Layer 2 Local Switching

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The Layer 2 Local Switching feature allows you to switch Layer 2 data between two interfaces on the same router, and in some cases to switch Layer 2 data between two circuits on the same interface port.

The interface-to-interface switching combinations supported by this feature are:

- ATM to ATM
- ATM to Ethernet
- ATM to Frame Relay
- Ethernet to Ethernet VLAN
- Frame Relay to Frame Relay (and since the appearance of Cisco IOS Release 12.0(28)S, also to Multilink Frame Relay).

Note On the 6500 series and 7600 series, only *like-to-like* local switching is supported, which means that from the above list only the ATM to ATM and the Frame Relay to Frame Relay combinations are supported.

The same-port switching feature introduced with Cisco IOS Release 12.0(30)S supports the following:

- Same-port switching for ATM (Permanent Virtual Circuit (PVC) and Permanent Virtual Path (PVP)
- Same-port switching for Ethernet VLAN
- Same-port switching for Frame Relay

However, same-port switching is not supported on the 6500 series and 7600 series.

Starting with Cisco IOS Release 12.0(30)S, cell packing is available during ATM VP or VC local switching—on the Cisco 12000 series router on IP Services Engine (ISE/Engine 3) line cards. For information about how to configure cell packing, refer to *Any Transport over MPLS*.

For information about Layer 2 Local Switching on the Cisco 10000 series routers, see the "Configuring Layer 2 Local Switching" section of the *Cisco 10000 Series Router Broadband Aggregation, Leased-Line, and MPLS Configuration Guide.*

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Finding Feature Information in This Module

Your Cisco IOS software release may not support all of the features documented in this module. To reach links to specific feature documentation in this module and to see a list of the releases in which each feature is supported, use the "Feature Information for Layer 2 Local Switching" section on page 39.

Finding Support Information for Platforms and Cisco IOS and Catalyst OS Software Images

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

Contents

Prerequisites for Layer 2 Local Switching

- You must enable Cisco Express Forwarding for the Cisco 7200 series router. You must use Cisco Express Forwarding or Distributed Cisco Express Forwarding for the Cisco 7500 series router. (Distributed Cisco Express Forwarding is enabled already by default on the Cisco 12000 series routers).
- For Frame Relay local switching, you must globally issue the **frame-relay switching** command.

Restrictions for Layer 2 Local Switching

The following sections list the restrictions for the Layer 2 Local Switching feature:

General Restrictions

- For ATM-to-ATM local switching, the following ATM types are supported for the Layer 2 Local Switching feature:
  - ATM adaptation layer 5 (AAL5)
  - ATM single cell relay adaptation layer 0 (AAL0), VC mode
  - ATM single cell relay VP mode on the Cisco 12000 series router
  - ATM single cell relay VC and VP modes on ISE line cards on the Cisco 12000 series router
- In ATM single cell relay AAL0, the ATM virtual path identifier/virtual channel identifier (VPI/VCI) values must match between the ingress and egress ATM interfaces on the Cisco 7200 series and 7500 series routers. If Layer 2 local switching is desired between two ATM VPIs and VCIs whose values do not match and are on two different interfaces, choose ATM AAL5. However, if the ATM AAL5 is using Operation, Administration, and Maintenance (OAM) transparent mode, the VPI and VCI values must match.
- VPI/VCI rewrite is supported on the Cisco 12000 series router.
- NSF/SSO: Layer 2 Local Switching is supported on Cisco 7500 series routers.

Supported Line Cards for the Cisco 10000 Series Routers

For information about Layer 2 Local Switching on the Cisco 10000 series routers, see the "Configuring Layer 2 Local Switching " section of the *Cisco 10000 Series Router Broadband Aggregation, Leased-Line, and MPLS Configuration Guide* at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/aggr/10000/swconfig/cfggdes/bba/localsw.htm

Supported Port Adapters on Cisco 7200 and 7500 Series Routers

Layer 2 local switching is supported on the following port adapters in the Cisco 7200 and 7500 series routers:

- PA-FE-TX (single-port Fast Ethernet 100BASE-TX)
- PA-FE-FX (single-port Fast Ethernet 100BASE-FX)
- PA-2FE-TX (dual-port Fast Ethernet 100BASE-TX)
- PA-2FE-FX (dual-port Fast Ethernet 100BASE-FX)
- PA-4E (4-port Ethernet adapter)
- PA-8E (8-port Ethernet adapter)
- PA-4T (4-port synchronous serial port adapter)
- PA-4T+ (enhanced 4-port synchronous serial port adapter)
- PA-8T (8-port synchronous serial port adapter)
- PA-12E/2FE (12-port Ethernet/2-port Fast Ethernet (FE) adapter) [Cisco 7200 only]
- PA-GE (Gigabit Ethernet port adapter) [Cisco 7200 only]
- PA-H (single-port High-Speed Serial Interface (HSSI) adapter)
- PA-2H (dual-port HSSI adapter)

- PA-MC-8E1 (8-port multichannel E1 G.703/G.704 120-ohm interfaces)
- PA-MC-2EI (2-port multichannel E1 G.703/G.704 120-ohm interfaces)
- PA-MC-8T1 (8-port multichannel T1 with integrated data service units (DSUs) and channel service units CSUs))
- PA-MC-4T1 (4-port multichannel T1 with integrated CSUs and DSUs)
- PA-MC-2T1 (2-port multichannel T1 with integrated CSUs and DSUs)
- PA-MC-8TE1+ (8-port multichannel T1/E1)
- PA-MC-T3 (1-port multichannel T3 interface)
- PA-MC-E3 (1-port multichannel E3 interface)
- PA-MC-2T3+ (2-port enhanced multichannel T3 port adapter)
- PA-MC-STM1 (1-port multichannel STM-1 port adapter) [Cisco 7500 only]
- PA-T3 (single-port T3 port adapter)
- PA-E3 (single-port E3 port adapter)
- PA-2E3 (2-port E3 port adapter)
- PA-2T3 (2-port T3 port adapter)
- PA-POS-OC-3SML (single-port Packet over SONET (POS), single-mode, long reach)
- PA-POS-OC-3SMI (single-port PoS, single-mode, intermediate reach)
- PA-POS-OC-3MM (single-port PoS, multimode)
- PA-A3-OC-3 (1-port ATM OC-3/STM1 port adapter, enhanced)
- PA-A3-OC-12 (1-port ATM OC-12/STM-4 port adapter, enhanced) [Cisco 7500 only]
- PA-A3-T3 (DS3 high-speed interface)
- PA-A3-E3 (E3 medium-speed interface)
- PA-A3-8T1IMA (ATM inverse multiplexer over ATM port adapter with 8 T1 ports)
- PA-A3-8E1IMA (ATM inverse multiplexer over ATM port adapter with 8 E1 ports)
- PA-A6 (Cisco ATM Port Adapter)

Supported Interface Processors on Cisco 7200 Series Routers

- C7200-I/O-2FE
- C7200-I/O-GE+E (Only the Gigabit Ethernet port of this port adapter is supported.)
- C7200-I/O-FE

Supported Interface Processors on Cisco 7500 Series Routers

- GEIP (Gigabit Ethernet interface processor)
- GEIP+ (enhanced Gigabit Ethernet interface processor)

Supported Port Adapters and Interface Processors on the Cisco 7600-SUP720/MSFC3 Router

- All port adapters on the Enhanced FlexWAN module
- All SPAs on the SIP-200 line cards

Supported Interface Processors on Cisco 12000 Series Routers

- All Cisco 12000 series line cards support Frame Relay-to-Frame Relay local switching.
- 8-port OC-3 ATM Engine 2 line cards support only like-to-like Layer 2 local switching.
- ISE (Engine 3) line cards support like-to-like and any-to-any local switching. Non-ISE line cards support only like-to-like local switching.

