Fast Ethernet Ring Protection Configuration

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Chapter 1   Introduction of Fast Ethernet Ring Protection

1.1   Overview

Ethernet ring protection protocol is a special type of link-layer protocol specially designed for constructing the ring Ethernet topology. The Ethernet protection protocol can shut down one link in a complete ring topology, preventing the data loop from forming the broadcast storm. If a link is broken, the protocol immediately resumes the link that is previously shut down. In this way, the nodes among the ring network can communicate with each other.

The Ethernet ring protection protocol can transmit data packets to the correct link by controlling the aging of the switch's MAC address table when the topology changes. In general, the time for a MAC address to age in the MAC address table is 300 seconds. The ring protection protocol can control the aging of the MAC address table in a short time.

The ring protection protocol and STP are both used for topology control on the link layer. STP is suitable for all kinds of complicated networks, which transmits the change of network topology hop by hop. The ring protection protocol is used for ring topology and adopts the pervasion mechanism to transmit the change of network topology. Therefore, the convergence of the ring protection protocol in the ring network is better than STP. In a sound network, the ring protection protocol can resume network communication within less than 50ms.

Note:
ring protection protocol supports that one switch is set to the node of multiple physical ring network, so that the tangency ring can be formed. The ring protection protocol does not support the tangency ring with public link.

1.2   Types of Ring Protection Protocol

Ethernet switch series support two types of ring protection protocol:

● Ethernet Automatic Protection Switching (EAPS), which is based on RFC-3619

● Ethernet Ring Protection Switching（ERPS）

Note:
Both switches of version 2.0.3 and hi-end switches of version 4.0.2B only support EAPS.

1.3 Basic Knowledge About Configuration of Ring Protection Protocol

Before the ring protection protocol is configured on the Ethernet switch, make sure that you have already read the following notices:

- One of important functions of the ring protection protocol is to stop the broadcast storm, so please make sure that before the ring link is reconnected all ring nodes are configured. For example, when EAPS is configured, after the master node and all transit nodes are configured, connect the network cable and the secondary port of the master node; when configuring ERPS, please keep at least one link disconnected until all ring nodes are configured. If the ring network is connected in the case that the configuration is not finished, the broadcast storm may easily occur.

- EAPS and ERPS are both reversible protection shift. For example, if a broken link of a port gets recovered, the protocol will change into the state before the shift.

- EAPS and ERPS can be configured on the same Ethernet switch at the same time, but they have to be used to control different ring networks. That is to say, EAPS and ERPS are incompatible and cannot run at the same time at the same ring network.

- The ring protection protocol can be running along with SSTP and RSTP at the same time and also can be running in the case that the STP is closed. The already set ring port will not take part in the calculation of the state of STP.

- switch software of version 2.0.3A and hi-end switch software of version 4.0.2B only support EAPS; switches of version 202A and hi-end switches of version 402A do not support the case that EAPS and STP are running at the same time.

- If the ring protection protocol is running without STP being shut down, we suggest configuring the **spanning-tree bpdu-terminal** function to prevent all ring nodes from forwarding BPDU and affecting the network performance.

- The ring protection protocol cannot be running along with MSTP at the same time. In case that EAPS or ERPS is configured, MSTP cannot be restarted.

- The ring protection protocol can configure a switch into multiple ring networks. But it does not support the complicated ring network with public links.

