Configuring Access Circuit Redundancy

This chapter provides information about the Access Circuit Redundancy (ACR) feature on the Cisco ASR 903 Router.

New and Changed Information

Feature	ASR 903 RSP1 Module	ASR 903 RSP2 Module	ASR 902 Router	Where Documented
CEM ACR	Cisco IOS XE Release 3.10S	Cisco IOS Release 3.14S	Cisco IOS XE Release 3.12S	
ATM ACR	Cisco IOS XE Release 3.12	NA	Cisco IOS XE Release 3.12S	

Prerequisites for Configuring ACR

- When configured as a part of the ACR group, the Working and Protect interfaces should be of same framing type.
- When Circuit Emulation (CEM) interfaces are created, they are not ACR enabled. You must configure CEM only under the virtual Synchronous Optical Networking (SONET) controller to enable ACR.

Restrictions for Configuring ACR

- Physical or soft IM OIR causes the APS switchover time to be higher (500 to 600 ms). Shut or no shut of the port and removal of the active working or protect also cause the APS switchover time to be high. To overcome these issues, force the APS switchover.
- On the RSP3 module, it takes a long time (more than half an hour) to copy scale configuration (8064 VT CEP) from bootflash to running configuration. To overcome this issue, you can copy the configuration one by one from the CLI.

Restrictions for CEM ACR

- ACR configuration is only supported with a Single Router Automatic Protection Switching (SR-APS) configuration. For more information about APS, see Time Division Multiplexing Guide
- Maximum of 12 ACR groups are supported on the router. A single IM supports only 2 ACR groups.
- Only one virtual controller is available for every ACR group.
- An ACR group supports only two member interfaces; Working interface and Protect interface.
- CEM-ACR interfaces cannot simultaneously support both Circuit Emulation Services over Packet (CESoP) and Structure-Agnostic Time Division Multiplexing over Packet (SAToP).
- Quality of Service (QoS) is not supported on a CEM-ACR interface except for default experimental bits (EXP) marking for Multiprotocol Label Switching (MPLS) pseudowires.
- CEM ACR is not supported on the RSP3 module in Cisco IOS XE Release 3.16.1S.

Restrictions for ATM ACR

- ATM ACR is not supported on the RSP3 module in Cisco IOS XE Release 3.16.1S.
- ACR configuration is only supported with a Single Router Automatic Protection Switching (SR-APS) configuration. For more information about APS, see.
- Maximum of 12 ACR groups are supporte d on the router. A single IM supports only 2 ACR groups.
- Only one virtual controller is available for every ACR group.
- An ACR group supports only two member interfaces; Working interface and Protect interface.
- Quality of Service (QoS) is not supported on a ATM-ACR interface except for default experimental bits (EXP) marking for Multiprotocol Label Switching (MPLS) pseudowires.
- For successful ATM ACR switchover, configuration of VCs must be the same for both working and protect interfaces. The switchover time is less than 200 ms.
- ATM-ACR PVP mode is *not* supported in Cisco IOS XE Release 3.12S.
- A delay of 8 seconds per PVC is required between every ACR swithover. For N number of PVCs, N*8 seconds of delay is required between every ACR swithcover. Following are the trigger for ACR switchover:
    - Reloading the IM with ACR port configuration
    - Executing shutdown command followed by a no shutdown command
    - Flapping of active port link
    - Removing or inserting a cable of active port.

- The maximum number of ACR-ATM interfaces supported in SONET mode is 84.
- The maximum number of ACR-ATM interfaces supported in SDH mode is 63.
- Configuring ATM followed by ACR-ATM configuration results in Standby RSP crashes. To migrate the ATM configuration to ACR-ATM or vice-versa, perform the following:
  - Remove the ATM configuration
  - Save the configuratiom and perform a reload
  - Upload a new image on the router
  - Configure the ACR-ATM feature
- Unidirectional traffic may drop after multiple ACR swithcovers and when SSO is performed.
- Maintenance tasks such as performing **shutdown** followed by a **no shutdown** at the virtual controller or interface are not allowed.

Information About ACR

CEM ACR

ACR enables local switching for CEM interfaces by creating a virtual CEM-ACR interface. All configuration changes made on the virtual CEM-ACR interface are applied automatically on both the working and protect interfaces. Switching from working to protect or protect to working interface occurs within 250 milliseconds at different scaled levels with line rate traffic.

The virtual CEM-ACR interface provides the simplicity of a single point of configuration and the flexibility of not running a backup pseudowire for the protect interface in a failure.

ATM ACR

ATM ACR interfaces are created at the ACR controller and the PVC are created at the virtual ACR interface. For each virtual interface one working and one protect interface (physical) exist. At any instance, only one interface is active.

The virtual interface state represents the active interface state. PVC's are created in the virtual interfaces.

