

# PoE+ Series Switches Ethernet Ring Protection (G8032-201003) Configuration Guide

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Models: S3150-8T2FP; S3260-8T2FP; S3260-16T4FP; S3400-24T4FP

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## Chapter 1 Introduce Fast Ethernet Ring Protection

### 1.1 Overview

The Fast Ethernet Ring Protection Protocol is a special type of link layer protocol designed specifically for building ring-shaped Ethernet topologies. The Ethernet ring protection protocol blocks a link when the ring network topology is complete, preventing data loops from forming broadcast storms. In the event of a link interruption, the protocol quickly restores the previously blocked link, enabling communication between nodes on the ring network.

The fast Ethernet ring protection protocol controls the aging of the switch MAC address table to ensure that data packets can be sent to the correct link when the topology changes. Generally, the aging time of MAC addresses in the address table is 300 seconds. The ring network protection protocol can control the MAC address table of the switch to age in a very short time.

Both the ring network protection protocol and the spanning tree protocol are used for link layer topology control. Spanning tree protocol is applicable to various complex networks, and it uses hop-by-hop method to propagate the change of network topology. The ring network protection protocol is dedicated to the ring topology, and uses the diffusion method to propagate topology change information. Therefore, in the ring network, the convergence performance of the ring network protection protocol is better than the spanning tree protocol. In the case of good network conditions, the time for the ring network protection protocol to resume network communication can be less than 50 milliseconds.

Description:

The Ethernet ring protection protocol supports the configuration of a switch as a node of multiple physical ring networks to form a tangent ring. The Ethernet ring protection protocol does not support intersecting rings with public links.

### 1.2 ERPS Related Concepts

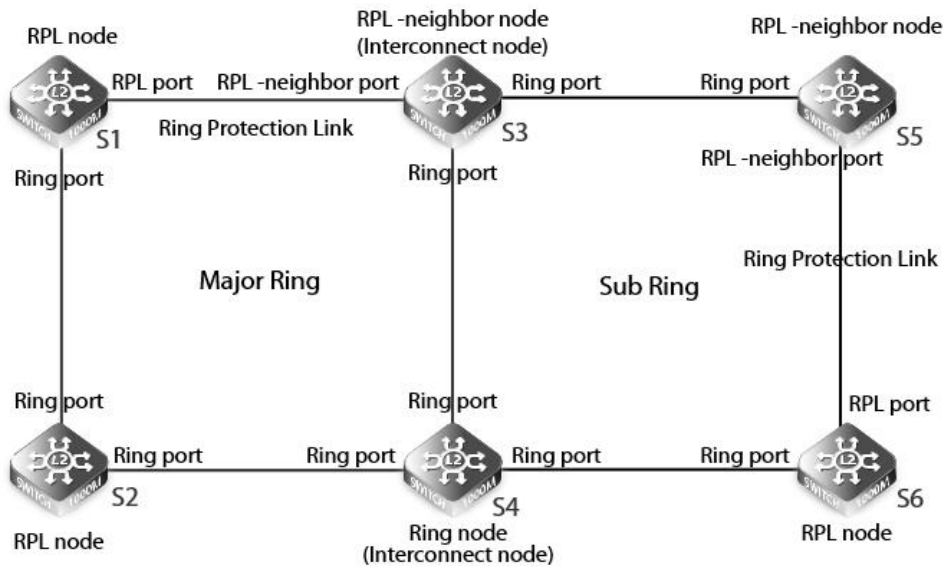


figure 1:ERPS Ethernet ring example

#### 1.2.1 Ring network level

ERPS supports multi-ring or hierarchical transport network topology, as shown in Figure 1. The main ring is a complete single ring, and the sub-ring is connected to the main ring (or sub-ring) through 2 interconnection nodes (interconnection-node). As shown in Figure 1, the red line is the main ring, including the nodes S1, link S1-S2, node S2, link S2-S4, node S4, link S4-S3, node S3, link S3-S1; the blue line is the sub-ring, including node S3, link S3- S5, node S5, link S5-S6, node S6, link S6-S4, node S4, but excluding links S4-S3.

