



# Implementing IEEE 802.1ah Provider Backbone Bridge

This module provides conceptual and configuration information for IEEE 802.1ah Provider Backbone Bridge on Cisco ASR 9000 Series Routers. The IEEE 802.1ah standard (Ref [4]) provides a means for interconnecting multiple provider bridged networks to build a large scale end-to-end Layer 2 provider bridged network.

The Cisco ASR 9000 Series Aggregation Services Routers now supports a scenario when the provider backbone bridge is a VPLS network. You can now configure pseudowires in the PBB edge bridge domain and core bridge domain. In either type of bridge domain, the pseudowire functionality remains the same as in the native bridge domain.

## Feature History for Implementing IEEE 802.1ah Provider Backbone Bridge

Release	Modification
Release 3.9.1	This feature was introduced on Cisco ASR 9000 Series Routers
Release 4.3.0	Support was added for these features: <ul style="list-style-type: none"><li>• Provider Backbone Bridge VPLS</li><li>• Multiple I-SID Registration Protocol Lite (MIRP Lite)</li></ul>
Release 4.3.2	Support was added for PBB-EVPN feature.
Release 5.1.2	Support was added for MMRP for PBB VPLS Flood Optimization feature.
Release 6.3.2	Support for PBB-EVPN on nV Satellite access interface bundle over ICL (Inter Chassis Link) bundle.



**Note** PBB EVPN is supported only on Cisco ASR 9000 2nd generation Ethernet line cards and Cisco ASR 9000 3rd generation Ethernet line cards.

PBB EVPN is not supported on Cisco ASR 9000 4th generation Ethernet line cards and Cisco ASR 9000 5th generation Ethernet line cards.

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## Prerequisites for Implementing 802.1ah Provider Backbone Bridge

This prerequisite applies to implementing 802.1ah Provider Backbone Bridge:

- You must be in a user group associated with a task group that includes the proper task IDs. The command reference guides include the task IDs required for each command.

If you suspect user group assignment is preventing you from using a command, contact your AAA administrator for assistance.

- You must be familiar with the multipoint bridging concepts. Refer to the [Implementing Multipoint Layer 2 Services](#) module.

## Information About Implementing 802.1ah Provider Backbone Bridge

To implement 802.1ah, you must understand these concepts:

### Benefits of IEEE 802.1ah standard

The benefits of IEEE 802.1ah provider backbone bridges are as follows:

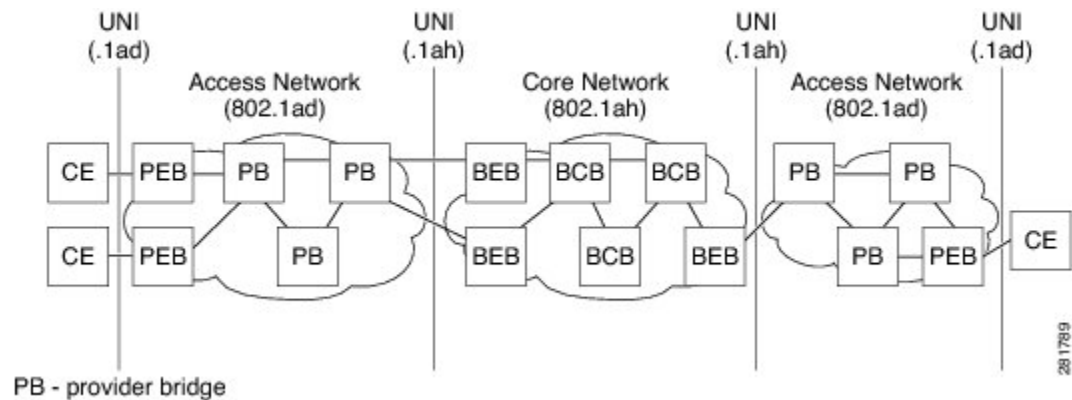
- Increased service instance scalability—Enables a service provider to scale the number of services (service VLANs or service instances) in a Provider Bridged Network (PBN).
- MAC address scalability—Encapsulates the customer packet, including MAC addresses, into a new ethernet frame with new MAC addresses (the backbone bridge MAC addresses). This eliminates the need for backbone core bridges to learn all MAC addresses of every customer and also eases the load on backbone edge bridges.
- VPLS pseudowire reduction and mesh scalability—The number of pseudowires in an IP/MPLS core can be significantly reduced. This is because a single VPLS service can now transport several customer service instances thereby allowing a fewer number of pseudowires in the IP/MPLS core to transport a large number of customer services.
- Layer 2 backbone traffic engineering—Enables explicit controls for Layer 2 traffic engineering by separating service discrimination function and moving it to the I-tags thereby leaving the backbone VLAN to be available for Layer 2 traffic engineering functions.
- Point-to-point service scalability and optimization-enables point-to-point service implementation that includes multiple options for service multiplexing as well as end point discovery.

- Backbone flood traffic reduction—Since there are fewer MAC addresses in the core of the network, the amount of flood traffic in the core network is reduced as there are fewer MAC addresses to be relearned when MAC tables get flushed due to topology changes.

## IEEE 802.1ah Standard for Provider Backbone Bridging Overview

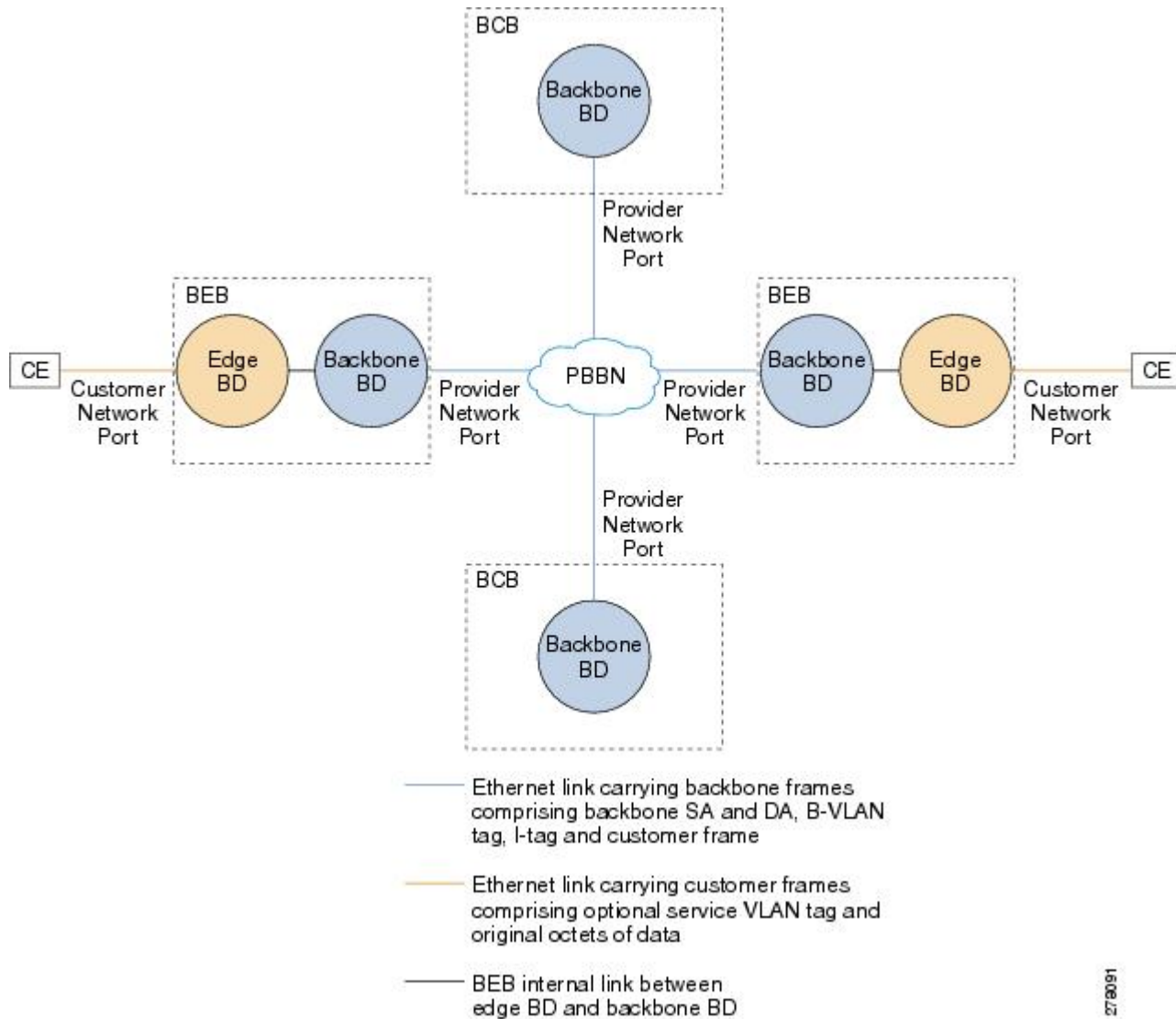
The IEEE 802.1ah Provider Backbone Bridge feature encapsulates or decapsulates end-user traffic on a Backbone Edge Bridge (BEB) at the edge of the Provider Backbone Bridged Network (PBBN). A Backbone Core Bridge (BCB) based network provides internal transport of the IEEE 802.1ah encapsulated frames within the PBBN. The following figure shows a typical 802.1ah PBB network.

**Figure 1: IEEE 802.1ah Provider Backbone Bridge**



The following figure shows a typical provider backbone network topology.

Figure 2: Provider Backbone Network Topology



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## Backbone Edge Bridges

Backbone edge bridges (BEBs) can contain either an I-Component or a B-Component. The I-Component maps service VLAN identifiers (S-VIDs) to service instance identifiers (I-SIDs) and adds a provider backbone bridge (PBB) header without a backbone VLAN tag (B-Tag). The B-Component maps I-SIDs to backbone VLANs (B-VLANs) and adds a PBB header with a B-Tag.

The IEEE 802.1ah standard specifies these three types of BEBs:

- The B-BEB contains the B-Component of the MAC-in-MAC bridge. It validates the I-SIDs and maps the frames onto the backbone VLAN (B-VLAN). It also switches traffic based on the B-VLANs within the core bridge.

- The I-BEB contains the I-Component of the MAC-in-MAC bridge. It performs B-MAC encapsulation and inserts the I-SIDs based on the provider VLAN tags (S-tags), customer VLAN tags (C-tags), or S-tag/C-tag pairs.
- The IB-BEB contains one or more I-Components and a single B-Component interconnected through a LAN segment.

**Note**

Only IB-BEBs are supported on Cisco ASR 9000 Series Routers. Cisco IOS XR supports IB-BEB bridge type at the Edge node.

## IB-BEB

The IB-BEB contains both the I-Component and the B-Component. The bridge selects the B-MAC and inserts the I-SID based on the provider VLAN tag (S-tag), the customer VLAN tag (C-tag), or both the S-tag and the C-tag. It validates the I-SIDs and it transmits and receives frames on the B-VLAN.

The IEEE 802.1ah on Provider Backbone Bridges feature supports all services mandated by the IEEE 802.1ah standard and extends the services to provides these additional functionalities:

- S-Tagged Service:
  - In multiplexed environments each S-tag maps to an I-SID and may be retained or removed.
  - In bundled environments multiple S-tags map to the same I-SID and the S-tags must be retained.
- C-Tagged Service:
  - In multiplexed environments each C-tag maps to an I-SID and may be retained or removed.
  - In bundled environments multiple C-tags map to the same I-SID and the C-tags must be retained.
- S/C-Tagged Service:
  - In multiplexed environments each S-tag/C-tag pair maps to an I-SID. The S-tag or the S-tag/C-tag pair may be retained or removed.
  - In bundled environments multiple S-tag/C-tags pairs map to the same I-SID and the S-tag/C-tag pair must be retained.
- Port-based Service
  - A port-based service interface is delivered on a Customer Network Port (CNP). A port-based service interface may attach to a C-VLAN Bridge, 802.1d bridge, router or end-station. The service provided by this interface forwards all frames without an S-Tag over the backbone on a single backbone service instance. A port-based interface discards all frames with an S-Tag that have non-null VLAN IDs.

This example shows how to configure a port-based service:

```
interface GigabitEthernet0/0/0/10.100 l2transport
encapsulation untagged
```

--> Creates an EFP for untagged frames.

```
interface GigabitEthernet0/0/0/10.101 l2transport
encapsulation dot1ad priority-tagged
```

--> Creates an EFP for null S-tagged frames.

```
interface GigabitEthernet0/0/0/10.102 l2transport
encapsulation dot1q priority-tagged
```

--> Creates an EFP for null C-tagged frames:

```
interface GigabitEthernet0/0/0/10.103 l2transport
encapsulation dot1q any
```

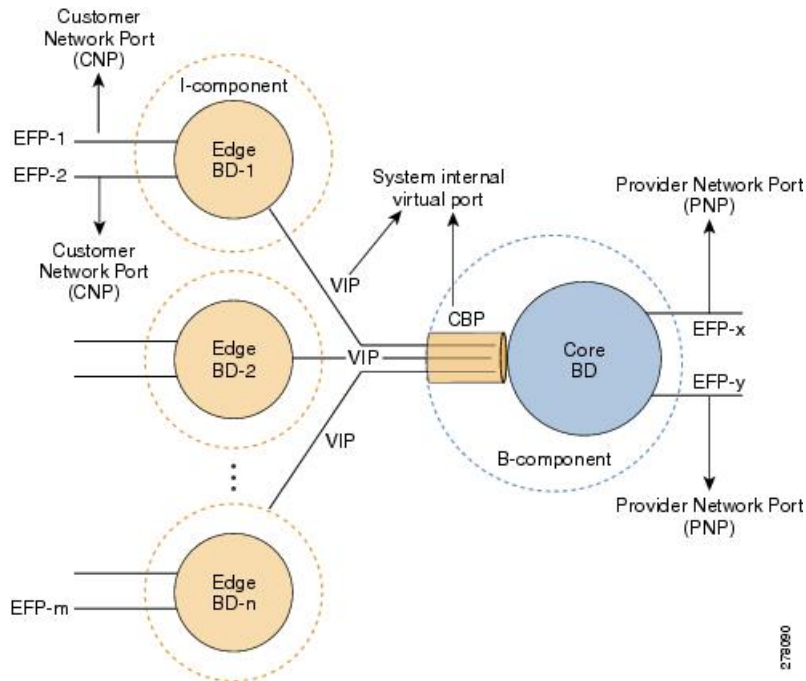
--> Creates an EFP for C-tagged frames:



**Note** To configure a port-based service, all the above EFPs must be added to the same edge bridge domain.

The following figure shows the PBB bridge component topology on the Cisco ASR 9000 Series Routers.

