Layer 2 Control Protocol Peering, Forwarding, and Tunneling

This feature module describes how to configure Layer 2 (L2) Control Protocol Peering, Forwarding, and Tunneling feature on the Cisco ASR 901 Series Aggregation Services Routers.

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 Layer 2 Control Protocol Peering, Forwarding, and Tunneling, on page 14.

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.

Prerequisites for Layer 2 Control Protocol Peering, Forwarding, and Tunneling

- A Cisco IOS software that supports Layer 2 Control Protocol Peering, Forwarding, and Tunneling must be installed previously on the Cisco ASR 901 Series Aggregation Services Router. For supported software releases, see Release Notes for Cisco ASR 901 Series Aggregation Services Router.

# Restrictions for Layer 2 Control Protocol Peering, Forwarding, and Tunneling

• If you want to peer Operation, Administration, and Maintenance (OAM) packets when **l2proto-forward tagged** command is configured at the interface level, you should also configure the **l2protocol peer lacp** command.

• Received L2CP Control Packets (like STP, CDP, and others) are not mirrored to the destination port.

• Forwarding L2CP tunneled packets over x-connect is not supported.

Layer 2 Control Protocol Forwarding

The ASR 901 forwards Layer 2 Control Protocol (L2CP) packets between customer-edge (CE) devices. Cisco ASR 901 router supports L2CP forwarding on Bridge-domain EVCs and on Cross-connect EVCs.

The following figure depicts an end-to-end layer 2 forwarding. The layer 2 traffic is sent through the S-network, and the S-network switches the traffic from end to end. The Cisco ASR 901 router forwards frames from the user network interface (UNI) to the network-to-network Interface (NNI) after appending S-tag. The third party provider edge (PE) router forwards the S-tagged frames. The PE peers the untagged Link Layer Discovery Protocol (LLDP) and Link Aggregation Control Protocol (LACP) frames. On the reverse path (from NNI to UNI), the S-tag is removed.

Figure 1: Layer 2 Forwarding
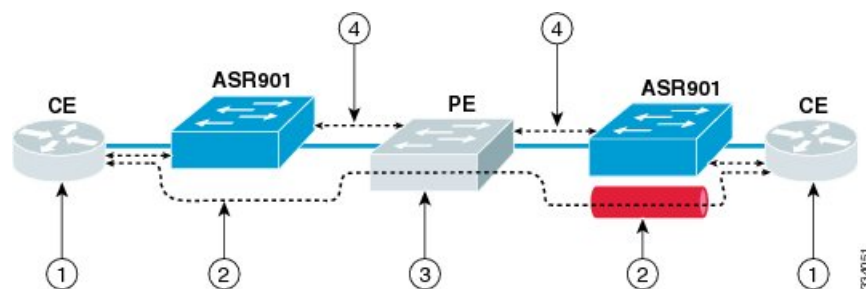
1	L2CP packets are forwarded between CE devices.	3	Third party PE forwards S-tagged frames and peers untagged frames.
2	Frames are forwarded from UNI to NNI after appending the S-tag. On the reverse path (NNI to UNI), S-tag is removed.	4	Untagged LLDP and LACP is peered.

Layer 2 Control Protocol Tunneling

Layer 2 Control Protocol Tunneling (L2PT) is a Cisco proprietary protocol for tunneling Ethernet protocol frames across layer 2 switching domains. The following tunnel protocols are supported:
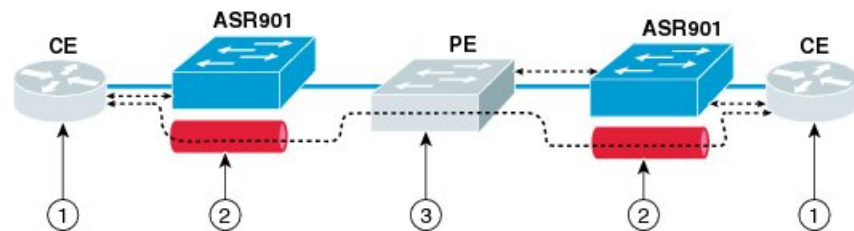
• Cisco Discovery Protocol (CDP)

- Dynamic Trunking Protocol (DTP)
- Link Aggregation Control Protocol (LACP)
- Link Layer Discovery Protocol (LLDP)
- Spanning Tree Protocol (STP)—including Multiservice Transport Platform (MSTP) and Per VLAN Spanning Tree (PVST)
- Virtual Trunking Protocol (VTP)

The ASR 901 router allows to tunnel layer 2 packets between CEs. The Cisco proprietary multicast address (01-00-0c-cd-cd-d0) is used while tunneling the packet over the NNI interfaces.