Chapter 2   EAPS Introduction

2.1   Related Concepts of EAPS
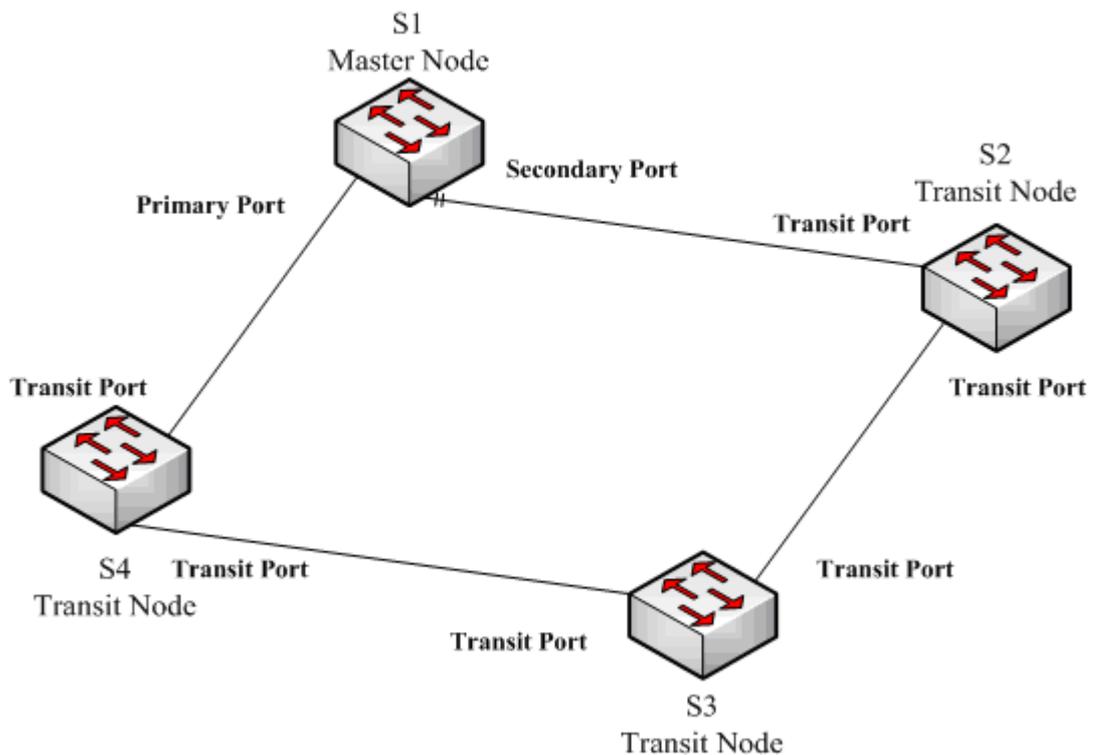
Figure 1.1 EAPS Ethernet ring

2.1.1   Roles of Ring's Nodes

Each switch on an Ethernet ring is a ring node. The ring nodes are classified into master nodes and transit nodes. Only one switch on the Ethernet ring can serve as a mere master node and other switches are worked as transit nodes.

Master node: It positively knows whether the ring's topology is complete, removes loopback, control other switches to update topology information.

Transit node: It only checks the state of the local port of the ring, and notifies the master node of the invalid link.

The role of each node can be specified by user through configuration. The thing is that each switch in the same ring can be set to only one kind of node. In figure 1.1, switch S1 is the master node of ring network, while switches S2, S3 and S4 are transit nodes.

2.1.2   Role of the Ring's Port

EAPS demands each switch has two ports to connect the ring network. Each port of the ring network also needs to be specified through configuration and the protocol supports the following kinds of port roles:

Primary port: the primary port can be configured only on the master node. The master node transmits the ring detection packets through the primary port.

Secondary port: the secondary port can be configured only on the master node. The master node receives the ring detection packets from the secondary port and judges whether the topology of the ring network is complete. In complete topology, the master node blocks the data packets on the secondary port, and prevents loopback from occurring; after a link on the ring network is interrupted, the master node removes the blocking state of the secondary port.

Transit port: the transmit port can only be configured on the transit node. Both ports through which the transit node connects the ring network are all transit ports.

Each port of the ring network can be configured as only one port role after the node's role of the switch and the control VLAN are configured. As shown in figure 1.1, the port through which master node S1 connects transit node S4 is a primary port, the port through which S1 connects S2 is a secondary port, and the ports through which other switches connect the ring network are all transit ports.

Note:
To configure a same switch to belong to multiple rings, the switch must connect different rings through different physical ports.

2.1.3   Control VLAN and Data VLAN

A private control VLAN is used between master node and transit node to transmit protocol packets. This control VLAN is specified by user through configuration and ring's ports are added also by user to the control VLAN, which guarantees that the protocol packets can be normally forwarded. In general, each port of the ring network is in the forwarding state in the control VLAN and the ports which do not belong to the ring network cannot forward the packets of control VLAN.

Note:
You can specify different control VLAN for each ring on a switch. The control VLAN is only used to forward the control packets of the ring network, not for L2/L3 communication. For example, if the VLAN port that corresponds to the control VLAN is established, the IP address of the VLAN port cannot be pinged through other devices.

The VLANs except the control VLAN are all data VLANs, which are used to transmit the packets of normal services or the management packets. It is the ring protection protocol that controls whether the port of the Ethernet ring can forward the packets of the data VLAN; the forwarding state of the non-ring port is controlled by STP.

Note:
The data VLAN can be used for normal L2/L3 communication. For example, you can establish a VLAN port corresponding to data VLAN and configure dynamic routing protocols.