**Figure 3: PBB Bridge Component Topology on Cisco ASR 9000 Series Routers**



## Multiple I-SID Registration Protocol Lite

The 802.1Qbe—Multiple I-SID Registration Protocol (MIRP) standard provides the ability to flush learned MAC address registration entries held in the filtering database of an I-component on a per I-SID basis. The backbone service instance identifier (I-SID) is a field in the backbone service instance tag which identifies the backbone service instance of a frame. MIRP defines mechanisms for I-SID flushing, and has the required capabilities to handle topology changes that occur in networks attached to a provider backbone bridged

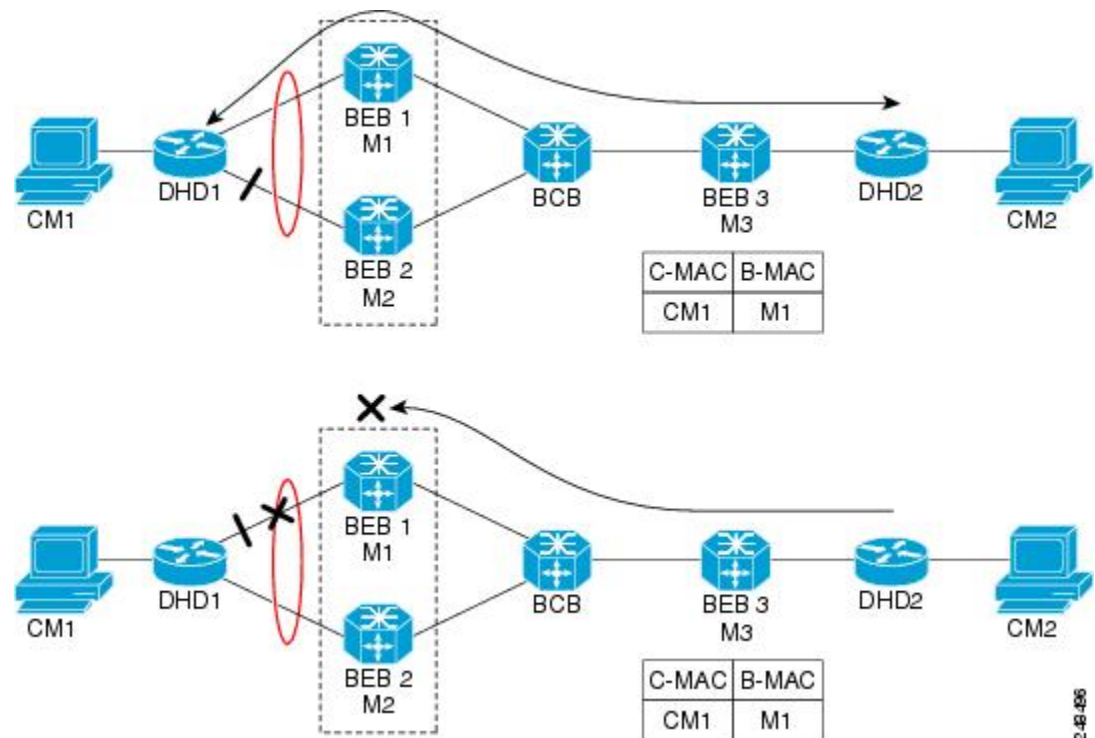
network. A backbone edge bridge (BEB) signals to other potentially affected BEBs, the need to alter certain learned associations between customer MAC addresses and backbone MAC addresses. In the absence of MIRP, customer connections across a provider backbone network can take several minutes to restore connectivity after a topology change in an access network.

In prior releases, PBB traffic was dropped for a MAC aging cycle when bridge forwarding topology changes occurred (due to unavailable ports or spanning tree topology changes) in a PBB edge bridge domain. This resulted in severe limitations for the use of PBB bridges.

Cisco ASR 9000 Series Aggregation Services Routers now support a simplified implementation of the MIRP protocol known as the Multiple I-SID Registration Protocol Lite (MIRP-Lite). The MIRP-Lite feature enables detection of a topology change at a site. A specially defined packet is flooded to all remote edge sites of the PBB network when a site detects a topology change. At the sender site, I-SID of the I-component is placed in the I-TAG of the frame header to specify the I-SID that needs a MAC flush. At the receiver site, each PBB edge switch performs I-SID checking. If the I-SID matches one of the I-components, the MAC in the I-component is flushed.

The use of MIRP in 802.1ah networks is illustrated in the following figure.

**Figure 4: MIRP in 802.1ah Networks**



Device DHD1 is dual-homed to two 802.1ah backbone edge bridges (BEB1 and BEB2). Assume that initially the primary path is through BEB1. In this configuration BEB3 learns that the host behind DHD1 (with MAC address CM1) is reachable via the destination B-MAC M1. If the link between DHD1 and BEB1 fails and the host behind DHD1 remains inactive, the MAC cache tables on BEB3 still refer to the BEB1 MAC address even though the new path is now via BEB2 with B-MAC address M2. Any bridged traffic destined from the host behind DHD2 to the host behind DHD1 is wrongly encapsulated with B-MAC M1 and sent over the MAC tunnel to BEB1, where the traffic drops.

To circumvent the dropping of traffic when the link between DHD1 and BEB1 fails, BEB2 performs two tasks:

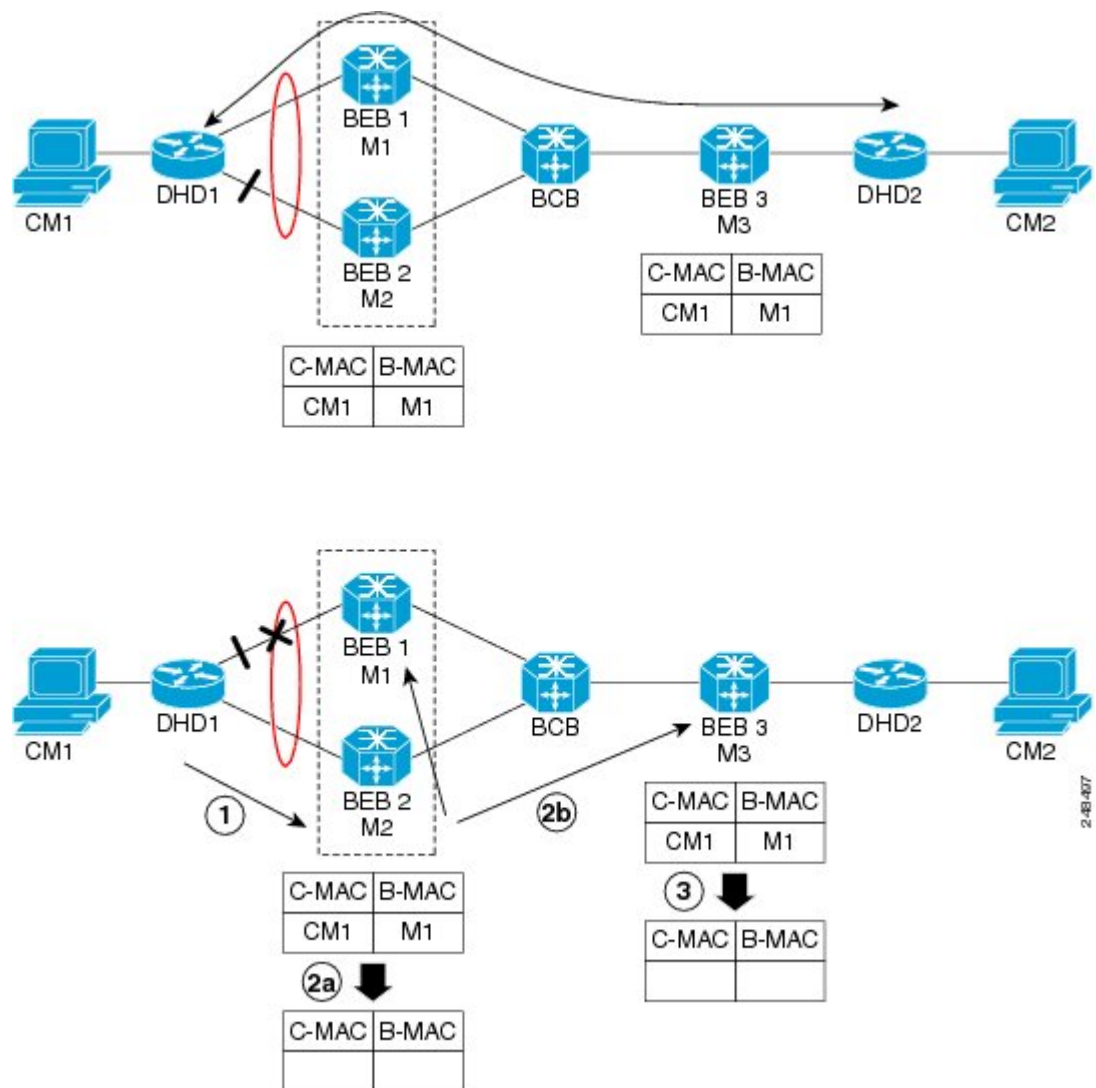
- Flushes its own MAC address table for the service or services.
- Requests the remote PE that receives the MIRP packet to clear its own MAC table. The MIRP message is transparent to the backbone core bridges (BCBs). The MIRP message is processed on a BEB because only BCBs learn and forward, based on B-MAC addresses and they are transparent to C-MAC addresses.



**Note** MIRP triggers C-MAC address flushing for both native 802.1ah and PBB over VPLS.

The following figure shows the operation of the MIRP.

**Figure 5: MIRP Operation**





## Provider Backbone Bridging Ethernet VPN

The Provider Backbone Bridging Ethernet VPN (PBB-EVPN) is a next generation L2VPN solution that addresses resiliency and forwarding policy requirements. This feature also introduces advanced multihoming options, support for multipath and user-defined BGP policy capabilities to Ethernet L2VPNs. PBB-EVPN uses BGP for MAC address distribution and learning over the packet-switched network (PSN). PBB-EVPN is a combination of the capabilities of PBB and Ethernet VPN that addresses these Carrier Ethernet and data center interconnect requirements:

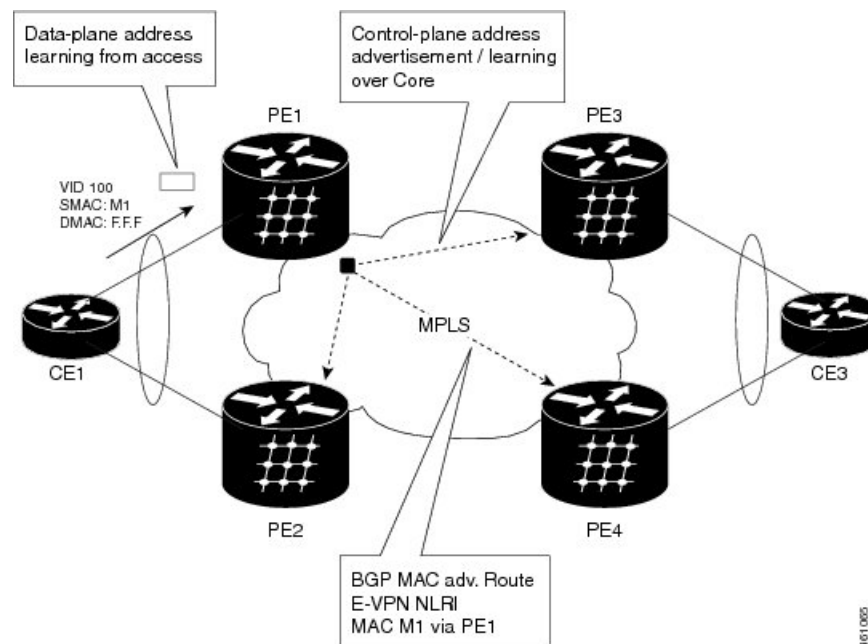
- All-active Redundancy and Load Balancing
- Simplified Provisioning and Operation
- Optimal Forwarding
- Fast Convergence
- MAC Address Scalability

## Ethernet VPN

Ethernet Virtual Private Network (EVPN) is a solution for secure and private connectivity of multiple sites within an organization. The EVPN service extends the benefits of Ethernet technology to the Wide Area Network (WAN). This service is delivered over MPLS networks.

EVPN allows you to manage routing over a virtual private network, providing complete control and security. EVPN introduces a solution for multipoint L2VPN services, with advanced multi-homing capabilities, using BGP for distributing customer or client MAC address reachability information over the MPLS/IP network. EVPN advertises each customer MAC address as BGP routes, therefore allowing BGP policy control over MAC addresses.