The following figure depicts Layer 2 Protocol Tunneling. The layer 2 traffic is sent through the S-network, and the S-network switches the traffic from end to end. The Cisco multicast address is added to the frames and sent from UNI to NNI. On the reverse path (NNI to UNI), protocol specific multicast address is attached to the frames and sent to the UNI.

Figure 2: Layer 2 Protocol Tunneling

1	CE layer 2 control protocol tunnel (end-to-end).	3	Third party PE forwards S-tagged frames and peers untagged frames.
2	Cisco multicast address is added to the frames and sent from UNI to NNI. On the reverse path (NNI to UNI), a protocol specific multicast address is attached to the frames and sent to UNI.	4	—

How to Configure Layer 2 Control Protocol Peering, Forwarding, and Tunneling

This section describes how to configure layer 2 control protocol peering, forwarding and tunneling:

Note The configuration defined for LACP impacts all slow protocols, and is applicable to all the options like peering, forwarding, and tunneling.

Configuring Layer 2 Peering

The ASR 901 router supports layer 2 peering functionality on a per Ethernet Flow Point (EFP) basis. It supports a maximum packet rate of 10 packets ps (per interface) for a protocol, and 100 packets ps for all protocols (on all interfaces).

Table 1: Options Supported on the ASR 901 Router, on page 4 displays the supported defaults and configuration options for the Cisco ASR 901 router.

Table 1: Options Supported on the ASR 901 Router

Protocol	Packet Type	Default Action	Configuration Option
CDP	Untagged	Peer	Peer/Forward/Tunnel
DTP	Untagged	Peer	Peer/Forward/Tunnel
LACP	Untagged	Peer	Peer/Forward/Tunnel
LLDP	Untagged	Peer	Peer/Forward/Tunnel
STP	Untagged	Peer	Peer/Forward/Tunnel
VTP	Untagged	Peer	Peer/Forward/Tunnel
CDP	Tagged	Drop	Forward/Tunnel
DTP	Tagged	Drop	Forward/Tunnel
LACP	Tagged	Drop	Forward/Tunnel
LLDP	Tagged	Drop	Forward/Tunnel
STP	Tagged	Drop	Forward/Tunnel
VTP	Tagged	Drop	Forward/Tunnel

Complete the following steps to configure layer 2 peering:

Note
- If an EFP is configured with layer 2 peering, then L2CP packets coming on the EFP is sent to the CPU for local protocol processing.
- Layer2 protocol peering is not supported on port-xconnect.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **service instance** *id* **ethernet**
5. **encapsulation** *encapsulation-type*
6. **l2protocol peer** [*protocol*]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable**	Enables privileged EXEC mode.

	Command or Action	Purpose
	Example: `Router> enable`	• Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Router(config)# interface gigabitethernet 0/6`	Specifies an interface type and number and enters interface configuration mode.
Step 4	**service instance** *id* **ethernet** **Example:** `Router(config-if)# service instance 20 ethernet`	Configures an Ethernet service instance on an interface. • *id*—Integer that uniquely identifies a service instance on an interface.
Step 5	**encapsulation** *encapsulation-type* **Example:** `Router(config-if-srv)# encapsulation untagged`	Defines the matching criteria to map untagged ingress Ethernet frames on an interface to the appropriate service instance.
Step 6	**l2protocol peer** [*protocol*] **Example:** `Router(config-if-srv)# l2protocol peer lacp`	Configures transparent Layer 2 protocol peering on the interface for a specified layer 2 protocol. • *protocol*—The protocol to be used. The options are: *cdp, dtp, lacp, lldp, stp,* and *vtp*. **Note** The peer option is not supported for DTP protocol.

Configuring Layer 2 Forwarding

Complete the following steps to configure layer 2 forwarding:

Note

- The layer 2 forwarding functionality is supported only on an untagged EFP (Only one untagged EFP exists per interface).
- Forwarding functionality is not supported with dot1q VLAN range encapsulation.
- If an interface is configured with layer 2 protocol forwarding, then L2CP packets on the interface are flooded on to the bridge domain. The flooding follows the translations specified in interface.
- Any manipulation of EXP bit is not supported while sending Bridge Protocol Data Units (BPDU) over xconnect.
- L2CP forwarding is supported only on xconnect interfaces/EFPs created over GigE/TenGig/Port-channel interfaces.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **l2proto-forward tagged** *protocol*
5. **service instance** *id* **ethernet**
6. **encapsulation untagged**
7. **l2protocol forward** [*protocol*]
8. **bridge-domain** *bridge-id*
9. **xconnect** *peer-ip-address vc-id* **encapsulation mpls**