How to Configure ACR

Configuring ACR (SONET Framing)

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**controller sonet** *slot/subslot/port* **Example:** `Router (config)# controller sonet 0/1/0`	Selects the work controller to configure and enters controller configuration mode. • *slot/subslot/port* —Specifies the location of the interface.
Step 4	**framing sonet** **Example:** `Router (config-controller)# framing sonet`	Configures the framing mode. • sonet—Enables SONET framing.
Step 5	**clock source** {**internal** | **line**} **Example:** `Router (config-controller)# clock source internal`	Sets the clock source. **Note** The clock source is set to internal if the opposite end of the connection is set to line and the clock source is set to line if the opposite end of the connection is set to internal. • internal—Specifies that the internal clock source is used. • line—Specifies that the network clock source is used. This is the default for T1 and E1.
Step 6	**aps group acr** *acr-no* **Example:** `Router(config-controller)# aps group acr 1`	Configures the APS group for the controller. • acr—Configures the ACR group on top of APS. • acr-no—A group number that is valid between 1 and 96. Any group number exceeding this range is not supported. **Note** • For Cisco ASR 900 RSP1 Module, the valid group number is between 1 and 96. • For Cisco ASR 900 RSP2 Module, the valid group number is between 1 and 192. The APS group can be either active or inactive: • Active—The interface that is currently sending and receiving data.

	Command or Action	Purpose
		• Inactive—The interface that is currently standing by to take over when the active fails.
Step 7	**aps working** *circuit-number* **Example:** `Router (config-controller)# aps working 1`	Identifies the interface as the Working interface. • circuit-number—Identification number for this particular channel in the APS pair. Since the interface only supports 1 + 1 redundancy, the only valid and the default value for working interface is 1.
Step 8	**exit** **Example:** `Router (config-controller)# exit`	Exits controller configuration mode.
Step 9	**controller sonet** *slot/subslot/port* **Example:** `Router (config)# controller sonet 0/2/0`	Selects the protect controller to configure and enters controller configuration mode. **Note** The controller selected for protect must be different from the work controller. • *slot/subslot/port* —Specifies the location of the interface.
Step 10	**aps group acr** *acr-no* **Example:** `Router(config-controller)# aps group acr 1`	Configures the APS group for the controller. • acr—Configures the ACR group on top of APS. • acr-no—A group number that is valid between 1 and 96. Any group number exceeding this range is not supported. **Note** • For Cisco ASR 900 RSP1 Module, the valid group number is between 1 and 96. • For Cisco ASR 900 RSP2 Module, the valid group number is between 1 and 192. The APS group can be either active or inactive: • Active—The interface that is currently sending and receiving data. • Inactive—The interface that is currently standing by to take over when the active fails.
Step 11	**aps protect** *circuit-number ip-address*	Identifies the interface as the Protect interface.

	Command or Action	Purpose
	Example: `Router(config-controller)# aps protect 1 4.1.1.1`	• *circuit-number* —Identification number for this particular channel in the APS pair. Because only 1+1 redundancy is supported, the only valid value is 1, and the Protect interface defaults to 1. • *ip-address* —IP address for the loopback interface. The Protect interface uses this IP address to communicate with the Working interface.
Step 12	**aps revert** *minutes* **Example:** `Router(config-controller)# aps revert 2`	(Optional) Configures the ACR interface as revert. • minutes—Specifies the time, in minutes, after which the revert process begins. **Note** Use the aps revert command only under the protect member of the ACR group.
Step 13	**exit** **Example:** `Router (config-controller)# exit`	Exits controller configuration mode.

What to do next

The following is a sample configuration of ACR using SONET framing:

```
Router# Configure terminal
Router(config)# Controller sonet 0/1/0
Router(config-controller)# aps group acr 1
Router(config-controller)# aps working 1
Router(config-controller)# exit
Router(config)# controller sonet 0/2/0
Router(config-controller)# aps group acr 1
Router(config-controller)# aps protect 1 4.1.1.1
Router(config-controller)# do show ip interface brief | incl Loop
Loopback0              4.1.1.1         YES NVRAM  up                    up
Router(config-controller)#end
```

Configuring ACR (SDH Framing)

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**controller sonet** *slot/subslot/port* **Example:** `Router (config)# controller sonet 0/0/2`	Selects the work controller to configure and enters controller configuration mode. • *slot/subslot/port* —Specifies the location of the interface.
Step 4	**framing sdh** **Example:** `Router (config-controller)# framing sdh`	Configures the framing mode. • sdh—Enables SDH framing for STM rates.
Step 5	**clock source** {**internal** | **line**} **Example:** `Router (config-controller)# clock source internal`	Sets the clock source. **Note** The clock source is set to internal if the opposite end of the connection is set to line and the clock source is set to line if the opposite end of the connection is set to internal. • internal—Specifies that the internal clock source is used. • line—Specifies that the network clock source is used. This is the default for T1 and E1.
Step 6	**aps group acr** *acr-no* **Example:** `Router (config-controller)# aps group acr 1`	Configures the APS group for the controller. • acr—Configures the ACR group on top of APS. • acr-no—A group number that is valid between 1 and 96. Any group number exceeding this range is not supported. **Note** • For Cisco ASR 900 RSP1 Module, the valid group number is between 1 and 96. • For Cisco ASR 900 RSP2 Module, the valid group number is between 1 and 192. The APS group can be either active or inactive. • Active—The interface that is currently sending and receiving data.

