ITU-T G.8032 Ethernet Ring Protection Switching

The ITU-T G.8032 Ethernet Ring Protection Switching feature implements protection switching mechanisms for Ethernet layer ring topologies. This feature uses the G.8032 Ethernet Ring Protection (ERP) protocol, defined in ITU-T G.8032, to provide protection for Ethernet traffic in a ring topology, while ensuring that no loops are within the ring at the Ethernet layer. The loops are prevented by blocking traffic on either a predetermined link or a failed link.

Effective from Cisco IOS Release 15.4 (3) S, the Cisco ASR 901 Router supports G.8032 on port-channel interface.

This chapter provides information about the following topics:

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the "Feature Information for ITU-T G.8032 Ethernet Ring Protection Switching" section.

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

Prerequisites for Configuring ITU-T G.8032 Ethernet Ring Protection Switching

• The Ethernet Flow Points (EFPs) must be configured.

Restrictions for Configuring ITU-T G.8032 Ethernet Ring Protection Switching

• G.8032 is supported only on EFP bridgedomains on the physical interface and port-channel interface.

• G.8032 is supported only on EFP with dot1q, dot1ad, QinQ, or dot1ad-dot1Q encapsulation type.

• G.8032 is not supported on xconnect interface.

• G.8032 does not support more than two ERP instances per ring.

• CFM hardware offloading is supported on the Cisco ASR 901 Router only from Cisco IOS Release 15.4(3)S.

• Link flap occurs while configuring the inclusion or exclusion VLAN list.

• Admin shut down is highly recommended before making any changes in Connectivity Fault Management (CFM) configuration.

• The **efd notify** command must be used under CFM configuration to notify G.8032 of failures, if any.

Information About Configuring ITU-T G.8032 Ethernet Ring Protection Switching

The following features are supported on the Cisco ASR 901 Routers from Cisco IOS Release 15.4(2)S onwards.

G.8032 Overview

The G.8032 provides protection switching mechanisms, and a protocol for Ethernet layer network (ETH) rings. Ethernet rings provide wide-area multipoint connectivity more economically due to their reduced number of links. The mechanisms and protocol provide reliable and stable protection; and prevents loop formation, which could fatally affect network operation and service availability.

You can prevent loops in an Ethernet ring by ensuring that, at any moment, traffic can flow on all but one of the ring links, the Ring Protection Link (RPL), where the link is blocked in the working state. When the system detects a link failure, a Ring Automatic Protection Switching (RAPS) Signal Failure message is multicast to all the nodes, and the failed links end-point ports are blocked. When the RPL owner receives the message, it unblocks the RPL link. This triggers protection switching and a new traffic pattern is established on the ring. The blocked ports are then moved to the nodes next to the failed ones.

Effective from Cisco IOS Release 15.4(3)S, the Cisco ASR 901 Router supports G.8032 on port-channel interface and CFM hardware offloading.

The following functions of G.8032 are supported on the Cisco ASR 901 Router:

- Sub-second switching
- EFP bridge domain over physical and port-channel interfaces
- Up to six rings per node
- Up to two ERP instances per ring
- Open-ring and closed-ring support
- Open-ring without virtual channel
- G.8032-REP TCN interworking (TCN propagation)
- G.8032-G.8032 TCN interworking—TCN propagation from subring to major ring
- Minimum supported convergence time is 200 ms for a single instance, and 400 ms for multiple instances.
- Effective from Cisco IOS Release 15.4 (3) S, the Cisco ASR 901 Router supports CFM hardware offloading with CCM interval 100ms, 10ms, and 3.3ms.
- Minimum supported convergence time is 100 ms for a single instance, and 200 ms for multiple instances.

ITU-T G.8032 Ethernet Ring Protection Switching Functionality

The Ethernet ring protection functionality includes the following:

- Loop avoidance
- The use of learning, forwarding, and Filtering Database (FDB) mechanisms

Loop avoidance in an Ethernet ring is achieved by ensuring that, at any time, traffic flows on all but the Ring Protection Link (RPL).

The following is a list of RPL types (or RPL nodes) and their functions:

- RPL owner—Responsible for blocking traffic over the RPL so that no loops are formed in the Ethernet traffic. There can be only one RPL owner in a ring.
- RPL neighbor node—An Ethernet ring node adjacent to the RPL. It is responsible for blocking its end of the RPL under normal conditions. This node type is optional and prevents RPL usage when protected.
- RPL next-neighbor node—Next-neighbor node is an Ethernet ring node adjacent to an RPL owner node or RPL neighbor node. It is mainly used for FDB flush optimization on the ring. This node is also optional.

The following figure illustrates the G.8032 Ethernet ring topology.

