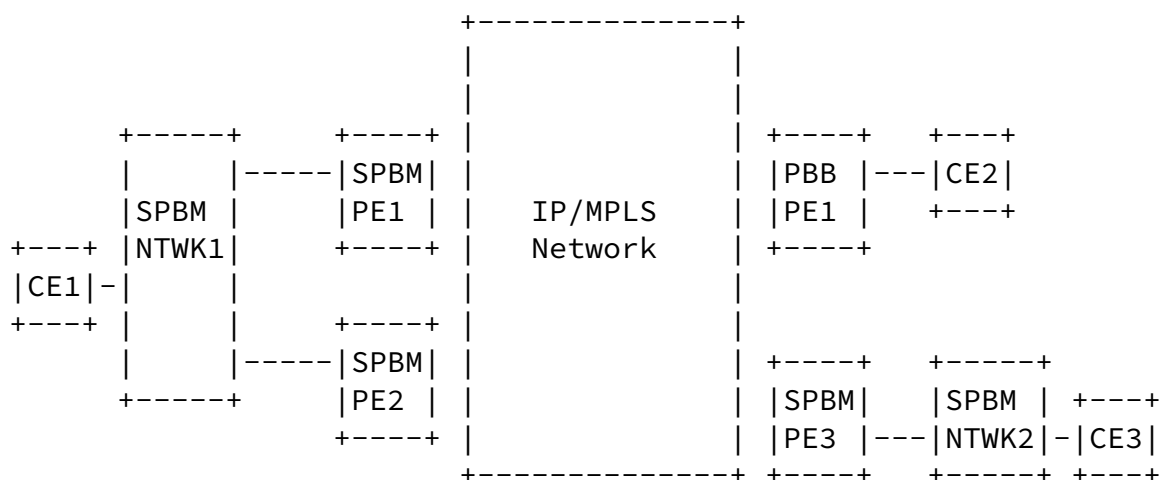


Figure 1: PBB and SPBM EVPN Network

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

- 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

```

+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|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

Allan et al.,

Expires October 2014

[Page 7]

Internet-Draft

[draft-ietf-l2vpn-spbm-evpn-01](#)

April 2014

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](#)

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Allan et al.,

Expires October 2014

[Page 8]

Internet-Draft

[draft-ietf-l2vpn-spbm-evpn-01](#)

April 2014

[8. Security Considerations](#)

For a future version of this document.

[9. IANA Considerations](#)

For a future version of this document.

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Allan et al.,

Expires October 2014

[Page 9]

Internet-Draft

[draft-ietf-l2vpn-spbm-evpn-01](#)

April 2014

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Allan et al.,

Expires October 2014

[Page 10]