**Figure 6: MAC Distribution in BGP (EVPN)**



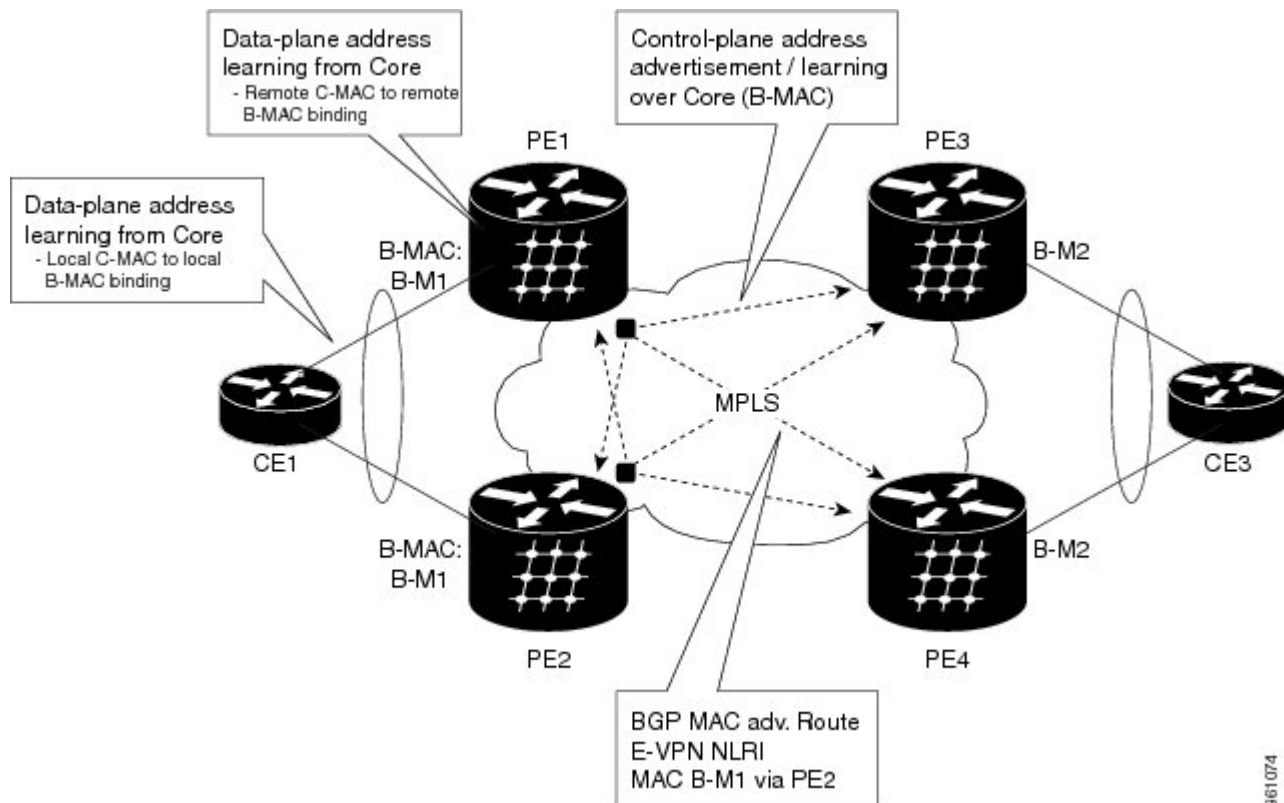
In the above figure, the provider edge (PE) routers run multi-protocol BGP to advertise and learn MAC addresses over MPLS. The customer MAC addresses are learnt in the data plane over attachment circuits

(links connecting customer devices to the PEs). Then, the MAC addresses are distributed over MPLS using BGP with an MPLS label identifying the EVPN instance.

## PBB-EVPN Overview

The PBB-EVPN solution combines Ethernet Provider Backbone Bridging (PBB - IEEE 802.1ah) with Ethernet VPN where, PEs perform as PBB Backbone Edge Bridge (BEB). The PEs receive 802.1Q Ethernet frames from their attachment circuits. These frames are encapsulated in the PBB header and forwarded over the IP/MPLS core. On the egress side (EVPN PE), the PBB header is removed after MPLS disposition, and the original 802.1Q Ethernet frame is delivered to the customer equipment.

**Figure 7: PBB-EVPN Network**



The PE routers perform these functions:

- Learns customer or client MAC addresses (C-MACs) over the attachment circuits in the data-plane, per normal bridge operation.
- Learns remote C-MAC to backbone MAC (B-MAC) bindings in the data-plane from traffic ingress from the core.
- Advertises local B-MAC address reachability information in BGP to all other PE nodes in the same set of service instances. Note that every PE has a set of local B-MAC addresses that uniquely identify the device.
- Builds a forwarding table from the received remote BGP advertisements, associating remote B-MAC addresses with remote PE IP addresses.

PBB-EVPN scales well for large network with millions of customer MAC addresses by constraining customer MAC address in access. Only B-MAC addresses are advertised in core, making the number of BGP routes exchanged manageable.

For PBB EVPN, the B-MAC flush is per B-MAC per Ethernet VPN Instance (EVI).

### EVPN Instance

E-VPN Instance (EVI) identifies a VPN in the MPLS/IP network. There can only be one EVI per core bridge.

### Ethernet Segment

Ethernet Segment is a site connected to one or more PEs. The Ethernet Segment could be a single device (i.e. Customer Edge (CE)) or an entire network, such as:

- Single-Homed Device (SHD)
- Multi-Homed Device (MHD) using Ethernet Multi-chassis Link Aggregation Group
- Single-Homed Network (SHN)
- Multi-Homed Network (MHN)

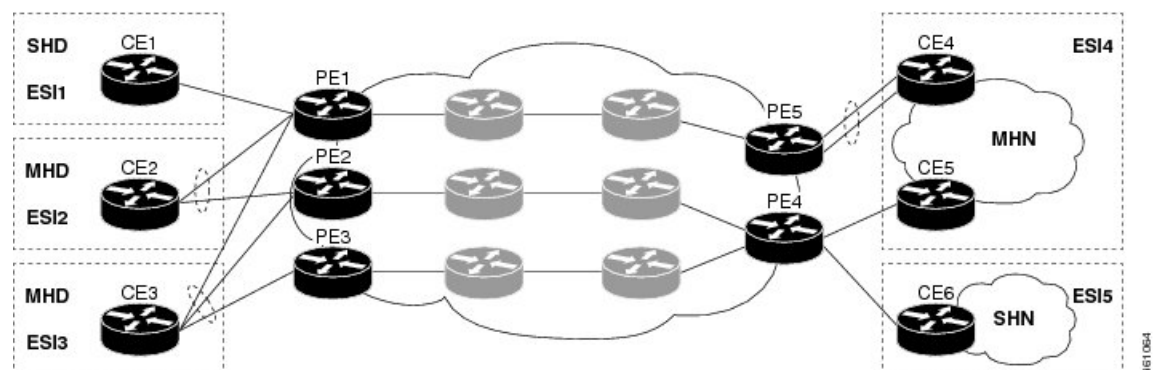
The Ethernet segment is uniquely identified by a 10-byte global Ethernet Segment Identifier (ESI).

The ESI format is RFC 7432 compliant. The ESI value depends on the ESI type. Currently, only ESI type 0 and 1 are supported. The following table shows the ESI format based on the ESI type.

ESI Type	Explanation	ESI Format
Type 0	Arbitrary ESI value based on configuration	1 octet ESI Type 0x00 9 octet ESI value
Type 1	Auto-generated ESI value based on LACP	1 octet ESI Type 0x01 6 octet CE LACP MAC address 2 octet CE LACP Port Key 1 octet value of 0x00

The following figure illustrates an example of Ethernet segment and ESI.

**Figure 8: Ethernet Segment**



### PBB-EVPN BGP Routes

PBB-EVPN defines a single new BGP network layer reachability information (NLRI) used to advertise different types of routes along with new attributes.

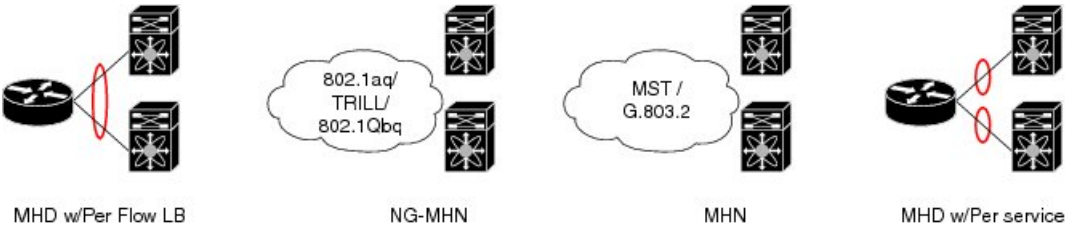
### Designated Forwarder Election

The Designated Forwarder (DF) election mechanism is used to determine a designated forwarder in dual-homed or multi-homed devices or networks. The election is performed on a per service basis. The DF filtering function for MHN differs from that for MHD in:

- **Directionality**—DF filtering for MHN is applied for traffic both ingress and egress on the access-facing Ethernet interfaces; whereas, DF filtering for MHD is applied only to traffic that egress the access-facing interfaces.
- **Traffic Type**—DF filtering for MHN impacts both unicast as well as flooded multi-destination traffic; whereas, DF filtering for MHD only applies to flooded multi-destination traffic.

The following figure shows the various DF filtering rules for MHN and MHD.

Figure 9: DF Filtering Comparison for MHN/MHD



Scenario	MHD w/Per Flow LB	MHN (always treated as SHN)	MHD w/Per service LB
Filtering Direction (on AC)	Egress	Egress Ingress	Egress Ingress
Filtered Traffic	Multicast	Multicast Unicast	Multicast Unicast
Granularity	EFP	EFP	EFP

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### Access Auto-Sensing

PEs connected to a multi-homed or dual-homed device may support active-active per flow also known as flow-based load balancing. PE services CEs via physical or bundle ports. An Ethernet segment identifier is assigned per port. This value is calculated from the connected CE using information such as, CE system priority, CE system ID and CE port key. The PE must auto-detect the access topology to determine the type of load balancing. The load balancing could be active-active per flow load-balancing, per service load-balancing or simply no load balancing.

## MMRP for PBB VPLS Flood Optimization

In a PBB network, traffic (unknown unicast, multicast, or broadcast) is flooded to all the PE devices in the network even if the devices do not host the service instance to which the traffic is destined.

The Multiple MAC Registration Protocol (MMRP) for PBB VPLS Flood Optimization feature optimizes the impact of the flooded traffic on PE devices by sending the traffic only to the PE devices interested in a particular service instance.

In a PBB over VPLS network, traffic between the PE devices flows over MPLS pseudo-wires that connect all the PE devices in a full mesh network topology.

Provider Back Bone Network Topology figure illustrates a typical 802.1ah PBB network.

For every I-SID (Service Instance VLAN ID) there is a corresponding multicast MAC address called the group B-MAC address, which is derived based on the I-SID. The group B-MAC address is used as the destination address in the outer MAC header when propagating flooded traffic across the provider backbone.

The MMRP is used by the PE devices to inform each other about the set of group B-MAC addresses corresponding to the I-SIDs of the service instances they host. This enables each device to determine which set of pseudo-wires flooded traffic should be forwarded on, that is, those pseudo-wires on which an MMRP registration has been received for the group B-MAC address corresponding to the I-SID.



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**Note** The PBB-VPLS flood optimization feature is enabled only on PBB-VPLS network and not on PBB over Ethernet network.

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## Configuring PBB-VPLS Flood Optimization

To configure the PBB-VPLS flood optimization feature, do the following:

### Enabling PBB-VPLS Flood Optimization on PBB Core Bridge

Perform this task to enable PBB-VPLS flood optimization on PBB core bridge.

#### SUMMARY STEPS

1. **configure**
2. **l2vpn**
3. **bridge group** *bridge-group-name*
4. **bridge-domain** *domain-name*
5. **pbb core**
6. **mmrp-flood-optimization**
7. Use the **commit** or **end** command.

## DETAILED STEPS

### Procedure

#### Step 1 **configure**

##### Example:

```
RP/0/RSP0/CPU0:router# configure
```

Enters Global Configuration mode.

#### Step 2 **l2vpn**

##### Example:

```
RP/0/RSP0/CPU0:router(config)# l2vpn
```

Enters L2VPN configuration mode.

#### Step 3 **bridge group** *bridge-group-name*

##### Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn)# bridge group pbb
```

Enters configuration mode for the named bridge group. This command creates a new bridge group or modifies the existing bridge group if it already exists. A bridge group organizes bridge domains.

#### Step 4 **bridge-domain** *domain-name*

##### Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg)# bridge-domain pbb-core
```

Enters configuration mode for the named bridge domain. This command creates a new bridge domain or modifies the existing bridge domain if it already exists.

#### Step 5 **pbb core**

##### Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd)# pbb core
```

Configures the bridge domain as PBB core and enters the PBB core configuration submode.

This command also creates an internal port known as Customer bridge port (CBP).

All the interfaces (bridge ports) under this bridge domain are treated as the provider network ports (PNP).

#### Step 6 **mrrp-flood-optimization**

##### Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd-pbb-core)# mmrp-flood-optimization
```

Enables the flood optimization for PBB over VPLS feature on the core bridge.

**Step 7** Use the **commit** or **end** command.

**commit** - Saves the configuration changes and remains within the configuration session.

**end** - Prompts user to take one of these actions:

- **Yes** - Saves configuration changes and exits the configuration session.
- **No** - Exits the configuration session without committing the configuration changes.
- **Cancel** - Remains in the configuration mode, without committing the configuration changes.

## Configuring Generic MRP Protocol Parameters

Perform this task to configure the generic MRP protocol parameters for PBB-VPLS flood optimization.

### SUMMARY STEPS

1. **configure**
2. **mmrp-flood-optimization**
3. (Optional) **periodic transmit interval** *seconds*
4. (Optional) **join-time** *milliseconds*
5. (Optional) **leaveall-time** *seconds*
6. (Optional) **leave-time** *seconds*
7. (Optional) **flood-time** *seconds*
8. Use the **commit** or **end** command.

### DETAILED STEPS

#### Procedure

**Step 1** **configure**

**Example:**

```
RP/0/RSP0/CPU0:router# configure
```

Enters the Global Configuration mode.

**Step 2** **mmrp-flood-optimization**

**Example:**

```
RP/0/RSP0/CPU0:router(config)# mmrp-flood-optimization
```

Enables the flood optimization for PBB over VPLS feature on the core bridge.

**Step 3** (Optional) **periodic transmit interval** *seconds***Example:**

```
RP/0/RSP0/CPU0:router(config-mmnp-flood-opt)# periodic transmit interval 3
```

Enables periodic Multiple MAC Registration Protocol Data Units (MMRPDUs).

**Step 4** (Optional) **join-time** *milliseconds***Example:**

```
RP/0/RSP0/CPU0:router(config-mmnp-flood-opt)# join time interval 300
```

Sets the join time for all active ports.