#### 1.2.2 Ring node role

Each switch that constitutes a ring network is a ring network node. The role of ring network nodes is divided into four types: RPL protection node, RPL neighbor node, interconnection node (interconnection-node) and ordinary node (Node). Select a physical link on each single ring as the RPL protection link, one of the two switches directly connected to this link as the RPL protection node, the other as the RPL neighbor node, and the remaining other switches as ordinary node. The interconnection node (interconnection-node) is the two intersection nodes that the sub-ring accesses to the main ring (or sub-ring).

As shown in Figure 1, in the main ring, S1 is the RPL protection node, S3 is the RPL neighbor node, and S2 and S4 are ordinary nodes; in the sub-ring, S6 is the RPL protection node, S5 is the RPL neighbor node, and passes The interconnection nodes (interconnection-node) S3 and S4 are connected to the main ring.

The node type of the ERPS protocol is mainly determined by the role of the port, but the node type of the interconnection node (interconnection-node) needs to be determined during configuration. By default, the node is not an interconnection node (interconnection-node).

The functions of the ring nodes are basically the same: detect the status of the local ring ports and send out notifications when the link fails. The difference is that the RPL protection node and the RPL neighbor node normally block the RPL link, but the ordinary node does not. The interconnection node (interconnection-node) has only one ring port connected to the sub-ring, and the node must also be another Nodes on the main ring (or sub-ring).

### 1.2.3 Ring port role

The ERPS protocol requires that each node has two ports connected to the ring network, and each port is called a ring port. In addition, on each single ring, there is also a ring network port as a ring protection link (RPL). As for the interconnection node (interconnection-node), although only the ring network port is connected to the sub-ring, it also has a virtual port to detect the connectivity between the two interconnection nodes (interconnection-node), which will be described later .

Normally, all ring network ports except RPL links on the ring network are in the forwarding state, and the RPL ports of the RPL protection node and RPL neighbor nodes are blocked to avoid loops. In the event of a ring link failure, the RPL protection node and RPL neighbor nodes unblock the RPL ports to restore network communication.

Only one RPL port can be configured in each ring node instance on a switch.

Description:

The ERPS protocol supports configuring the aggregation port as a ring network port.

### 1.2.4 ERPS and CFM

Configure MEP on the ERPS port to monitor ring links. The ring network port uses down mep to monitor the status of the ring link where it is located; the ring port of the interconnected node accessing the sub-ring must also be configured with up mep to monitor connectivity on the main ring, as shown in Figure 2.

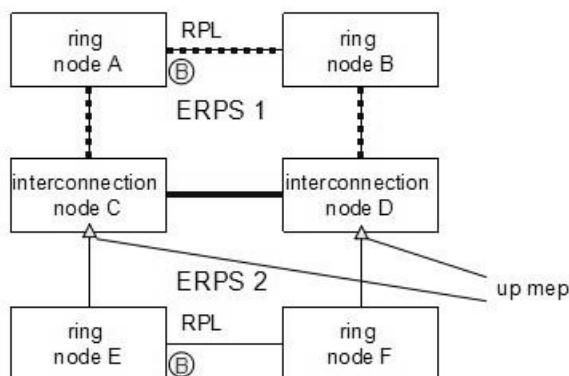


Figure 2: The virtual port of the interconnected node is configured on the Up MEP port

In Figure 2, all ERPS ring ports are configured with down mep, and ring me links are monitored through down mep, such as ring link AC. Down mep is configured on one ring port of node A and node C respectively Later, monitoring, link failure or recovery from failure, send corresponding notifications to the ERPS control module; at the same time, down mep is also responsible for receiving and sending R-APS messages. Up mep is only configured on the ring network port of the interconnected node accessing the sub-ring to monitor the connectivity of the main ring. When the main ring path between the interconnected nodes is unavailable or communication is restored, the corresponding is sent to the ERPS control module announcement of. In addition, it is not only necessary to configure up mep for the ring port of the interconnected node to access the sub-ring, because it is also a ring port, so it also needs to configure down mep.

Description:

The up mep configured on the ring network port of the interconnected node accessing the sub-ring is used to monitor the connectivity of the main ring. In this case, it is equivalent to monitoring the virtual port of the link of the main ring.

