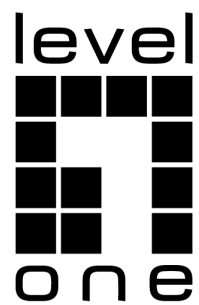


# ERPS (G8032-201003)

## Configuration



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# Chapter 1 Introduction of Fast Ethernet Ring Network Protection

## 1.1 Overview

Fast Ethernet ring protection protocol is a special kind of link layer protocol, which is used to construct the ring Ethernet topology. The Ethernet protection protocol blocks a link in the case that the ring topology is complete, preventing the data loop against forming the broadcast storm. In case of link interruption, the protocol quickly enables the link to be restored to the status before link interruption so that the communication between the nodes of the loop can be restored.

Fast ring network protection protocol can ensure through controlling the aging of MAC address table for the switch that the data packets can be sent to the correct link when the topology takes change. Under normal circumstances, the aging time of the MAC address in the address table is 300 seconds. The ring network protection protocol can control the aging of the MAC address table for the switch in a very short period of time.

Ring network protection protocol and spanning tree protocol are both used for link layer topology control. The spanning tree protocol is suitable for all kinds of complex networks, which uses the hop-by-hop method to transmit the change in the network topology. The ring network protection protocol is dedicated to the ring topology, which uses the diffusion method to transmit the topological change. Therefore, in the ring network, the convergence performance of the ring protection protocol is better than that of the spanning tree protocol. In the case of good network condition, the ring network protection protocol can restore network communication within less than 50 ms.

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Note:

Ring network protection protocol supports a switch configured as the node of multiple physical ring networks to form a tangent ring. It does not support the intersecting rings with public links.

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## 1.2 ERPS-Related Concepts

### 1.2.1 Ring Network Node Role

Each switch constituting the ring network is a ring network node. The ring network node role falls into three kinds: RPL protection node, RPL neighbor node and ordinary node. A physical link is selected from each single ring as RPL protection link; one of two switches directly connected to this link is taken as RPL protection node and the other is taken as RPL neighbor node; and the remaining switches are used as ordinary nodes.

The node type of the ERPS protocol is determined by the port role. For the ring network nodes, their functions are basically the same: detecting the status of local ring network port and sending a notification when the link fails. Differently, under normal circumstances, the RPL protection node and the RPL neighbor node block the RPL link, but the ordinary node does not block the RPL link.

## 1.2.2 Ring Network Port Role

The ERPS protocol requires that each node has two ports that are connected to the RING network. Each port is called "Ring Port". In addition, in each single ring, there is also a ring network port as the ring network protection link (RPL).

Under normal circumstances, all the ring network ports but the RPL link in the ring network are in the forwarding state. RPL ports of the RPL protection node and the RPL neighbor node are blocked to avoid the loop. In the case of the failure in the ring network link, the RPL protection node and RPL neighbor nodes don't block the RPL port any more, restoring the network communication.

In one switch, each ring network node instance can only be configured with one RPL port.

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Note:

ERPS protocol supports the configuration of the aggregated port as ring network port.

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## 1.2.3 Revertive Mode

In some ring networks, under normal circumstances, the network resources of the link channel for data stream transmission would be better; but the channel of RPL is only used for backup; so the revertive mode is used in the switching clearance to return the data stream to the channel with better network resources. For some ring networks, as they don't have high requirements for network resources, they needn't immediately return to the original link channel after the switching is restored. So, the non-returning mode is adopted so that the times of returning to switching can be reduced.

In the operation of returning mode, when a switch is cleared, the data stream will return to the original channel, blocking RPL. In the case of fault clearance, the data stream returns under the premise of the timeout of the WTR timer, avoiding protection switching in the case of intermittent faults. In the case of clearing manual switching or forced switch commands, there is need to wait for the WTB timer. In the operation of non-revertive mode, when a switching is cleared, the data stream still remains in RPL channel as long as there is no fault in the RPL channel.