**Step 5** (Optional) **leaveall-time** *seconds***Example:**

```
RP/0/RSP0/CPU0:router(config-mmnp-flood-opt)# leaveall-time 10
```

Sets the leave all time for all active ports.

**Step 6** (Optional) **leave-time** *seconds***Example:**

```
RP/0/RSP0/CPU0:router(config-mmnp-flood-opt)# leave-time 40
```

Sets the leave time for all active ports.

**Step 7** (Optional) **flood-time** *seconds***Example:**

```
RP/0/RSP0/CPU0:router(config-mmnp-flood-opt)# flood-time 1000
```

Enables flooding of traffic to the entire core bridge when the PBB-VPLS Flood Optimization feature is enabled on the core bridge.

**Step 8** Use the **commit** or **end** command.

**commit** - Saves the configuration changes and remains within the configuration session.

**end** - Prompts user to take one of these actions:

- **Yes** - Saves configuration changes and exits the configuration session.
- **No** - Exits the configuration session without committing the configuration changes.
- **Cancel** - Remains in the configuration mode, without committing the configuration changes.



# How to Implement 802.1ah Provider Backbone Bridge

This section contains these procedures:

## Restrictions for Implementing 802.1ah Provider Backbone Bridge

The following features are not supported:

- Cross-connect based point to point services over MAC-in-MAC
- One Edge bridge to multiple Core bridge mapping
- I type backbone edge bridge (I-BEB) and B type backbone edge bridge (B-BEB)
- IEEE 802.1ah over VPLS
- Multiple source B-MAC addresses per chassis
- Direct encapsulation of 802.1ah formatted packets natively over an MPLS LSP encapsulation
- To use the sub-interface configurations **encapsulation dot1ad** (or **encapsulation dot1q**) and **encapsulation dot1ad second-dot1q any** (or **encapsulation dot1q second-dot1q any**) together on the same physical interface, use the **exact** keyword as shown below. Else, it results in traffic loss.

```
Router(config)# interface hundredGigE 0/0/0/0.0
Router(config-subif)# encapsulation dot1ad 200 exact

Router(config)# interface hundredGigE 0/0/0/0.1
Router(config-subif)# encapsulation dot1ad 200 dot1q any
Router(config-subif)# commit
```

The following additional restriction applies when implementing Provider Backbone Bridge Ethernet VPN (PBB-EVPN):

- The Provider Edge and Route Reflector routers must run software supporting the same IETF draft version of L2VPN Ethernet VPN (EVPN). Due to the differences in BGP Network Layer Reachability Information (NLRI) encoding, later draft versions are not backward compatible with earlier ones. The following table shows the supported draft for various Cisco IOS XR software releases.

Cisco IOS XR software release	Supported L2VPN EVPN draft version	
	draft-ietf-l2vpn-evpn-04	draft-ietf-l2vpn-evpn-06
5.1.1 and older releases	✓	—
5.2.0	✓	—
5.1.2 and later releases except 5.2.0	—	✓

## Configuring Ethernet Flow Points on CNP and PNP Ports

Perform this task to configure an Ethernet flow point (EFP) on the customer network port (CNP) or the provider network port (PNP).

### SUMMARY STEPS

1. **configure**

2. **interface** *type interface-path-id.subinterface* **l2transport**
3. **encapsulation dot1q** *vlan-id* or **encapsulation dot1ad** *vlan-id* or **encapsulation dot1ad** *vlan-id* **dot1q** *vlan-id*
4. Use the **commit** or **end** command.

## DETAILED STEPS

### Procedure

#### Step 1 **configure**

##### Example:

```
RP/0/RSP0/CPU0:router# configure
```

Enters the Global Configuration mode.

#### Step 2 **interface** *type interface-path-id.subinterface* **l2transport**

##### Example:

```
RP/0/RSP0/CPU0:router(config)# interface
GigabitEthernet0/0/0/10.100 l2transport
```

Configures an interface for L2 switching.

#### Step 3 **encapsulation dot1q** *vlan-id* or **encapsulation dot1ad** *vlan-id* or **encapsulation dot1ad** *vlan-id* **dot1q** *vlan-id*

##### Example:

```
RP/0/RSP0/CPU0:router(config-subif)# encapsulation dot1q 100
or
encapsulation dot1ad 100
or
encapsulation dot1ad 100 dot1q 101
```

Assigns the matching VLAN ID and Ethertype to the interface

#### Step 4 Use the **commit** or **end** command.

**commit** - Saves the configuration changes and remains within the configuration session.

**end** - Prompts user to take one of these actions:

- **Yes** - Saves configuration changes and exits the configuration session.
- **No** - Exits the configuration session without committing the configuration changes.
- **Cancel** - Remains in the configuration mode, without committing the configuration changes.

## Configuring PBB Edge Bridge Domain and Service Instance ID

Perform this task to configure a PBB edge domain and the service ID.



**Note** To configure the PBB feature, login with admin user privileges and issue the **hw-module profile feature l2** command to select an ASR 9000 Ethernet line card ucode version that supports the PBB feature. The PBB feature will not be supported on the ASR 9000 Ethernet line card unless you make this configuration. For more information on configuring the feature profile, refer to the *Cisco ASR 9000 Series Aggregation Services Router System Management Configuration Guide*.

### SUMMARY STEPS

1. **configure**
2. **l2vpn**
3. **bridge group** *bridge-group-name*
4. **bridge-domain** *domain-name*
5. **interface** *type interface-path-id.subinterface*
6. **pbb edge i-sid** *service-id* **core-bridge** *core-bridge-name*
7. Use the **commit** or **end** command.

### DETAILED STEPS

#### Procedure

##### Step 1 **configure**

###### Example:

```
RP/0/RSP0/CPU0:router# configure
```

Enters the Global Configuration mode.

##### Step 2 **l2vpn**

###### Example:

```
RP/0/RSP0/CPU0:router(config)# l2vpn
```

Enters L2VPN configuration mode.

##### Step 3 **bridge group** *bridge-group-name*

###### Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn)# bridge group pbb
```

Enters configuration mode for the named bridge group. This command creates a new bridge group or modifies the existing bridge group if it already exists. A bridge group organizes bridge domains.

**Step 4**     **bridge-domain** *domain-name*

Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg)# bridge-domain pbb-edge
```

Enters configuration mode for the named bridge domain. This command creates a new bridge domain or modifies the existing bridge domain, if it already exists.

**Step 5**     **interface** *type interface-path-id.subinterface*

Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd)# interface GigabitEthernet0/5/0/0.20
```

Assigns the matching VLAN ID and Ethertype to the interface. This EFP is considered as the CNP for the Edge bridge.

**Step 6**     **pbb edge i-sid** *service-id* **core-bridge** *core-bridge-name*

Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd)# pbb edge i-sid 1000 core-bridge pbb-core
```

Configures the bridge domain as PBB edge with the service identifier and the assigned core bridge domain, and enters the PBB edge configuration submode.

This command also creates the Virtual instance port (VIP) that associates the PBB Edge bridge domain to the specified Core bridge domain.

All the interfaces (bridge ports) under this bridge domain are treated as the customer network ports (CNP).

**Step 7**     Use the **commit** or **end** command.

**commit** - Saves the configuration changes and remains within the configuration session.

**end** - Prompts user to take one of these actions:

- **Yes** - Saves configuration changes and exits the configuration session.
- **No** - Exits the configuration session without committing the configuration changes.
- **Cancel** - Remains in the configuration mode, without committing the configuration changes.

## Configuring the PBB Core Bridge Domain

Perform this task to configure the PBB core bridge domain.

### SUMMARY STEPS

1. **configure**
2. **l2vpn**
3. **bridge group** *group-name*
4. **bridge-domain** *domain-name*
5. **interface** *type interface-path-id.subinterface*

6. **pbb core**
7. Use the **commit** or **end** command.

## DETAILED STEPS

### Procedure

---

**Step 1**     **configure****Example:**

```
RP/0/RSP0/CPU0:router# configure
```

Enters Global Configuration mode.

**Step 2**     **l2vpn****Example:**

```
RP/0/RSP0/CPU0:router(config)# l2vpn
```

Enters L2VPN configuration mode.

**Step 3**     **bridge group** *group-name***Example:**

```
RP/0/RSP0/CPU0:router(config-l2vpn)# bridge group pbb
```

Enters configuration mode for the named bridge group. This command creates a new bridge group or modifies the existing bridge group, if it already exists. A bridge group organizes bridge domains.

**Step 4**     **bridge-domain** *domain-name***Example:**

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg)# bridge-domain pbb-core
```

Enters configuration mode for the named bridge domain. This command creates a new bridge domain or modifies the existing bridge domain if it already exists.

**Step 5**     **interface** *type interface-path-id.subinterface***Example:**

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd)# interface GigabitEthernet0/5/0/0.20
```

Assigns the matching VLAN ID and Ethertype to the interface.

**Step 6**     **pbb core****Example:**

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd)# pbb core
```

Configures the bridge domain as PBB core and enters the PBB core configuration submode.

This command also creates an internal port known as Customer bridge port (CBP).

All the interfaces (bridge ports) under this bridge domain are treated as the provider network ports (PNP).

**Step 7** Use the **commit** or **end** command.

**commit** - Saves the configuration changes and remains within the configuration session.

**end** - Prompts user to take one of these actions:

- **Yes** - Saves configuration changes and exits the configuration session.
- **No** - Exits the configuration session without committing the configuration changes.
- **Cancel** - Remains in the configuration mode, without committing the configuration changes.

## Configuring Backbone VLAN Tag under the PBB Core Bridge Domain

Perform this task to configure the backbone VLAN tag under the PBB core bridge domain.

### SUMMARY STEPS

1. **configure**
2. **l2vpn**
3. **bridge group** *bridge-group-name*
4. **bridge-domain** *domain-name*
5. **interface** *type interface-path-id.subinterface*
6. **interface** *type interface-path-id. subinterface*
7. **pbb core**
8. **rewrite ingress tag push dot1ad** *vlan-id symmetric*
9. Use the **commit** or **end** command.

### DETAILED STEPS

#### Procedure

**Step 1** **configure**

**Example:**

```
RP/0/RSP0/CPU0:router# configure
```

Enters the Global Configuration mode.

**Step 2** **l2vpn**

**Example:**

```
RP/0/RSP0/CPU0:router(config)# l2vpn
```

Enters L2VPN configuration mode.

**Step 3** **bridge group** *bridge-group-name*

Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn)# bridge group pbb
```

Enters configuration mode for the named bridge group. This command creates a new bridge group or modifies the existing bridge group if it already exists. A bridge group organizes bridge domains.

**Step 4** **bridge-domain** *domain-name*

Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg)# bridge-domain pbb-core
```

Enters configuration mode for the named bridge domain. This command creates a new bridge domain or modifies the existing bridge domain if it already exists.

**Step 5** **interface** *type interface-path-id.subinterface*

Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd)# interface GigabitEthernet0/5/0/0.20
```

Assigns the matching VLAN ID and Ethertype to the interface.

**Step 6** **interface** *type interface-path-id. subinterface*

Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd-ac)# interface GigabitEthernet0/5/0/1.15
```

Adds an interface to a bridge domain that allows packets to be forwarded and received from other interfaces that are part of the same bridge domain. The interface now becomes an attachment circuit on this bridge domain.

**Step 7** **pbb core**

Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd)# pbb core
```

Configures the bridge domain as PBB core and enters the PBB core configuration submode.

This command also creates an internal port known as Customer bridge port (CBP).

All the interfaces (bridge ports) under this bridge domain are treated as the provider network ports (PNP).

**Step 8** **rewrite ingress tag push dot1ad** *vlan-id symmetric*

Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd-pbb-core)# end
```

Configures the backbone VLAN tag in the Mac-in-MAC frame and also, sets the tag rewriting policy.

**Note**

All PNPs in a Core bridge domain use the same backbone VLAN.

**Step 9** Use the **commit** or **end** command.

**commit** - Saves the configuration changes and remains within the configuration session.

**end** - Prompts user to take one of these actions:

- **Yes** - Saves configuration changes and exits the configuration session.
- **No** - Exits the configuration session without committing the configuration changes.
- **Cancel** - Remains in the configuration mode, without committing the configuration changes.

## Configuring Backbone Source MAC Address

The backbone source MAC address (B-SA) is a unique address for a backbone network. Each Cisco ASR 9000 Series Router has one backbone source MAC address. If B-SA is not configured, then the largest MAC in the EEPROM is used as the PBB B-SA.



**Note**

The backbone source MAC address configuration is optional. If you do not configure the backbone source MAC address, the Cisco ASR 9000 Series Routers allocate a default backbone source MAC address from the chassis backplane MAC pool.

Perform this task to configure the backbone source MAC address.

### SUMMARY STEPS

1. **configure**
2. **l2vpn**
3. **pbb**
4. **backbone-source-address** *mac-address*
5. Use the **commit** or **end** command.

### DETAILED STEPS

#### Procedure

**Step 1** **configure**

**Example:**



```
RP/0/RSP0/CPU0:router# configure
```

Enters the Global Configuration mode.

**Step 2**     **l2vpn**

**Example:**

```
RP/0/RSP0/CPU0:router(config)# l2vpn
```

Enters L2VPN configuration mode.

**Step 3**     **pbb**

**Example:**

```
RP/0/RSP0/CPU0:router(config-l2vpn)# pbb
```

Enters PBB configuration mode.

**Step 4**     **backbone-source-address** *mac-address*

**Example:**

```
RP/0/RSP0/CPU0:router(config-l2vpn-pbb)# backbone-source-address 0045.1200.04
```

Configures the backbone source MAC address.

**Step 5**     Use the **commit** or **end** command.

**commit** - Saves the configuration changes and remains within the configuration session.

**end** - Prompts user to take one of these actions:

- **Yes** - Saves configuration changes and exits the configuration session.
- **No** - Exits the configuration session without committing the configuration changes.
- **Cancel** - Remains in the configuration mode, without committing the configuration changes.

---

## Configuring Unknown Unicast Backbone MAC under PBB Edge Bridge Domain

Perform this task to configure the unknown unicast backbone MAC under the PBB edge bridge domain.

### SUMMARY STEPS

1. **configure**
2. **l2vpn**
3. **bridge group** *bridge-group-name*
4. **bridge-domain** *domain-name*
5. **interface** *type interface-path-id.subinterface*
6. **pbb edge i-sid** *service-id* **core-bridge** *core-bridge-name*

7. **unknown-unicast-bmac** *mac-address*
8. Use the **commit** or **end** command.

## DETAILED STEPS

### Procedure

#### Step 1 **configure**

##### Example:

```
RP/0/RSP0/CPU0:router# configure
```

Enters the Global Configuration mode.

#### Step 2 **l2vpn**

##### Example:

```
RP/0/RSP0/CPU0:router(config)# l2vpn
```

Enters L2VPN configuration mode.

#### Step 3 **bridge group** *bridge-group-name*

##### Example:

```
RRP/0/RSP0/CPU0:router(config-l2vpn)# bridge group pbb
```

Enters configuration mode for the named bridge group. This command creates a new bridge group or modifies the existing bridge group if it already exists. A bridge group organizes bridge domains.

#### Step 4 **bridge-domain** *domain-name*

##### Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg)# bridge-domain pbb-edge
```

Enters configuration mode for the named bridge domain. This command creates a new bridge domain or modifies the existing bridge domain if it already exists.

