



IEEE 802.1ad Support on Provider Bridges

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Service provider bridges (also called provider bridges) allow switches in a service provider network to transparently carry a customer's Layer 2 control frames, such as Spanning Tree Protocol (STP) bridge protocol data units (BPDUs) or Cisco Discovery Protocol frames, separate from the service provider's traffic and from other customer traffic in the service provider's network. User network interface (UNI) ports of a provider bridge interface with customer devices and have a specific set of requirements defined by the IEEE 802.1ad standard. These requirements enable provider bridges to have the same functionality as Layer 2 protocol tunneling (L2PT) and Q-in-Q (QnQ) bridges.

This document describes the IEEE 802.1ad implementation on Cisco switches using Layer 2 switch ports.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the [“Feature Information for IEEE 802.1ad Support on Provider Bridges”](#) section on page 13.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to <http://www.cisco.com/go/cfn>. An account on Cisco.com is not required.

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Restrictions for IEEE 802.1ad Support on Provider Bridges

- The IEEE 802.1ad Support on Provider Bridges feature is not supported on the Cisco ME3400 series switch.

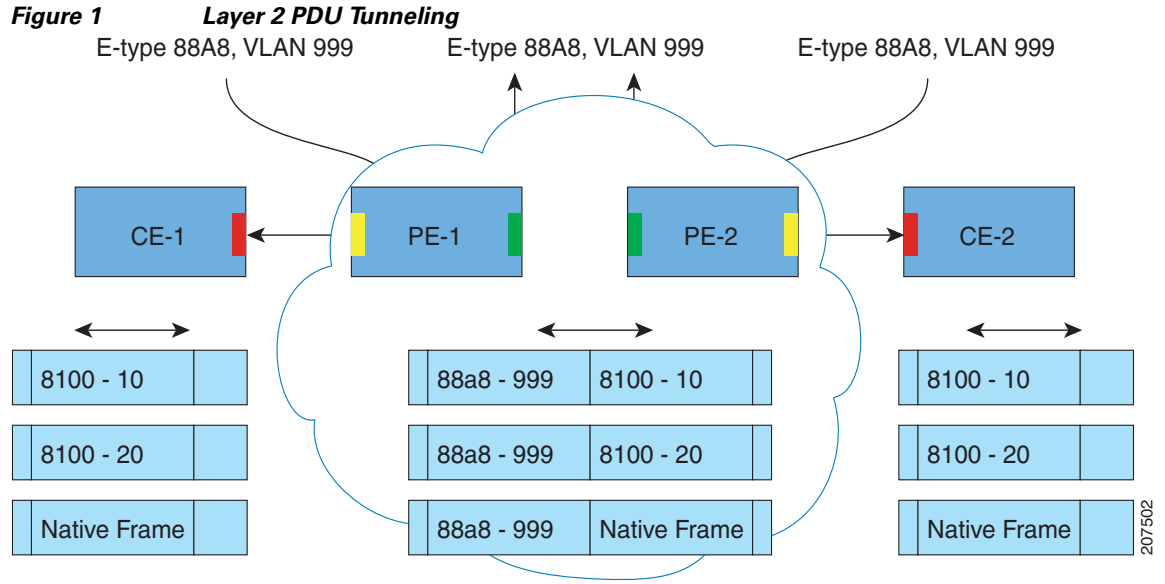
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Service Provider Bridges

Provider bridges pass the network traffic of many customers, and each customer's traffic flow must be isolated from one another. For Layer 2 protocols within customer domains to function properly, geographically separated customer sites must appear to be connected via a LAN, and the provider network must be transparent.

The IEEE has reserved 33 Layer 2 MAC addresses for customer devices operating Layer 2 protocols. If a provider bridge uses these standard MAC addresses for its Layer 2 protocols, the customers' and service provider's Layer 2 traffic will be mixed together. Provider bridges solve this traffic-mixing issue by providing Layer 2 protocol data unit (PDU) tunneling for customers using a provider bridge (S-bridge) component and a provider edge bridge (C-bridge) component. [Figure 1](#) shows the topology.