  Starting in Cisco IOS Release 12.0(31)S2, ISE customer-facing interfaces support the following types of like-to-like and any-to-any local switching:

  - ATM to ATM
  - ATM to Ethernet
  - ATM to Frame Relay
  - Ethernet to Ethernet VLAN
  - Frame Relay to Frame Relay (including Multilink Frame Relay)
  - Same-port switching for ATM (PVC and PVP)
  - Same-port switching for Ethernet VLAN
  - Same-port switching for Frame Relay

Note Native Layer 2 Tunnel Protocol Version 3 (L2TPv3) tunnel sessions on customer-facing line cards can coexist with tunnel sessions that use a tunnel-server card.

- Starting in Cisco IOS Release 12.0(32)S, ISE customer-facing link bundling interfaces support the following type of local switching:
  - Ethernet to Ethernet VLAN
- Starting in Cisco IOS Release 12.0(32)SY, customer-facing interfaces on Engine 5 shared port adapters (SPAs) and SPA Interface Processors (SIPs) support the following types of like-to-like local switching:
  - Ethernet to Ethernet VLAN
  - Frame Relay to Frame Relay (including Multilink Frame Relay)
  - Same-port switching for Ethernet VLAN
  - Same-port switching for Frame Relay
- Starting in Cisco IOS Release 12.0(33)S, ISE customer-facing link bundling interfaces and customer-facing link bundling interfaces on Engine 5 shared port adapters (SPAs) and SPA Interface Processors (SIPs) support the following types of like-to-like and any-to-any local switching:
  - Ethernet to Ethernet VLAN
  - ATM to Ethernet

Unsupported Hardware

The following hardware is not supported:

- Cisco 7200—non-VXR chassis
- Cisco 7500—Route Switch Processor (RSP)1 and 2
- Cisco 7500—Versatile Interface Processor (VIP) 2-40 and below
- Cisco 12000 series—4-port OC-3 ATM Engine-0 line card
- Cisco 12000 series—4-port OC-12 ATM Engine-2 line card
- Cisco 12000 series—1-port OC-12 ATM Engine-0 line card
- Cisco 12000 series—Ethernet Engine-1, Engine-2, and Engine-4 line cards

Information About Layer 2 Local Switching

To configure the the Layer 2 Local Switching feature, you should understand the following concepts:

- Layer 2 Local Switching Overview, page 6
- NSF/SSO—Local Switching Overview, page 6
- Layer 2 Local Switching Applications, page 7

For information about Layer 2 Local Switching on the Cisco 10000 series routers, see the “Configuring Layer 2 Local Switching ” section of the *Cisco 10000 Series Router Broadband Aggregation, Leased-Line, and MPLS Configuration Guide* at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/aggr/10000/swconfig/cfggdes/bba/localsw.htm

Layer 2 Local Switching Overview

Local switching allows you to switch Layer 2 data between two interfaces of the same type (for example, ATM to ATM, or Frame Relay to Frame Relay) or between interfaces of different types (for example, Frame Relay to ATM) on the same router. The interfaces can be on the same line card or on two different cards. During these kinds of switching, the Layer 2 address is used, not any Layer 3 address.

Additionally, same-port local switching allows you to switch Layer 2 data between two circuits on the same interface.

NSF/SSO—Local Switching Overview

Nonstop forwarding (NSF) and stateful switchover (SSO) improve the availability of the network by providing redundant route processors and checkpointing of data to ensure minimal packet loss when the primary route processor goes down. NSF/SSO support is available for the following locally switched attachment circuits:

- Ethernet to Ethernet VLAN
- Frame Relay to Frame Relay

Layer 2 Local Switching Applications

Incumbent local exchange carriers (ILECs) who use an interexchange carrier (IXC) to carry traffic between two local exchange carriers can use the Layer 2 Local Switching feature. Telecom regulations require the ILECs to pay the IXCs to carry that traffic. At times, the ILECs cannot terminate customer connections that are in different local access and transport areas (LATAs). In other cases, customer connections terminate in the same LATA, which may also be on the same router.

For example, company A has more than 50 LATAs across the country and uses three routers for each LATA. Company A uses companies B and C to carry traffic between local exchange carriers. Local switching of Layer 2 frames on the same router might be required.

Similarly, if a router is using, for example, a channelized interface, it might need to switch incoming and outgoing traffic across two logical interfaces that reside on a single physical port. The same-port local switching feature addresses that implementation.

Figure 1 shows a network that uses local switching for both Frame Relay to Frame Relay and ATM to Frame Relay local switching.

Figure 1 Local Switching Example

How to Configure Layer 2 Local Switching

The following sections explain the tasks you can perform to configure the Layer 2 Local Switching feature:

- Configuring ATM-to-ATM PVC Local Switching and Same-Port Switching, page 8 (required)
- Configuring ATM-to-ATM PVP Local Switching, page 9 (required)
- Configuring ATM PVP Same-Port Switching, page 10 (required)
- Configuring ATM-to-Ethernet Port Mode Local Switching, page 11 (required)
- Configuring ATM-to-Ethernet VLAN Mode Local Switching, page 13 (required)
- Configuring Ethernet VLAN Same-Port Switching, page 15 (required)
- Configuring Ethernet Port Mode to Ethernet VLAN Local Switching, page 17 (required)
- Configuring ATM-to-Frame Relay Local Switching, page 18 (required)
- Configuring Frame Relay-to-Frame Relay Local Switching, page 20 (required)

- Configuring Frame Relay Same-Port Switching, page 22 (required)
- Verifying Layer 2 Local Switching, page 23 (optional)

For information about Layer 2 Local Switching on the Cisco 10000 series routers, see the "Configuring Layer 2 Local Switching " section of the *Cisco 10000 Series Router Broadband Aggregation, Leased-Line, and MPLS Configuration Guide* at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/aggr/10000/swconfig/cfggdes/bba/localsw.htm

Configuring ATM-to-ATM PVC Local Switching and Same-Port Switching

You can configure local switching for both ATM AAL5 and ATM AAL0 encapsulation types.

Creating the ATM PVC is not required. If you do not create a PVC, one is created for you. For ATM-to-ATM local switching, the autoprovisioned PVC is given the default encapsulation type AAL0 cell relay.

Note Starting with Cisco IOS Release 12.0(30)S, you can configure same-port switching following the steps in this section.

Use the following steps to configure ATM-to-ATM PVC local switching and same-port switching.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface atm***slot*/*subslot*/*port*
4. **pvc** *vpi*/*vci* **l2transport**
5. **encapsulation** *layer-type*
6. **exit**
7. **exit**
8. **connect** *connection-name interface pvc interface pvc*

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.

	Command or Action	Purpose
Step 3	**interface atm***slot*/*subslot*/*port* **Example:** `Router(config)# interface atm1/0`	Specifies an ATM line card, subslot (if available), and port, and enters interface configuration mode.
Step 4	**pvc** *vpi*/*vci* **l2transport** **Example:** `Router(config-if)# pvc 1/200 l2transport`	Assigns a VPI and VCI and enters ATM PVC l2transport configuration mode. • The **l2transport** keyword indicates that the PVC is a switched PVC instead of a terminated PVC.
Step 5	**encapsulation** *layer-type* **Example:** `Router(cfg-if-atm-l2trans-pvc)# encapsulation aal5`	Specifies the encapsulation type for the ATM PVC. Both AAL0 and AAL5 are supported. • Repeat Steps 3 through 5 for another ATM PVC on the same router.
Step 6	**exit** **Example:** `Router(cfg-if-atm-l2trans-pvc)# exit`	Exits PVC l2transport configuration mode and returns to interface configuration mode.
Step 7	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.
Step 8	**connect** *connection-name interface pvc interface pvc* **Example:** `Router(config)# connect atm-con atm1/0/0 0/100 atm2/0/0 0/100`	Creates a local connection between the two specified permanent virtual circuits.