#### Step 5 **interface** *type interface-path-id.subinterface*

##### Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd)# interface GigabitEthernet0/5/0/0.20
```

Assigns the matching VLAN ID and Ethertype to the interface.

#### Step 6 **pbb edge i-sid** *service-id* **core-bridge** *core-bridge-name*

##### Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd)# pbb edge i-sid 1000 core-bridge pbb-core
```

Configures the bridge domain as PBB edge with the service identifier and the assigned core bridge domain and enters the PBB edge configuration submode.

This command also creates the Virtual instance port (VIP) that associates the PBB Edge bridge domain to the specified Core bridge domain.

All the interfaces (bridge ports) under this bridge domain are treated as the customer network ports (CNP).

### Step 7 **unknown-unicast-bmac** *mac-address*

Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd-pbb-edge)# unknown-unicast-bmac 1.1.1
```

Configures unknown unicast backbone MAC address.

#### Note

On Trident line cards, once you configure the unknown unicast BMAC, the BMAC is used to forward customer traffic with multicast, broadcast and unknown unicast destination MAC address.

### Step 8 Use the **commit** or **end** command.

**commit** - Saves the configuration changes and remains within the configuration session.

**end** - Prompts user to take one of these actions:

- **Yes** - Saves configuration changes and exits the configuration session.
- **No** - Exits the configuration session without committing the configuration changes.
- **Cancel** - Remains in the configuration mode, without committing the configuration changes.

## Configuring Static MAC addresses under PBB Edge Bridge Domain

Perform this task to configure the static MAC addresses under the PBB edge bridge domain.

### SUMMARY STEPS

1. **configure**
2. **l2vpn**
3. **bridge group** *bridge-group-name*
4. **bridge-domain** *domain-name*
5. **interface** *type interface-path-id.subinterface*
6. **interface** *type interface-path-id.subinterface*
7. **pbb edge i-sid** *service-id* **core-bridge** *core-bridge-name*
8. **static-mac-address** *cda-mac-address* **bmac** *bda-mac-address*
9. Use the **commit** or **end** command.

## DETAILED STEPS

### Procedure

#### Step 1 **configure**

##### Example:

```
RP/0/RSP0/CPU0:router# configure
```

Enters the Global Configuration mode.

#### Step 2 **l2vpn**

##### Example:

```
RP/0/RSP0/CPU0:router(config)# l2vpn
```

Enters L2VPN configuration mode.

#### Step 3 **bridge group** *bridge-group-name*

##### Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn)#bridge group pbb
```

Enters configuration mode for the named bridge group. This command creates a new bridge group or modifies the existing bridge group if it already exists. A bridge group organizes bridge domains.

#### Step 4 **bridge-domain** *domain-name*

##### Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg)#bridge-domain pbb-edge
```

Enters configuration mode for the named bridge domain. This command creates a new bridge domain or modifies the existing bridge domain if it already exists.

#### Step 5 **interface** *type interface-path-id.subinterface*

##### Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd)#interface GigabitEthernet0/5/0/0.20
```

Assigns the matching VLAN ID and Ethertype to the interface.

#### Step 6 **interface** *type interface-path-id.subinterface*

##### Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd-ac)#interface GigabitEthernet0/5/0/1.15
```

Adds an interface to a bridge domain that allows packets to be forwarded and received from other interfaces that are part of the same bridge domain. The interface now becomes an attachment circuit on this bridge domain.

**Step 7** **pbb edge i-sid** *service-id* **core-bridge** *core-bridge-name*

Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd)#pbb edge i-sid 1000 core-bridge pbb-core
```

Configures the bridge domain as PBB edge with the service identifier and the assigned core bridge domain and enters the PBB edge configuration submenu.

This command also creates the Virtual instance port (VIP) that associates the PBB Edge bridge domain to the specified Core bridge domain.

All the interfaces (bridge ports) under this bridge domain are treated as the customer network ports (CNP).

**Step 8** **static-mac-address** *cda-mac-address* **bmac** *bda-mac-address*

Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd-pbb-edge)#static-mac-address 0033.3333.3333 bmac 0044.4444.4444
```

Configures the static CMAC to BMAC mapping under the PBB Edge submenu.

**Step 9** Use the **commit** or **end** command.

**commit** - Saves the configuration changes and remains within the configuration session.

**end** - Prompts user to take one of these actions:

- **Yes** - Saves configuration changes and exits the configuration session.
- **No** - Exits the configuration session without committing the configuration changes.
- **Cancel** - Remains in the configuration mode, without committing the configuration changes.

## Configuring PBB VPLS

Perform these tasks to configure PBB VPLS:

### Configuring Access Pseudowire in I-Component

Perform this task to configure the static MAC addresses under the PBB edge bridge domain.

#### SUMMARY STEPS

1. **configure**
2. **l2vpn**
3. **bridge group** *bridge-group-name*
4. **bridge-domain** *domain-name*
5. **mac withdraw state-down**
6. **exit**

7. **interface** *type interface-path-id.subinterface*
8. **interface** *type interface-path-id.subinterface*
9. **neighbor** { *A.B.C.D* } **pw-id** *value*
10. **exit**
11. **pbb edge i-sid** *service-id* **core-bridge** *core-bridge-name*
12. Use the **commit** or **end** command.

## DETAILED STEPS

### Procedure

#### Step 1 **configure**

##### Example:

```
RP/0/RSP0/CPU0:router# configure
```

Enters the Global Configuration mode.

#### Step 2 **l2vpn**

##### Example:

```
RP/0/RSP0/CPU0:router(config)# l2vpn
```

Enters L2VPN configuration mode.

#### Step 3 **bridge group** *bridge-group-name*

##### Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn)# bridge group pbb
```

Enters bridge group configuration mode. This command creates a new bridge group or modifies the existing bridge group if it already exists. A bridge group organizes bridge domains.

#### Step 4 **bridge-domain** *domain-name*

##### Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg)# bridge-domain pbb-edge
```

Enters bridge domain configuration mode. This command creates a new bridge domain or modifies the existing bridge domain if it already exists.

#### Step 5 **mac withdraw state-down**

##### Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd)# mac withdraw state-down
```

(Optional) Enables MAC withdrawal.

#### Step 6 **exit**

Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd-mac) # exit
```

Exits the current configuration mode.

**Step 7** **interface** *type interface-path-id.subinterface*

Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd) # interface GigabitEthernet0/5/0/0.20
```

Assigns the matching VLAN ID and Ethertype to the interface.

**Step 8** **interface** *type interface-path-id.subinterface*

Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd-ac) # interface GigabitEthernet0/5/0/1.15
```

Adds an interface to a bridge domain that allows packets to be forwarded and received from other interfaces that are part of the same bridge domain. The interface now becomes an attachment circuit on this bridge domain.

**Step 9** **neighbor** { *A.B.C.D* } **pw-id** *value*

Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd) # neighbor 10.1.1.2 pw-id 1000
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd-pw) #
```

Adds an access pseudowire port to a bridge domain.

- Use the *A.B.C.D* argument to specify the IP address of the cross-connect peer.

**Note**

*A.B.C.D* can be a recursive or non-recursive prefix.

- Use the **pw-id** keyword to configure the pseudowire ID and ID value. The range is 1 to 4294967295.

**Step 10** **exit**

Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd-pw) # exit
```

Exits the current configuration mode.

**Step 11** **pbb edge i-sid** *service-id core-bridge core-bridge-name*

Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd) # pbb edge i-sid 1000 core-bridge pbb-core
```

Configures the bridge domain as PBB edge with the service identifier and the assigned core bridge domain and enters the PBB edge configuration submode.

All the interfaces (bridge ports) under this bridge domain are treated as the customer network ports (CNP).

**Step 12** Use the **commit** or **end** command.

**commit** - Saves the configuration changes and remains within the configuration session.

**end** - Prompts user to take one of these actions:

- **Yes** - Saves configuration changes and exits the configuration session.
- **No** - Exits the configuration session without committing the configuration changes.
- **Cancel** - Remains in the configuration mode, without committing the configuration changes.

## Configuring Core Pseudowire in B-Component

Perform this task to configure the static MAC addresses under the PBB edge bridge domain.

### SUMMARY STEPS

1. **configure**
2. **l2vpn**
3. **bridge group** *bridge-group-name*
4. **bridge-domain** *domain-name*
5. **vfi** { *vfi-name* }
6. **neighbor** { *A.B.C.D* } { **pw-id** *value* }
7. Use the **commit** or **end** command.

### DETAILED STEPS

#### Procedure

##### Step 1 **configure**

**Example:**

```
RP/0/RSP0/CPU0:router# configure
```

Enters the Global Configuration mode.

##### Step 2 **l2vpn**

**Example:**

```
RP/0/RSP0/CPU0:router(config)# l2vpn
```

Enters L2VPN configuration mode.

##### Step 3 **bridge group** *bridge-group-name*

**Example:**

```
RP/0/RSP0/CPU0:router(config-l2vpn)#bridge group pbb
```



Enters configuration mode for the named bridge group. This command creates a new bridge group or modifies the existing bridge group if it already exists. A bridge group organizes bridge domains.

**Step 4** **bridge-domain** *domain-name*

Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg)#bridge-domain pbb-core
```

Enters configuration mode for the named bridge domain. This command creates a new bridge domain or modifies the existing bridge domain if it already exists.

**Step 5** **vfi** { *vfi-name* }

Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd)# vfi PBB-core-vfi
```

Configures the virtual forwarding interface (VFI) parameters and enters L2VPN bridge group bridge domain VFI configuration mode.

- Use the *vfi-name* argument to configure the name of the specified virtual forwarding interface.

**Step 6** **neighbor** { *A.B.C.D* } { **pw-id** *value* }

Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd)# neighbor 10.1.1.2 pw-id 1000
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd-pw)#
```

Adds an access pseudowire port to a bridge domain or a pseudowire to a bridge virtual forwarding interface (VFI).

- Use the *A.B.C.D* argument to specify the IP address of the cross-connect peer.

**Note**

*A.B.C.D* can be a recursive or non-recursive prefix.

- Use the **pw-id** keyword to configure the pseudowire ID and ID value. The range is 1 to 4294967295.

**Step 7** Use the **commit** or **end** command.

**commit** - Saves the configuration changes and remains within the configuration session.

**end** - Prompts user to take one of these actions:

- **Yes** - Saves configuration changes and exits the configuration session.
- **No** - Exits the configuration session without committing the configuration changes.
- **Cancel** - Remains in the configuration mode, without committing the configuration changes.

## Configuring PBB-EVPN

This section provides information on:

## Configuring PBB Core Bridge Domains

Perform this task to create the PBB Core bridge domain and assign it's corresponding EVPN EVI ID.

### SUMMARY STEPS

1. **configure**
2. **l2vpn**
3. **bridge group** *group\_name*
4. **bridge-domain** *bridge\_domain\_name*
5. **pbb core**
6. **evpn evi** *evi\_id*
7. Use the **commit** or **end** command.

### DETAILED STEPS

#### Procedure

##### Step 1 **configure**

###### Example:

```
RP/0/RSP0/CPU0:router# configure
```

Enters the Global Configuration mode.

##### Step 2 **l2vpn**

###### Example:

```
RP/0/RSP0/CPU0:router(config)# l2vpn
```

Enters L2VPN configuration mode.

##### Step 3 **bridge group** *group\_name*

###### Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn)# bridge group group1
```

Enters bridge group configuration mode. This command creates a new bridge group. A bridge group organizes bridge domains.

##### Step 4 **bridge-domain** *bridge\_domain\_name*

###### Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg)#bridge-domain sample-pbb-core#
```

Enters bridge group domain configuration mode. This command creates a new bridge domain.

**Step 5**     **pbb core**

Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd)# pbb core
```

Configures the bridge domain as PBB core and enters the PBB core configuration submode.

This command also creates an internal port known as Customer bridge port (CBP). All the interfaces (bridge ports) under this bridge domain are treated as the provider network ports (PNP).

**Step 6**     **evpn evi *evi\_id***

Example:

```
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd-pbb-core)# evpn evi 100
```

Enters EVPN configuration mode and configures the Ethernet VPN ID. The EVI ID range is from 1 to 65534.

**Step 7**     Use the **commit** or **end** command.

**commit** - Saves the configuration changes and remains within the configuration session.

**end** - Prompts user to take one of these actions:

- **Yes** - Saves configuration changes and exits the configuration session.
- **No** - Exits the configuration session without committing the configuration changes.
- **Cancel** - Remains in the configuration mode, without committing the configuration changes.

## Configuring PBB Edge Bridge Domains

As a pre-requisite, a PBB-EVPN provider edge (PE) must be configured with PBB Edge Bridge Domains which in one side are associated to ethernet flow points matching traffic from access interfaces and on the other side are linked to PBB Core Bridge Domains for traffic forwarding through the core.

For more information on configuring Edge Bridge Domains, see [Configuring PBB Edge Bridge Domain and Service Instance ID](#).