	Command or Action	Purpose
		• Inactive—The interface that is currently standing by to take over when the active fails.
Step 7	**aps working** *circuit-number* **Example:** `Router (config-controller)# aps working 1`	Identifies the interface as the Working interface. • circuit-number—Identification number for this particular channel in the APS pair. Since the interface only supports 1 + 1 redundancy, the only valid and the default value for working interface is 1.
Step 8	**exit** **Example:** `Router (config-controller)# exit`	Exits controller configuration mode.
Step 9	**controller sonet** *slot/subslot/port* **Example:** `Router (config)# controller sonet 0/2/0`	Selects the protect controller to configure and enters controller configuration mode. **Note** The controller selected for protect must be different from the work controller. • *slot/subslot/port* —Specifies the location of the interface.
Step 10	**aps group acr** *acr-no* **Example:** `Router(config-controller)# aps group acr 1`	Configures the APS group for the controller. • acr—Configures the ACR group on top of APS. • acr-no—A group number that is valid between 1 and 96. Any group number exceeding this range is not supported. **Note** • For Cisco ASR 900 RSP1 Module, the valid group number is between 1 and 96. • For Cisco ASR 900 RSP2 Module, the valid group number is between 1 and 192. The APS group can be either active or inactive: • Active—The interface that is currently sending and receiving data. • Inactive—The interface that is currently standing by to take over when the active fails.
Step 11	**aps protect** *circuit-number ip-address*	Identifies the interface as the Protect interface.

	Command or Action	Purpose
	Example: `Router(config-controller)# aps protect 1 4.1.1.1`	• *circuit-number* —Identification number for this particular channel in the APS pair. Because only 1+1 redundancy is supported, the only valid value is 1, and the Protect interface defaults to 1. • *ip-address* —IP address for the loopback interface. The Protect interface uses this IP address to communicate with the Working interface.
Step 12	**aps revert** *minutes* **Example:** `Router(config-controller)# aps revert 2`	(Optional) Configures the ACR interface as revert. • minutes—Specifies the time, in minutes, after which the revert process begins. **Note** Use the aps revert command only under the protect member of the ACR group.
Step 13	**exit** **Example:** `Router (config-controller)# exit`	Exits controller configuration mode.

What to do next

The following is a sample configuration of ACR interface using SDH framing:

```
Router# configure terminal
Router(config)# controller sonet 0/0/2
Router(config-controller)# framing sdh
Router(config-controller)# clock source internal
Router(config-controller)# aps group acr 10
Router(config-controller)# aps working 1
Router(config-controller)# exit
Router# configure terminal
Router(config)# controller sonet 0/0/3
Router(config-controller)# framing sdh
Router(config-controller)# clock source internal
Router(config-controller)# aps group acr 10
Router(config-controller)# aps protect 1 22.22.22.22
Router(config-controller)# exit
```

Configuring CEM (SONET Framing)

Procedure

	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	**controller sonet-acr** *acr_no* **Example:** `Router (config)# controller sonet-acr 1`	Selects the controller to configure. • *acr_no* —Specifies the controller unit number.
Step 4	**sts-1** *number* **Example:** `Router (config-controller)# sts-1 1`	Specifies the STS identifier.
Step 5	**vtg** *vtg-number* **t1** *t1-line-number* **cem-group** *group number* **unframed** **Example:** `Router (config-ctrlr-sts1)# vtg 1 t1 1 cem-group 1 unframed`	Creates a single Structure-Agnostic TDM over Packet (SAToP) CEM group. • **vtg**—Specifies the vtg number from 1-7. • *t1-line-number*—Identifies the T1 line number from 1 to 4. • **cem-group**—Creates a circuit emulation channel from one or more timeslots of a T1 or E1 line. • *group-number* —Identifies the channel number to be used for this channel from 0-215. • **unframed**—Specifies that a single CEM channel is being created including all timeslots and the framing structure of the line.

Step 6	OR,
	Example:
	`vtg vtg-number t1 t1-line-number cem-group group number timeslots timeslot-range`
	Example:
	`Router (config-ctrlr-sts1)# vtg 1 t1 1 cem-group 1 timeslots 1-10`
		Creates a Circuit Emulation Services over Packet
		Switched Network (CESoPSN) CEM group.
		• **timeslots**—Specifies the timeslots to be included in the CEM channel.
		• *timeslot-range* —Specifies the timeslots range from 1 to 24.

	Command or Action	Purpose
Step 7	**exit** **Example:** `Router (config-ctrlr-sts1)# exit`	Exits controller configuration mode.