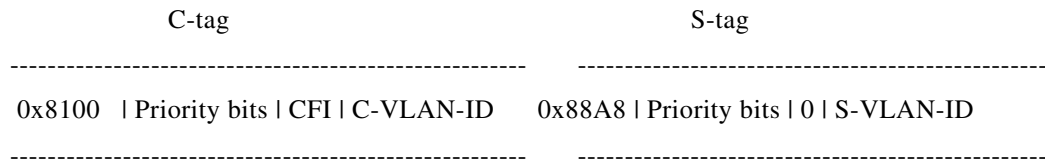


S-Bridge Component

The S-bridge component is capable of inserting or removing a service provider VLAN (S-VLAN) for all traffic on a particular port. IEEE 802.1ad adds a new tag called a Service tag (S-tag) to all ingress frames from the customer to the service provider.

The VLAN in the S-tag is used for forwarding the traffic in the service provider network. Different customers use different S-VLANs, which results in each customer's traffic being isolated. In the S-tag, provider bridges use an Ethertype value different than the standard 802.1Q Ethertype value, and they do not understand the standard Ethertype. This difference makes customer traffic tagged with the standard Ethertype appear as untagged in the provider network so customer traffic is tunneled in the port VLAN of the provider port. 802.1ad service provider user network interfaces (S-UNIs) and network-network interfaces (NNIs) implement the S-bridge component.

For example, a VLAN tag has a VLAN ID of 1, the C-tag Ethertype value is 8100 0001, the S-tag Ethertype value is 88A8 0001, and the class of service (CoS) is zero.



C-Bridge Component

All C-VLANs entering on a UNI port in an S-bridge component are provided the same service (marked with the same S-VLAN). C-VLAN components are not supported, but a customer may want to tag a particular C-VLAN packet separately to differentiate between services. Provider bridges allow C-VLAN packet tagging with a provider edge bridge, called the C-bridge component of the provider bridge. C-bridge components are C-VLAN aware and can insert or remove a C-VLAN 802.1Q tag. The C-bridge UNI port is capable of identifying the customer 802.1Q tag and inserting or removing an S-tag on the

packet on a per service instance or C-VLAN basis. A C-VLAN tagged service instance allows service instance selection and identification by C-VLAN. 801.1ad customer user network interfaces (C-UNIs) implement the C-component.

MAC Addresses for Layer 2 Protocols

Customers' Layer 2 PDUs received by a provider bridge are not forwarded, so Layer 2 protocols running in customer sites do not know the complete network topology. By using a different set of addresses for the Layer 2 protocols running in provider bridges, IEEE 802.1ad causes customers' Layer 2 PDUs entering the provider bridge to appear as unknown multicast traffic and forwards it on customer ports (on the same S-VLAN). Customers' Layer 2 protocols can then run transparently.

Table 1 shows the Layer 2 MAC addresses reserved for the C-VLAN component.

Table 1 *Reserved Layer 2 MAC Addresses for the C-VLAN Component*

Assignment	Value
Bridge Group Address	01-80-C2-00-00-00
IEEE 802.3 Full Duplex PAUSE Operation	01-80-C2-00-00-01
IEEE 802.3 Slow_Protocols_Multicast_Address	01-80-C2-00-00-02
IEEE 802.1X PAE Address	01-80-C2-00-00-03
Provider Bridge Group Address	01-80-C2-00-00-08
Provider Bridge GVRP Address	01-80-C2-00-00-0D
IEEE 802.1AB Link Layer Discovery Protocol Multicast Address	01-80-C2-00-00-0E
Reserved for future standardization	01-80-C2-00-00-04 01-80-C2-00-00-05 01-80-C2-00-00-06 01-80-C2-00-00-07 01-80-C2-00-00-09 01-80-C2-00-00-0A 01-80-C2-00-00-0B 01-80-C2-00-00-0C 01-80-C2-00-00-0F

Table 2 shows the Layer 2 MAC addresses reserved for the S-VLAN component. These addresses are a subset of the C-VLAN component addresses, and the C-bridge does not forward the provider's BPDUs to a customer network.

Table 2 *Reserved Layer 2 MAC Addresses for the S-VLAN Component*

Assignment	Value
IEEE 802.3 Full Duplex PAUSE Operation	01-80-C2-00-00-01
IEEE 802.3 Slow_Protocols_Multicast_Address	01-80-C2-00-00-02

Table 2 *Reserved Layer 2 MAC Addresses for the S-VLAN Component (continued)*

Assignment	Value
IEEE 802.1X PAE Address	01-80-C2-00-00-03
Provider Bridge Group Address	01-80-C2-00-00-08
Reserved for future standardization	01-80-C2-00-00-04
	01-80-C2-00-00-05
	01-80-C2-00-00-06
	01-80-C2-00-00-07
	01-80-C2-00-00-09
	01-80-C2-00-00-0A

IEEE 802.1ad Support on Provider Bridges Feature

The IEEE 802.1ad Support on Provider Bridges feature is implemented on switch ports and supports the following IEEE 802.1ad specified functions:

- Operation of individual provider bridges
- Configuration and management of individual provider bridges
- Management of spanning tree and VLAN topologies within a provider network

In Cisco IOS Release 12.2(54)SE, the Cisco ME 3400E and Catalyst 3750 Metro switch platforms support this feature. The Cisco ME3400 switch platform does not support this feature.