## Configuring EVPN Ethernet Segment

Explicit configuration of Ethernet Segment parameters such as ESI and service carving behaviors (manual or dynamic) is required only for Dual Homed scenarios with Active/Active per Service load-balancing.



**Note** By default, Dual Homed scenarios with Active/Active per Flow load-balancing auto-sense ESI values from CE's LACP information.



**Note** PBB-EVPN configuration allows to create only 24 ICCP-groups.

Perform this task to configure the EVPN Ethernet segment.

## SUMMARY STEPS

1. **configure**
2. **evpn**
3. **interface type** *interface-path-id*
4. **ethernet-segment**
5. **backbone-source-mac** *mac\_address*
6. **force single-homed**
7. **identifier type** *esi-type esi-identifier*
8. **bgp route-target** *ipv4/v6-address*
9. **load-balancing-mode per-service**
10. **service-carving manual primary** *{isis}* **secondary** *{isis}*
11. Use the **commit** or **end** command.

## DETAILED STEPS

### Procedure

---

#### Step 1 **configure**

##### Example:

```
RP/0/RSP0/CPU0:router# configure
```

Enters the Global Configuration mode.

#### Step 2 **evpn**

##### Example:

```
RP/0/RSP0/CPU0:router(config)# evpn
```

Enters EVPN configuration mode.

#### Step 3 **interface type** *interface-path-id*

##### Example:

```
RP/0/RSP0/CPU0:router(config-evpn)# interface gigabitEthernet 0/1/0/4
```

Enters the physical port interface or the bundle interface configuration mode.

#### Step 4 **ethernet-segment**

##### Example:

```
RP/0/RSP0/CPU0:router(config-evpn-ac)# ethernet-segment
```

Enters the EVPN ethernet-segment configuration mode.

**Step 5** **backbone-source-mac** *mac\_address*

**Example:**

```
RP/0/RSP0/CPU0:router(config-evpn-ac-es)# backbone-source-mac 0045.1200.04
```

Configures the backbone source MAC address.

**Step 6** **force single-homed**

**Example:**

```
RP/0/RSP0/CPU0:router(config-evpn-ac-es)# force single-homed
```

Specifies forced attributes for this Ethernet Segment.

**Step 7** **identifier type** *esi-type esi-identifier*

**Example:**

```
RP/0/RSP0/CPU0:router(config-evpn-ac-es)# identifier type 0 ce.01.ce.01.ce.01.ce.01.01
```

Configures the Ethernet segment identifier (ESI) of an interface.

**Step 8** **bgp route-target** *ipv4/v6-address*

**Example:**

```
RP/0/RSP0/CPU0:router(config-evpn-ac-es)# bgp route-target ce01.ce01.ce01
```

Configures the BGP Import Route-Target for the Ethernet-Segment.

**Note**

This command configuration is mandatory for ESI type 0.

**Step 9** **load-balancing-mode per-service**

**Example:**

```
RP/0/RSP0/CPU0:router(config-evpn-ac-es)# load-balancing-mode per-service
```

Specifies the load balancing mode.

**Step 10** **service-carving manual primary** *{isid}* **secondary** *{isid}*

**Example:**

```
RP/0/RSP0/CPU0:router(config-evpn-ac-es)# service-carving manual primary 100 secondary 200
```

Specifies a list of service identifiers (isid) as active and standby services. The **isid** range is from 256 to 16777216.

**Step 11** Use the **commit** or **end** command.

**commit** - Saves the configuration changes and remains within the configuration session.

**end** - Prompts user to take one of these actions:

- **Yes** - Saves configuration changes and exits the configuration session.
- **No** - Exits the configuration session without committing the configuration changes.
- **Cancel** - Remains in the configuration mode, without committing the configuration changes.

## Configuring BGP Route Target

By default, these parameters are auto-derived from the PE's configuration:

- Route Distinguisher (RD) for global Ethernet Segment table

Default: Auto-generated RD based on loopback IP address

- EVI's BGP Route Distinguisher (RD)

Default: Auto-generated RD based on loopback IP address

- EVI's BGP Route Target. Default: Auto-generated RT based on EVI ID

Perform this task to overwrite the auto-generated BGP RD/RT values.

### SUMMARY STEPS

1. **configure**
2. **evpn**
3. **bgp**
4. **rd** { 2-byte as\_number | 4-byte as\_number | IP\_address | none } : { nn }
5. **exit**
6. **evpn**
7. **evi** evi\_id
8. **bgp**
9. **route-target** [ import | export ] { 2-byte as\_number | 4-byte as\_number | IP\_address | none } : { nn }
10. **rd** { 2-byte as\_number | 4-byte as\_number | IP\_address | none } : { nn }
11. Use the **commit** or **end** command.

### DETAILED STEPS

#### Procedure

##### Step 1 **configure**

##### Example:

```
RP/0/RSP0/CPU0:router# configure
```

Enters the Global Configuration mode.

**Step 2**      **evpn****Example:**

```
RP/0/RSP0/CPU0:router(config)# evpn
```

Enters EVPN configuration mode.

**Step 3**      **bgp****Example:**

```
RP/0/RSP0/CPU0:router(config-evpn)# bgp
```

Enters EVPN BGP configuration mode and configures static BGP settings for the Ethernet Segment ES:GLOBAL EVI, which is used for handling ES routes.

**Step 4**      **rd { 2-byte as\_number | 4-byte as\_number | IP\_address | none } : { nn }****Example:**

```
RP/0/RSP0/CPU0:router(config-evpn-bgp)# rd 200:50
```

Configures the route distinguisher.

**Step 5**      **exit****Example:**

```
RP/0/RSP0/CPU0:router(config-evpn-bgp)# exit
```

Returns to the global configuration mode.

**Step 6**      **evpn****Example:**

```
RP/0/RSP0/CPU0:router(config)# evpn
```

Enters EVPN configuration mode.

**Step 7**      **evi evi\_id****Example:**

```
RP/0/RSP0/CPU0:router(config-evpn)# evi 100
```

Configures Ethernet VPN ID.

The EVI ID range is from 1 to 65534.

**Step 8**      **bgp****Example:**

```
RP/0/RSP0/CPU0:router(config-evpn-evi)# bgp
```

Enters the BGP configuration mode for the specific EVI.

**Step 9** **route-target** [ **import** | **export** ] { *2-byte as\_number* | *4-byte as\_number* | *IP\_address* | **none** } : { *nn* }

**Example:**

```
RP/0/RSP0/CPU0:router(config-evpn-evi-bgp)# route-target 10:20
```

Creates a route-target extended community.

- The **import** keyword imports routing information from the target VPN extended community.
- The **export** keyword exports routing information to the target VPN extended community.

**Step 10** **rd** { *2-byte as\_number* | *4-byte as\_number* | *IP\_address* | **none** } : { *nn* }

**Example:**

```
RP/0/RSP0/CPU0:router(config-evpn-evi-bgp)# rd 25:30
```

Configures the route distinguisher.

**Step 11** Use the **commit** or **end** command.

**commit** - Saves the configuration changes and remains within the configuration session.

**end** - Prompts user to take one of these actions:

- **Yes** - Saves configuration changes and exits the configuration session.
- **No** - Exits the configuration session without committing the configuration changes.
- **Cancel** - Remains in the configuration mode, without committing the configuration changes.

## Configuring Global EVPN Timers

Perform this task to configure global EVPN timers.

### SUMMARY STEPS

1. **configure**
2. **evpn**
3. **timers** [**flushagain** | **peering** | **programming** | **recovery**]
4. Use the **commit** or **end** command.

### DETAILED STEPS

#### Procedure

**Step 1** **configure**



**Example:**

```
RP/0/RSP0/CPU0:router# configure
```

Enters the Global Configuration mode.

**Step 2**    **evpn****Example:**

```
RP/0/RSP0/CPU0:router evpn
```

Enters EVPN configuration mode.

**Step 3**    **timers [flushagain | peering | programming | recovery]****Example:**

```
RP/0/RSP0/CPU0:router(config-evpn)# timers flushagain 40
```

Configures global EVPN timers.

- Flush-again timer (for AApS only): When a MAC flush is sent, usually at the end of the programming timer expiration, a flush-again timer is started for the flush-again timer value. When it expires, another MAC flush message (MVRP or STP-TCN) is sent to the CE. This timer can be configured per segment-interface.

Range: 0 to 120 seconds, 0 means disabled

Default: 60 seconds

- Peering timer: Once all conditions are met to advertise to BGP, the PE waits for the peering timer value before advertising its RT, ESI and, Local MAC if it is Single-Home.

Range: 0 to 300 seconds, 0 means disabled

Default: 45 seconds

- Programming timer: Indicated time required by the HW to apply the carving results. At the end of the programming timer expiration, the next Ethernet Segment route object will be processed.

Range: 0 to 100000 microseconds

Default: 1500 microseconds

- Recovery timer (for AApS only): Once the interface is up, the PE waits for the recovery timer value in order to allow the CE running STP protocol to converge. This timer can be configured per segment-interface.

Range: 20 to 3600 seconds

Default: 20 seconds

**Note**

Changing timers is only useful for scale configurations.

**Step 4**    Use the **commit** or **end** command.

**commit** - Saves the configuration changes and remains within the configuration session.

**end** - Prompts user to take one of these actions:

- **Yes** - Saves configuration changes and exits the configuration session.
- **No** - Exits the configuration session without committing the configuration changes.
- **Cancel** - Remains in the configuration mode, without committing the configuration changes.

## Configuring EVPN Timers Per Ethernet Segment and CE flushing mechanism

Perform this task to configure per Ethernet segment timers.

### SUMMARY STEPS

1. **configure**
2. **evpn**
3. **interface type** *interface-path-id*
4. **ethernet-segment**
5. **mac-flush mvrp**
6. **timers [flushagain | recovery]**
7. Use the **commit** or **end** command.

### DETAILED STEPS

#### Procedure

##### Step 1 **configure**

###### Example:

```
RP/0/RSP0/CPU0:router# configure
```

Enters the Global Configuration mode.

##### Step 2 **evpn**

###### Example:

```
RP/0/RSP0/CPU0:router(config)# evpn
```

Enters EVPN configuration mode.

##### Step 3 **interface type** *interface-path-id*

###### Example:

```
RP/0/RSP0/CPU0:router(config-evpn)# interface gigabitEthernet 0/1/0/4
```

Enters the physical port interface or the bundle interface configuration mode.

##### Step 4 **ethernet-segment**

###### Example:

```
RP/0/RSP0/CPU0:router(config-evpn-ac)# ethernet-segment
```

Enters the EVPN ethernet-segment configuration mode.

#### Step 5 **mac-flush mvrp**

##### Example:

```
RP/0/RSP0/CPU0:router(config-evpn-ac)#
```

Specifies MAC flush mode for this Ethernet Segment.

#### Step 6 **timers [flushagain | recovery]**

##### Example:

```
RP/0/RSP0/CPU0:router(config-evpn-ac)# timers flushagain 40
```

Configures per Ethernet segment timers.

- Flush-again timer (for AApS only): When a MAC flush is sent, usually at the end of the programming timer expiration, a flush-again timer is started for the flush-again timer value. When it expires, another MAC flush message (MVRP or STP-TCN) is sent to the CE. This timer can be configured per segment-interface.

Range: 0 to 120 seconds, 0 means disabled

Default: 60 seconds

- Recovery timer (for AApS only): Once the interface is up, the PE waits for the recovery timer value in order to allow the CE running STP protocol to converge. This timer can be configured per segment-interface.

Range: 20 to 3600 seconds

Default: 20 seconds

##### Note

Changing timers is only useful for scale configurations.

#### Step 7 Use the **commit** or **end** command.

**commit** - Saves the configuration changes and remains within the configuration session.

**end** - Prompts user to take one of these actions:

- **Yes** - Saves configuration changes and exits the configuration session.
- **No** - Exits the configuration session without committing the configuration changes.
- **Cancel** - Remains in the configuration mode, without committing the configuration changes.

## Configuring Multichassis Link Aggregation

Multichassis Link Aggregation (MCLAG) is used in scenarios involving Multi Homed Devices. You must create an ICCP redundancy group in order to specify relevant MLACP parameters, such as, **mlacp system mac**, **mlacp system priority**, **mlacp node id** and backbone interfaces.



##### Note

Even though the redundancy group is created under the **redundancy-iccp-group** sub-mode, the solution does not rely on an actual ICCP session between PEs connected to the same site. The mode singleton command has been introduced to alert ICCP module.

For more information on configuring MCLAG, refer to the Configuring Link Bundling on the Cisco ASR 9000 Series Router module in the *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Configuration Guide*.

## Configuring BGP Routing Process

A prerequisite of PBB-EVPN involves enabling the new EVPN address family under the BGP routing process and under BGP neighbor submode. For more information on BGP, refer to the *Implementing BGP* module in the *Cisco ASR 9000 Series Aggregation Services Router Routing Configuration Guide*.

Perform this task to enable EVPN address family under BGP routing process and BGP neighbor submode.

### SUMMARY STEPS

1. **configure**
2. **router bgp** *asn\_id*
3. **address-family l2vpn evp**
4. **exit**
5. **neighbor** *peer\_ip\_add*
6. **address-family l2vpn evpn**
7. **address-family l2vpn evpn**
8. Use the **commit** or **end** command.

### DETAILED STEPS

#### Procedure

##### Step 1 **configure**

###### Example:

```
RP/0/RSP0/CPU0:router# configure
```

Enters the Global Configuration mode.

##### Step 2 **router bgp** *asn\_id*

###### Example:

```
RP/0/RSP0/CPU0:router(config)# router bgp 100
```

Specifies the BGP AS number and enters the BGP configuration mode, allowing you to configure the BGP routing process.

##### Step 3 **address-family l2vpn evp**

###### Example:

```
RP/0/RSP0/CPU0:router(config-bgp)# address-family l2vpn evpn
```

Enables EVPN address family under BGP routing process and enters EVPN address family configuration submode.

**Step 4** **exit**

**Example:**

```
RP/0/RSP0/CPU0:router(config-bgp)# exit
```

Exits the current configuration mode.