What to do next

The following is a sample configuration of CEM interface using SONET framing:

```
Router# Configure terminal
Router(config)# controller sonet-acr 1
Router(config-ctrlr-sts1)# sts-1 1
Router(config-ctrlr-sts1)# vtg 1 t1 1 cem-group 1 timeslots 1-10
Router(config-ctrlr-sts1)# end
```

Configuring CEM (SDH Framing)

Procedure

	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	**controller sonet-**acr acr_no **Example:** `Router (config)# controller sonet-acr 1`	Selects the virtual controller to configure and enters controller configuration mode. • acr_no—A group number that is valid between 1 and 96. Any group number exceeding this range is not supported.
Step 4	**framing sdh** **Example:** `Router (config-controller)# framing sdh`	Configures the framing mode. • sdh—Enables SDH framing for STM rates.
Step 5	**aug mapping au-4** **Example:**	Selects AU-4 Administrative Unit Group (AUG) mapping.

	Command or Action	Purpose
	`Router (config-controller)# aug mapping au-4`	
Step 6	**au-4** *au-4-number* **tug-3** *tug-3-number* **Example:** `Router (config-controller)# au-4 1 tug-3 2`	Specifies the AU-4 and TUG-3 number of an E1 line that has been mapped to an AU-4. • au-4—Specifies administrative unit • au-4-number—A number in the range of 1 to 3. • tug-3—Specifies tributary unit group • tug-3-number—A number in the range of 1 to 7.

Step 7	Do one of the following:
	• **tug-2** *tug-2 number* **e1** *e1-line-number* **cem-group** *group number* **timeslots** *timeslot-range*
	Example:
	`Router (config-controller)# tug-2 1 e1 2 cem-group 1 timeslots 1-8`
	Example:
	Example:
	Example:
	tug-2 *tug-2 number* **e1** *e1-line-number* **cem-group** *group number* **unframed**
	Example:
	`Router (config-controller)# tug-2 1 e1 2 cem-group 1 unframed`
	Example:
	Example:
	Example:
	tug-2 *tug-2 number* **e1** *e1-line-number* **framing unframed**
		Creates a CEM group for the AU-4. Valid E1 values are from 1 to 3.

Step 8	**exit** **Example:** `Router (config-controller)# exit`	Exits controller configuration mode.

What to do next

The following is an example for configuring CEM interface using SDH framing (AU-4):

```
Router# configure terminal
Router(config)# controller sonet-acr 1
Router(config-ctrlr-sts1)# framing sdh
Router(config-ctrlr-sts1)# aug mapping au-4
Router(config-ctrlr-sts1)# au-4 1 tug-3 1
Router(config-ctrlr-sts1)# tug-2 1 e1 1 cem-group 0 timeslots 1-31
Router(config-ctrlr-sts1)# end
```

The following is an example for configuring CEM interface using SDH framing (AU-3):

```
Router# configure terminal
Router(config)# controller sonet 0/2/1
Router(config-ctrlr-sts1)# framing sdh
Router(config-ctrlr-sts1)# aug mapping au-3
Router(config-ctrlr-sts1)# aps group acr 1
Router(config-ctrlr-sts1)# aps working 1
Router(config-ctrlr-sts1)# end
Router# configure terminal
Router(config)# controller sonet 0/2/2
Router(config-controller)# framing sdh
Router(config-controller)# clock source internal
Router(config-controller)# aps group acr 1
Router(config-controller)# aps protect 1 22.22.22.22
Router(config-controller)# end
Router# configure terminal
Router(config)# controller sonet-acr 1
Router(config-ctrlr-sts1)# au-3 1
Router(config-ctrlr-sts1)# tug-2 1 t1 1 cem-group 0 timeslot 1-24
Router(config-ctrlr-sts1)# end
Router(config-controller)# do show ip interface brief | incl Loop
Loopback0 22.22.22.22 YES NVRAM up up
Router(config-controller)# end
```

Configuring ATM-ACR on ATM VC Interface for SDH Mode

Procedure

	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	**controller sonet-acr** *acr_no* **Example:**	Configures ACR controller level. • *acr_no* —Specifies the controller unit number.