### 1.2.5 Ring network interconnection mode using R-APS virtual channel

For the sub-ring, the interconnection node is the node that connects the sub-ring with the rest of the network. For example, in Figure 1, the main ring is connected. The up mep port of the interconnected node monitors the connectivity of the main ring, which is called the R-APS virtual channel. Through the R-APS virtual channel, two interconnected nodes can communicate with R-APS through the rest of the network.

The sub-ring sends (and accepts) R-APS information to the network through the R-APS virtual channel, and the R-APS information can be transmitted as a data stream in the network. Of course, R-APS information should be distinguished from ordinary data streams. Therefore, for different ERPS ring networks, different control vlans are used to carry R-APS information.

Of course, there are also network states in which the interconnected nodes do not use the R-APS channel when connecting the sub-ring and the rest of the network, and the state of the R-APS channel is all in the forwarding state.

### 1.2.6 R-APS transmission VLAN

R-APS messages are transmitted in the R-APS channel. Therefore, a VLAN must be set up specifically for the R-APS channel. Different nodes set up different VLANs, but for a certain node, the other nodes set up VLANs can be used as VLANs for ordinary data flow transmission.

When configuring a VLAN for R-APS, if the VLAN is not created, the ERPS system will automatically create the VLAN for it.

The status of the ERPS ring network port on the R-APS channel is the same as the state of ordinary data flow, except for the sub-ring that does not use the R-APS virtual channel, because the R-APS channel of the interconnected node on this sub-ring is suspended, so The nodes on the sub-rings that do not use the R-APS virtual channel are all in the forwarding state.

Description:

The VLAN of the MEP port where the ERPS port is located must be the same as the R-APS transmission VLAN.

### 1.2.7 Return mode

In some ring networks, under normal circumstances, the network resource of the link channel for data flow transmission is better, and the channel where the RPL is located is only used for backup. Therefore, when the switch is cleared, the return mode is used to return the data stream to A good channel for network resources. In some ring networks, the requirements for network resources are not so high, and there is no need to return to the original link channel immediately after the switching recovery. Therefore, the non-return mode can also reduce the number of return switching.

In the return mode operation, when a switch is cleared, the data flow is restored to the original channel, blocking the RPL. In the case of clearing the fault, the return of the data stream needs to be used to avoid protection switching in the case of intermittent faults after the WTR timer expires; in the case of clearing the manual switching or forced switching command, you need to wait for the WTB timer. In non-return mode operation, when a switch is cleared, as long as the RPL channel is not faulty, the data flow will still be on the RPL channel.

Description:

The WTR timer and WTB timer only take effect in the return mode.

### 1.2.8 Nimble mode

Because erps depends on the CFM module, the configuration of CFM is more complicated and error-prone, and because it depends on CFM, erps has a long processing cycle for sending and receiving packets, which affects the switching speed. In order to simplify configuration and accelerate switching, a new nimble mode has been developed. In nimble mode, only erps related commands need to be configured, and cfm does not need to be configured. Ring ports also do not need to rely on down mep and up mep.

Description:

For backward compatibility, the original configuration mode and mode are retained. The default is the original configuration mode, and the nimble mode will take effect only after the nimble mode is configured.

## 1.3 ERPS Message Type

The types of messages used by the ERPS protocol are shown in Table 2.1.

Message type	Explanation
<b>Forced Switch (FS)</b>	Ring network nodes (including RPL nodes) notify other nodes after performing a forced switching command.
<b>Signal Fail (SF)</b>	Ring nodes (including RPL nodes) notify other nodes after detecting the local link failure.
<b>Manual Switch (MS)</b>	Ring network nodes (including RPL nodes) notify other nodes after manual switching commands.
<b>No Request (NR)</b>	The ring network node notifies other nodes after detecting that all local ring network links are restored.
<b>No Request, RPL Blocked (NR-RB)</b>	The ring network protection node notifies other nodes that the ring network protection switching is restored.

Table 2.1 ERPS ring network protection protocol message types

## 1.4 ERPS Ring Network Protection Mechanism

### 1.4.1 Stable state

In a stable state, the ring protection node blocks the RPL port and continuously sends NR-RB protocol packets in a configurable period. All ordinary nodes that receive NR-RB messages set the local ring network port to the forwarding state. In a steady state, ordinary nodes do not send protocol messages. Can modify the protection configuration commands NR-RB node sends packets send-time period by the node.