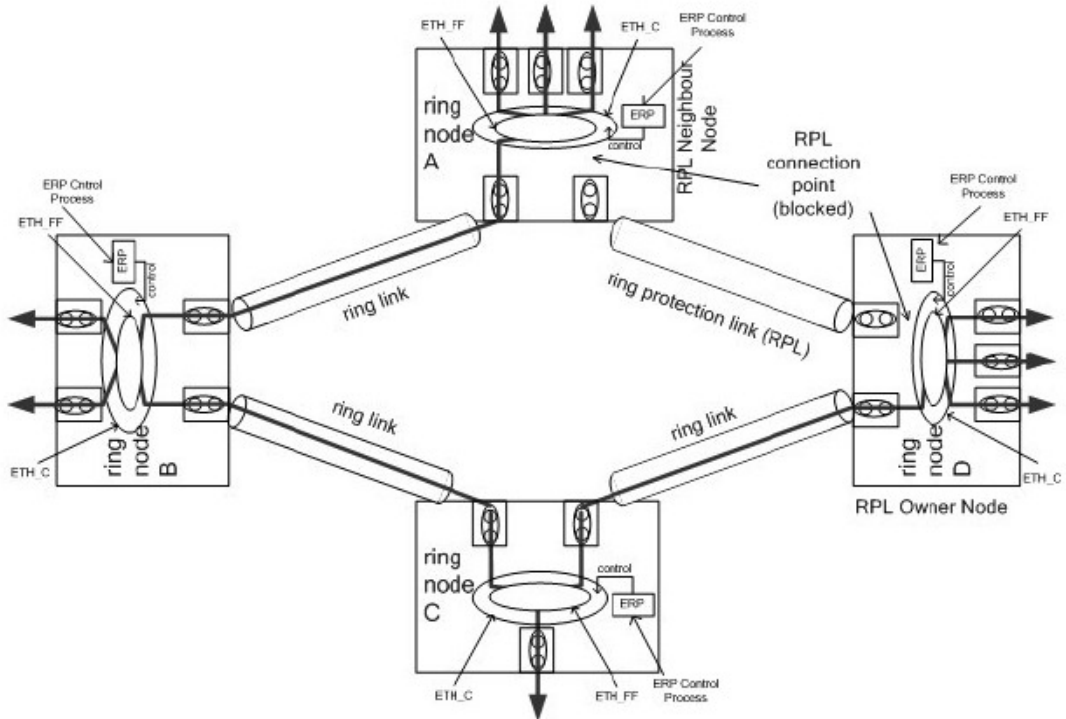*Figure 1: G.8032 Ethernet Ring Topology*
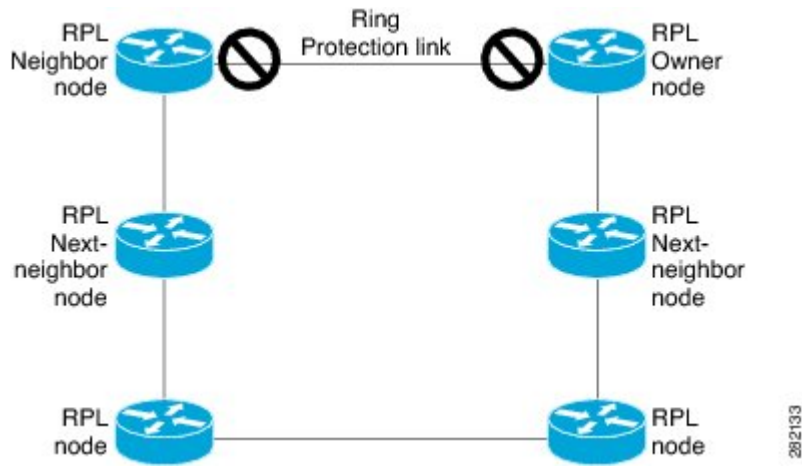
Single-Ring Topology

The following figure shows a 4-node G.8032 single-ring topology. The RPL link is between node A and node D, and when the network works, the RPL link is blocked by the RPL owner node D and RPL neighbor node A.

Figure 2: Single-Ring Topology

Multiple-Rings Topology

The following figure shows two interconnected rings in the multiple-rings topology. Ring ERP1 consists of nodes A, B, C, and D, and the links between these nodes. Ring ERP2 consists of nodes C, D, E, and F, and the links between C-to-F, F-to-E, and E-to-D. Ring ERP2 on its own does not form a closed loop since the link of C-to-D is owned and controlled by ring ERP1. The closed loop for ring ERP2 can be accomplished by introducing an RAPS virtual channel between the interconnected nodes, C and D, of the subring. The RAPS messages of ring ERP2 are encapsulated and transmitted over this virtual channel. If the RAPS virtual channel is not used to close the subring, the RAPS messages are terminated at the interconnected nodes. The

blocked ports on all the nodes in the ring block only the data traffic, not the RAPS messages to prevent segmentation of the RAPS channel for a nonvirtual channel ring implementation.