Configuring ATM-to-ATM PVP Local Switching

Use the following steps to configure ATM-to-ATM PVP local switching.

Starting with Cisco IOS Release 12.0(30)S, you can configure same-port switching, as detailed in the "Configuring ATM PVP Same-Port Switching" section on page 10.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface atm***slot*/*subslot*/*port*
4. **atm pvp** *vpi* **l2transport**
5. **exit**
6. **exit**
7. **connect** *connection-name interface pvp interface pvp*

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 atm***slot*/*subslot*/*port* **Example:** `Router(config)# interface atm1/0`	Specifies an ATM line card, subslot (if available), and port, and enters interface configuration mode.
Step 4	**atm pvp** *vpi* **l2transport** **Example:** `Router(config-if)# atm pvp 100 l2transport`	Identifies the virtual path and enters PVP l2transport configuration mode. The **l2transport** keyword indicates that the PVP is a switched PVP instead of a terminated PVP. • Repeat Steps 3 and 4 for another ATM permanent virtual path on the same router.
Step 5	**exit** **Example:** `Router(config-if-atm-l2trans-pvp)# exit`	Exits PVP l2transport configuration mode and returns to interface configuration mode.
Step 6	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.
Step 7	**connect** *connection-name interface pvp interface pvp* **Example:** `Router(config)# connect atm-con atm1/0 100 atm2/0 200`	In global configuration mode, creates a local connection between the two specified permanent virtual paths.

Configuring ATM PVP Same-Port Switching

Use the following steps to configure ATM PVP switching on a single ATM interface.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface atm***slot*/*subslot*/*port*
4. **atm pvp** *vpi* **l2transport**

5. **exit**
6. **exit**
7. **connect** *connection-name interface pvp interface pvp*

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 atm***slot*/*subslot*/*port* **Example:** `Router(config)# interface atm1/0/0`	Specifies an ATM line card, subslot (if available), and port, and enters interface configuration mode.
Step 4	**atm pvp** *vpi* **l2transport** **Example:** `Router(config-if)# atm pvp 100 l2transport`	Specifies one VPI and enters PVP l2transport configuration mode. Repeat this step for the other ATM permanent virtual path on this same port. • The **l2transport** keyword indicates that the indicated PVP is a switched PVP instead of a terminated PVP.
Step 5	**exit** **Example:** `Router(config-if-atm-l2trans-pvp)# exit`	Exits PVP l2transport configuration mode and returns to interface configuration mode.
Step 6	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.
Step 7	**connect** *connection-name interface pvp interface pvp* **Example:** `Router(config)# connect atm-con atm1/0/0 100 atm1/0/0 200`	In global configuration mode, creates the local connection between the two specified permanent virtual paths.

Configuring ATM-to-Ethernet Port Mode Local Switching

For ATM to Ethernet Port mode local switching, creating the ATM PVC is not required. If you do not create a PVC, one is created for you. For ATM-to-Ethernet local switching, the autoprovisioned PVC is given the default encapsulation type AAL5SNAP.

ATM-to-Ethernet local switching supports both the IP and Ethernet interworking types.

ATM-to-Ethernet local switching supports the following encapsulation types:

- ATM-to-Ethernet with IP interworking: AAL5SNAP, AAL5MUX
- ATM-to-Ethernet with Ethernet interworking: AAL5SNAP

Use the following steps to configure local switching between ATM and Ethernet port mode.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface atm***slot*/*subslot*/*port*
4. **pvc** *vpi*/*vci* **l2transport**
5. **encapsulation** *layer-type*
6. **exit**
7. **exit**
8. **interface fastethernet***slot*/*subslot*/*port*
9. **exit**
10. **connect** *connection-name interface pvc interface* **interworking ip | ethernet**

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 atm***slot*/*subslot*/*port* **Example:** `Router(config)# interface atm1/0`	Specifies an ATM line card, subslot (if available), and port, and enters interface configuration mode.
Step 4	**pvc** *vpi*/*vci* **l2transport** **Example:** `Router(config-if)# pvc 1/200 l2transport`	Assigns a VPI and VCI and enters PVC l2transport configuration mode. • The **l2transport** keyword indicates that the PVC is a switched PVC instead of a terminated PVC.
Step 5	**encapsulation** *layer-type* **Example:** `Router(cfg-if-atm-l2trans-pvc)# encapsulation aal5snap`	Specifies the encapsulation type for the PVC.

	Command or Action	Purpose
Step 6	**exit** **Example:** `Router(config-if-atm-l2trans-pvc)# exit`	Exits PVC l2transport configuration mode and returns to interface configuration mode.
Step 7	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.
Step 8	**interface fastethernet***slot*/*subslot*/*port* **Example:** `Router(config)# interface fastethernet6/0/0`	Specifies a Fast Ethernet line card, subslot (if available), and port, and enters interface configuration mode.
Step 9	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.
Step 10	**connect** *connection-name interface pvc interface* **interworking ip** | **ethernet** **Example:** `Router(config)# connect atm-eth-con atm1/0 0/100 fastethernet6/0/0 interworking ethernet`	In global configuration mode, creates a local connection between the two interfaces and specifies the interworking type. • Both the IP and Ethernet interworking types are supported.

Configuring ATM-to-Ethernet VLAN Mode Local Switching

For ATM-to-Ethernet VLAN Mode local switching, creating the ATM PVC is not required. If you do not create a PVC, one is created for you. For ATM-to-Ethernet local switching, the autoprovisioned PVC is given the default encapsulation type AAL5SNAP.

ATM-to-Ethernet local switching supports both the IP and Ethernet interworking types.

ATM-to-Ethernet local switching supports the following encapsulation types:

- ATM-to-Ethernet with IP interworking: AAL5SNAP, AAL5MUX
- ATM-to-Ethernet with Ethernet interworking: AAL5SNAP

The VLAN header is removed from frames that are received on an Ethernet subinterface.

Use the following steps to configure local switching for ATM to Ethernet in VLAN mode.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface atm***slot*/*subslot*/*port*
4. **pvc** *vpi*/*vci* **l2transport**
5. **encapsulation** *layer-type*
6. **exit**

7. **interface fastethernet***slot/port/subinterface-number*
8. **encapsulation dot1q** *vlan-id*
9. **exit**
10. **connect** *connection-name interface pvc interface* **interworking ip | ethernet**

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 atm***slot/subslot/port* **Example:** `Router(config)# interface atm1/0/0`	Specifies an ATM line card, subslot (if available), and port, and enters interface configuration mode.
Step 4	**pvc** *vpi/vci* **l2transport** **Example:** `Router(config-if)# pvc 1/200 l2transport`	Assigns a VPI and VCI and enters PVC l2transport configuration mode. • The **l2transport** keyword indicates that the PVC is a switched PVC instead of a terminated PVC.
Step 5	**encapsulation** *layer-type* **Example:** `Router(cfg-if-atm-l2trans-pvc)# encapsulation aal5snap`	Specifies the encapsulation type for the PVC.
Step 6	**exit** **Example:** `Router(cfg-if-atm-l2trans-pvc)# exit`	Exits PVC l2transport configuration mode and returns to interface configuration mode.
Step 7	**interface fastethernet***slot/port/subinterface-number* **Example:** `Router(config-if)# interface fastethernet6/0/0.1`	Specifies a Fast Ethernet line card, subslot (if available), port, and subinterface, and enters subinterface configuration mode.
Step 8	**encapsulation dot1q** *vlan-id* **Example:** `Router(config-subif)# encapsulation dot1q 100`	Enables the interface to accept 802.1Q VLAN packets.