	Command or Action	Purpose
	`Router (config)# controller sonet-acr 1`	
Step 4	**au-4** *au-4-number* **tug-3** *tug-3-number* **Example:** `Router (config-controller)# au-4 1 tug-3 2`	Specifies the AU-4 and TUG-3 number of an E1 line that has been mapped to an AU-4. • au-4—Specifies administrative unit • au-4-number—A number in the range of 1 to 3. • tug-3—Specifies tributary unit group • tug-3-number—A number in the range of 1 to 7.
Step 5	**tug-2** *tug-2 number* **e1** *e1-line-number atm* **Example:** `Router (config-controller)# tug-2 1 e1 2 atm` **Example:**	Creates a group for the AU-4. Valid E1 values are from 1 to 3.
Step 6	**interface atm-acr atm-acr-interface-number** **Example:** `Router(config)# interface atm-acr 1.1/1/1/1`	Configures the ATM-ACR interface level.
Step 7	**pvc** *vpi*/*vpc* **Example:** `Router(config-if)# pvc 1/99 l2transport`	Configures a PVC for the interface and assigns the PVC a VPI and VCI. Do not specify 0 for both the VPI and VCI.
Step 8	**xconnect** *peer-router-id vcid* **encapsulation mpls** **Example:** `Router (config-if)# xconnect 2.2.2.2 15 encapsulation mpls`	Configures a pseudowire to transport the data across the MPLS network. • *peer-router-id* —IP address of the remote provider edge (PE) peer router. • *vcid* —A 32-bit identifier to assign to the pseudowire. The same vcid must be used for both ends of the pseudowire. The valid vcid values are 1-4294967295. • **encapsulation mpls**—Sets MPLS for tunneling mode.
Step 9	**exit** **Example:** `Router (config-if)# exit`	Exits controller configuration mode.

What to do next

The following example show ACR virtual interface for ATM PVC in SR-APS environment

```
Router(config)# controller SONET-ACR 10
Router(config-controller)# au-4 1 tu 1
Router(config-ctrlr-tug3)# tu 1 e1 1 atm
Router(config)# interface ATM-ACR1.1/1/1/1
Router(config-if)# pvc 1/99 l2transport
Router(config-if)# xconnect 2.2.2.2 15 encapsulation mpls
Router(config-if)# exit
```

Configuring ATM-ACR on ATM VC Interface for SONET Mode

Procedure

	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	**controller sonet-acr** *acr_no* **Example:** `Router (config)# controller sonet-acr 1`	Configures ACR controller level. • *acr_no* —Specifies the controller unit number.
Step 4	**sts-1** *number* **Example:** `Router (config-controller)# sts-1 1`	Specifies the STS identifier.
Step 5	**vtg** *vtg-number* **t1** *t1-line-number* **atm** **Example:** `Router (config-ctrlr-sts1)# vtg 1 t1 1 atm`	Creates a single Structure-Agnostic TDM over ATM. • **vtg**—Specifies the vtg number from 1-7. • *t1-line-number*—Identifies the T1 line number from 1 to 4.
Step 6	**interface atm-acr atm-acr-interface-number** **Example:** `Router(config)# interface atm-acr 1.1/1/1`	Specifies the ATM-ACR interface and enters interface configuration mode.

	Command or Action	Purpose
Step 7	**pvc** *vpi*/*vpc* **Example:** `Router(config-if)# pvc 1/99 l2transport`	Configures a PVC for the interface and assigns the PVC a VPI and VCI. Do not specify 0 for both the VPI and VCI.
Step 8	**xconnect** *peer-router-id vcid* **encapsulation mpls** **Example:** `Router(config-if)# xconnect 2.2.2.2 15 encapsulation mpls`	Configures a pseudowire to transport the data across the MPLS network. • *peer-router-id* —IP address of the remote provider edge (PE) peer router. • *vcid* —A 32-bit identifier to assign to the pseudowire. The same vcid must be used for both ends of the pseudowire. The valid vcid values are 1-4294967295. • **encapsulation mpls**—Sets MPLS for tunneling mode.
Step 9	**exit** **Example:** `Router(config-if)# exit`	Exits controller configuration mode.

What to do next

The following example show ACR virtual interface for ATM PVC in SR-APS environment

```
Router(config)# controller SONET-ACR 10
Router(config-controller)# sts-1 1
Router(config-ctrlr-tug3)# vtg 1 e1 1 atm
Router(config)# interface atm-acr1.1/1/1
Router(config-if)# pvc 1/99 l2transport
Router(config-if)# xconnect 2.2.2.2 15 encapsulation mpls
Router(config-if)# exit
```

Verifying ACR Configurations

This section includes show commands for ACR:

The following example shows the acr groups that have been configured or deleted:

```
Router# show acr group
ACR Group      Working I/f     Protect I/f     Currently Active    Status
-------------------------------------------------------------------------
1              SONET 4/1/0    SONET 3/1/0    SONET 4/1/0
The following example shows the configured working and protect cem interfaces under the ACR
 controller:
Router# show acr group 1 detail cem
ACR Group      Working I/f     Protect I/f     Currently Active    Status
-------------------------------------------------------------------------
CE1            CEM4/1/0       CEM3/1/0       CEM4/1/0
CEM CKT Details
Cktid  State on Working    State on Protect
```

```
1      Provision Success   Provision Success
```

The following example shows the configuration under the ACR controller:

```
Example of a configuration using CESoP:
Router# show running-config | sec SONET-ACR 1
controller SONET-ACR 1
framing sdh
aug mapping au-4
!
au-4 1 tug-3 1
  tug-2 1 e1 1 cem-group 0 timeslots 1-31
Example of a configuration using SAToP:
Router# show running-config | sec SONET-ACR 2
controller SONET-ACR 2
framing sdh
aug mapping au-4
!
au-4 1 tug-3 1
  tug-2 1 e1 1 cem-group 1001 unframed
```