Figure 3: Multiple-Rings Topology
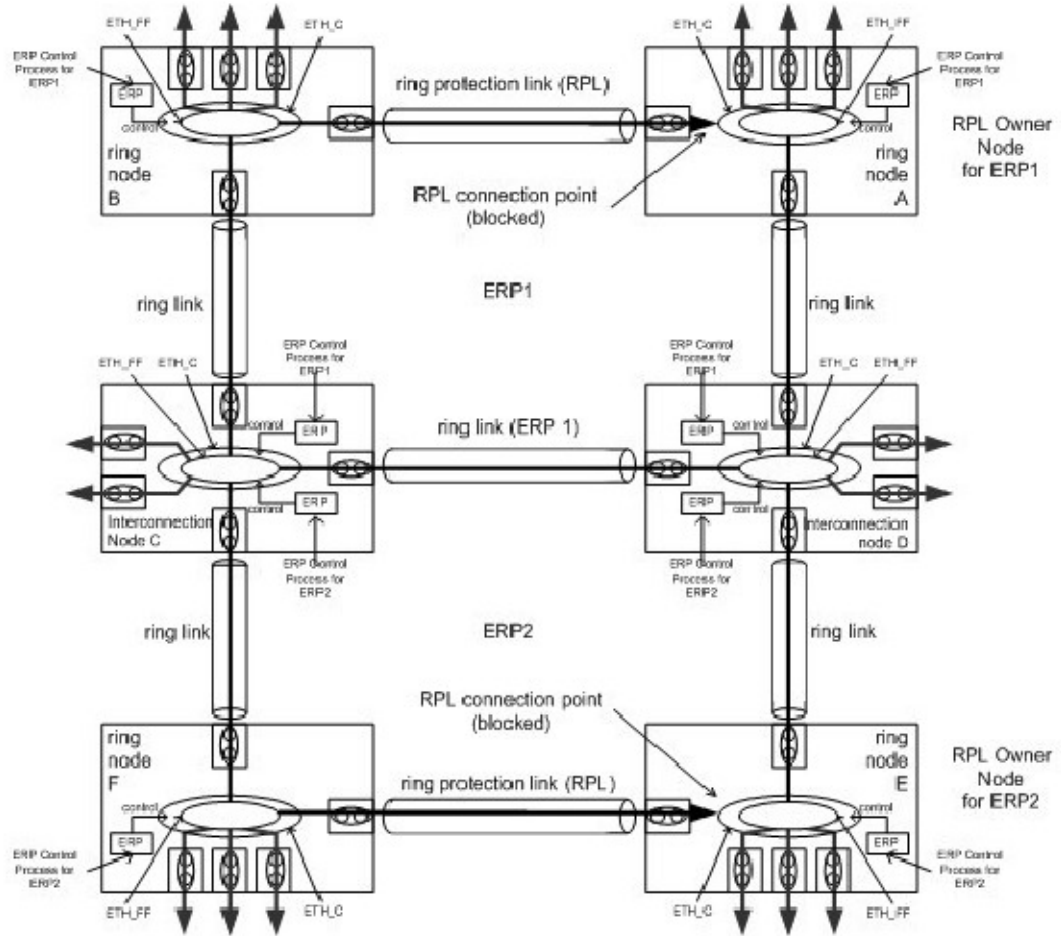
R-APS Control Messages

Nodes on the ring use control messages called Ring Automatic Protection Switching (R-APS) messages to coordinate the activities of switching the ring protection link (RPL) on and off. Any failure along the ring triggers a R-APS Signal Failure (R-APS SF) message in both directions of the nodes adjacent to the failed link, after the nodes have blocked the port facing the failed link. On obtaining this message, the RPL owner unblocks the RPL port.

Note A single link failure in the ring ensures a loop-free topology.

CFM Protocols and Link Failures

Connectivity Fault Management (CFM) and link status messages are used to detect ring link failure and node failure. During the recovery phase, when the failed link is restored, the nodes adjacent to the restored link send RAPS No Request (RAPS-NR) messages. On obtaining this message, the RPL owner blocks the RPL port and sends a RAPS-NR or RAPS Root Blocked (RAPS-RB) message. These messages cause all other nodes, except the RPL owner in the ring, to unblock all the blocked ports. The Ethernet Ring Protection (ERP) protocol works for both unidirectional failure and multiple link failure scenarios in a ring topology.

When CFM monitoring is configured, note the following points:

- Static remote MEP (RMEP) checking should be enabled.

- The MEPs should be configured to enable Ethernet fault detection.

Note The G.8032 ERP protocol uses CFM Continuity Check Messages (CCMs) at an interval of 1 second. At this interval (which is supported only on selected platforms), SONET-like switching time performance and loop-free traffic can be achieved.

Note The G.8032 ERP protocol uses CFM Continuity Check Messages (CCMs) at an interval of 3.3 ms. At this interval (which is supported only on selected platforms), SONET-like switching time performance and loop-free traffic can be achieved.

Note For G.8032 with Connectivity Fault Management (CFM) hardware offload, the CFM VLANs must be included in the exclusion VLANs list to avoid the down state of G.8032 rings.

G.8032 Ring-Supported Commands and Functionality

A G.8032 ring supports these basic operator administrative commands:

- Force switch (FS)—Allows the operator to forcefully block a particular ring port. Note the following points about FS commands:

    - Effective even if there is an existing SF condition

    - Multiple FS commands for ring are supported

    - May be used to allow immediate maintenance operations

- Manual switch (MS)—Allows the operator to manually block a particular ring port. Note the following points about MS commands:

    - Ineffective in an existing FS or signal failure (SF) condition

    - Overridden by new FS or SF conditions

    - Multiple MS commands cancel all MS commands

- Clear—Cancels an existing FS or MS command on the ring port. The Clear command is used at the ring protection link (RPL) owner to clear a nonrevertive mode condition.

A G.8032 ring can support multiple instances. An instance is a logical ring running over a physical ring. Such instances are used for various reasons, such as load-balancing VLANs over a ring. For example, odd-numbered VLANs may go in one direction of the ring, and even-numbered VLANs may go in the other direction. Specific VLANs can be configured under only one instance. They cannot overlap multiple instances. Otherwise, data traffic or Ring Automatic Protection Switching (R-APS) messages may cross logical rings, which is not desirable.

G.8032 ERP Timers

The G.8032 Ethernet Ring Protection (ERP) protocol specifies the use of different timers to avoid race conditions and unnecessary switching operations:

- Delay timers—Used by the Ring Protection Link (RPL) owner to verify that the network has stabilized before blocking the RPL. Note the following points about delay timers.

  - After a signal failure (SF) condition, a Wait-to-Restore (WTR) timer is used to verify that the SF is not intermittent.

  - The WTR timer can be configured by the operator. The default time interval is 5 minutes; the time interval ranges from 1 to 12 minutes.

  - After a force switch (FS) or a manual switch (MS) command is issued, a Wait-to-Block (WTB) timer is used to verify that no background condition exists.

    > **Note** The WTB timer interval may be shorter than the WTR timer interval.