Layer 2 PDU Destination MAC Addresses for Customer-Facing C-Bridge UNI Ports

Table 3 shows the Layer 2 PDU destination MAC addresses for customer-facing C-bridge UNI ports and how frames are processed.

Table 3 *Layer 2 PDU Destination MAC Addresses for Customer-Facing C-Bridge UNI Ports*

MAC Address	Protocol	Significance on the C-Bridge UNI Port	Default Action
01-80-C2-00-00-00	Bridge Group Address (end-to-end BPDUs)	Data, BPDU (based on the CLI configuration of the l2protocol command)	BPDU
01-80-C2-00-00-01	802.3X Pause Protocol	BPDU	MAC address processes
01-80-C2-00-00-02	Slow protocol address: 802.3ad LACP, 802.3ah OAM, Cisco Discovery Protocol, DTP, PagP, UDLD, VTP	BPDU	BPDU
01-80-C2-00-00-03	802.1x	BPDU	BPDU
01-80-C2-00-00-04	Reserved for future media access method	Drop	Drop

Table 3 Layer 2 PDU Destination MAC Addresses for Customer-Facing C-Bridge UNI Ports

MAC Address	Protocol	Significance on the C-Bridge UNI Port	Default Action
01-80-C2-00-00-05	Reserved for future media access method	Drop	Drop
01-80-C2-00-00-06	Reserved for future bridge use	Drop	Drop
01-80-C2-00-00-07	Ethernet Local Management Interface	BPDU	BPDU
01-80-C2-00-00-08	Provider STP (BPDU)	Drop	Drop
01-80-C2-00-00-09	Reserved for future bridge use	Drop	Drop
01-80-C2-00-00-0A	Reserved for future bridge use	Drop	Drop
01-80-C2-00-00-0B	Reserved for future S-bridge purposes	Drop	Drop
01-80-C2-00-00-0C	Reserved for future S-bridge purposes	Drop	Drop
01-80-C2-00-00-0D	Provider bridge GVRP address	Drop	Drop
01-80-C2-00-00-0E	802.1ab LLDP	Data, BPDU (based on the CLI configuration of the l2protocol command)	BPDU
01-80-C2-00-00-0F	Reserved for future C-bridge or Q-bridge use	Drop	Drop
01-80-C2-00-00-10	All bridges address	BPDU	Peer
01-80-C2-00-00-20	GMRP	Data	Data
01-80-C2-00-00-21	GVRP	Data	Data
01-80-C2-00-00-22-2F	Other GARP addresses	Data	Data
01-00-0C-CC-CC-CC	Cisco's Cisco Discovery Protocol, DTP, PagP, UDLD, VTP (end-to-end)	Data, BPDU (based on the CLI configuration of the l2protocol command)	BPDU
01-00-0C-CC-CC-CD	Cisco's PVST (end-to-end)	Data, BPDU (based on the CLI configuration of the l2protocol command)	BPDU

Layer 2 PDU Destination MAC Addresses for Customer-Facing S-Bridge UNI Ports

If a port is operating as a customer-facing S-bridge UNI, the destination MAC addresses shown in Table 4 are used for defining the Layer 2 protocol PDU processing at the S-bridge UNI.

Table 4 shows the Layer 2 PDU destination MAC addresses for customer-facing S-bridge ports and how frames are processed.