The following example shows the loopback ip address for the router:

```
Router# show ip interface brief | i Loopback
Loopback0              22.22.22.22     YES NVRAM  up                    up
```

The following example shows the cem-acr circuit status:

```
Router# show cem circuit
CEM Int.       ID   Ctrlr     Admin     Circuit         AC
---------------------------------------------------------------
CEM-ACR1       1    UP        UP      Active          UP
CEM-ACR1       2    UP        UP      Active          UP
CEM-ACR1       3    UP        UP      Active          UP
CEM-ACR1       4    UP        UP      Active          UP
CEM-ACR1       5    UP        UP      Active          UP
CEM-ACR1       6    UP        UP      Active          UP
CEM-ACR1       7    UP        UP      Active          UP
CEM-ACR1       8    UP        UP      Active          UP
```

The following example shows the cem-acr circuit details for cem-group 0 under the CEM-ACR interface:

```
Router# show cem circuit int cem-acr 1 0
CEM-ACR1, ID: 0, Line: UP, Admin: UP, Ckt: ACTIVE
Controller state: up, T1/E1 state: up
Idle Pattern: 0xFF, Idle CAS: 0x8
Dejitter: 8 (In use: 0)
Payload Size: 32
Framing: Framed (DS0 channels: 1)
CEM Defects Set
None
Signalling: No CAS
RTP: No RTP
Ingress Pkts:    774186              Dropped:             0
Egress Pkts:     774187              Dropped:             0
CEM Counter Details
Input Errors:    0                   Output Errors:       0
Pkts Missing:    0                   Pkts Reordered:      0
Misorder Drops:  0                   JitterBuf Underrun:  0
Error Sec:       0                   Severly Errored Sec: 0
Unavailable Sec: 0                   Failure Counts:      0
Pkts Malformed:  0                   JitterBuf Overrun:   0
```

The following example shows the cem-acr circuit details for cem-group 1001 under the CEM-ACR interface:

```
Router# show cem circuit int cem-acr 1 1001
CEM-ACR1, ID: 1001, Line: UP, Admin: UP, Ckt: ACTIVE
Controller state: up, T1/E1 state: up
Idle Pattern: 0xFF, Idle CAS: 0x8
```

```
Dejitter: 5 (In use: 0)
Payload Size: 256
Framing: Unframed
CEM Defects Set
None
Signalling: No CAS
RTP: No RTP
Ingress Pkts:    3096748             Dropped:             0
Egress Pkts:     3096748             Dropped:             0
CEM Counter Details
Input Errors:    0                   Output Errors:       0
Pkts Missing:    0                   Pkts Reordered:      0
Misorder Drops:  0                   JitterBuf Underrun:  0
Error Sec:       0                   Severly Errored Sec: 0
Unavailable Sec: 0                   Failure Counts:      0
Pkts Malformed:  0                   JitterBuf Overrun:   0
```

The following example shows the mpls l2 transport vc details for the specified vc. In this case it is the vc with vc-id = 1001:

```
Router# show mpls l2 vc 1001 det
Local interface: CE1 up, line protocol up, CESoPSN Basic 0 up
  Destination address: 66.66.66.66, VC ID: 1001, VC status: up
    Output interface: Te0/2/0, imposed label stack {1629}
    Preferred path: not configured
    Default path: active
    Next hop: 61.1.1.2
  Create time: 03:28:57, last status change time: 03:27:37
    Last label FSM state change time: 00:51:41
  Signaling protocol: LDP, peer 66.66.66.66:0 up
    Targeted Hello: 22.22.22.22(LDP Id) -> 66.66.66.66, LDP is UP
    Graceful restart: configured and enabled
    Non stop routing: not configured and not enabled
    Status TLV support (local/remote)   : enabled/supported
      LDP route watch                   : enabled
      Label/status state machine        : established, LruRru
      Last local dataplane   status rcvd: No fault
      Last BFD dataplane     status rcvd: Not sent
      Last BFD peer monitor  status rcvd: No fault
      Last local AC  circuit status rcvd: No fault
      Last local AC  circuit status sent: No fault
      Last local PW i/f circ status rcvd: No fault
      Last local LDP TLV     status sent: No fault
      Last remote LDP TLV    status rcvd: No fault
      Last remote LDP ADJ    status rcvd: No fault
    MPLS VC labels: local 586, remote 1629
    Group ID: local 0, remote 0
    MTU: local 0, remote 0
    Remote interface description:
  Sequencing: receive disabled, send disabled
  Control Word: On (configured: autosense)
  SSO Descriptor: 66.66.66.66/1001, local label: 586
  Dataplane:
    SSM segment/switch IDs: 1410842/2339386 (used), PWID: 571
  VC statistics:
    transit packet totals: receive 3119684, send 3112390
    transit byte totals:   receive 155984200, send 130720380
    transit packet drops:  receive 0, seq error 0, send 0
```