DETAILED STEPS

	Command or Action	**Purpose**
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Router(config)# interface gigabitethernet 0/1`	Specifies an interface type and number and enters interface configuration mode.
Step 4	**l2proto-forward tagged** *protocol* **Example:** `Router(config-if)# l2proto-forward tagged cdp`	Configures a layer 2 control protocol forwarding on an interface. • *protocol*—Specifies the protocol to be forwarded.
Step 5	**service instance** *id* **ethernet** **Example:** `Router(config-if)# service instance 20 ethernet`	Configures an Ethernet service instance on an interface. • *id*—Integer that uniquely identifies a service instance on an interface.
Step 6	**encapsulation untagged** **Example:** `Router(config-if-srv)# encapsulation untagged`	Defines the matching criteria to map untagged ingress Ethernet frames on an interface to the appropriate service instance.
Step 7	**l2protocol forward** [*protocol*] **Example:**	Enables forwarding of untagged packets of specified protocol in a service instance.

	Command or Action	Purpose
	`Router(config-if-srv)# l2protocol forward cdp`	• *protocol*—The protocol to be used. The options are: *cdp, dtp, lacp, lldp, stp,* and *vtp*. Perform Step 8 if you want to bind a service instance to a bridge domain. Go to Step 9 if you want to bind an attachment to a xconnect.
Step 8	**bridge-domain** *bridge-id* **Example:** `Router(config-if-srv)# bridge-domain 200`	Binds a service instance to a bridge domain instance. • *bridge-id*—Identifier for the bridge domain instance.
Step 9	**xconnect** *peer-ip-address vc-id* **encapsulation mpls** **Example:** `Router(config-if-srv)# xconnect 1.1.1.1 100 encapsulation mpls`	Binds an attachment circuit to a pseudowire. • *peer-ip-address*—IP address of the remote provider edge (PE) peer. The remote router ID can be any IP address, as long as it is reachable. • *vc-id*—The 32-bit identifier of the virtual circuit (VC) between the PE routers. • **encapsulation**—Specifies the tunneling method to encapsulate the data in the pseudowire. • **mpls**—Specifies MPLS as the tunneling method.

Configuring Layer 2 Tunneling

The ASR 901 router supports layer 2 control protocol tunneling functionality on a per EFP basis. This functionality is supported for tagged and untagged packets based on CDP, DTP, LACP, LLDP, STP, and VTP protocols.

If an EFP is configured for layer 2 control protocol tunneling, then:

- Any L2CP packet coming on the EFP is forwarded to the bridge domain (BD) with Cisco proprietary multicast address (01-00-0c-cd-cd-d0).
- Any packet coming on the BD with Cisco proprietary multicast address (01-00-0c-cd-cd-d0) is stamped with well known L2CP MAC address (on EFP which has layer 2 protocol tunneling configured).
- A packet with Cisco proprietary multicast address is forwarded as is if l2protocol tunnel is not configured.

Complete the following steps to configure layer 2 tunneling:

Note

- Layer 2 protocol tunneling is not supported on xconnect EFPs.
- Tunneling functionality is not supported with dot1q VLAN range encapsulation.
- Layer 2 protocol tunneling supports a maximum packet rate of 10 packets ps (per interface) for a protocol, and 100 packets ps for all protocols (on all interfaces).
- Layer2 protocol tunneling is not supported on port-xconnect.

SUMMARY STEPS

1. **enable**

2. **configure terminal**
3. **interface** *type number*
4. **service instance** *id* **ethernet**
5. **encapsulation** *encapsulation-type*
6. **l2protocol tunnel** [*protocol*]
7. **bridge-domain** *bridge-id*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** Example: `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** Example: `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* Example: `Router(config)# interface gigabitethernet 0/4`	Specifies an interface type and number and enters interface configuration mode.
Step 4	**service instance** *id* **ethernet** Example: `Router(config-if)# service instance 9 ethernet`	Configure an Ethernet service instance on an interface. • *id*—Integer that uniquely identifies a service instance on an interface.
Step 5	**encapsulation** *encapsulation-type* Example: `Router(config-if-srv)# encapsulation untagged`	Sets the encapsulation method used by the interface. • *encapsulation type*—Type of encapsulation to be used.
Step 6	**l2protocol tunnel** [*protocol*] Example: `Router(config-if-srv)# l2protocol tunnel cdp`	Configures transparent Layer 2 protocol tunneling on the interface for the specified Layer 2 protocol. • *protocol*—(Optional) The protocol to be used. The options are: *cdp, dtp, lacp, lldp, stp,* and *vtp*.
Step 7	**bridge-domain** *bridge-id* Example: `Router(config-if-srv)# bridge-domain 9`	Binds a service instance to a bridge domain instance. • *bridge-id*—Identifier for the bridge domain instance.