	Command or Action	Purpose
Step 9	**exit** **Example:** `Router(config-subif)# exit`	Exits subinterface configuration mode and returns to global configuration mode.
Step 10	**connect** *connection-name interface pvc interface* **interworking ip** | **ethernet** **Example:** `Router(config)# connect atm-eth-vlan-con atm1/0/0 0/100 fastethernet6/0/0.1 interworking ethernet`	In global configuration mode, creates a local connection between the two interfaces and specifies the interworking type. • Both the IP and Ethernet interworking types are supported.

Configuring Ethernet VLAN Same-Port Switching

Use the following steps to configure switching from one VLAN to another VLAN on the same Ethernet port.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface fastethernet***slot/port.subinterface-number*
4. **encapsulation dot1q** *vlan-id*
5. **exit**
6. **interface fastethernet***slot/port.subinterface-number*
7. **encapsulation dot1q** *vlan-id*
8. **exit**
9. **connect** *connection-name interface interface*

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.

	Command or Action	Purpose
Step 3	**interface fastethernet***slot***/***port.subinterface-number* **Example:** `Router(config)# interface fastethernet6/0.1`	Specifies the first Fast Ethernet line card, subslot (if available), port, and subinterface, and enters subinterface configuration mode.
Step 4	**encapsulation dot1q** *vlan-id* **Example:** `Router(config-subif)# encapsulation dot1q 10`	Enables that subinterface to accept 802.1Q VLAN packets and specifies the first VLAN.
Step 5	**exit** **Example:** `Router(config-subif)# exit`	Exits subinterface configuration mode and returns to global configuration mode.
Step 6	**interface fastethernet***slot***/***port.subinterface-number* **Example:** `Router(config)# interface fastethernet6/0.2`	In global configuration mode, specifies the second Fast Ethernet line card, subslot (if available), port, and subinterface, and enters subinterface configuration mode.
Step 7	**encapsulation dot1q** *vlan-id* **Example:** `Router(config-subif)# encapsulation dot1q 20`	Enables this subinterface to accept 802.1Q VLAN packets and specifies the second VLAN.
Step 8	**exit** **Example:** `Router(config-subif)# exit`	Exits subinterface configuration mode and returns to global configuration mode.
Step 9	**connect** *connection-name interface interface* **Example:** `Router(config)# connect conn fastethernet6/0.1 fastethernet6/0.2`	In global configuration mode, creates a local connection between the two subinterfaces (and hence their previously specified VLANs) on the same Fast Ethernet port.

Configuring Ethernet Port Mode to Ethernet VLAN Local Switching

This section explains how to configure local switching for Ethernet (port mode) to Ethernet VLAN.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface fastethernet***slot*/*subslot*/*port*
4. **interface fastethernet***slot*/*port*/*subinterface-number*
5. **encapsulation dot1q** *vlan-id*
6. **exit**
7. **connect** *connection-name interface interface* [**interworking ip** | **ethernet**]

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 fastethernet***slot*/*subslot*/*port* **Example:** `Router(config)# interface fastethernet3/0/0`	Specifies a Fast Ethernet line card, subslot (if available), and port, and enters interface configuration mode. This is the interface on one side of the PE router that passes Ethernet packets to and from the customer edge (CE) router.
Step 4	**interface fastethernet***slot*/*port*/*subinterface-number* **Example:** `Router(config)# interface fastethernet6/0/0.1`	Specifies a Fast Ethernet line card, subslot (if available), port, and subinterface, and enters subinterface configuration mode. This is the interface on the other side of the PE router than passes Ethernet VLAN packets to and from the CE router.
Step 5	**encapsulation dot1q** *vlan-id* **Example:** `Router(config-subif)# encapsulation dot1q 100`	Enables the interface to accept 802.1Q VLAN packets.

	Command or Action	Purpose
Step 6	**exit** **Example:** `Router(config-subif)# exit`	Exits subinterface configuration mode and returns to global configuration mode.
Step 7	**connect** *connection-name interface interface* [**interworking ip** | **ethernet**] **Example:** `Router(config)# connect eth-ethvlan-con fastethernet3/0/0 fastethernet6/0/0.1 interworking ethernet`	Creates a local connection between the two interfaces and specifies the interworking type. • Both the IP and Ethernet interworking types are supported.

Configuring ATM-to-Frame Relay Local Switching

You use the **interworking ip** keywords for configuring ATM-to-Frame Relay local switching.

FRF.8 Frame Relay-to-ATM service interworking functionality is not supported. Frame Relay discard-eligible (DE) bits do not get mapped to ATM cell loss priority (CLP) bits, and forward explicit congestion notification (FECN) bits do not get mapped to ATM explicit forward congestion indication (EFCI) bits.

For additional information about ATM-to-Frame Relay Local Switching, see the "Configuring Frame Relay-ATM Interworking" section of the *Cisco IOS Wide Area Networking Configuration Guide*.

Creating the PVC is not required. If you do not create a PVC, one is created for you. For ATM-to-Ethernet local switching, the automatically provisioned PVC is given the default encapsulation type AAL5SNAP.

ATM-to-Frame Relay local switching supports the following encapsulation types:

- AAL5SNAP
- AAL5NLPID (Cisco 12000 series router uses AAL5MUX instead, for IP interworking)

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface atm***slot*/*subslot*/*port*
4. **pvc** *vpi*/*vci* **l2transport**
5. **encapsulation** *layer-type*
6. **exit**
7. **interface serial***slot*/*port*
8. **encapsulation frame-relay** [**cisco** | **ietf**]
9. **frame-relay interface-dlci** *dlci* **switched**
10. **exit**
11. **connect** *connection-name interface pvc interface dlci* [**interworking ip** | **ethernet**]

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 atm***slot*/*subslot*/*port* **Example:** `Router(config)# interface atm1/0`	Specifies an ATM line card, subslot (if available), and port, and enters interface configuration mode.
Step 4	**pvc** *vpi*/*vci* **l2transport** **Example:** `Router(config-if)# pvc 1/200 l2transport`	Assigns a VPI and VCI and enters PVC l2transport configuration mode. • The **l2transport** keyword indicates that the PVC is a switched PVC instead of a terminated PVC.
Step 5	**encapsulation** *layer-type* **Example:** `Router(cfg-if-atm-l2trans-pvc)# encapsulation aal5snap`	Specifies the encapsulation type for the PVC.
Step 6	**exit** **Example:** `Router(cfg-if-atm-l2trans-pvc)# exit`	Exits PVC l2transport configuration mode and returns to interface configuration mode.
Step 7	**interface serial***slot*/*subslot*/*port* **Example:** `Router(config-if)# interface serial6/0/0`	Specifies a channelized line card, subslot (if available), and serial port.
Step 8	**encapsulation frame-relay** [**cisco** | **ietf**] **Example:** `Router(config-if)# encapsulation frame-relay ietf`	Specifies Frame Relay encapsulation for the interface. • The encapsulation type does not matter for local switching. It has relevance only for terminated circuits.
Step 9	**frame-relay interface-dlci** *dlci* **switched** **Example:** `Router(config-if)# frame-relay interface-dlci 100 switched`	(Optional) Configures a switched Frame Relay DLCI. • If you do not create a Frame Relay PVC in this step, one is automatically created by the **connect** command.