- Guard timer—Used by all nodes when changing state; the guard timer blocks latent outdated messages from causing unnecessary state changes. The guard timer can be configured. The default time interval is 500 ms; the time interval ranges from 10 to 2000 ms.

- Hold-off timers—Used by the underlying Ethernet layer to filter out intermittent link faults. The hold-off timer can be configured. The default time interval is 0 seconds; the time interval ranges from 0 to 10 seconds. Faults are reported to the ring protection mechanism only if this timer expires.

Protection Switching Functionality in a Single Link Failure and Recovery

The following figure illustrates protection switching functionality in a single-link failure.

The figure represents an Ethernet ring topology consisting of seven Ethernet ring nodes. The ring protection link (RPL) is the ring link between Ethernet ring nodes A and G. In this topology, both ends of the RPL are blocked. Ethernet ring node G is the RPL owner node, and Ethernet ring node A is the RPL neighbor node.

Figure 4: G.8032 Ethernet Ring Protection Switching in a Single-Link Failure
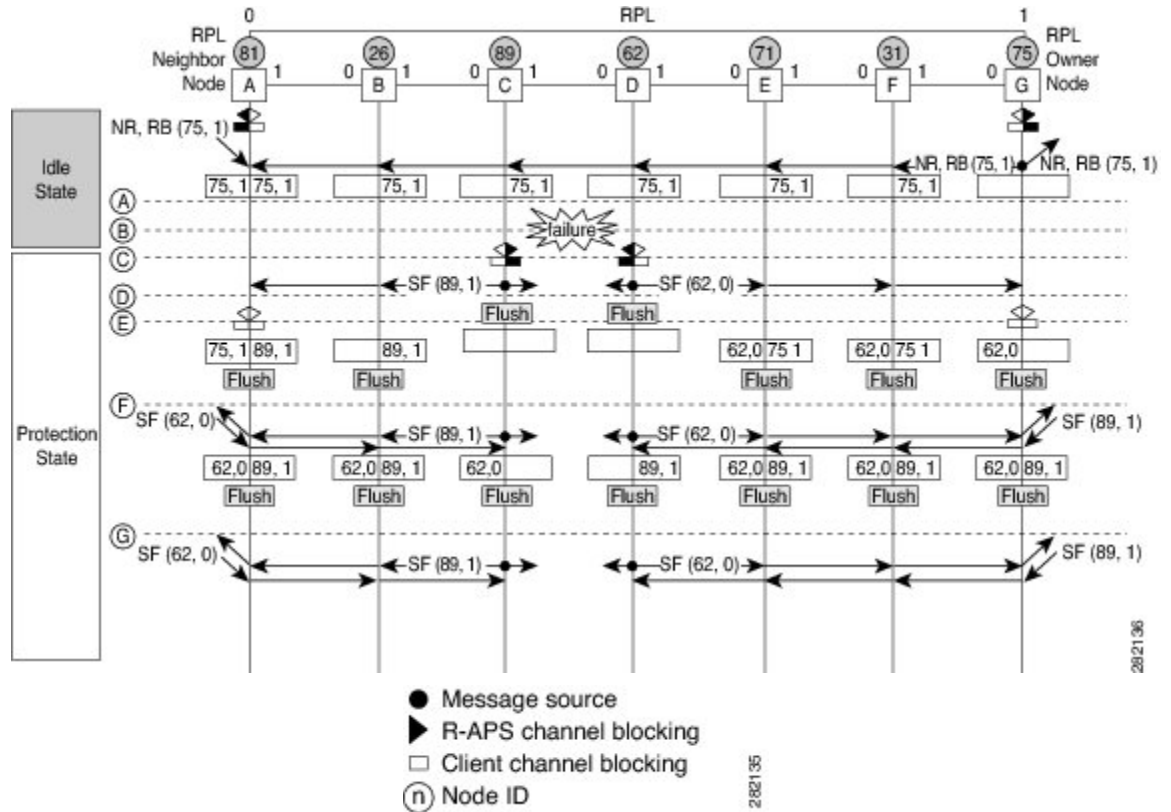
The following sequence describes the steps followed in the single-link failure:

1   A link operates in the normal condition.

2   A failure occurs.

3   Ethernet ring nodes C and D detect a local signal failure (SF) condition and after the hold-off time interval, block the failed ring port and perform the FDB flush.

4   Ethernet ring nodes C and D start sending Ring Automatic Protection Switching (R-APS) SF messages periodically along with the (node ID and bidirectional path-protected ring (BPR) identifier pair) on both ring ports while the SF condition persists.

5   All Ethernet ring nodes receiving an R-APS SF message perform the FDB flush. When the RPL owner node G and RPL neighbor node A receive an R-APS SF message, the Ethernet ring node unblocks its end of the RPL and performs the FDB flush.

6   All Ethernet ring nodes receiving a second R-APS SF message perform the FDB flush again; the additional FDB flush is because of the node ID and BPR-based configuration.

7   R-APS SF messages are detected on the Ethernet Ring indicating a stable SF condition. Further R-APS SF messages trigger no further action.

The following figure illustrates the steps taken in a revertive operation in a single-link failure.