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Note:

WTR timer and WTB timer are valid only in revertive mode.

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## 1.3 Type of ERPS Packets

The type of packet used by the ERPS protocol is shown in table 2.1.

Table 4.1 ERPS Ring Network Protection Protocol Packet Type

Type of packet	Description
Forced Switch (FS)	Ring network node (including RPL node) notifies other nodes after the forced switching command.
Signal Fail (SF)	Ring network node (including RPL node) notifies other nodes after finding the local link failure in the detection.

Manual Switch (MS)	Ring network node (including RPL node) notifies other nodes after manual switching commands.
No Request (NR)	Ring network node notifies other nodes after finding all the local ring network links are recovered in the detection.
No Request, RPL Blocked (NR-RB)	Ring network protection node notifies other nodes of the recovery of ring network protection switching.

## 1.4 ERPS Ring Network Protection Mechanism

### 1.4.1 Stable State

In the stable state, the RPL port is blocked by the ring network protection node, which continuously sending the NR-RB protocol message with a configurable cycle.

For all the ordinary nodes that receive NR-RB packets, the local ring network port is set as the forwarding state. In the stable state, ordinary nodes do not send protocol packets.

The protection node is modified by configuring the command through the “send-time” node to send the cycle of the NR-RB packet.

### 1.4.2 Local Link Failure Processing

When a ring network node detects the local link failure, the blocking state of the enabled local port (including the RPL port or the ordinary ring port which has not yet entered the forwarding state) is immediately eliminated, and then the SF protocol message begins to be sent and the aging of local MAC address table begins.

For all other nodes receiving SF packets, the local packet sending first stops, and then the blocking state of the local enabled port is relieved and the address table aging starts.

The disabled node for the link continuously sends the SF packet taking the configured “send-time” as the cycle. In this process, if the port for another node recovers from the failure state, this node will restore the state of port as the forwarding state after receiving SF packets.

### 1.4.3 Local Link Recovery Processing

When the ring network node finds that the local ring network port recovers from the failure state in the detection, it will keep the port still in the blocking state and begins to continue to send NR packets.

In the process of sending NR packet, if the node receives the SF packet from other nodes, it indicates that there are other disabled links in the network; the local node stops sending the NR packet and sets the recovered port to be in the forwarding state.

If local node does not receive new SF packet, it will start switching recovery timer after the ring network protection node (RPL node) receives the NR packet; and after the timer timeout, RPL node blocks the RPL port once again and sends NR-RB packet and

then starts the address table aging. The network communication recovers to the initial stable state.

#### 1.4.4 Protection Switching - Link Recovery

When the ring network node finds that the local ring network port recovers from the failure state in the detection, it will keep the port still in the blocking state and begins to continue to send NR packets.

In the process of sending NR packet, if the node receives the SF packet from other nodes, it indicates that there are other disabled links in the network; the local node stops sending the NR packet and sets the recovered port to be in the forwarding state.

If local node does not receive new SF packet, it will recover the link after the ring network protection node (RPL node) receives the NR packet. But when the link is recovered, the revertive mode and non-revertive mode are not consistent in behavior and function.

##### 1.4.4.1 Revertive mode

In revertive mode, the ring network link will be recovered. After RPL node receives the NR packet, it will start switching recovery timer; after the timer timeout, RPL node blocks the RPL port once again and sends the NR-RB packet; and then the address table aging starts, the network communication is recovered to the initial stable state.

##### 1.4.4.2 Non-revertive mode

In the non-revertive mode, the ring network link is not automatically recovered. After receiving the NR packet, the RPL node does not make any response; after other ring network nodes receive the NR packets, they don't do any action. Only when the RPL node receives the "Clear" command, the RPL node blocks the RPL link and continues to send RB NR packets to two ring network ports, and then execute Flush FDB. After the disabled node receives the RB NR packet, it relieves the blocking state of the port. After receiving the RB NR packet, the ring network node executes Flush FDB.