Table 4 *Layer 2 PDU Destination MAC Addresses for Customer-Facing S-Bridge UNI Ports*

MAC Address	Protocol	Significance on the S-Bridge UNI Port	Default Action
01-80-C2-00-00-00	Bridge Group Address (BPDUs)	Data, BPDU (based on the CLI configuration of the I2protocol command)	Data
01-80-C2-00-00-01	802.3X Pause Protocol	BPDU	MAC address processes
01-80-C2-00-00-02	Slow protocol address: 802.3ad LACP, 802.3ah OAM	BPDU	BPDU
01-80-C2-00-00-03	802.1x	BPDU	BPDU
01-80-C2-00-00-04	Reserved for future media access method	Drop	Drop
01-80-C2-00-00-05	Reserved for future media access method	Drop	Drop
01-80-C2-00-00-06	Reserved for future bridge use	Drop	Drop
01-80-C2-00-00-07	Ethernet Local Management Interface	BPDU	BPDU (drop on NNI)
01-80-C2-00-00-08	Provider STP (BPDU)	BPDU	BPDU
01-80-C2-00-00-09	Reserved for future bridge use	Drop	Drop
01-80-C2-00-00-0A	Reserved for future bridge use	Drop	Drop
01-80-C2-00-00-0B	Reserved for future S-bridge purposes	Data	Data
01-80-C2-00-00-0C	Reserved for future S-bridge purposes	Data	Data
01-80-C2-00-00-0D	Provider bridge GVRP address	Data	Data
01-80-C2-00-00-0E	802.1ab LLDP	Data, BPDU (based on the CLI configuration of the I2protocol command)	Data
01-80-C2-00-00-0F	Reserved for future C-bridge or Q-bridge use	Data	Data
01-80-C2-00-00-10	All bridges address	Data	Data
01-80-C2-00-00-20	GMRP	Data	Data
01-80-C2-00-00-21	GVRP	Data	Data
01-80-C2-00-00-22-2F	Other GARP addresses	Data	Data

Table 4 Layer 2 PDU Destination MAC Addresses for Customer-Facing S-Bridge UNI Ports

MAC Address	Protocol	Significance on the S-Bridge UNI Port	Default Action
01-00-0C-CC-CC-CC	Cisco's Cisco Discovery Protocol, DTP, PagP, UDLD, VTP	Data, BPDU (based on the CLI configuration of the l2protocol command)	Data
01-00-0C-CC-CC-CD	Cisco's PVST	Data, BPDU (based on the CLI configuration of the l2protocol command)	Data

How to Configure IEEE 802.1ad Support on Provider Bridges

- [Configuring a Switch Port to Process 802.1ad BPDUs, page 8](#) (required)

Configuring a Switch Port to Process 802.1ad BPDUs

In an 802.1ad network, the default behavior for Layer 2 PDUs on an interface depends on the 802.1ad interface type. If the interface type is an S-bridge UNI, all Layer 2 PDUs are tunneled. If the interface type is a C-bridge UNI, all Layer 2 PDUs are processed (peered)

PDU processing on the S-bridge UNI is the same as on an 802.1ad NNI. Both interface types have the same scope of MAC addresses. Perform the tasks in this section to configure one switch port to forward 802.1ad BPDUs end to end and another switch port to peer (process) BPDUs:

- [Configuring a Switch Port to Forward BPDUs, page 8](#)
- [Configuring a Switch Port to Process BPDUs, page 9](#)

Configuring a Switch Port to Forward BPDUs

Perform this task to configure a switch port to forward BPDUs.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **switchport access vlan** *vlan-id*
5. **ethernet dot1ad** { **nni** | **uni** { **c-port** | **s-port** } }
6. **l2protocol** [**peer** | **forward**] [*protocol*]
7. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Switch> enable	Enables privileged EXEC mode. <ul style="list-style-type: none">Enter your password if prompted.
Step 2	configure terminal Example: Switch# configure terminal	Enters global configuration mode.
Step 3	interface <i>type number</i> Example: Switch(config)# interface gigabitethernet 0/2	Configures an interface.
Step 4	switchport access vlan <i>vlan-id</i> Example: Switch(config-if)# switchport access vlan 500	Sets the VLAN when an interface is in access mode.
Step 5	ethernet dot1ad { <i>nni</i> <i>uni</i> { <i>c-port</i> <i>s-port</i> }} Example: Switch(config-if)# ethernet dot1ad uni s-port	Configures a dot1ad NNI or UNI port.
Step 6	l2protocol [<i>peer</i> <i>forward</i>] [<i>protocol</i>] Example: Switch(config)# l2protocol forward vtp	Processes or forwards Layer 2 BPDUs. <ul style="list-style-type: none">In this example, only VTP PDUs will be forwarded.
Step 7	end Example: Switch(config-if)# end Switch#	Returns the CLI to privileged EXEC mode.

Configuring a Switch Port to Process BPDUs

Perform this task to configure a switch port to process BPDUs.