Figure 5: Single-Link Failure Recovery (Revertive Operation)
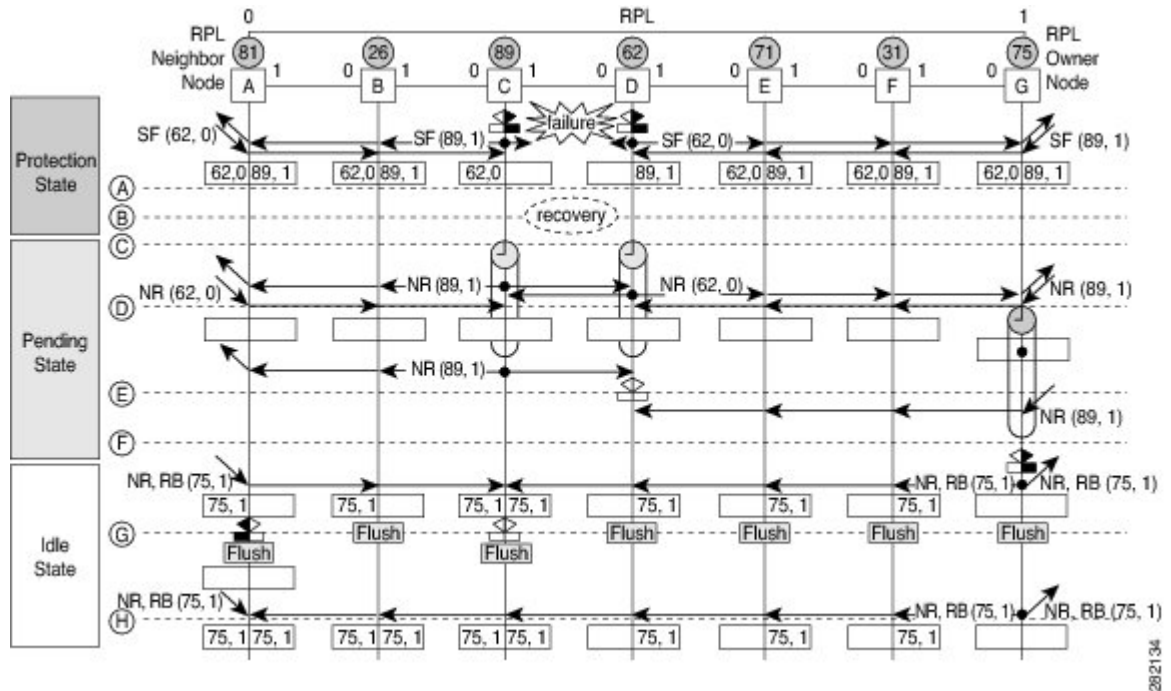
The following sequence describes the steps followed in the single-link failure revertive (recovery) operation:

1 A link operates in the stable SF condition.

2 Recovery of link failure occurs.

3 Ethernet ring nodes C and D detect clearing of the SF condition, start the guard timer, and initiate periodic transmission of the R-APS No Request (NR) messages on both ring ports. (The guard timer prevents the reception of R-APS messages.)

4 When the Ethernet ring nodes receive an R-APS NR message, the node ID and BPR identifier pair of a receiving ring port is deleted and the RPL owner node starts the Wait-to-Restore (WTR) timer.

5 When the guard timer expires on Ethernet ring nodes C and D, the nodes may accept the new R-APS messages, if any. Ethernet ring node D receives an R-APS NR message with a higher node ID from Ethernet ring node C, and unblocks its nonfailed ring port.

6 When the WTR timer expires, the RPL owner node blocks its end of the RPL, sends R-APS (NR or route blocked [RB]) message with the (node ID and BPR identifier pair), and performs the FDB flush.

7 When Ethernet ring node C receives an R-APS (NR or RB) message, the node removes the block on its blocked ring ports, and stops sending R-APS NR messages. On the other hand, when the RPL neighbor node A receives an R-APS NR or RB message, the node blocks its end of the RPL. In addition, Ethernet ring nodes A to F perform the FDB flush when receiving an RAPS NR or RB message because of the node ID and BPR-based configuration.

How to Configure ITU-T G.8032 Ethernet Ring Protection Switching

Configuring the Ethernet Ring Profile

To configure an Ethernet ring profile, complete the following steps.

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	**ethernet ring g8032 profile** *profile-name*
	
	Example:
	
	`Router(config)# ethernet ring g8032`
	`profile`
	`profile1`
		Creates the Ethernet ring profile and enters the Ethernet ring profile configuration mode.

Step 4	**timer{guard** *seconds***| hold-off** *seconds* **| wtr** *minutes***}**
	
	Example:
	
	`Router(config-erp-profile)# timer`
	`hold-off 5`
		Specifies the time interval for the guard, hold-off, and Wait-to-Restore (WTR) timers.

Step 5	**non-revertive**
	
	Example:
	
	`Router(config-erp-profile)#`
	`non-revertive`
		Specifies a nonrevertive Ethernet ring instance.
		
		By default, Ethernet ring instances are revertive.

Step 6	**end** **Example:** `Router(config-erp-profile)# end`	Returns to privileged EXEC mode.

Configuring an Ethernet Protection Ring

To configure an Ethernet Protection Ring (EPR), complete the following steps.

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	**ethernet ring g8032** *ring-name* **Example:** `Router(config)# ethernet ring g8032 ring1`	Creates the Ethernet ring and enters the Ethernet ring port configuration mode.
Step 4	**port0 interface** *type number* **Example:** `Router(config-erp-ring)# port0 interface gigabitethernet 0/1`	Connects port0 of the local node to the Ethernet ring and enters Ethernet ring protection mode.
Step 5	**monitor service instance** *instance-id* **Example:** `Router(config-erp-ring-port)# monitor service instance 1`	(Optional) Assigns the Ethernet service instance to monitor the ring port (port0) and detect ring failures. If this command is used, the service instance should be configured with CFM sessions. In such a scenario, CFM session failures, if any, will be tracked as G.8032 link failures. **Note** We recommend that you use this command in microwave links where signal degradation will not be identified as physical link failures. If this command is not used, G.8032 will track only the physical link failures.
Step 6	**exit** **Example:** `Router(config-erp-ring-port)# exit`	Exits the Ethernet ring port configuration mode.