### 1.4.2 Local link failure treatment

After detecting a local link failure, a ring node first immediately unblocks the local non-failed ports (including RPL ports or ordinary ring ports that have not yet entered the forwarding state), and then begins to send SF protocol packets and perform local MAC address Table aging.

All other nodes that receive SF messages first stop sending local messages, and then unblock the local undamaged ports, and perform address table aging.

The link failure node continues to send SF messages with the configured send-time period. During this process, if the port of another node recovers from the failure state, the node will set the recovery port to SF message after receiving the SF message. Forwarding status.

### 1.4.3 Local link recovery process

Ring network node detects local loop network port when recovering from a failed state, it will remain blocked ports, and began to continue to send NR messages.

In the process of sending NR messages, if a node receives SF messages from other nodes, indicating that there are other failed links in the network, the local node will stop sending NR messages and set the restored port to the forwarding state.

If the local node does not receive a new SF message, after the ring protection node (the node where the RPL is located) receives the NR message, it will start a switching recovery timer. After the timer expires, the RPL node re-blocks the RPL port and sends NR-RB message, and then the address table aging, network communication returns to the original stable state.

### 1.4.4 Protection switching-link recovery

Ring network node detects local loop network port when recovering from a failed state, it will remain blocked ports, and began to continue to send NR messages.

In the process of sending NR messages, if a node receives SF messages from other nodes, indicating that there are other failed links in the network, the local node will stop sending NR messages and set the restored port to the forwarding state.

If the local node does not receive a new SF message, after the ring network protection node (the node where the RPL is located) receives the NR message, it performs link recovery. However, when the link is restored, the behavior and function of the return mode and the non-return mode are inconsistent.

#### 1.4.4.1 Return mode

In the return mode, the ring link will be restored. After receiving the NR message, the RPL node will start the switching recovery timer. After the timer expires, the RPL node re-blocks the RPL port, sends the NR-RB message, and then aging the address table, the network communication returns to the original stable state .

#### 1.4.4.2 Non-return mode

In non-return mode, the ring link will not be automatically restored. After receiving the NR message, the RPL node does not make any response, and the other nodes of the ring network do nothing after receiving the NR message. Only when the RPL node receives the Clear command, the RPL node blocks the RPL link and continues to send NR RB messages to the two ring ports, then Flush FDB. The faulty node receives the NR RB message and unblocks the port. The ring network nodes execute FDB Flush after receiving the NR RB message.

### 1.4.5 Protection switching-manual switching

In the normal ring network state, after receiving a manual switching command, the ring network node blocks the data flow channel and the R-APS channel (blocks a data flow channel and the R-APS channel port), opens other ring network ports, and continues Send MS messages to the two ring ports, then Flush FDB. After receiving the MS message, the remaining ring network nodes open the data flow channel and R-APS channel through the RPL. After receiving the MS message, the ring network node that sends the MS message stops sending the MS message. The ring network node executes FDB Flush after receiving the MS message.

The above action completes a manual switchover operation. In order for the switchover to proceed normally, there are a few points to note:

(1) When a manual switching command already exists in the ring network, subsequent manual switching commands are invalid. The node that received the new switching command should reject the new switching command and notify it, and the manual switching is rejected.

(2) A node that has generated a manual switching command locally, if it receives an MS message with a different node ID, this node should clear the local manual switching command and send an NR message. At the same time, the node should keep blocking the ring network port blocked by the previous manual switching command.

(3) A node that has generated a manual switching command locally. If a higher priority local request or message is received, this node should clear the manual switching request and execute the higher priority request.

After receiving the Clear command, the node that performs the manual switching command clears the manual switching command. The node should keep blocking the ring network ports blocked by the previous manual switching command, and continue to send NR messages to the two ring network ports. In the next link recovery, the behavior and function of the return mode and non-return mode are inconsistent.

#### 1.4.5.1 Return mode

In the return mode, the ring link will be restored. After receiving the NR message, the RPL node starts the WTB timer. After the WTB timer expires, the RPL node blocks the RPL link, sends an NR RB message, and then flushes FDB. After receiving the NR RB message, the remaining ring nodes unblock all non-RPL links, and then flush FDB.