SUMMARY STEPS

- enable**
- configure terminal**
- interface** *type number*
- switchport mode** {*access* | *trunk*}
- ethernet dot1ad** {*nni* | *uni* {*c-port* | *s-port*}}

6. `l2protocol [peer | forward] [protocol]`
7. `end`

DETAILED STEPS

	Command or Action	Purpose
Step 1	<code>enable</code> Example: <code>Switch> enable</code>	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	<code>configure terminal</code> Example: <code>Switch# configure terminal</code>	Enters global configuration mode.
Step 3	<code>interface type number</code> Example: <code>Switch(config)# interface gigabitethernet 0/3</code>	Configures an interface.
Step 4	<code>switchport mode {access trunk}</code> Example: <code>Switch(config-if)# switchport mode trunk</code>	Sets the interface type.
Step 5	<code>ethernet dot1ad {nni uni {c-port s-port}}</code> Example: <code>Switch(config-if)# ethernet dot1ad uni c-port</code>	Configures a dot1ad NNI or UNI port.
Step 6	<code>l2protocol [peer forward] [protocol]</code> Example: <code>Switch(config)# l2protocol peer vtp</code>	Processes or forwards Layer 2 BPDUs. <ul style="list-style-type: none"> • In this example, only VTP PDUs will be processed.
Step 7	<code>end</code> Example: <code>Switch(config-if)# end</code> <code>Switch#</code>	Returns the CLI to privileged EXEC mode.

Configuration Examples for IEEE 802.1ad Support on Provider Bridges

- [Example: Configuring an 802.1ad S-Bridge UNI, page 11](#)
- [Example: Configuring an 802.1ad C-Bridge UNI, page 11](#)

Example: Configuring an 802.1ad S-Bridge UNI

The following example shows how to configure GigabitEthernet interface 0/2 of a PE as an 802.1ad S-bridge UNI. In this example, only Cisco Discovery Protocol PDUs will be forwarded (tunneled). Cisco Discovery Protocol PDUs will be forwarded between the PE and a customer device.

```
Switch# configure terminal
Switch(config)# interface GigabitEthernet 0/2
Switch(config-if)# switchport access vlan 500
Switch(config-if)# ethernet dot1ad uni s-port
Switch(config-if)# l2protocol forward cdp
```

Example: Configuring an 802.1ad C-Bridge UNI

The following example shows how to configure interface GigabitEthernet 0/3 of a PE as an 802.1ad C-bridge UNI. In this example, only Cisco Discovery Protocol PDUs will be processed.

```
Switch# configure terminal
Switch(config)# interface GigabitEthernet 0/3
Switch(config-if)# switchport mode trunk
Switch(config-if)# ethernet dot1ad uni c-port
Switch(config-if)# l2protocol peer cdp
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands: master list of commands with complete command syntax, command mode, command history, defaults, usage guidelines, and examples	Cisco IOS Master Commands List, All Releases
Cisco IOS Carrier Ethernet commands: complete command syntax, command mode, command history, defaults, usage guidelines, and examples	Cisco IOS Carrier Ethernet Command Reference
Configuring Carrier Ethernet	Cisco IOS Carrier Ethernet Configuration Guide, Release 12.2SR

Standards

Standard	Title
IEEE 802.1ad	<i>Provider Bridges</i>

MIBs

MIB	MIBs Link
None	To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFC	Title
None	—

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for IEEE 802.1ad Support on Provider Bridges

Table 5 lists the release history for this feature.

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Note

Table 5 lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Table 5 Feature Information for IEEE 802.1ad Support on Provider Bridges

Feature Name	Releases	Feature Information
802.1ad Support for Cat3K Switches	12.2(54)SE	<p>The IEEE 802.1ad Support on Provider Bridges feature is the IEEE 802.1ad implementation on Cisco switches using Layer 2 switch ports.</p> <p>In 12.2(54)SE, this feature was introduced on the Cisco ME 3400E and Catalyst 3750 Metro switch platforms.</p> <p>The following commands were introduced or modified: ethernet dot1ad, l2protocol, show ethernet dot1ad.</p>

Glossary

DTP—Dynamic Trunking Protocol

GARP—Generic Attribute Registration Protocol

GMRP—GARP Multicast Registration Protocol

GVRP—Generic VLAN Registration Protocol

LLDP—Link Layer Discovery Protocol

OAM—Operations, Administration, and Maintenance

PagP—Port Aggregation Protocol

PVST—Per-VLAN Spanning Tree

UDLD—UniDirectional Link Detection

VTP—VLAN Trunk Protocol

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