	Command or Action	Purpose
Step 7	**port1 {interface** *type number* **| none}** **Example:** Router(config-erp-ring)# port1 interface gigabitethernet 0/1	Connects port1 of the local node to the Ethernet ring and enters the Ethernet ring protection mode.
Step 8	**monitor service instance** *instance-id* **Example:** Router(config-erp-ring-port)# monitor service instance 2	(Optional) Assigns the Ethernet service instance to monitor the ring port (port1) and detect ring failures. If this command is used, the service instance should be configured with CFM sessions. In such a scenario, CFM session failures, if any, will be tracked as G.8032 link failures. **Note** We recommend that you use this command in microwave links where signal degradation will not be identified as physical link failures. If this command is not used, G.8032 will track only the physical link failures.
Step 9	**exit** **Example:** Router(config-erp-ring-port)# exit	Exits Ethernet ring port configuration mode.
Step 10	**exclusion-list vlan-ids** *vlan-id* **Example:** Router(config-erp-ring)# exclusion-list vlan-ids 2	(Optional) Specifies VLANs that are unprotected (unblocked) by the Ethernet ring protection mechanism. If the command is not used, VLANS that are not defined in the inclusion list in Step 16 will be completely blocked for the traffic. If the command is used, VLANS that are not defined in the inclusion list and exclusion list will be completely blocked for the traffic.
Step 11	**open-ring** **Example:** Router(config-erp-ring)# open-ring	(Optional) Specifies the Ethernet ring as an open ring. By default, Ethernet ring is closed.
Step 12	**instance** *instance-id* **Example:** Router(config-erp-ring)# instance 1	Configures the Ethernet ring instance and enters the Ethernet ring instance configuration mode.
Step 13	**description** *descriptive-name* **Example:** Router(config-erp-inst)#	Specifies a descriptive name for the Ethernet ring instance.

	Command or Action	Purpose
	`description cisco_customer_instance`	
Step 14	**profile** *profile-name* **Example:** `Router(config-erp-inst)# profile profile1`	Specifies the profile associated with the Ethernet ring instance configured in Step 12.
Step 15	**rpl {port0 | port1 } { owner | neighbor | next-neighbor}** **Example:** `Router(config-erp-inst)# rpl port0 neighbor`	Specifies the Ethernet ring port on the local node as the RPL owner, neighbor, or next neighbor.
Step 16	**inclusion-list vlan-ids** *vlan-id* **Example:** `Router(config-erp-inst)# inclusion-list vlan-ids 11`	Specifies the VLANs that are protected by the Ethernet ring protection mechanism.
Step 17	**aps-channel** **Example:** `Router(config-erp-inst)# aps-channel`	Enters the Ethernet ring instance aps-channel configuration mode.
Step 18	**level** *level-value* **Example:** `Router(config-erp-inst-aps)# level 5`	Specifies the Automatic Protection Switching (APS) message level for the node on the Ethernet ring. All the nodes in the Ethernet ring must be configured at the same level. The default level is 7.
Step 19	**port0 service instance** *instance-id* **Example:** `Router(config-erp-inst-aps)# port0 service instance 100`	Associates APS channel information with port0.
Step 20	**port1 service instance** *instance-id* **Example:** `Router(config-erp-inst-aps)# port1 service instance 100`	Associates APS channel information with port1.
Step 21	**end** **Example:** `Router(config-erp-inst-aps)# end`	Returns to privileged EXEC mode.

Configuring Topology Change Notification Propagation

To configure topology change notification (TCN) propagation, complete the following steps.

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	**ethernet tcn-propagation G8032 to {REP	G8032}** **Example:** `Router (config)# ethernet tcn-propagation G8032 to G8032`	Allows topology change notification (TCN) propagation from a source protocol to a destination protocol. **Note** Source and destination protocols vary by platform and release.
Step 4	**end** **Example:** `Router(config)# end`	Returns to privileged EXEC mode.

Verifying Ethernet Ring Protection Configuration

Verifying ERP Switching Configuration

To verify an ERP switching configuration, use the **show ethernet ring g8032 configuration** command, as shown in this example:

```
Router# show ethernet ring g8032 configuration

Ethernet ring erp
 Port0: Port-channel5 (Monitor: Service Instance 5)
 Port1: Port-channel6 (Monitor: Service Instance 6)
 Exclusion-list VLAN IDs: 5-6
 Open-ring: no
 Instance 1
  Description: ERP_FOR_VLANS_1000-1299
  Profile:    erp
```

```
 RPL:          port0 RPL Owner
 Inclusion-list VLAN IDs: 1000-1299
 APS chanel
  Level: 6
  Port0: Service Instance 1000
  Port1: Service Instance 1000
 State: configuration resolved
Instance 2
 Description: ERP_FOR_VLANS_1500-1799
 Profile:     erp
 RPL:
 Inclusion-list VLAN IDs: 1500-1799
 APS channel
  Level: 5
  Port0: Service Instance 1500
  Port1: Service Instance 1500
 State: configuration resolved
 <cr>
```