2.1.4 Symbol of a Complete Ring Network

Both the master node and the transit node can show whether the current ring network is complete through the state symbol "COMPLETE". On the master node, only when all links of the ring network are normal, the primary port is in forwarding state and the secondary port is in blocking state can the "COMPLETE" symbol be real; on the transit node, only when its two transit ports are in forwarding state can the "COMPLETE" symbol be true.

The state symbol of the ring network helps user to judge the topology state of the current network.

2.2 Type of EAPS Packets

The EAPS packets can be classified into the following types, as shown in table 1.1.

Table 1.1 Type of EAPS packets

Type of the packet	Description
HEALTH	It is transmitted by the master node to detect whether the topology of the ring network is complete.
LINK-DOWN	It is transmitted by the transit node to indicate that link interruption occurs in the ring network.
RING-DOWN-FLUSH-FDB	It is transmitted by the master node after interruption of the ring network is detected and the packets show the MAC address aging table of the transit node.
RING-UP-FLUSH-FDB	It is transmitted by the master node after interruption of the ring network is resumed and the packets show the MAC address aging table of the transit node.

2.3 EAPS Mechanism

2.3.1 Ring Detection and Control of Master Node

The master node transmits the HEALTH packets to the control VLAN through the primary port in a configurable period. In normal case, the HEALTH packets will pass through all other nodes of the ring network and finally arrive at the secondary port of the master node.

The secondary port blocks all data VLANs in primitive condition. When receiving the HEALTH packets continuously, the secondary port keeps blocking data VLANs and blocking the loop. If the secondary port does not receive the HEALTH packets from the primary port in a certain time (which can be configured), it will regard the ring network is out of effect. Then the master node removes the blocking of data VLANs on the secondary port, ages the local MAC address table, and transmits the RING-DOWN-FLUSH-FDB packets to notify other nodes.

If the master node receives the HEALTH packets at the secondary port that is open to data VLANs, the ring network is resumed. In this case, the master node immediately

blocks data VLANs on the secondary port, updates the local topology information and reports other nodes to age the MAC address table through RING-UP-FLUSH-FDB packets.

You can configure related commands on the Hello-time node and the Fail-time node to modify the interval for the primary port to transmit the HEALTH packets and the time limit for the secondary port to wait for the HEALTH packets.

2.3.2 Notification of Invalid Link of Transit Node

After the transit port of the transit node is out of effect, the LINK-DOWN packet will be immediately transmitted by the other transit port to notify other nodes. In normal case, the packet passes through other transit nodes and finally arrives at one port of the master node.

After the master node receives the LINK-DOWN packet, it thinks that the ring network is invalid. In this case, the master node removes the blocking of data VLANs on its secondary port, ages the local MAC address table, transmits the RING-DOWN-FLUSH-FDB packet and notifies other nodes.

2.3.3 Resuming the Link of the Transit Node

After the transit port is resumed, it does not immediately transmit the packets of data VLANs, but enters the Pre-Forwarding state. A transit port in pre-forwarding state only transmits and receives the control packets from the control VLAN.

If there is only one transit port invalid in the ring network and when the port enters the pre-forwarding state, the secondary port of the master node can receive the HEALTH packet from the primary port again. In this case, the master node blocks data VLANs on the secondary port again and transmits the notification of ageing address table outside. After the node with a transit port in pre-forwarding state receives the notification of aging address table, the node will first modify the pre-forwarding port to the forwarding port and then ages the local MAC address table.

If a transit mode does not receives the notification of aging address table from the master node, it thinks that the link to the master node is already out of effect, the transit node will automatically set the pre-forwarding port to be a forwarding one.

You can configure the related commands through the pre-forward-time node to modify the time for the transit port to keep the pre-forwarding state.

Chapter 3   EAPS Settings

3.1   Reading Before EAPS Configuration

Before configuring EAPS, please read the following items carefully:

- EAPS can be configured along with ERPS or SSTP/RSTP, but not with MSTP, at the same time.

- The configuration of the control VLAN of the ring network does not automatically establish the corresponding systematic VLAN. You need to establish the systematic VLAN manually through global VLAN configuration command.

- The port of each ring can forward the packets from the control VLAN of the ring, while other ports, even in the Trunk mode, cannot forward the packets from the control VLAN.

- By default, Fail-time of the master node is triple longer than Hello-time, so that packet delay is avoided from shocking the ring protection protocol. After Hello-time is modified, Fail-time need be modified accordingly.