	Command or Action	Purpose
Step 10	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.
Step 11	**connect** *connection-name interface pvc interface dlci* [**interworking ip** | **ethernet**] **Example:** `Router(config)# connect atm-fr-con atm1/0 0/100 serial6/0/0 100 interworking ip`	Creates a local connection between the two interfaces.

Configuring Frame Relay-to-Frame Relay Local Switching

For background information about Frame Relay-to-Frame Relay Local Switching, see the *Distributed Frame Relay Switching* feature module.

With Cisco IOS Release 12.0(30)S, you can switch between virtual circuits on the same port, as detailed in the "Configuring Frame Relay Same-Port Switching" section on page 22.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip cef** [**distributed**]
4. **frame-relay switching**
5. **interface** *type number*
6. **encapsulation frame-relay** [**cisco** | **ietf**]
7. **frame-relay interface-dlci** *dlci* **switched**
8. **exit**
9. **exit**
10. **connect** *connection-name interface dlci interface dlci*

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.

	Command or Action	Purpose
Step 3	**ip cef** [**distributed**] **Example:** `Router(config)# ip cef`	Enables Cisco Express Forwarding operation. • For the Cisco 7500 series router, use the **ip cef distributed** command. (On the Cisco 12000 series router, this command is already enabled by default). • For the Cisco 7200 series router, use the **ip cef** command.
Step 4	**frame-relay switching** **Example:** `Router(config)# frame-relay switching`	Enables PVC switching on a Frame Relay DCE device or a Network-to-Network Interface (NNI).
Step 5	**interface** *type number* **Example:** `Router(config)# interface serial 0`	Specifies a Frame Relay interface and enters interface configuration mode.
Step 6	**encapsulation frame-relay** [**cisco** | **ietf**] **Example:** `Router(config-if)# encapsulation frame-relay`	Enables Frame Relay encapsulation. • The default is **cisco** encapsulation. • You do not need to specify an encapsulation type.
Step 7	**frame-relay interface-dlci** *dlci* **switched** **Example:** `Router(config-if)# frame-relay interface-dlci 100 switched`	(Optional) Creates a switched PVC and enters Frame Relay DLCI configuration mode. • Repeat steps 5 through 7 for each switched PVC. • If you do not create a Frame Relay PVC in this step, it will automatically be created by the **connect** command.
Step 8	**exit** **Example:** `Router(config-fr-dlci)# exit`	Exits Frame Relay DLCI configuration mode and returns to interface configuration mode.
Step 9	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.
Step 10	**connect** *connection-name interface dlci interface dlci* **Example:** `Router(config)# connect connection1 serial0 100 serial1 101`	Defines a connection between Frame Relay PVCs.

Configuring Frame Relay Same-Port Switching

Use the following steps to configure local Frame Relay switching on a single interface.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip cef** [**distributed**]
4. **frame-relay switching**
5. **interface** *type number*
6. **encapsulation frame-relay** [**cisco** | **ietf**]
7. **frame-relay intf-type** [**dte** | **dce** | **nni**]
8. **frame-relay interface-dlci** *dlci* **switched**
9. **exit**
10. **exit**
11. **connect** *connection-name interface dlci interface dlci*

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	**ip cef** [**distributed**] **Example:** `Router(config)# ip cef`	Enables Cisco Express Forwarding operation. • For the Cisco 7500 series router, use the **ip cef distributed** command. (On the Cisco 12000 series router, this command is already enabled by default). • For the Cisco 7200 series router, use the **ip cef** command.
Step 4	**frame-relay switching** **Example:** `Router(config)# frame-relay switching`	Enables PVC switching on a Frame Relay DCE device or a NNI.
Step 5	**interface** *type number* **Example:** `Router(config)# interface serial 0`	Specifies a Frame Relay interface and enters interface configuration mode.

	Command or Action	Purpose
Step 6	**encapsulation frame-relay** [**cisco** | **ietf**] **Example:** `Router(config-if)# encapsulation frame-relay`	Enables Frame Relay encapsulation. • The default is **cisco** encapsulation. • You do not need to specify an encapsulation type.
Step 7	**frame-relay intf-type** [**dce** | **dte** | **nni**] **Example:** `Router(config-if)# frame-relay intf-type nni`	(Optional) Enables support for a particular type of connection: • DCE • DTE (default) • NNI
Step 8	**frame-relay interface-dlci** *dlci* **switched** **Example:** `Router(config-if)# frame-relay interface-dlci 100 switched`	(Optional) Creates a switched PVC and enters Frame Relay DLCI configuration mode. • If you do not create a Frame Relay PVC in this step, it will automatically be created by the **connect** command.
Step 9	**exit** **Example:** `Router(config-fr-dlci)# exit`	Exits Frame Relay DLCI configuration mode and returns to interface configuration mode.
Step 10	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.
Step 11	**connect** *connection-name interface dlci interface dlci* **Example:** `Router(config)# connect connection1 serial1/0 100 serial1/0 200`	Defines a connection between the two data links.

Verifying Layer 2 Local Switching

This section provides the following verification tasks and troubleshooting information:

- Verifying Layer 2 Local Switching Configuration, page 24
- Verifying the NSF/SSO Local Switching Configuration, page 25
- Troubleshooting Tips, page 26

Verifying Layer 2 Local Switching Configuration

To verify configuration of the Layer 2 Local Switching feature, use the following commands on the provider edge (PE) router:

SUMMARY STEPS

1. **show connection** [**all** | *element* | **id** *ID* | **name** *name* | **port** *port*]
2. **show atm pvc**
3. **show frame-relay pvc** [*pvc*]

DETAILED STEPS

Step 1 **show connection** [**all** | *element* | **id** *ID* | **name** *name* | **port** *port*]

The **show connection** command displays the local connection between an ATM interface and a Fast Ethernet interface:

```
Router# show connection name atm-eth-con

ID  Name            Segment 1              Segment 2         State
=====================================================================
1   atm-eth-con     ATM0/0/0 AAL5 0/100    FastEthernet6/0/0  UP
```

This example displays the local connection between an ATM interface and a serial interface:

```
Router# show connection name atm-fr-con

ID  Name            Segment 1              Segment 2         State
=====================================================================
1   atm-fr-con     ATM0/0/0 AAL5 0/100    Serial1/0/0  16     UP
```

This example displays a same-port connection on a serial interface.

```
Router# show connection name same-port

ID  Name            Segment 1              Segment 2         State
=====================================================================
1   same-port      Serial1/1/1  101       Serial1/1/1  102    UP
```

Step 2 **show atm pvc**

The **show atm pvc** command shows that interface ATM3/0 is UP:

```
Router# show atm pvc

            VCD/                                        Peak   Avg/Min   Burst
Interface   Name   VPI   VCI   Type   Encaps      SC  Kbps   Kbps      Cells    Sts
3/0         10     1     32    PVC    FRATMSRV    UBR 155000                    UP
```

Step 3 **show frame-relay pvc** [*pvc*]

The **show frame-relay pvc** command shows a switched Frame Relay PVC:

```
Router# show frame-relay pvc 16

PVC Statistics for interface POS5/0 (Frame Relay NNI)
DLCI = 16, DLCI USAGE = SWITCHED, PVC STATUS = UP, INTERFACE = POS5/0
LOCAL PVC STATUS = UP, NNI PVC STATUS = ACTIVE
input pkts 0 output pkts 0 in bytes 0
out bytes 0 dropped pkts 100 in FECN pkts 0
```

```
in BECN pkts 0 out FECN pkts 0 out BECN pkts 0
in DE pkts 0 out DE pkts 0
out bcast pkts 0 out bcast bytes 0
switched pkts 0
Detailed packet drop counters:
no out intf 0 out intf down 100 no out PVC 0
in PVC down 0 out PVC down 0 pkt too big 0
pvc create time 00:25:32, last time pvc status changed 00:06:31
```

Verifying the NSF/SSO Local Switching Configuration

Layer 2 local switching provides NSF/SSO support for Local Switching of the following attachment circuits on the same router:

- Ethernet (port mode) to Ethernet VLAN
- Frame Relay to Frame Relay

For information about configuring NSF/SSO on the Route Processors, see the *Stateful Switchover* feature module. To verify that the NSF/SSO: Layer 2 Local Switching is working correctly, follow the steps in this section.