### 1.4.5.2 Non-return mode

In non-return mode, the ring link will not be automatically restored. After receiving the NR message, the RPL node does not make any response, and the other nodes of the ring network do nothing after receiving the NR message. Only when the RPL node receives the Clear command, the RPL node blocks the RPL link and continues to send NR RB messages to the two ring ports, then Flush FDB. After receiving the NR RB message, the remaining ring nodes unblock all non-RPL links, and then flush FDB.

### 1.4.6 Protection switching-forced switching

In the normal ring network state, after receiving a forced switching command, the ring network node blocks the data flow channel and the R-APS channel (blocks a data flow channel and R-APS channel port), opens other ring network ports, and continues Send FS packets to the two ring ports, then Flush FDB. After receiving the FS message, the remaining ring network nodes open the data flow channel and R-APS channel through the RPL. After receiving the FS message, the ring network node that sends the FS message stops sending the FS message. After receiving the FS message, the ring network nodes execute FDB Flush.

The above action completes the operation of a forced switchover. In order for the switchover to proceed normally, one thing to note:

When a mandatory switching command already exists in the ring network, all subsequent mandatory switching requests are accepted unless the node has previously accepted a mandatory switching request. At the same time, the node that receives the new switching command needs to perform the forced switching operation again, block the port, and send FS packets. Of course, the execution of multiple forced switching commands will divide the ring network, so this bad situation should be properly avoided.

After receiving the Clear command, the node that performs the forced switching command clears the forced switching command. The node should keep blocking the ring network port blocked by the previous forced switching command, and continue to send NR messages to the two ring network ports. In the next link recovery, the behavior and function of the return mode and non-return mode are inconsistent.

#### 1.4.6.1 Return mode

In the return mode, the ring link will be restored. After receiving the NR message, the RPL node starts the WTB timer. After the WTB timer expires, the RPL node blocks the RPL link, sends an NR RB message, and then flushes FDB. After receiving the NR RB message, the remaining ring nodes unblock all non-RPL links, and then flush FDB.

#### 1.4.6.2 Non-return mode

In non-return mode, the ring link will not be automatically restored. After receiving the NR message, the RPL node does not make any response, and the other nodes of the ring network do nothing after receiving the NR message. Only when the RPL node receives the Clear command, the RPL node blocks the RPL link and continues to send NR RB messages to the two ring ports, then Flush FDB. After receiving the NR RB message, the remaining ring nodes unblock all non-RPL links, and then flush FDB.

### 1.4.7 Switch over recovery processing

The ring network protection node (RPL Owner) implements ring network switching recovery through timer WTR (Wait-to-Restore Timer) and timer WTB (Wait-to-Block Timer). The WTR timer and WTB timer are used to avoid frequent protection switching on the ring network.

The WTR timer is only effective in the return mode. In the non-return mode, when the ring network recovers from the failure in the protected state, the ring network recovery is not performed, so it is not necessary to start the WTR timer. In the return mode, the node where the RPL is located starts the WTR timer after receiving the NR message from other nodes. Before the timer expires, the node where the RPL is located maintains the forwarding state of the RPL port and does not send ring recovery notifications. If the node where the RPL is located receives the SF message again, it means that the ring network has not been fully restored, and the node stops the WTR timer. After the WTR timer expires, the node where the RPL is located will block the RPL port again.

The WTB timer only takes effect in the return mode and is used when clearing the forced switching and manual switching commands. When clearing multiple forced switching commands, the WTB timer should ensure that a single forced switching command will not cause RPL to block repeatedly. When clearing a manual switchover command, the WTB timer should prevent the RPL node from receiving an outdated remote MS request during the recovery process to cause a closed loop.

The WTB timer must ensure that there is sufficient time to receive remote FS, SF, and MS messages. Therefore, the time to define the WTB timer is 5 seconds longer than the Guard timer. This time is enough for a ring node to send a report to send 2 R-APS message and let the entire ring network confirm each situation.