Verifying Functional State of a Ring

To verify a brief description of the functional state of the ERP instance, use the **show ethernet ring g8032 brief [**ring-name**] [instance [**instance-id **]]** command, as shown in this example:

```
Router# show ethernet ring g8032 brief erp instance 1
R: Interface is the RPL-link
F: Interface is faulty
B: Interface is blocked
FS: Local forced switch
MS: Local manual switch

RingName                         Inst NodeType  NodeState    Port0    Port1
--------------------------------------------------------------------------
erp                              1    Owner      Idle         R,B
```

Verifying Ring Status

To verify the status summary of a ring , use the **show ethernet ring g8032 status [**ring-name**] [instance [**instance-id **]]** command, as shown in this example:

```
Router# show ethernet ring g8032 status erp instance 1
Ethernet ring erp instance 1 is RPL Owner node in Idle State
 Port0: Port-channel5 (Monitor: Service Instance 5)
  APS-Channel: Port-channel5
  Status: RPL, blocked
  Remote R-APS NodeId: 0000.0000.0000, BPR: 0
 Port1: Port-channel6 (Monitor: Service Instance 6)
  APS-Channel: Port-channel6
  Status: Non-RPL
  Remote R-APS NodeId: 0000.0000.0000, BPR: 0
 APS Level: 6
 Profile: erp
  WTR interval: 1 minutes
  Guard interval: 2000 milliseconds
  HoldOffTimer: 0 seconds
  Revertive mode
```

Verifying Ring Summary

To view the summary of the number of ERP instances in each state of the ERP switching process, use the **show ethernet ring g8032 summary** command, as shown in this example:

```
Router# show ethernet ring g8032 summary
Chassis Node Id: 4403.a70c.4e98
```

```
States
----------------------------
 Init             0
 Idle             2
 Protection       0
 Manual Switch    0
 Forced Switch    0
 Pending          0
----------------------------
 Total            2
```

Verifying Events and Messages in a Ring

To verify the number the number of events and R-APS messages received for an ERP instance, use the **show ethernet ring g8032 statistics [** *ring-name***] [instance [***instance-id* **]]** command, as shown in this example:

```
Router# show ethernet ring g8032 statistics erp instance 1
Statistics for Ethernet ring erp instance 1
 Local SF detected:
  Port0: 1
  Port1: 0
 FOP PM detected:
  Port0: 0
  Port1: 0

 R-APS   Port0(Tx/Rx)                  Port1(Tx/Rx)
         Last Tx time                  Last Tx time
         Last Rx time                  Last Rx time
---------------------------------------------------------------------------------
 NR    : 6/14                          6/13
         Wed May 14 15:46:44.391       Wed May 14 15:46:44.391
         Wed May 14 15:47:42.699       Wed May 14 15:47:42.699
 NR,RB : 157/0                         157/0
         Wed May 14 16:00:34.391       Wed May 14 16:00:34.391
         Never                         Never
 SF    : 5/4                           5/2
         Wed May 14 15:46:40.043       Wed May 14 15:46:40.043
         Wed May 14 15:46:44.639       Wed May 14 15:46:45.503
 MS    : 0/0                           0/0
         Never                         Never
         Never                         Never
 FS    : 0/0                           0/0
         Never                         Never
         Never                         Never
 EVENT : 0/0                           0/0
         Never                         Never
         Never                         Never

 State          Last entry into state time
---------------------------------------------------------------------------------
 Init          : Wed May 14 15:46:29.903
 Idle          : Wed May 14 15:47:44.391
 Protection    : Wed May 14 15:46:30.039
 Manual Switch : Never
 Forced Switch : Never
 Pending       : Wed May 14 15:46:44.391

Router# show ethernet ring g8032 statistics erp instance 2
Statistics for Ethernet ring erp instance 2
 Local SF detected:
  Port0: 1
  Port1: 0
 FOP PM detected:
  Port0: 0
  Port1: 0

 R-APS   Port0(Tx/Rx)                  Port1(Tx/Rx)
         Last Tx time                  Last Tx time
         Last Rx time                  Last Rx time
```

```
--------------------------------------------------------------------------------
NR      : 6/14                                 6/13
          Wed May 14 15:46:44.395             Wed May 14 15:46:44.395
          Wed May 14 15:47:42.699             Wed May 14 15:47:42.699
NR,RB : 0/155                                 0/3
          Never                               Never
          Wed May 14 16:00:42.255             Wed May 14 15:47:47.255
SF      : 5/3                                 5/1
          Wed May 14 15:46:43.191             Wed May 14 15:46:43.191
          Wed May 14 15:46:44.643             Wed May 14 15:46:43.407
MS      : 0/0                                 0/0
          Never                               Never
          Never                               Never
FS      : 0/0                                 0/0
          Never                               Never
          Never                               Never
EVENT : 0/0                                   0/0
          Never                               Never
          Never                               Never

State           Last entry into state time
--------------------------------------------------------------------------------
Init        : Wed May 14 15:46:32.827
Idle        : Wed May 14 15:47:47.255
Protection  : Wed May 14 15:46:33.123
Manual Switch : Never
Forced Switch : Never
Pending     : Wed May 14 15:46:44.395
```

Verifying Port Status of a Ring

To verify the Ethernet ring port status information for the interface, use the **show ethernet ring g8032 port status interface [***type number* **]** command, as shown in this example:

```
Router# show ethernet ring g8032 port status interface po5
Port: Port-channel5
 Ring: erp
        Block vlan list: 1-4,7-1499,1800-4095
        Unblock vlan list: 5-6,1500-1799
        REQ/ACK: 0/0
        Instance 1 is in Blocked state
        Instance 2 is in Unblocked state
```

Verifying ERP Profile Settings

To verify the settings for one or more ERP profiles, use the **show ethernet ring g8032 profile [***profile-name***]** command, as shown in this example:

```
Router# show ethernet ring g8032 profile erp
Ethernet ring profile name: erp
  WTR interval: 1 minutes
  Guard interval: 2000 milliseconds
  HoldOffTimer: 0 seconds
  Revertive mode
```

Troubleshooting Tips

The following table lists the troubleshooting tips for Configuring the ITU-T G.8032 Ethernet Ring Protection feature.