Verifying Layer 2 Peering

To verify the layer 2 protocol peering functionality, use the **show ethernet service instance** command as shown below.

```
Router# show ethernet service instance id 99 interface gigabitEthernet0/4 detail
Service Instance ID: 99
Service Instance Type: static
Associated Interface: GigabitEthernet0/4
Associated EVC:
L2protocol peer cdp
CE-Vlans:
Encapsulation: untagged
Interface Dot1q Tunnel Ethertype: 0x8100
State: Up
EFP Statistics:
   Pkts In    Bytes In   Pkts Out  Bytes Out
         0          0          0          0
EFP Microblocks:
****************
Microblock type: Bridge-domain
Bridge-domain: 99
```

Verifying Layer 2 Forwarding

To verify the layer 2 protocol forwarding functionality, use the **show ethernet service instance** command as shown below.

```
Router# show ethernet service instance id 99 interface gigabitEthernet 0/0 detail
Service Instance ID: 99
Service Instance Type: static
Associated Interface: GigabitEthernet0/0
Associated EVC:
L2protocol forward cdp lldp
CE-Vlans:
Encapsulation: untagged
Interface Dot1q Tunnel Ethertype: 0x8100
State: Up
EFP Statistics:
Pkts In Bytes In Pkts Out Bytes Out
0 0 0 0
EFP Microblocks:
****************
Microblock type: Bridge-domain
Bridge-domain: 99
```

Verifying Layer 2 Tunneling

To verify the layer 2 control protocol tunneling functionality, use the **show ethernet service instance** command as shown below.

```
Router# show ethernet service instance id 9 interface GigabitEthernet 0/4 detail
Service Instance ID: 9
Service Instance Type: static
Associated Interface: GigabitEthernet0/4
Associated EVC:
L2protocol tunnel
```

```
CE-Vlans:
Encapsulation: untagged
Interface Dot1q Tunnel Ethertype: 0x8100
State: Up
EFP Statistics:
Pkts In Bytes In Pkts Out Bytes Out
0 0 0 0
EFP Microblocks:
****************
Microblock type: Bridge-domain
Bridge-domain: 9
```

Configuration Examples

This section provides sample configuration examples for Layer 2 Control Protocol Peering, Forwarding, and Tunneling feature on the routers.

Example: Configuring Layer 2 Peering

The following is a sample configuration of layer 2 peering.

```
!
interface GigabitEthernet0/0
negotiation auto
l2proto-forward tagged -- forwards all tagged frames, and drops untagged frames
cdp enable
service instance 9 ethernet
encapsulation dot1q 9
rewrite ingress tag pop 1 symmetric
bridge-domain 9
!
service instance 99 ethernet
encapsulation untagged
l2protocol peer cdp lldp -- peers lldp and cdp
bridge-domain 99
!
!
```

Example: Configuring Layer 2 Forwarding

The following is a sample configuration of layer 2 protocol forwarding at untagged EFP.

```
Building configuration...
Current configuration : 267 bytes
!
interface Port-channel1
 negotiation auto
!
 service instance 9 ethernet
  encapsulation untagged
  l2protocol forward cdp
  bridge-domain 9
 !
end
```

The following is a sample configuration of layer 2 protocol forwarding of tagged BPDUs at the port-channel interface level.

```
Current configuration : 270 bytes
!
interface Port-channel1
 no negotiation auto
 l2proto-forward tagged cdp
 service instance 9 ethernet
  encapsulation untagged
  bridge-domain 9
 !
 service instance 99 ethernet
  encapsulation dot1q 99
  rewrite ingress tag pop 1 symmetric
  bridge-domain 99
 !
end
```

Note   By default, tagged and untagged BPDUs are forwarded on port-xconnect.

The following is a sample configuration for interface level forwarding.

```
interface GigabitEthernet0/3
 no ip address
 negotiation auto
 l2proto-forward tagged cdp lldp
service instance 100 ethernet
  encapsulation dot1q 100
  rewrite ingress tag pop 1 symmetric
  xconnect 55.55.55.55 123 encapsulation mpls
service instance 200 ethernet
  encapsulation dot1q 200
  rewrite ingress tag pop 1 symmetric
  xconnect 66.66.66.66 124 encapsulation mpls
service instance 300 ethernet
  encapsulation untagged
  l2protocol peer cdp
l2protocol forward lacp
bridge-domain 300
```

The following is a sample configuration for Default Encapsulation EFP.

```
interface GigabitEthernet0/3
no ip address
 negotiation auto
service instance 200 ethernet
 encapsulation default
 l2protocol forward cdp stp
 l2protocol peer lldp
 xconnect 33.33.33.33 123 encapsulation mpls
```

Note   No explicit L2CP related configuration needs to be done for port-xconnect.