## Chapter 2 ERPS Configuration

### 2.1 ERPS Configuration Instructions

Before configuring the ERPS ring protection protocol, please read the following notes:

- (1) The ERPS port must be carried on the MEP port of the CFM. The MEP information must be configured for the ERPS port to match the MEP port. After successful, the ERPS port can be enabled normally.
- (2) It is necessary to configure the default VLAN (or control vlan) of all ring network ports to be consistent to ensure the normal forwarding of ERPS packets.
- (3) When using both ERPS and EAPS protocols, the default VLAN and control VLAN of the ERPS ring network port cannot be the same as the control VLAN of EAPS. EAPS protocol packets cannot be forwarded in the EAPS control VLAN.
- (4) A port cannot be used as a ring port of ERPS and EAPS protocols at the same time.
- (5) The ERPS protocol supports the configuration of physical ports or aggregate ports as ring ports. However, physical ports that have been configured for link aggregation, 802.1X authentication, or port security cannot be configured as ERPS ring network ports.

(6) About nimble mode: for backward compatibility, the original configuration mode and mode are retained, the default is the original configuration mode, and the nimble mode will only take effect after the nimble mode is configured

## 2.2 ERPS Configuration Tasks

- (2) Configure ring network nodes
- (3) Configure ring network port
- (4) View the status of the ring network protection protocol

### 2.2.1 Configure nimble mode

In the global configuration mode, follow the steps below to configure the switch to ERPS nimble mode.

Command	Purpose
Switch_config# <b>erps nimble-mode</b>	Configure ERPS nimble mode

### 2.2.2 Configure ring network nodes

In the global configuration mode, follow the steps below to configure the switch as an ERPS node.

Command	Purpose
Switch_config# <b>erps id</b>	Configure ERPS ring network node instances and enter node configuration mode. id: ring network instance number, range 0-7.
Switch_config_ring# <b>control-vlan value</b>	required. Configure the control VLAN of the local node. no control-vlan, delete the control VLAN of the local node. The node must not be changed after normal operation. value: range 1-4094. The default is no control-vlan.
Switch_config_ring# <b>interconnection-node</b>	required. Configure the local node as an interconnected node. no interconnection-node, configure the local node not to be an interconnect node. The node must not be changed after normal operation. The default is that the local node is not an interconnected node.
Switch_config_ring# <b>raps-virtual-channel</b>	required. Configure the local node to use R-APS virtual channels. no raps-virtual-channel, configure the local node not to use R-APS virtual channel. The node must not be changed after normal operation. By default, the local node uses the R-APS virtual channel.
Switch_config_ring# <b>revertive-mode</b>	required. Configure the return mode of the local node to return mode. no revertive-mode, set the return mode of the local node to non-revertive mode. The node must not be changed after normal operation. By default, the local node is in return mode.
Switch_config_ring# <b>version value</b>	Configure the version of the local node. value: Default 1, range 0-2.
Switch_config_ring# <b>wtr-time value</b>	Configure the WTR timeout period of the switch recovery timer. value: Timer timeout time, default 20 seconds, range 10-720 seconds.
Switch_config_ring# <b>guard-time value</b>	Configure the Guard timer timeout period. When a port recovers from a failed state, the Guard timer prohibits the processing of received protocol packets for a short period of time to avoid erroneous protocol actions due to receipt of expired packets. value: The unit is 10 milliseconds, the default is 50, and the range is 10-2000.
Switch_config_ring# <b>send-time value</b>	Configure the protocol packet sending interval. value: Packet sending period, default 5 seconds, range 1-10.
Switch_config_ring# <b>exit</b>	Exit the node configuration mode and start the node.

Description:

- (1) Use the no erps id command to delete the ring network node configuration and node port configuration.
- (2) Although the three commands interconnection-node, raps-virtual-channel and revertive-mode are mandatory commands, they all have default configurations. If the value is modified, these commands can be omitted.



### 2.2.3 Configure ring ports

Follow the steps below to configure the switch port as a ring port.

Command	Purpose
Switch_config# <b>interface</b> <i>interface-type interface-number</i>	Enter the port configuration mode. intf-name: port name.
Switch_config_intf# <b>erps id ring-port</b>	Configure the port as the normal ring port of the specified node. id: ring network instance number.
Switch_config_intf# <b>erps id rpl</b>	Configure the port as the ring protection link of the specified node. When auto discovery is enabled, this command is equivalent to changing the priority value to 0. id: ring network instance number.
Switch_config_intf# <b>erps id neighbour</b>	Configure the port as the RPL neighbor port of the specified node, and the port must be connected to the RPL port and must be configured as an RPL neighbor port. id: ring network instance number.
Switch_config_intf# <b>exit</b>	Exit the port configuration mode.