- By default, Pre-Forward-Time of the transit node is triple longer than Hello-time of the master node so that it is ensured that the master node can detect the recovery of the ring network before the transit port enters the pre-forwarding state. If Hello-time configured on the master node is longer than Fre-Forward-Time of the transit node, loopback is easily generated and broadcast storm is then triggered.

- By default, the ring's nodes that are configured on S6800 and S8500 are all working on the distributive control mode so that an excellent convergence performance can be obtained. The working mode of the ring protection protocol can be changed through the node configuration commands **distributed-mode** and **centralized-mode**.

- EAPS can set a physical or aggregation port to be a ring port. If link aggregation, 802.1X or port security has been already configured on a physical port, the physical port cannot be set to be a ring's port any more.

3.2   EAPS Configuration Tasks

- Configuring the Master Node

- Configuring the Transit Node

- Configuring the Port of Ethernet Ring

- Browsing the State of the Ring Protection Protocol

3.3   EAPS Settings

3.3.1   Configuring the Master Node

Configure a switch to be the master node of a ring network according to the following steps:

Command	Purpose
Switch# **configure**	Enters the switch configuration mode.
Switch_config# **no spanning-tree**	Shuts down the currently running STP.
Switch_config# **spanning-tree bpdu-terminal**	Forbids the switch to forward STP BPDU.
Switch_config# **ether-ring** *id*	Sets a node and enters the node configuration mode. id: ID of the node
Switch_config_ring# **control-vlan** *vlan-id*	Configures the control VLAN. Vlan-id: ID of the control VLAN
Switch_config_ring# **master-node**	Configures the node type to be a master node.
Switch_config_ring# **hello-time** *value*	This step is optional. Configures the cycle for the master node to transmit the HEALTH packets. Value: It is a time value ranging from 1 to 10 seconds and the default value is 1 second.
Switch_config_ring# **fail-time** *value*	This step is optional. Configures the time for the secondary port to wait for the HEALTH packets. Value: It is a time value ranging from 3 to 30 seconds and the default value is 3 second.
Switch_config_ring# **distributed-mode**	This step is optional. Configures the distributive mode for the ring protection protocol. This command is only used for S6800 and S8500.
Switch_config_ring# **centralized-mode**	This step is optional. Configures the centralized mode for the ring protection protocol. This command is only used for S6800 and S8500.
Switch_config_ring# **exit**	Saves the current settings and exits the node configuration mode.
Switch_config# **vlan** *vlan-id*	Establishes the corresponding control VLAN.

Remark:

The **no ether-ring** *id* command is used to delete the node settings and port settings of the Ethernet ring.

3.3.2　Configuring the Transit Node

Configure a switch to be the transit node of a ring network according to the following steps:

Command	Purpose
Switch# **configure**	Enters the switch configuration mode.
Switch_config# **no spanning-tree**	Shuts down the currently running STP.
Switch_config**# spanning-tree bpdu-terminal**	Forbids the switch to forward STP BPDU.
Switch_config# **ether-ring** *id*	Sets a node and enters the node configuration mode. id：ID of the node
Switch_config_ring# **control-vlan** *vlan-id*	Configures the control VLAN. vlan-id：ID of the control VLAN
Switch_config_ring# **transit-node**	Configures the node type to be a transit node.
Switch_config_ring# **pre-forward-time** *value*	This step is optional. Configures the time of maintaining the pre-forward state on the transit port. value：It is a time value ranging from 3 to 30 seconds and the default value is 3 second.
Switch_config_ring# **exit**	Saves the current settings and exits the node configuration mode.
Switch_config# **vlan** *vlan-id*	Establishes the corresponding control VLAN.

3.3.3　Configuring the Port of Ethernet Ring

Configure a port of a switch to be the port of Ethernet ring according to the following steps:

Command	Purpose
Switch# **configure**	Enters the switch configuration mode.
Switch_config# **interface** *intf-name*	Enters the interface configuration mode. intf-name: Stands for the name of an interface.
Switch_config_intf# **ether-ring** *id* **primary-port** **{ secondary-port | transit-port }**	Configures the type of the port of Ethernet ring. id：ID of the node of Ethernet ring
Switch_config_intf**# exit**	Exits from interface configuration mode.

Remark:

The **no ether-ring** *id* **primary-port** { **secondary-port** | **transit-port** } command can be used to cancel the port settings of Ethernet ring.