SUMMARY STEPS

1. **ping**
2. **redundancy force-switchover**
3. **show connect all**
4. **ping**

DETAILED STEPS

Step 1 Issue the **ping** command or initiate traffic between the two CE routers.

Step 2 Force the switchover from the active RP to the standby RP by using the **redundancy force-switchover** command. This manual procedure allows for a “graceful” or controlled shutdown of the active RP and switchover to the standby RP. This graceful shutdown allows critical cleanup to occur.

Step 3 Issue the **show connect all** command to ensure that the Layer 2 Local Switching connection on the dual RP is operating.

```
Router# show connect all

ID      Name          Segment 1     Segment 2     State
2      Eth-Vlan1      Fa1/1/1       Fa6/0/0/0.1   UP
```

Step 4 Issue the **ping** command from the CE router to verify that the contiguous packet outage was minimal during the switchover.

Troubleshooting Tips

You can troubleshoot Layer 2 local switching using the following commands on the PE router:

- **debug atm l2transport**
- **debug conn**
- **debug frame-relay pseudowire**
- **show frame-relay pvc**
- **show connection**
- **show atm pvc**

Configuration Examples for Layer 2 Local Switching

This section provides the following configuration examples:

ATM-to-ATM Local Switching: Example

The following example shows local switching on ATM interfaces configured for AAL5:

```
interface atm1/0/0
 pvc 0/100 l2transport
 encapsulation aal5

interface atm2/0/0
 pvc 0/100 l2transport
 encapsulation aal5

connect aal5-conn atm1/0/0 0/100 atm2/0/0 0/100
```

ATM PVC Same-Port Switching: Example

The following example shows same-port switching between two PVCs on one ATM interface:

```
interface atm1/0/0
 pvc 0/100 l2transport
 encapsulation aal5
 pvc 0/200 l2transport
```

```
 encapsulation aal5

connect conn atm1/0/0 0/100 atm1/0/0 0/200
```

ATM PVP Same-Port Switching: Example

The following example shows same-port switching between two PVPs on one ATM interface:

```
interface atm1/0/0
 atm pvp 100 l2transport
 atm pvp 200 l2transport

connect conn atm1/0/0 100 atm1/0/0 200
```

ATM-to-Ethernet Local Switching: Examples

ATM-to-Ethernet local switching terminates an ATM frame to an Ethernet/VLAN frame over the same PE router. Two interworking models are used: Ethernet mode and IP mode.

ATM to Ethernet VLAN: Example

The following example shows an Ethernet interface configured for Ethernet VLAN, and an ATM PVC interface configured for AAL5 encapsulation. The **connect** command allows local switching between these two interfaces and specifies the interworking type as Ethernet mode.

```
interface fastethernet6/0/0.1
 encapsulation dot1q 10

interface atm2/0/0
 pvc 0/400 l2transport
 encapsulation aal5

connect atm-ethvlan-con atm2/0/0 0/400 fastethernet6/0/0.1 interworking ethernet
```

ATM to Ethernet Port Mode: Example

The following example shows an Ethernet interface configured for Ethernet and an ATM interface configured for AAL5SNAP encapsulation. The **connect** command allows local switching between these two interfaces and specifies the interworking type as IP mode.

```
interface atm0/0/0
 pvc 0/100 l2transport
 encapsulation aal5snap

interface fastethernet6/0/0

connect atm-eth-con atm0/0/0 0/100 fastethernet6/0/0 interworking ip
```

Ethernet VLAN Same-Port Switching: Example

The following example shows same-port switching between two VLANs on one Ethernet interface:

```
interface fastethernet0/0.1
 encapsulation dot1q 1
interface fastethernet0/0.2
```

```
 encapsulation dot1q 2

connect conn FastEthernet0/0.1 FastEthernet0/0.2
```

ATM-to-Frame Relay Local Switching: Example

The following example shows a serial interface configured for Frame Relay and an ATM interface configured for AAL5SNAP encapsulation. The **connect** command allows local switching between these two interfaces.

```
interface serial1/0
 encapsulation frame-relay

interface atm1/0
 pvc 7/100 l2transport
 encapsulation aal5snap

connect atm-fr-conn atm1/0 7/100 serial1/0 100 interworking ip
```

Frame Relay-to-Frame Relay Local Switching: Example

The following example shows serial interfaces configured for Frame Relay. The **connect** command allows local switching between these two interfaces.

```
frame-relay switching
ip cef distributed

interface serial3/0/0
 encapsulation frame-relay
 frame-relay interface-dlci 100 switched
 frame-relay intf-type dce

interface serial3/1/0
 encapsulation frame-relay ietf
 frame-relay interface-dlci 200 switched
 frame-relay intf-type dce

connect fr-con serial3/0/0 100 serial3/1/0 200
```

Frame Relay DLCI Same-Port Switching: Example

The following example shows same-port switching between two data links on one Frame Relay interface:

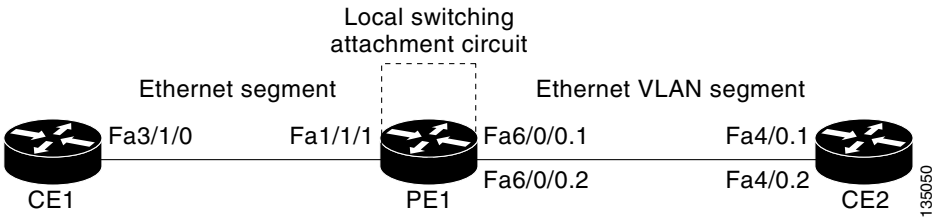
```
interface serial1/0
 encapsulation frame-relay
 frame-relay int-type nni

connect conn serial1/0 100 serial1/0 200
```

NSF/SSO: Ethernet Port Mode to Ethernet VLAN Local Switching: Example

The following configuration uses the network topology shown in Figure 2.

Figure 2 NSF/SSO: Layer 2 Local Switching: Ethernet to Ethernet VLAN



The following example shows the configuration of the the CE interfaces to connect to the PE1 router:

CE1	CE2
ip routing ! interface fa3/1/0 description: connection to PE fa1/1/1 no shutdown ip address 10.1.1.1 255.255.255.0	ip routing ! interface fa4/0 no shutdown ! interface fa4/0.1 description: connection to PE1 fa6/0/0.1 encapsulation dot1Q 10 ip address 10.1.1.2 255.255.255.0 ! interface fa4/0.2 description - connection to PE1 fa6/0/0.2 encapsulation dot1Q 20 ip address 172.16.1.2 255.255.255.0

The following example shows the configuration of the PE1 router with NSF/SSO and the PE interfaces to the CE routers:

PE1

```
redundancy
 no keepalive-enable
 mode sso
!
hw-module slot 2 image disk0:rsp-pv-mz.shaft.111004
hw-module slot 3 image disk0:rsp-pv-mz.shaft.111004
!
ip routing
ip cef distributed
!
interface fa1/1/1
 description - connection to CE1 fa3/1/0
 no shutdown
 no ip address
!
interface fa4/0/0
 description - connection to CE3 fa6/0
 no shutdown
 no ip address
!
interface fa6/0/0
 no shutdown
 no ip address
!
interface fa6/0/0.1
 description - connection to CE2 fa4/0.1
 encapsulation dot1Q 10
 no ip address
!
interface fa6/0/0.2
 description - connection to CE2 fa4/0.2
 encapsulation dot1Q 20
 no ip address
```