**Step 5** **neighbor *peer\_ip\_add***

**Example:**

```
RP/0/RSP0/CPU0:router(config-bgp)# neighbor 10.1.1.1
```

Places the router in neighbor configuration mode for BGP routing and configures the neighbor IP address as a BGP peer.

**Step 6** **address-family l2vpn evpn**

**Example:**

```
RP/0/RSP0/CPU0:router(config-bgp)# exit
```

Enables EVPN address family under BGP routing process and enters EVPN address family configuration submode.

**Step 7** **address-family l2vpn evpn**

**Example:**

```
RP/0/RSP0/CPU0:router(config-bgp-nbr)# address-family l2vpn evpn
```

Enables EVPN address family under BGP routing process and enters EVPN address family configuration submode.

**Step 8** Use the **commit** or **end** command.

**commit** - Saves the configuration changes and remains within the configuration session.

**end** - Prompts user to take one of these actions:

- **Yes** - Saves configuration changes and exits the configuration session.
- **No** - Exits the configuration session without committing the configuration changes.
- **Cancel** - Remains in the configuration mode, without committing the configuration changes.

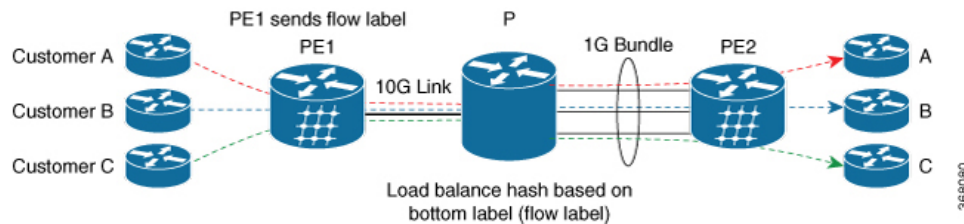
## PBB EVPN Flow Label

The PBB EVPN Flow Label feature enables provider (P) routers to use flow-based load balancing to forward traffic between the provider edge (PE) devices. A flow label is created based on indivisible packet flows entering an imposition PE, and it is inserted as the lower most label in the packet. P routers use flow label for load balancing to provide better traffic distribution across ECMP paths or link-bundled paths in the core. A

flow is identified either by the source and destination IP address and layer 4 source and destination ports of the traffic, or the source and destination MAC address of the traffic.

Consider the following topology where PBB EVPN imposition router, PE1, adds a flow label in the EVPN traffic. The PBB EVPN disposition router, PE2, allows mixed types of traffic; some have flow label, others do not. The P router use flow label to load balance the traffic between the PEs. PE2 ignores flow label in traffic, and uses one EVPN label for all unicast traffic.

**Figure 10: PBB EVPN Flow Label**



## Configure PBB EVPN Flow Label

Perform these tasks to configure PBB EVPN Flow Label feature.

```
RP/0/RSP0/CPU0:router#configure
RP/0/RSP0/CPU0:router(config)#l2vpn
RP/0/RSP0/CPU0:router(config-l2vpn)#bridge group PBB
RP/0/RSP0/CPU0:router(config-l2vpn-bg)#bridge-domain EDGE
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd)#interface Bundle-Ether1.10
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd-ac)#pbb edge i-sid 1010 core-bridge CORE
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd-ac-pbb-edge)#exit
!
RP/0/RSP0/CPU0:router(config-l2vpn-bg)#bridge-domain CORE
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd)#pbb-core
RP/0/RSP0/CPU0:router(config-l2vpn-bg-bd-pbb-core)#evpn evi 10
!
RP/0/RSP0/CPU0:router(config)#evpn
RP/0/RSP0/CPU0:router(config-evpn)#evi 10
RP/0/RSP0/CPU0:router(config-evpn-instance)#load-balancing
RP/0/RSP0/CPU0:router(config-evpn-instance-lb)#flow-label static
!
RP/0/RSP0/CPU0:router(config)#router bgp 20
RP/0/RSP0/CPU0:router(config-bgp)#address-family l2vpn evpn
RP/0/RSP0/CPU0:router(config-bgp-af)#commit
```

### Running Configuration

This section shows PBB EVPN Flow Label running configuration.

```
l2vpn
 bridge group PBB
   bridge-domain EDGE
     interface Bundle-Ether1.10
       pbb edge i-sid 1010 core-bridge CORE

 bridge-domain CORE
   pbb-core
     evpn evi 10
```

```

evpn
 evi 10
  load-balancing
  flow-label static

router bgp 20
 address-family l2vpn evpn

```

### Verification

Verify PBB EVPN Flow Label configuration.

```

RP/0/RSP0/CPU0:router#show evpn evi vpn-id 10 detail
EVI          Bridge Domain          Type
-----
10           EVPN                   PBB
  Unicast Label   : 24001
  Multicast Label : 24002
  Flow Label: Y
  RD Config: none
  RD Auto   : (auto) 1.1.1.1:10
  RT Auto   : 1:10
  Route Targets in Use          Type
  -----
  1:10                          Import
  1:10                          Export

```

## Configuration Examples for Implementing 802.1ah Provider Backbone Bridge

This section provides these configuration examples:

### Configuring Ethernet Flow Points: Example

This example shows how to configure Ethernet flow points:

```

config
interface GigabitEthernet0/0/0/10.100 l2transport
 encapsulation dot1q 100
or
 encapsulation dot1ad 100
or
 encapsulation dot1ad 100 dot1q 101

```

### Configuring PBB Edge Bridge Domain and Service Instance ID: Example

This example shows how to configure the PBB edge bridge domain:

```

config
l2vpn
 bridge group PBB
  bridge-domain PBB-EDGE
  interface GigabitEthernet0/0/0/38.100
  !
  interface GigabitEthernet0/2/0/30.150

```

```

!
pbb edge i-sid 1000 core-bridge PBB-CORE
!
!
!

```

## Configuring PBB Core Bridge Domain: Example

This example shows how to configure the PBB core bridge domain:

```

config
l2vpn
bridge group PBB
bridge-domain PBB-CORE
interface G0/5/0/10.100
!
interface G0/2/0/20.200
!
pbb core
!
!
!

```

## Configuring Backbone VLAN Tag: Example

This example shows how to configure the backbone VLAN tag:

```

config
l2vpn
bridge group PBB
bridge-domain PBB-CORE
interface G0/5/0/10.100
!
interface G0/2/0/20.200
!
pbb core
rewrite ingress tag push dot1ad 100 symmetric
!
!
!

```

## Configuring Backbone Source MAC Address: Example

This example shows how to configure the backbone source MAC address:

```

config
l2vpn
pbb
backbone-source-mac 0045.1200.04
!
!

```

## Configuring Static Mapping and Unknown Unicast MAC Address under the PBB Edge Bridge Domain

This example shows how to configure static mapping and unknown unicast MAC address under the PBB edge bridge domain:



```

config
l2vpn
  bridge group PBB
    bridge-domain PBB-EDGE
    interface GigabitEthernet0/0/0/38.100
    !
    interface GigabitEthernet0/2/0/30.150
    !
  pbb edge i-sid 1000 core-bridge PBB-CORE
    static-mac-address 0033.3333.3333 bmac 0044.4444.4444
    unknown-unicast-bmac 0123.8888.8888
    !
  !
  !

```

## Configuring PBB-VPLS: Example

This example shows you how to configure PBB VPLS.

### Configuring Access Pseudowire in I-component

```

l2vpn
  bridge group PBB
    bridge-domain PBB-EDGE
      mac withdraw state-down ----- can be used with MIRP, optional
    interface GigabitEthernet0/0/0/38.100
    interface GigabitEthernet0/2/0/30.150
    neighbor 10.10.10.1 pw-id 1010 ----- configures access PW
    !
  pbb edge i-sid 1200 core-bridge PBB-CORE
  !
  !
  !

```

### Configuring Core Pseudowire in B-component

```

l2vpn
  bridge group PBB
    bridge-domain PBB-CORE
      interface G0/5/0/10.100
    !
  vfi PBB-CORE-vfi
    neighbor 1.1.1.1 pw-id 1004 ----- configures core PW
    !
  !
  !

```

## Configuring MIRP Lite: Example

The MIRP feature is enabled by default. However, MIRP packets are sent when the attachment circuit is not functional and you have configured **mac withdraw state-down** as shown:

```

l2vpn
  bridge group PBB
    bridge-domain PBB-EDGE
  mac withdraw state-down

```

However, if you have not configured mac withdraw state-down, then MIRP packets are sent when the attachment circuit is functional.

## Configuring PBB-EVPN: Example

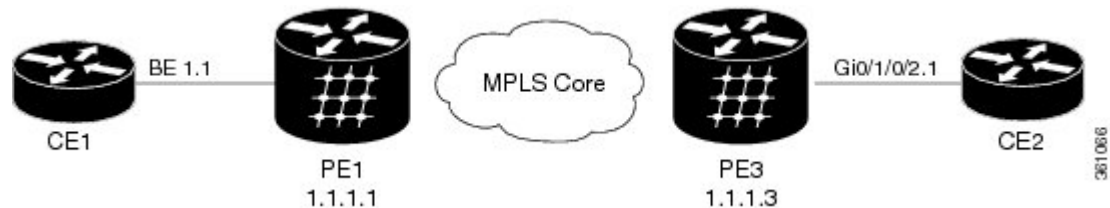
This section provides examples for:

### PBB-EVPN on Single Homed Device/Single Homed Network

This example covers:

- PBB-EVPN service between two PEs in the same AS with single homed CEs
- Dual attached CE using a bundle interface connected to PE1.
- Single attached CE connected to PE2
- EVI carrying traffic from single I-SID
- PBB source MAC customized via configuration on both PEs for easier tracking
- BGP RD/RT auto-derived from BGP ASN and EVI ID

**Figure 11: PBB-EVPN on Single Homed Device/Single Homed Network**



#### Configuration on PE1:

```

interface Bundle-Ether1.1 l2transport
    encapsulation dot1q 1 200

l2vpn
    pbb
        backbone-source-mac 00aa.00bb.00cc
    bridge group gr1
        bridge-domain bd1
            interface Bundle-Ether1.1
                pbb edge i-sid 300 core-bridge core_bd1

    bridge group gr2
        bridge-domain core_bd1
        pbb core
            evpn evi 1000
!
router bgp 100
    bgp router-id 1.1.1.1
    address-family l2vpn evpn
    !
    neighbor 1.1.1.3
        remote-as 100
  
```

```
address-family l2vpn evpn
```

#### Configuration on PE3:

```
interface GigabitEthernet 0/1/0/2.1 l2transport
 encapsulation dot1q 200

l2vpn
 pbb
  backbone-source-mac 00bb.00cc.00dd
 bridge group gr1
  bridge-domain bd1
   interface GigabitEthernet0/1/0/2.1
    pbb edge i-sid 300 core-bridge core_b1

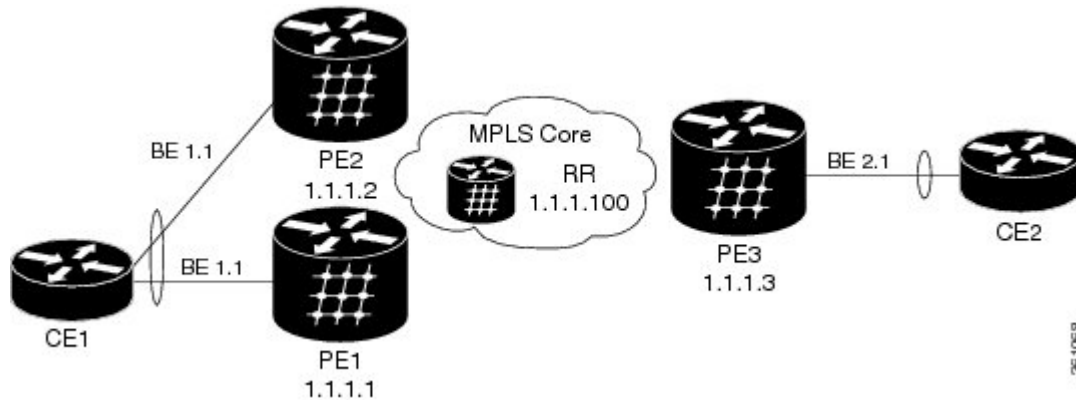
  bridge group gr2
   bridge-domain core_bd1
    pbb core
     evpn evi 1000
!
router bgp 100
 bgp router-id 1.1.1.3
 address-family l2vpn evpn
!
 neighbor 1.1.1.1
  remote-as 100
 address-family l2vpn evpn
```

## PBB EVPN on Dual Homed Device/Multi Homed Device with Active/Active per Flow load-balancing

This examples covers:

- PBB-EVPN service among three PEs in the same AS with a dual homed CE (behind PE1 and PE2) and a single homed CE (behind PE3)
- PE1/PE2 configured to perform active/active per Flow loadbalancing allowing ingress traffic from the same I-SID to be handled by both PEs
- Example shows EVI carrying traffic from a single I-SID
- PBB I-SID values must match among PEs connected to a common dual homed site
- ICCP must be configured in PE1, PE2 using a new mode (mode singleton); where no ICCP neighbor is configured. Note that MLACP parameters such as system MAC/priority must be identical while MLACP node ID must be unique on PE1/PE2
- ESI must be identical on PEs connected to a common dual homed site. Example shows default behavior where ESI value is auto-derived from CE's LACP information
- PBB source MAC must be the same on PEs connected to a dual homed site operating on active/active per flow load-balancing. Example shows default behavior where PBB source MAC value is auto-derived from CE's LACP information
- CE must be configured with one bundle interface that includes all member interfaces connecting to both PEs
- BGP RD/RT auto-derived from BGP ASN and EVI ID

Figure 12: PBB EVPN on Dual Homed Device/Multi Homed Device with Active/Active per Flow load-balancing