The following example shows the mpls l2 transport vc details for the specified vc. In this case it is the vc with vc-id = 5001:

```
Router# show mpls l2 vc 5001 det
```

```
Local interface: CE1 up, line protocol up, SATOP E1 1001 up
  Destination address: 66.66.66.66, VC ID: 5001, VC status: up
    Output interface: Te0/2/0, imposed label stack {1613}
    Preferred path: not configured
    Default path: active
    Next hop: 61.1.1.2
  Create time: 03:29:05, last status change time: 03:27:45
    Last label FSM state change time: 00:51:49
  Signaling protocol: LDP, peer 66.66.66.66:0 up
    Targeted Hello: 22.22.22.22(LDP Id) -> 66.66.66.66, LDP is UP
    Graceful restart: configured and enabled
    Non stop routing: not configured and not enabled
    Status TLV support (local/remote)   : enabled/supported
      LDP route watch                   : enabled
      Label/status state machine        : established, LruRru
      Last local dataplane   status rcvd: No fault
      Last BFD dataplane     status rcvd: Not sent
      Last BFD peer monitor  status rcvd: No fault
      Last local AC  circuit status rcvd: No fault
      Last local AC  circuit status sent: No fault
      Last local PW i/f circ status rcvd: No fault
      Last local LDP TLV     status sent: No fault
      Last remote LDP TLV    status rcvd: No fault
      Last remote LDP ADJ    status rcvd: No fault
    MPLS VC labels: local 865, remote 1613
    Group ID: local 0, remote 0
    MTU: local 0, remote 0
    Remote interface description:
  Sequencing: receive disabled, send disabled
  Control Word: On (configured: autosense)
  SSO Descriptor: 66.66.66.66/5001, local label: 865
  Dataplane:
    SSM segment/switch IDs: 2176983/3482449 (used), PWID: 850
  VC statistics:
    transit packet totals: receive 12488973, send 12445403
    transit byte totals:   receive 3347044764, send 3285586392
    transit packet drops:  receive 0, seq error 0, send 0
```

The following example shows the currently configured APS groups on the router:

```
Router# show aps
SONET 0/5/2 APS Group 25: protect channel 0 (Inactive) (HA)
        Working channel 1 at 1.1.1.1 (Enabled)  (HA)
        bidirectional, non-revertive
        PGP timers (extended for HA): hello time=1; hold time=10
                hello fail revert time=120
        SDH framing; SDH MSP signalling by default
        Received K1K2: 0x00 0x05
                No Request (Null)
        Transmitted K1K2: 0x00 0x00
                No Request (Null)
        Remote APS configuration: (null)
SONET 0/0/2 APS Group 25: working channel 1 (Active) (HA)
        Protect at 1.1.1.1
        PGP timers (from protect): hello time=1; hold time=10
        SDH framing
        Remote APS configuration: (null)
```

The following example shows ATM ACR configuration on the router:

```
Router# show running-config | sec ACR
controller SONET-ACR 1
 framing sdh
```

```
 aug mapping au-4
 !
 au-4 1 tug-3 1
  mode c-12
  tug-2 1 e1 1 atm
 !
 au-4 1 tug-3 2
  mode c-12
 !
 au-4 1 tug-3 3
  mode c-12
interface ATM-ACR1.1/1/1/1
 no ip address
pvp 1/99 l2transport
xconnect 51.1.1.2 3 encapsulation mpls
```

The following example shows ATM ACR interfaces on the router:

```
Router# show interface ATM0/1/1.1/1/1/1 | in pac
  5 minute input rate 4000 bits/sec, 10 packets/sec
  5 minute output rate 4000 bits/sec, 10 packets/sec
     3000 packets input, 156000 bytes, 0 no buffer
     3000 packets output, 156000 bytes, 0 underruns
Router# show xconnect all
Legend: XC ST=Xconnect State S1=Segment1 State S2=Segment2 State
UP=Up DN=Down AD=Admin Down IA=Inactive
SB=Standby HS=Hot Standby RV=Recovering NH=No Hardware
XC ST Segment 1 S1 Segment 2 S2
------+---------------------------------+--+---------------------------------+--
PN pri ac AT1.1/1/1:10/10(ATM AAL5) UP mpls 3.3.3.3:1 UP
Router# show atm pvc
Keys: CI = ATM0/3/2.1/1/1, CH = ATM0/4/2.1/1/1, CG = ATM-ACR1.1/1/1,
VCD / Peak Av/Min Burst
Interface Name VPI VCI Type Encaps SC Kbps Kbps Cells St
CG 1 10 10 PVC AAL5 UBR 1536 UP
```

Troubleshooting the ACR configuration

This section provides the supported debug commands to troubleshoot the ACR configuration:

Caution We suggest you do not use these debug commands without TAC supervision.