The following example shows the configuration of ICMP Router Discovery Protocol (IRDP) on the CE router for Interworking IP for ARP mediation:

CE1	CE2

`interface FastEthernet3/1/0`
` ip irdp`
` ip irdp maxadvertinterval 0`
	`interface FastEthernet4/0.1`
	` ip irdp`
	` ip irdp maxadvertinterval 0`

The following example shows the configuration of OSPF on the CE routers:

CE1	CE2

`interface loopback 1`
` ip address 10.11.11.11 255.255.255.255`
`!`
`router ospf 10`
` network 10.11.11.11 0.0.0.0 area 0`
` network 192.168.1.1 0.0.0.0 area 0`
	`interface loopback 1`
	` ip address 12.12.12.12 255.255.255.255`
	`!`
	`router ospf 10`
	` network 10.12.12.12 0.0.0.0 area 0`
	` network 192.168.1.2 0.0.0.0 area 0`

The following example shows the configuration of local switching on the PE1 router for interworking Ethernet:

```
connect eth-vlan1 fa1/1/1 fa6/0/0.1 interworking ethernet
connect eth-vlan2 fa4/0/0 fa6/0/0.2 interworking ethernet
```

The following example shows the configuration of local switching on the PE1 router for interworking IP:

```
connect eth-vlan1 fa1/1/1 fa6/0/0.1 interworking ip
connect eth-vlan2 fa4/0/0 fa6/0/0.2 interworking ip
```

Additional References

The following sections provide references related to the Layer 2 Local Switching feature.

Related Documents

Related Topic	Document Title
High availability for Any Transport over MPLS	*AToM: SSO/NSF Support and Graceful Restart*
L2VPN interworking	*L2VPN Interworking*
Frame Relay-to-ATM interworking	*Configuring Frame Relay-ATM Interworking*
Frame Relay-to-Frame Relay local switching	*Distributed Frame Relay Switching*
Layer 2 Tunnel Protocol Version 3	*Layer 2 Tunnel Protocol Version 3*
Any Transport over MPLS	*Any Transport over MPLS*
Layer 2 Local Switching for the Cisco 10000 series router	*Cisco 10000 Series Router Broadband Aggregation, Leased-Line, and MPLS Configuration Guide*

Standards

Standard	Title
draft-ietf-l2tpext-l2tp-base-03.txt	*Layer Two Tunneling Protocol (Version 3) 'L2TPv3'*
draft-martini-l2circuit-trans-mpls-09.txt	*Transport of Layer 2 Frames Over MPLS*
draft-martini-l2circuit-encap-mpls-04.txt	*Encapsulation Methods for Transport of Layer 2 Frames Over IP and MPLS Networks*
draft-ietf-ppvpn-l2vpn-00.txt	*An Architecture for L2VPNs*

MIBs

MIB	MIBs Link
• CISCO-IETF-PW-MIB (PW-MIB) • CISCO-IETF-PW-MPLS-MIB (PW-MPLS-MIB) • CISCO-IETF-PW-ENET-MIB (PW-ENET-MIB) • CISCO-IETF-PW-FR-MIB (PW-FR-MIB)	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

Command Reference

This section documents new and modified commands only.

- **connect (L2VPN local switching)**
- **encapsulation (Layer 2 local switching)**
- **show connection**

connect (L2VPN local switching)

To create Layer 2 data connections between two ports on the same router, use the **connect** command in global configuration mode. To remove such connections, use the **no** form of this command.

connect *connection-name interface* [*dlci* | *pvc* | *pvp*] *interface* [*dlci* | *pvc* | *pvp*] [**interworking ip** | **ethernet**]

no connect *connection-name interface* [*dlci* | *pvc* | *pvp*] *interface* [*dlci* | *pvc* | *pvp*] [**interworking ip** | **ethernet**]

Syntax Description

connection-name	A name for this local switching connection.
interface	The interface type and number used to create a local switching connection; for example serial1/0 or atm1/0/1.
dlci	(Optional) The data-link connection identifier (DLCI) assigned to the interface.
pvc	(Optional) The permanent virtual circuit (PVC) assigned to the interface, expressed by its vpi/vci (Virtual Path and Virtual Channel identifiers).
pvp	(Optional) The permanent virtual path (PVP) assigned to the interface.
interworking ip | **ethernet**	(Optional) Specifies that this local connection enables different transport types to be switched locally. This keyword is not necessary for configurations that locally switch the same transport type, such as ATM to ATM, or Frame Relay to Frame Relay. Choices are: • **ip**—Causes IP packets to be extracted from the attachment circuit and sent over the pseudowire. Attachment circuit frames that do not contain IPv4 packets are dropped. • **ethernet**—Causes Ethernet frames to be extracted from the attachment circuit and sent over the pseudowire. Ethernet end-to-end transmission is assumed. Attachment circuit frames that do not contain Ethernet frames are dropped. In the case of VLAN, the VLAN tag is removed, leaving a pure Ethernet frame.

Command Default

No default behavior or values

Command Modes

Global configuration

Command History

Release	Modification
12.0(27)S	This command was introduced for local switching.
12.2(25)S	This command was integrated into Cisco IOS Release 12.2(25)S.
12.0(30)S	This command was integrated into Cisco IOS Release 12.0(30)S.
12.2(28)SB	This command was integrated into Cisco IOS Release 12.2(28)SB.
12.4(11)T	This command was integrated into Cisco IOS Release 12.4(11)T.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Examples

The following example shows an Ethernet interface configured for Ethernet, plus an ATM interface configured for AAL5SNAP encapsulation. The **connect** command allows local switching between these two interfaces and specifies the interworking type as IP mode.

```
Router(config)# interface atm0/0/0
Router(config-if)# pvc 0/100 l2transport
Router(cfg-if-atm-l2trans-pvc)# encapsulation aal5snap

Router(config)# interface fastethernet6/0/0.1
Router(config-subif)# encapsulation dot1q 100

Router(config)# connect atm-eth-con atm0/0/0 0/100 fastethernet6/0/0.1 interworking ip
```

Related Commands

Command	Description
frame-relay switching	Enables PVC switching on a Frame Relay DCE or NNI.

encapsulation (Layer 2 local switching)

To configure the ATM adaptation layer (AAL) for a Layer 2 local switching ATM permanent virtual circuit (PVC), use the **encapsulation** command in ATM PVC L2transport configuration mode. To remove an encapsulation from a PVC, use the **no** form of this command.

encapsulation *layer-type*

no encapsulation *layer-type*

Syntax Description

layer-type	Adaptation layer type. The values are: • **aal5** • **aal0** • **aal5snap** • **aal5mux** • **aal5nlpid** (not available on Cisco 12000 series)

Command Default

If you do not create a PVC, one is created for you. The default encapsulation types for autoprovisioned PVCs are as follows:

- For ATM-to-ATM local switching, the default encapsulation type for the PVC is AAL0.
- For ATM-to-Ethernet or ATM-to-Frame Relay local switching, the default encapsulation type for the PVC is AAL5SNAP.