#### 1.4.5 Protection Switching - Manual Switching

In the normal ring network state, after the ring network node receives a manual switching command, it blocks data stream channel (Blocking a data stream channel) and opens other ring network ports and continues to send MS packets to two ring network ports, and then execute Flush FDB. After other ring network nodes receive the MS packet, they open RPL data stream channel. After receiving the MS packet, the ring network node sending MS packet stops sending MS packet. After receiving the MS packet, the ring network nodes execute Flush FDB.

The above action completes an operation of manual switching; in order to keep switching operation normal, there are several points deserving our attention:

(1) When a manual switching command has existed in the ring network, the later manual switching commands are invalid. The node receiving new switching command must refuse new switching command and give notice that the manual switching is rejected.

(2) For the node which has generated manual switching command locally, if receiving MS packets of different node IDs, this node should remove the local manual switching command and send the NR packet. At the same time, the node continues to block the ring network port blocked by previous manual switching commands.

(3) For the node which has generated manual switching command locally, if receiving higher priority of local request or packet, this node shall remove manual switching requests and execute the higher priority of requests.

For the node which generates manual switching command, after receiving the “Clear” command, it removes manual switch command. The node continues to block the ring network port blocked by previous manual switching commands and sends NR packets to two ring network ports. But when the link is recovered, the revertive mode and non-revertive mode are not consistent in behavior and function.

#### 1.4.5.1 Revertive mode

In revertive mode, the ring network link will be recovered. After the RPL node receives the NR packet, it starts the WTB timer. After the timeout of the WTB timer, the RPL node will block the RPL link and send the RB NR packet, and then execute FDB Flush. After other ring network nodes receive the RB NR packet, they eliminate the blocking state of all non-RPL links, and then execute FDB Flush.

#### 1.4.5.2 Non-revertive mode

In the non-revertive mode, the ring network link is not automatically recovered. After receiving the NR packet, the RPL node does not make any response; after other ring network nodes receive the NR packets, they don't do any action. Only when the RPL node receives the “Clear” command, the RPL node blocks the RPL link and continues to send NR RB packets to two ring network ports, and then execute Flush FDB. After other ring network nodes receive the NR RB packet, they eliminate the blocking state of non-RPL link and execute Flush FDB.

### 1.4.6 Protection Switching - Forced Switching

In the normal ring network state, after the ring network node receives a forced switching command, it blocks data stream channel (Blocking a data stream channel) and opens other ring network ports and continues to send FS packets to two ring network ports, and then execute Flush FDB. After other ring network nodes receive the FS packet, they open RPL data stream channel. After receiving the FS packet, the ring network node sending FS packet stops sending FS packet. After receiving the FS packet, the ring network nodes execute Flush FDB.

The above action completes an operation of forced switching; in order to keep switching operation normal, there is one point deserving our attention:

When a forced switching command has existed in the ring network, the later forced switching commands are acceptable unless this node has accepted a forced switching request in advance. At the same time, the node receiving new switching command must execute forced switching once again, block the port and send FS packets. Of course, the repeated execution of forced switching command will segment the ring network, so it is appropriate to avoid such adverse situation.

For the node which generates forced switching command, after receiving the “Clear” command, it removes forced switching command. The node continues to block the ring network port blocked by previous forced switching commands and sends NR packets to two ring network ports. But when the link is recovered, the revertive mode and non-revertive mode are not consistent in behavior and function.

#### 1.4.6.1 Revertive mode

In revertive mode, the ring network link will be recovered. After the RPL node receives the NR packet, it starts the WTB timer. After the timeout of the WTB timer, the RPL node will block the RPL link and send the RB NR packet, and then execute FDB Flush. After other ring network nodes receive the NR RB packet, they eliminate the blocking state of all non-RPL links, and then execute FDB Flush.