- **debug acr events**: Provides details on all events occurring on the ACR interface.
- **debug acr errors**: Provides debugging information on errors.
- **debug acr state**: Provides debugging information on state change – when there is a switchover.
- **debug cem events**: Provides debugging information to create and delete CEM circuits.
- **debug cem errors**: Provides debugging information about possible errors while creating and deleting of CEM circuits.
- **debug cem states**: Debugs to show the state changes of CEM circuits.
- debug atm events: Provides details on all events occurring on the ATM interface
- debug atm error: Provides debugging information on errors.
- debug atm state: Provides debugging information on state change – when there is a switchover.

UPSR Path Protection

A Unidirectional Path Switching Ring (UPSR) is a unidirectional network with two rings, one ring used as the working ring and the other as the protection ring. The same signal flows through both rings, one clockwise and the other counterclockwise. It is called UPSR because monitoring is done at the path layer. A node receives two copies of the electrical signals at the path layer, compares them, and chooses the one with the better quality. If part of a ring between two ADMs fails, the other ring still can guarantee the continuation of data flow. UPSR, like the one-plus-one scheme, has fast failure recovery.

UPSR Path Protection is supported at a VT level and an STS level.

Once a signal fail condition or a signal degrade condition is detected, the hardware initiates an interrupt to software that switches from the working path to the protection path. Nonrevertive options are valid for UPSR path protection.

Note 1X OC-192 and 8X OC-48 interface modules only supports the nonrevertive option. The nonrevertive option is the default mode.

Note When an active link of UPSR and APS is configured on the same interface module and the interface module reloads, the convergence number for UPSR circuits to switch to backup is high ranging 100–200 ms. When each circuit is configured separately, the convergence time is always under 50 ms.

The below table gives the maximum number of path level circuits that are supported in each mode.

Modes	Supported Scale
VT 1.5	84
STS-1	48
STS 3c	16
STS 12c	4
STS 48c	1

The UPSR path protection supports the following feature:

- SONET local connect and cross connect are supported at VT-15 CEP, STS-1c, STS-3c, STS-12c, and STS-48c levels. UPSR is also supported on TDM endpoints that are mapped to a pseudowire. T1 SAToP, T3 SAToP, and CT3 are supported on an UPSR ring only with local connect mode.

  Starting with Cisco IOS XE Fuji 16.9.x, the cross connect of T1, T3, and CT3 circuits to UPSR is supported. For cross-connect configuration, see *Configuring UPSR*.

Restrictions for UPSR Path Protection

- UPSR Dual Ring Interconnect (DRI) is not supported.

- UPSR Dual Node Interconnect (DNI) is not supported.

Configuring UPSR

Protection Group Configuration

```
enable
configure terminal
protection-group 401 type STS48c
controller protection-group 401
type STS48c
cem-group 19001 cep
end
```

Cross-connect Configuration with the CT3 mode

For cross connect with the CT3 mode, the CEM protection group interface supports only the VT-15 mode.

```
protection-group 2 type vt1.5
controller protection-group 2
type vt1.5
cem-group 16002 unframed

controller sonet 0/4/0
sts-1 1
mode vt-15
vtg 1 t1 2 protection-group 2 working

controller sonet 0/5/0
sts-1 1
mode vt-15
vtg 1 t1 2 protection-group 2 protect
```

Configuring UPSR Work and Protection Path Configuration

UPSR Work Path Configuration:

```
enable
configure terminal
controller MediaType 0/3/6
mode sonet
controller sonet 0/3/6
rate oc48
sts-1 1 - 48 mode sts-48c
protection-group 401 working
end
```

UPSR Protect Path Configuration:

```
enable
configure terminal
controller MediaType 0/12/6
mode sonet
controller sonet 0/12/6
rate oc48
sts-1 1 - 48 mode sts-48c
protection-group 401 protect
end
```

Verifying UPSR Configuration

Use the **show protection-group** command to verify UPSR configuration:

```
show protection-group
PGN    Type     Working I/f                Protect I/f              Active Status
-------------------------------------------------------------------------------
401    STS48C   SONET0/3/6.1-48            SONET0/12/6.1-48           W         A
-------------------------------------------------------------------------------
Status legend:D=Deleted FO=Force SF=SignalFailure SD=SignalDegrade
                        FL=Fail M=Manual L=Lockout C=Clear A=Auto
 (W)=working, (P)=protect
```

Associated Commands

The following table shows the Associated Commands for UPSR configuration:

Commands	Links
controller protection-group	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/mcl/allreleasemcl/all-book/all-03.html
protection-group	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/mcl/allreleasemcl/all-book/all-10.html
protection-group [**working** | **protect**]	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/mcl/allreleasemcl/all-book/all-10.html
show protection-group	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/mcl/allreleasemcl/all-book/all-14.html
type sts48c	http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/mcl/allreleasemcl/all-book/all-15.html

Additional References

Related Documents

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

Standards

Standard	Title
None	—

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

RFC	Title
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