The following is a sample configuration for port-xconnect.

```
interface GigabitEthernet 0/4
 xconnect 44.44.44.44 123 encapsulation mpls
```

Example: Configuring Layer 2 Tunneling

The following is a sample configuration of Layer 2 control protocol tunneling for untagged packets.

```
Building configuration...
Current configuration : 151 bytes
!
interface GigabitEthernet0/1
negotiation auto
service instance 10 ethernet
encapsulation untagged
l2protocol tunnel cdp
bridge-domain 10
!
Service instance 100 ethernet
encapsulation dot1q 100
l2protocol tunnel lldp
rewrinte ingress tag pop 1 symmetric
bridge-domain 100
!
interface GigabitEthernet
negotiation auto
service instance 20 ethernet
encapsulation untagged
l2protocol tunnel
bridge-domain 20
!
end
```

The following is a sample configuration of Layer 2 control protocol tunneling for tagged packets.

> **Note** The configuration given below applies to only one router. Similar configuration has to be applied on two routers.

```
Building configuration...
Current configuration : 153 bytes
!
interface GigabitEthernet
 negotiation auto
 service instance 10 ethernet
  encapsulation dot1q 100
  l2protocol tunnel
  bridge-domain 50
 !
!
interface GigabitEthernet0/1
 negotiation auto
 service instance 10 ethernet
  encapsulation dot1q 100
  bridge-domain 50
 !
end
```

The following is a sample configuration of layer 2 protocol tunneling for receiving untagged LLDP packets from customer nodes and tunneling them tagged over provider network.

Router 1

```
Building configuration...
Current configuration : 151 bytes
!
interface GigabitEthernet0/1
 negotiation auto
 service instance 10 ethernet
  encapsulation untagged
  l2protocol tunnel lldp
  bridge-domain 20
 !
!
interface GigabitEthernet
 negotiation auto
 service instance 10 ethernet
  encapsulation dot1q 100
  rewrite ingress tag pop 1 symmetric
  bridge-domain 20
 !
end
```

Router 2

```
Current configuration : 170 bytes
!
interface GigabitEthernet
 negotiation auto
 service instance 20 ethernet
  encapsulation dot1q 100
  rewrite ingress tag pop 1 symmetric
  bridge-domain 30
 !
!
interface GigabitEthernet
 negotiation auto
 service instance 20 ethernet
  encapsulation untagged
  l2protocol tunnel lldp
  bridge-domain 30
 !
end
```

Additional References

The following sections provide references related to the Layer 2 Control Protocol Peering, Forwarding, and Tunneling feature.

Related Documents

Related Topic	Document Title
Cisco IOS Commands	Cisco IOS Master Commands List, All Releases

Related Topic	Document Title
Command Reference	
Cisco IOS Interface and Hardware Component Commands	Cisco IOS Interface and Hardware Component Command Reference
Cisco IOS LAN Switching Commands	Cisco IOS LAN Switching Command Reference

Standards

Standard	Title
None	—

MIBs

MIB	MIBs Link
None	To locate and download MIBs for selected platforms, Cisco IOS 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 Technical Support website contains thousands of pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content.	http://www.cisco.com/techsupport

Feature Information for Layer 2 Control Protocol Peering, Forwarding, and Tunneling

Table 2: Feature Information for Layer 2 Control Protocol Peering, Forwarding, and Tunneling, on page 15 lists the features in this module and provides links to specific configuration information.

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator enables you to determine which software images support a specific software release, feature

set, or platform. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn . An account on Cisco.com is not required.

Note   Table 2: Feature Information for Layer 2 Control Protocol Peering, Forwarding, and Tunneling, on page 15 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 2: Feature Information for Layer 2 Control Protocol Peering, Forwarding, and Tunneling

Feature Name	Releases	Feature Information
Layer 2 Control Protocol Peering and Forwarding	15.2(2)SNG	This feature was introduced on the Cisco ASR 901 routers. The following sections provide information about this feature: The following command was introduced: l2proto-forward
Layer 2 Control Protocol Tunneling	15.2(2)SNH1	This feature was introduced on the Cisco ASR 901 routers. The following sections provide information about this feature:
Layer 2 Control Protocol Forwarding over xconnect	15.4(1)S	This feature was introduced on the Cisco ASR 901 routers.