#### 1.4.6.2 Non-revertive mode

In the non-revertive mode, the ring network link is not automatically recovered. After receiving the NR packet, the RPL node does not make any response; after other ring network nodes receive the NR packets, they don't do any action. Only when the RPL node receives the “Clear” command, the RPL node blocks the RPL link and continues to send NR RB packets to two ring network ports, and then execute Flush FDB. After other ring network nodes receive the NR RB packet, they eliminate the blocking state of all non-RPL links and execute Flush FDB.

### 1.4.7 Switching Recovery Processing

The ring network protection node (RPL owner) realizes the ring network switching recovery through the WTR timer (Wait-to-Restore timer) and the WTB timer (Wait-to-Block timer). The WTR timer and WTB timer can be used to avoid frequent switching on the ring network.

The WTR timer is only valid in the revertive mode; in the non-revertive mode, after the fault recovery of the ring network from the protection state, the ring network doesn't recover, so there is no need to start the WTR timer. In the revertive mode, after the RPL node receives the NR message from other nodes, it starts the WTR timer; after the timeout of timer, the RPL node maintains the forwarding state of the RPL port, and it does not send the ring network recovery notification. If the RPL node receives the SF message, it indicates that the ring network has not been fully recovered; at this time, the node stop sthe WTR timer. After the timeout of WTR timer, the RPL node will re-block the RPL port.

The WTB timer is effective only in the revertive mode, which is used at the time of clearing the forced and manual switching command. When the forced switching command is cleared repeatedly, the WTB timer must ensure that a single forced switching command does not make RPL blocked repeatedly. When a manual switching command is cleared, the WTB timer must prevent RPL node against causing a closed ring because of receiving an outdated remote MS request in the recovery process.

The WTB timer must ensure that there is sufficient time to receive the remote SF, FS and MS packets, so the time of defining the WTB timer is 5 seconds longer than that of defining the Guard timer. This period of time is enough for one ring network node sending the packet to send 2 R-APS packets and allow the entire ring network to confirm each situation.



## Chapter 2 ERPS Configuration

### 2.1 ERPS Configuration Instructions

Please read the following instructions before configuring the ERPS ring network protection protocol:

- It must be configured that the default VLANs (or control VLANs) of all ring network ports are consistent, ensuring that the ERPS packet can be forwarded normally.
- In the case that the ERPS and EAPS protocols are used simultaneously, the default VLAN and control VLAN for ERPS ring network port cannot be the same as control VLAN for EAPS. The control VLAN for EAPS cannot forward the ERPS protocol packet.
- One port cannot be simultaneously used as the ring network port of ERPS and EAPS protocols.
- The ERPS protocol supports the configuration of physical port or aggregate port as the ring network port. However, the physical port that has been configured with the link aggregation, 802.1X authentication or port security cannot be configured as an ERPS ring network port.

### 2.2 ERPS Configuration Tasks

- Configuring the ring network nodes
- Configuring the ring network ports
- Checking ring network protection protocol status

#### 2.2.1 Configuring the Ring Network Nodes

In the global configuration mode, the switch is configured as ERPS node according to the following steps.

Command	Purpose
Switch(config)# <b>erps</b> <i>id</i>	Configure ERPS ring network node instance and enter the node configuration mode.  <i>id</i> : Ring network instance number; Range 0-7.
Switch(config_ring)# <b>control-vlan</b> <i>value</i>	Mandatory. Configure the control VLAN of the local node. No control VLAN: Delete the control VLAN of the local node. After the normal operation of the node, the change shall not be allowed.

	Value: Range: 1-4094. By default, no control-vlan.
Switch(config_ring)# <b>wtr-time</b> <i>value</i>	Configure the timeout value of WTR timer.  Value: Timeout value: by default, 20 seconds; range: 10-720 seconds.
Switch(config_ring)# <b>guard-time</b> <i>value</i>	Configure the timeout value of Guard Timer.  When a port is recovered from the failure state, the Guard timer is prohibited to handle the received protocol packets in a short period of time to avoid the wrong protocol action caused by receiving the outdated packet.  Value: 10 ms as the unit; 50 as the default value; range of 10-2000;
Switch(config_ring)# <b>send-time</b> <i>value</i>	Configure the protocol packet sending cycle.  Value: Packet sending cycle: by default, 5 seconds; range: 1-10.
Switch(config_ring)# <b>exit</b>	Exit from node configuration mode and enable the node.