**Configuration on PE1:**

```

redundancy
iccp
group 1
mlacp node 1
mlacp system mac 0aaa.0bbb.0ccc
mlacp system priority 1
backbone interface GigabitEthernet0/1/0/2
mode singleton

interface bundle-Ether1
mlacp iccp-group 1

interface bundle-Ether1.1 l2transport
encapsulation dot1q 10
l2vpn
bridge group gr1
bridge-domain bd1
interface bundle-ether1.1
pbb edge i-sid 600 core-bridge core_bd1

bridge group gr2
bridge-domain core_bd1
pbb core
evpn evi 1000
!
router bgp 100
bgp router-id 1.1.1.1
address-family l2vpn evpn
!
neighbor 1.1.1.100
remote-as 100
address-family l2vpn evpn

```

**Configuration on PE2:**

```

redundancy
iccp
group 1
mlacp node 2
mlacp system mac 0aaa.0bbb.0ccc
mlacp system priority 1
backbone interface GigabitEthernet0/1/0/2

```

```

mode singleton

interface bundle-Ether1
mlacp iccp-group 1

interface bundle-Ether1.1 l2transport
encapsulation dot1q 10
l2vpn
bridge group gr1
bridge-domain bd1
interface bundle-Ether1.1
pbb edge i-sid 600 core-bridge core_b1

bridge group gr2
bridge-domain core_bd1
pbb core
evpn evi 1000
!
router bgp 100
bgp router-id 1.1.1.2
address-family l2vpn evpn
!
neighbor 1.1.1.100
remote-as 100
address-family l2vpn evpn

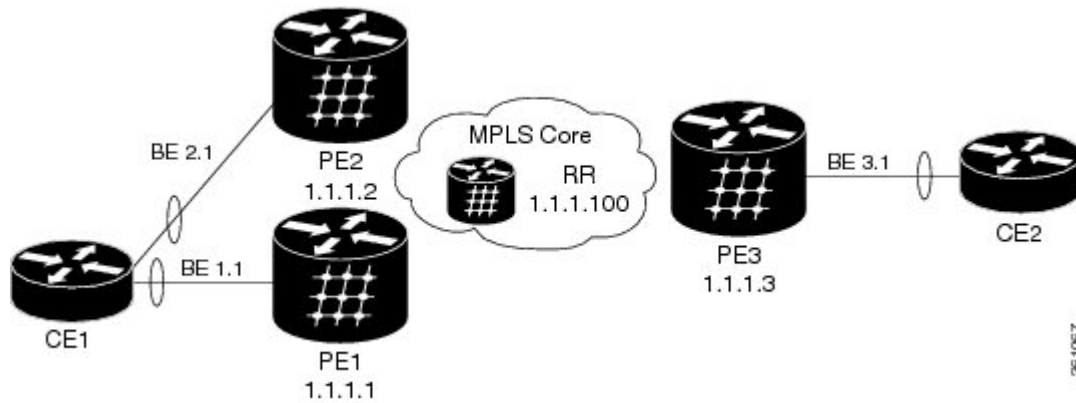
```

## PBB EVPN on Dual Homed Device/Multi Homed Device with Active/Active per Service load-balancing and Dynamic Service Carving

This example covers:

- PBB-EVPN service among three PEs in the same AS with a dual homed CE (behind PE1 and PE2) and a single homed CE (behind PE3)
- PE1/PE2 configured to perform active/active per service (i.e. per-ISID) loadbalancing with dynamic service carving/DF election allowing traffic from some I-SIDs to be handled by PE1 while the rest to be handled by PE2
- EVI carrying traffic from two I-SIDs
- PBB I-SID values must match among PEs connected to a common dual homed site
- ICCP must be configured in PE1, PE2 using a new mode (mode singleton); where no ICCP neighbor is configured. ICCP configuration required to handle core isolation failures. Example uses same MLACP system mac/priority and unique MLACP node values on PE1/PE2
- ESI must be identical between PEs for a dual homed site. User configuration must be entered to guarantee that
- PBB source MAC must be different on each PE connected to a dual homed site. By default, PE uses system-wide PBB source MAC
- CE must be configured with two bundle interfaces. One for each set of member interfaces leading to a different PE
- BGP RD/RT auto-derived from BGP ASN and EVI ID

**Figure 13: PBB EVPN on Dual Homed Device/Multi Homed Device with Active/Active per Service load-balancing and Dynamic Service Carving**



**Configuration on PE1:**

```

redundancy
iccp
group 66
mlacp node 1
mlacp system mac 0aaa.0bbb.0ccc
mlacp system priority 1
backbone interface GigabitEthernet0/1/0/2
mode singleton

interface Bundle-Ether1
mlacp iccp-group 66
interface bundle-Ether1.1 l2transport
encapsulation dot1q 10

interface bundle-Ether1.20 l2transport
encapsulation dot1q 20

evpn
interface bundle-Ether1
ethernet-segment
identifier type 0 01.11.00.00.00.00.00.01
load-balancing-mode per-service

l2vpn
bridge group gr1
bridge-domain bd1
interface bundle-ether1.1
pbb edge i-sid 300 core-bridge core_bd1

bridge-domain bd20
interface bundle-ether1.20
pbb edge i-sid 320 core-bridge core_bd1

bridge group gr2
bridge-domain core_bd1
pbb core
evpn evi 1000
!
router bgp 100
bgp router-id 1.1.1.1
address-family l2vpn evpn
!

```

```
neighbor 1.1.1.100
remote-as 100
address-family l2vpn evpn
```

#### Configuration on PE2:

```
redundancy
iccp
group 66
mlacp node 2
mlacp system mac 0aaa.0bbb.0ccc
mlacp system priority 1
backbone interface GigabitEthernet0/1/0/2
mode singleton

interface Bundle-Ether2
mlacp iccp-group 66

interface bundle-Ether2.1 l2transport
encapsulation dot1q 10

interface bundle-Ether2.20 l2transport
encapsulation dot1q 20

evpn
interface bundle-Ether2
ethernet-segment
identifier type 0 01.11.00.00.00.00.00.01
load-balancing-mode per-service
l2vpn
bridge group gr1
bridge-domain bd1
interface bundle-Ether2.1
pbb edge i-sid 300 core-bridge core_bd1

bridge-domain bd20
interface bundle-Ether2.20
pbb edge i-sid 320 core-bridge core_bd1

bridge group gr2
bridge-domain core_bd1
pbb core
evpn evi 1000
!
router bgp 100
bgp router-id 1.1.1.2
address-family l2vpn evpn
!
neighbor 1.1.1.100
remote-as 100
address-family l2vpn evpn
```

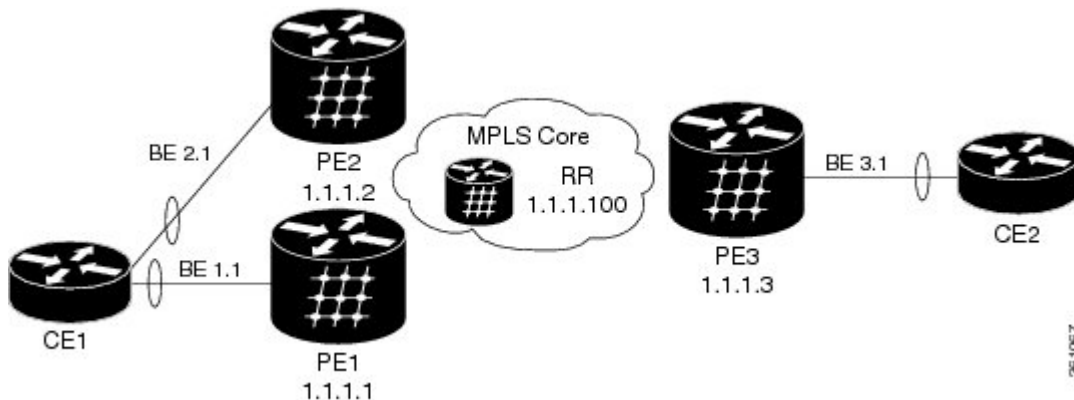
## PBB EVPN on Dual Homed Device/Multi Homed Device with Active/Active per Service load-balancing and Manual Service Carving

This example covers:

- PBB-EVPN service among three PEs in the same AS with a dual homed CE (behind PE1 and PE2) and a single homed CE (behind PE3)

- PE1/PE2 configured to perform active/active per service (i.e. per-ISID) load balancing with manual service carving/DF election
- PE1 configured to forward traffic from I-SID range 256-276 and backup for I-SID 277-286. PE2 configured to behave in the opposite manner of PE1
- EVI carrying traffic from two I-SIDs
- PBB I-SID values must match among PEs connected to a common dual homed site
- ICCP must be configured in PE1, PE2 using a new mode (mode singleton); where no ICCP neighbor is configured. ICCP configuration required to handle core isolation failures. Example uses same MLACP system mac/priority and unique MLACP node values on PE1/PE2
- ESI must be identical between PEs for a dual homed site. User configuration must be entered to guarantee that
- PBB source MAC must be different on each PE connected to a dual homed site. Example below customizes PBB source MAC value via configuration for easier tracking
- CE must be configured with two bundle interfaces. One for each set of member interfaces leading to a different PE
- BGP RD/RT auto-derived from BGP ASN and EVI ID

**Figure 14: PBB EVPN on Dual Homed Device/Multi Homed Device with Active/Active per Service load-balancing and Manual Service Carving**



**Configuration on PE1:**

```

redundancy
iccp
group 66
mlacp node 1
mlacp system mac 0aaa.0bbb.0ccc
mlacp system priority 1
backbone interface GigabitEthernet0/1/0/2
mode singleton

interface Bundle-Ether1
mlacp iccp-group 66

interface bundle-Ether1.1 l2transport
encapsulation dot1q 10

```



```

interface bundle-Ether1.20 l2transport
    encapsulation dot1q 20

evpn
    interface bundle-Ether1
        ethernet-segment
            identifier type 0 01.11.00.00.00.00.00.01
            load-balancing-mode per-service
            service-carving manual primary isid 256-276 secondary isid 277-286
l2vpn
    pbb
        backbone-source-mac 00aa.00bb.00cc
    bridge group gr1
        bridge-domain bd_256
            interface bundle-ether1.1
                pbb edge i-sid 260 core-bridge core_bd1

        bridge-domain bd_286
            interface bundle-ether1.20
                pbb edge i-sid 280 core-bridge core_bd1
    bridge group gr2
        bridge-domain core_bd1
            pbb core
            evpn evi 1000
!
router bgp 100
    bgp router-id 1.1.1.1
    address-family l2vpn evpn
    !
    neighbor 1.1.1.100
        remote-as 100
        address-family l2vpn evpn

```

**Configuration on PE2:**

```

redundancy
    iccp
        group 66
            mlacp node 2
            mlacp system mac 0aaa.0bbb.0ccc
            mlacp system priority 1
            backbone interface GigabitEthernet0/1/0/2
            mode singleton

interface Bundle-Ether2
    mlacp iccp-group 66

interface bundle-Ether2.1 l2transport
    encapsulation dot1q 10

interface bundle-Ether2.20 l2transport
    encapsulation dot1q 20

evpn
    interface bundle-Ether2
        ethernet-segment
            identifier type 0 01.11.00.00.00.00.00.01
            load-balancing-mode per-service
            service-carving manual primary 277-286 secondary 256-276

l2vpn
    pbb

```

```

backbone-source-mac 00cc.00dd.00ee
bridge group gr1
bridge-domain bd1
interface bundle-Ether2.1
pbb edge i-sid 260 core-bridge core_b1

bridge-domain bd30

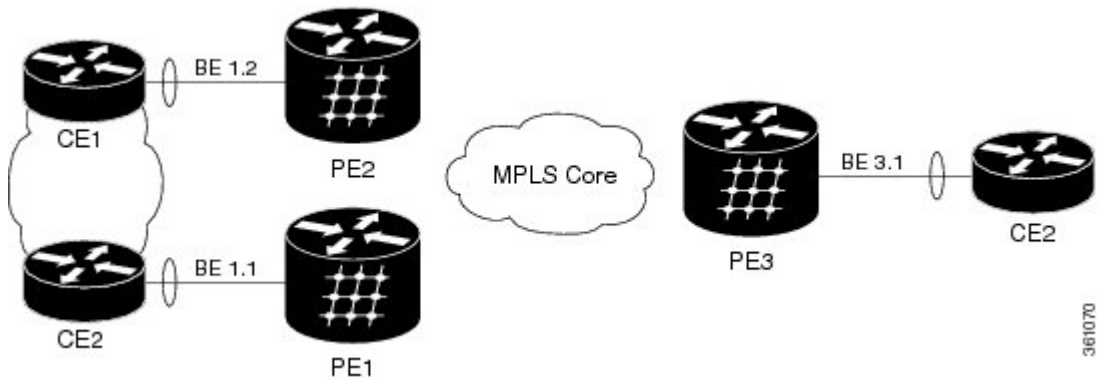
Interface bundle-Ether2.20
pbb edge i-sid 280 core-bridge core_b1
bridge group gr2
bridge-domain core_bd1
pbb core
evpn evi 1000
!
router bgp 100
bgp router-id 1.1.1.2
address-family l2vpn evpn
!
neighbor 1.1.1.100
remote-as 100
address-family l2vpn evpn

```

## PBB-EVPN Multi Homed Network

This example shows how to configure PBB-EVPN on a Multi Homed Network with Active-Active per service load balancing:

**Figure 15: PBB-EVPN Multi Homed Network**



### Configuration on PE1:

```

interface bundle-Ether1.1 l2transport
encapsulation dot1q 1

evpn
interface bundle-Ether1
ethernet-segment
load-balancing-mode per-service
l2vpn
pbb
backbone-source-mac 00aa.00bb.00cc
bridge group gr1
bridge-domain bd1
interface bundle-ether1.1
pbb edge i-sid 400 core-bridge core_bd1

```

```
bridge group gr2
bridge-domain core_bd1
pbb core
evpn evi 1000
```

**Configuration on PE2:**

```
interface bundle-Ether1.1 l2transport
encapsulation dot1q 1
evpn
interface bundle-Ether1
ethernet-segment
load-balancing-mode per-service

l2vpn
pbb
backbone-source-mac 00cc.00dd.00ee
bridge group gr1
bridge-domain bd1
interface bundle-Ether1.1
pbb edge i-sid 400 core-bridge core_bd1

bridge group gr2
bridge-domain core_bd1
pbb core
evpn evi 1000
```