Description:

- (1) Use the no erps id rpl port configuration command to modify the RPL port to a common ring network port.
- (2) Use the no erps id ring-port (neighbour) port configuration command to delete the common ring network port (RPL neighbour port) or RPL port configuration.
- (3) In the case where the ring network node is not globally configured, the erps id ring-port (neighbour) and rpl commands will simultaneously create the ring network node.
- (4) up mep can only be configured in the connection-node node, and the connection-node can only be configured with one ring network port.

### 2.2.4 Ring Control Commands

In monitoring mode, use the following commands to control the status of the ring network.

Command	Purpose
<b>erps id ForcedSwitch interface</b> <i>interface-type interface-number</i>	Forcibly switch the node to the interface interface-type interface-number. id: ring network instance number.
<b>erps id ManualSwitch interface</b> <i>interface-type interface-number</i>	Manually switch the node to the interface interface-type interface-number. id: ring network instance number.
<b>erps id Clear</b>	Clear node switching commands. id: ring network instance number.

### 2.2.5 View the Status of the Ring Protection Protocol

Use the following command to view the status of the ring network protection protocol.

Command	Purpose
<b>show erps id</b>	View summary information about ring protection protocols and ring ports. id: ring network instance number.
<b>show erps id detail</b>	View detailed information on ring network protection protocols and ports.
<b>show erps interface</b> <i>interface-type</i> <i>interface-number</i>	View the status information of the ring network ports.

## 2.3 Configuration Example

### 2.3.1 Configuration Example 1-ERPS Nimble Mode Configuration

#### 2.3.1.1 Configure switch S1:

```
!  
link scan fast 10  
!  
port-protected 1  
!  
!  
!  
! ethernet cfm ENABLE  
!  
!  
no spanning-tree  
spanning-tree bpdu-terminal  
!  
erps nimble-mode  
erps 1  
    control-vlan 20  
exit  
!  
vlan 1-4094  
!  
interface GigaEthernet0/2  
    switchport enhanced-link  
    switchport mode dot1q-tunnel-uplink  
    ethernet cfm ENABLE  
    erps 1 ring-port  
    erps 1 cfm-disable  
!  
interface GigaEthernet0/3  
    switchport enhanced-link  
    switchport mode dot1q-tunnel-uplink  
    ethernet cfm ENABLE  
    erps 1 rpl  
    erps 1 cfm-disable  
!
```

#### 2.3.1.2 Configure switch S2:

```
link scan fast 10  
!  
port-protected 1  
!  
!  
!  
! ethernet cfm ENABLE  
!  
!  
no spanning-tree  
spanning-tree bpdu-terminal  
!  
erps nimble-mode  
erps 1  
    control-vlan 20  
exit  
!  
!  
!  
vlan 1,10,20,30,40,100  
!  
!  
interface GigaEthernet0/2  
    switchport enhanced-link
```

```
switchport mode dot1q-tunnel-uplink
ethernet cfm ENABLE
erps 1 ring-port
erps 1 cfm-disable
!
interface GigaEthernet0/4
switchport enhanced-link
switchport mode dot1q-tunnel-uplink
ethernet cfm ENABLE
erps 1 ring-port
erps 1 cfm-disable
!
```

### 2.3.1.3 Configure switch S3:

```
!
link scan fast 10
!
port-protected 1
!
!
!
!
ethernet cfm ENABLE
!
!
!
no spanning-tree
spanning-tree bpdu-terminal
!
erps nimble-mode
erps 1
control-vlan 20
exit
!
!
vlan 1,10,20,40,100
!
interface GigaEthernet0/3
switchport mode dot1q-tunnel-uplink
ethernet cfm ENABLE
erps 1 neighbour
erps 1 cfm-disable
!
interface GigaEthernet0/4
switchport mode dot1q-tunnel-uplink
ethernet cfm ENABLE
erps 1 ring-port
erps 1 cfm-disable
!
```