**Note:**

Use the “**no erps id**” command to delete the ring network node configuration and node port configuration.

### 2.2.3 Configuring the Ring Network Ports

The switch port is configured as the ring network port according to the following steps.

Command	Purpose
Switch(config)# <b>interface</b> <i>interface-type</i> <i>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 an ordinary ring network port for the specified node.  Id: Ring network instance number.
Switch(config-intf)# <b>erps id rpl</b>	Configure the port as a ring network protection link for the specified node. In the case of automatically discovering enabling, the function of this command is equivalent to the change of a priority value to 0.  Id: Ring network instance number.
Switch(config-intf)# <b>erps id neighbour</b>	Configure the port as a RPL neighbor port of the specified node; meanwhile, this port must be connected to the RPL port and must be configured as a RPL neighbor port.

	Id: Ring network instance number.
Switch(config-intf)# <b>exit</b>	Exit from port configuration mode.

**Note:**

1. Configure the command through the “**no erps id rpl**” port, and change the RPL port into ordinary ring network port.
2. Configure the command through the “**no erps id ring-port(neighbor)**” port, delete the ordinary ring network port (RPL neighbor port) or RPL port configuration.
3. In the case that the ring network node is not configured globally, use the command “**erps id ring-port (neighbor)**” and “**rpl**” to simultaneously create the ring network nodes.

## 2.2.4 Ring Network Control Commands

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

Command	Purpose
<b>erps id ForcedSwitch interface</b> <i>interface-type interface-number</i>	For the node, execute the forced switching to the port “interface-type interface-number”. Id: Ring network instance number.
<b>erps id ManualSwitch interface</b> <i>interface-type interface-number</i>	For the node, execute the manual switching to the port “interface-type interface-number”. Id: Ring network instance number.
<b>erps id Clear</b>	Clear the switching command of the node. Id: Ring network instance number.

## 2.2.5 Checking Ring Network Protection Protocol Status

Use the following commands to check the ring network protection protocol status.

Command	Purpose
<b>show erps id</b>	Check the summary information of ring network protection protocol and ring network port. Id: Ring network instance number.
<b>show erps id detail</b>	Check the detailed information of ring network protection protocol and port.
<b>show erps interface</b> <i>interface-type interface-number</i>	Check the status information of ring network port.

## 2.3 ERPS Configuration Instance

### 2.3.1 Configuration Instance - ERPS

#### 2.3.1.1 Configuring the Switch S1:

```
!  
link scan fast 10  
!  
!  
erps 1  
    control-vlan 20  
exit  
!  
vlan 1-4094  
!  
interface GigaEthernet0/2  
    switchport enhanced-link  
    switchport mode trunk  
    erps 1 ring-port  
!  
interface GigaEthernet0/3  
    switchport enhanced-link  
    switchport mode trunk  
    erps 1 rpl  
!
```

#### 2.3.1.2 Configuring the Switch S2:

```
!
```

```
link scan fast 10

!

!

erps 1
    control-vlan 20
exit

!

vlan 1-4094

!

interface GigaEthernet0/2
    switchport enhanced-link
    switchport mode trunk
    erps 1 ring-port
!

interface GigaEthernet0/4
    switchport enhanced-link
    switchport mode trunk
    erps 1 ring-port
!
```

### 2.3.1.3 Configuring the Switch S3:

```
!
link scan fast 10
!
!
erps 1
    control-vlan 20
exit
!
vlan 1-4094
!
interface GigaEthernet0/3
```

```
    switchport enhanced-link
    switchport mode trunk
    erps 1 neighbour
!
interface GigaEthernet0/4
    switchport enhanced-link
    switchport mode trunk
    erps 1 ring-port
!
```