Note   We recommend that you do not use these debug commands without TAC supervision.

Table 1: Troubleshooting Tips for G.8032 ERP Configuration

Command Name	Description
[no] debug ethernet ring g8032 all	Enables debugging all Ethernet Ring Protocol (ERP) messages.
[no] debug ethernet ring g8032 errors	Enables debugging ERP errors.
[no] debug ethernet ring g8032 events	Enables debugging ERP events.
[no] debug ethernet ring g8032 fsm	Enables debugging Finite State Machine (FSM) state changes for ERP instances
[no] debug ethernet ring g8032 ha	Enables debugging ERP high availability (HA) features.
[no] debug ethernet ring g8032 packets	Enables debugging ERP packets.
[no] debug ethernet ring g8032 parser	Enables debugging ERP messages related to G.8032 parser.
[no] debug ethernet ring g8032 timing	Enables debugging timing of ERP events.
[no] debug ethernet ring g8032 memmgr	Enables debugging G.8032 memory manager messages.
[no] debug ethernet ring g8032 cfgmgr	Enables debugging G.8032 configuration manager messages.
[no] debug ethernet ring g8032 ctrlmgr	Enables debugging G.8032 control manager messages.
[no] debug ethernet ring g8032 instmgr	Enables debugging G.8032 instance manager messages.
[no] debug ethernet ring g8032 pseudo-preemption	Enables debugging G.8032 pseudo-preemption messages.

Configuration Examples for ITU-T G.8032 Ethernet Ring Protection Switching

Example: Configuration for Ethernet Ring Protection

The following is a sample ERP switching configuration:

```
Owner:

!
ethernet ring g8032 profile closed_ring
 timer wtr 1
 timer guard 2000
ethernet ring g8032 pp_closed
 port0 interface GigabitEthernet0/9
  monitor service instance 1
 port1 interface GigabitEthernet0/10
  monitor service instance 5
 instance 1
  profile closed_ring
  rpl port0 owner
  inclusion-list vlan-ids 1-10
  aps-channel
   level 5
   port0 service instance 10
   port1 service instance 10
!

!

Router# show run | sec cfm
asr901-platf-multi-nni-cfm
ethernet cfm ieee
ethernet cfm global
ethernet cfm domain closed_ring1 level 4
 service closed_ring1 evc closed_ring1 vlan 1 direction down
  continuity-check
  continuity-check interval 1s
  efd notify g8032
ethernet cfm domain closed_ring5 level 4
 service closed_ring5 evc closed_ring5 vlan 5 direction down
  continuity-check
  continuity-check interval 1s
  efd notify g8032

!

!

Neighbor:

Router# show run | sec ring
ethernet ring g8032 profile closed_ring
 timer wtr 1
 timer guard 2000
ethernet ring g8032 closed_ring
 port0 interface GigabitEthernet0/9
  monitor service instance 5
 port1 interface GigabitEthernet0/6
  monitor service instance 4
 instance 1
  profile closed_ring
  rpl port0 neighbor
  inclusion-list vlan-ids 1-10
  aps-channel
```

```
     level 5
     port0 service instance 10
     port1 service instance 10
 !
```

Additional References

The following sections provide references related to the Configuring ITU-T G.8032 Ethernet Ring Protection feature.

Related Documents

Related Topic	Document Title
Cisco IOS Commands	Cisco IOS Master Commands List, All Releases
Cisco ASR 901 Command Reference	Cisco ASR 901 Series Aggregation Services Router Command Reference
	Cisco ASR 901S Series Aggregation Services Router Command Reference
Cisco IOS Interface and Hardware Component Commands	Cisco IOS Interface and Hardware Component Command Reference

Standards

Standard	Title
None	—

RFCs

RFC	Title
None	—

Technical Assistance

Description	Link
The Cisco Technical Support website contains thousands of pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content.	http://www.cisco.com/techsupport

Feature Information for Configuring ITU-T G.8032 Ethernet Ring Protection Switching

The following table lists the features in this module and provides links to specific configuration information.

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator enables you to determine which software images support a specific software release, feature set, or platform. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn . An account on Cisco.com is not required.

Note The following table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Table 2: Feature Information for Configuring ITU-T G.8032 Ethernet Ring Protection Switching

Feature Name	Releases	Feature Information
Configuring ITU-T G.8032 Ethernet Ring Protection Switching	15.4(2)S	This feature was introduced on the Cisco ASR 901 Routers. The following sections provide information about this feature: • G.8032 Overview, on page 2 • How to Configure ITU-T G.8032 Ethernet Ring Protection Switching, on page 11 • Configuration Examples for ITU-T G.8032 Ethernet Ring Protection Switching, on page 20

Feature Name	Releases	Feature Information
Psuedo Preemption Support	15.4(3)S	This feature was introduced on the Cisco ASR 901 Routers. The following sections provide information about this feature: • G.8032 Overview, on page 2 • How to Configure ITU-T G.8032 Ethernet Ring Protection Switching, on page 11
CFM Filtering Hardware Offload Support	15.4(3)S	This feature was introduced on the Cisco ASR 901 Routers. The following section provides information about this feature: • G.8032 Overview, on page 2