Command Modes

ATM PVC L2transport configuration

Command History

Release	Modification
12.0(27)S	This command was introduced for Layer 2 local switching.
12.2(25)S	This command was integrated into Cisco IOS Release 12.2(25)S.
12.0(30)S	This command was integrated into Cisco IOS Release 12.0(30)S.
12.2(28)SB	This command was integrated into Cisco IOS Release 12.2(28)SB.
12.4(11)T	This command was integrated into Cisco IOS Release 12.4(11)T.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

Usage Guidelines

The **pvc** command and the **encapsulation** command work together. The use of these commands with Layer 2 local switching is slightly different from the use of these commands with other applications. The following list highlights the differences:

- For Layer 2 local switching, you must add the **l2transport** keyword to the **pvc** command. The **l2transport** keyword enables the PVC to transport Layer 2 packets.
- The Layer 2 local switching **encapsulation** command works only with the **pvc** command. You cannot create switched virtual circuits or VC bundles to transport Layer 2 packets. You can use only PVCs to transport Layer 2 packets.

Table 1 shows the encapsulation types supported for each transport type:

Table 1 Supported Encapsulation Types

Interworking Type	Encapsulation Type
ATM to ATM	AAL0, AAL5
ATM to Ethernet with IP interworking	AAL5SNAP, AAL5MUX
ATM to Ethernet with Ethernet interworking	AAL5SNAP
ATM to Frame-Relay	AAL5SNAP, AAL5NLPID

Examples

The following example shows how to configure a PVC to transport AAL0 packets for Layer 2 local switching:

```
pvc 1/100 l2transport
 encapsulation aal0
```

Related Commands

Command	Description
pvc	Creates or assigns a name to an ATM PVC.

show connection

To display the status of interworking connections, use the **show connection** command in privileged EXEC mode.

show connection [**all** | *element* | **id** *ID* | **name** *name* | **port** *port*]

Syntax Description

all	(Optional) Displays information about all interworking connections.
element	(Optional) Displays information about the specified connection element.
id *ID*	(Optional) Displays information about the specified connection identifier.
name *name*	(Optional) Displays information about the specified connection name.
port *port*	(Optional) Displays information about all connections on an interface. (In Cisco IOS Release 12.0S, only ATM, serial, and Fast Ethernet are shown.)

Command Modes

Privileged EXEC

Command History

Release	Modification
12.1(2)T	This command was introduced as **show connect** (FR-ATM).
12.0(27)S	This command was integrated into Cisco IOS Release 12.0(27)S and updated to show all ATM, serial, and Fast Ethernet interworking connections.
12.2(25)S	This command was integrated into Cisco IOS Release 12.2(25)S.
12.4(2)T	The command output was changed to add Segment 1 and Segment 2 fields for Segment state and channel ID.
12.0(30)S	This command was integrated into Cisco IOS Release 12.0(30)S.
12.2(28)SB	This command was integrated into Cisco IOS Release 12.2(28)SB.
12.4(8)	This command was integrated into Cisco IOS Release 12.4(8).
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.4(11)T	This command was integrated into Cisco IOS Release 12.4(11)T.
12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.

Examples

The following example shows the local interworking connections on a router:

```
Router# show connection

ID   Name               Segment 1            Segment 2           State
======================================================================
1    conn1          ATM 1/0/0 AAL5 0/100   ATM 2/0/0 AAL5 0/100   UP
2    conn2          ATM 2/0/0 AAL5 0/300   Serial0/1 16           UP
3    conn3          ATM 2/0/0 AAL5 0/400   FA 0/0.1 10            UP
4    conn4          ATM 1/0/0 CELL 0/500   ATM 2/0/0 CELL 0/500   UP
5    conn5          ATM 1/0/0 CELL 100     ATM 2/0/0 CELL 100     UP
```

Table 1 describes the significant fields shown in the display.

Table 2 show connection Field Descriptions

Field	Description
ID	Arbitrary connection identifier assigned by the operating system.
Name	Name of the connection.
Segment 1 Segment 2	Information about the interworking segments, including: • Interface name and number. • Segment state, interface name and number, and channel ID. Segment state will displays nothing if the segment state is UP, "-" if the segment state is DOWN, and "***Card Removed***" if the segment state is DETACHED. • Type of encapsulation (if any) assigned to the interface. • Permanent virtual circuit (PVC) assigned to the ATM interface, data-link connection identifier (DLCI) assigned to the serial interface, or VLAN ID assigned to the Ethernet interface.
State or Status	Status of the connection, which is one of the following: INVALID, UP, ADMIN UP, ADMIN DOWN, OPER DOWN, COMING UP, NOT VERIFIED, ERR.

Related Commands

Command	Description
connect (L2VPN local switching)	Connects two different or like interfaces on a router.
show atm pvc	Displays the status of ATM PVCs and SVCs.
show frame-relay pvc	Displays the status of Frame Relay interfaces.

Feature Information for Layer 2 Local Switching

Table 3 lists the release history for this feature.

Not all commands may be available in your Cisco IOS software release. For release information about a specific command, see the command reference documentation.

Cisco IOS software images are specific to a Cisco IOS software release, a feature set, and a platform. Use Cisco Feature Navigator to find information about platform support and Cisco IOS software image support. Access Cisco Feature Navigator at http://www.cisco.com/go/fn. You must have an account on Cisco.com. If you do not have an account or have forgotten your username or password, click **Cancel** at the login dialog box and follow the instructions that appear.

Note Table 3 lists only the Cisco IOS software release that introduced support for a given feature in a given Cisco IOS software release train. Unless noted otherwise, subsequent releases of that Cisco IOS software release train also support that feature.

Table 3 Feature Information for Layer 2 Local Switching

Feature Name	Releases	Feature Information
Layer 2 Local Switching	12.0(27)S 12.2(25)S 12.0(30)S 12.0(31)S2 12.0(32)SY 12.2(28)SB 12.4(11)T 12.2(33)SRB 12.2(33)SXH	The Layer 2 Local Switching feature allows you to switch Layer 2 data between two interfaces on the same router, and in some cases to switch Layer 2 data between two circuits on the same interface port. The feature was introduced in Cisco IOS Release 12.0(27)S on the Cisco 7200 and 7500 series routers. The feature was integrated into Cisco IOS Release 12.2(25)S. In Cisco IOS Release 12.0(30)S, support for same-port switching was added. Support for Layer 2 interface-to-interface local switching was added on the Cisco 12000 series router. In Cisco IOS Release 12.0(31)S2, support was added for customer-facing IP Service Engine (ISE) interfaces on the Cisco 12000 series router. In Cisco IOS Release 12.0(32)SY, support was added for customer-facing interfaces on Engine 5 shared port adapters (SPAs) and SPA Interface Processors (SIPs) on the Cisco 12000 series router. In Cisco IOS Release 12.2(28)SB, this feature was updated to include NSF/SSO support on the Cisco 7500 series routers for the following local switching types on nonstop forwarding/stateful switchover (NSF/SSO): • NSF/SSO—Ethernet-to-Ethernet VLAN local switching support • NSF/SSO—Frame Relay-to-Frame Relay local switching support In Cisco IOS Release 12.4(11)T, support was added for the following local switching types: • Ethernet to Ethernet VLAN • Same-port switching for Ethernet VLAN • Frame Relay to Frame Relay • Same-port switching for Frame Relay In Cisco IOS Release 12.2(28)SB, for information about Layer 2 Local Switching on the Cisco 10000 series routers, see the “Configuring Layer 2 Local Switching” section of the *Cisco 10000 Series Router Broadband Aggregation, Leased-Line, and MPLS Configuration Guide* at the following URL: http://www.cisco.com/univercd/cc/td/doc/product/aggr/10000/swconfig/cfggdes/bba/localsw.htm In Cisco IOS Release 12.2(33)SXH, support was added for like-to-like Local Switching (that is, ATM to ATM, and FR to FR only) on 6500 series switches and 7600 series routers. Same-port switching was not added on those devices.