3.3.4 Browsing the State of the Ring Protection Protocol

Run the following command to browse the state of the ring protection protocol:

Command	Purpose
show ether-ring *id*	Browses the summary information about the ring protection protocol and the port of Ethernet ring. id：ID of Ethernet ring
show ether-ring *id* **detail**	Browses the detailed information about the ring protection protocol and the port of Ethernet ring.
show ether-ring *id* **interface** *intf-name*	Browses the state of the Ether-ring port or that of the common port.

3.4 EAPS Configuration Example
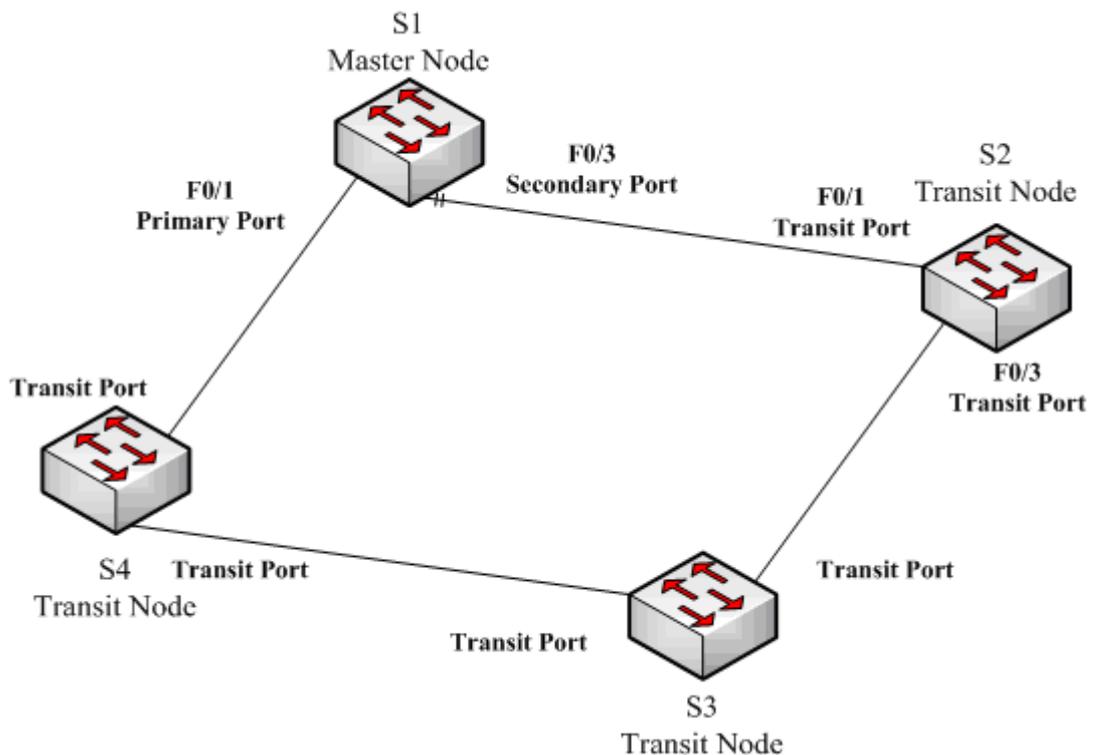
3.4.1 Configuration Example

Figure 2.1 Security settings of EAPS Ethernet ring

As shown in figure 2.1, master node S1 and transit node S2 are configured as follows. As to the settings of other nodes, they are same to S2's settings.

Configuring switch S1:

Shuts down STP and configures the Ether-ring node:

S1_config# no spanning-tree
S1_config# ether-ring 1
S1_config_ring1# control-vlan 2
S1_config_ring1# master-node

Configures the time related parameters:

S1_config_ring1# hello-time 2
S1_config_ring1# fail-time 6

Exits from the node configuration mode:

S1_config_ring1# exit

Configures the primary port and the secondary port:

S1_config# interface fastEthernet 0/1
S1_config_f0/1# ether-ring 1 primary-port
S1_config_f0/1# exit
S1_config# interface fastEthernet 0/3
S1_config_f0/3# ether-ring 1 secondary-port
S1_config_f0/3# exit

Establishes the control VLAN:

S1_config# vlan 2
S1_config_vlan2# exit
S1_config# interface range f0/1 , 3
S1_config_if_range# switchport mode trunk
S1_config_if_range# exit

Configuring switch S2:

S1_config# no spanning-tree
S1_config# ether-ring 1
S1_config_ring1# control-vlan 2
S1_config_ring1# transit-node
S1_config_ring1# pre-forward-time 8
S1_config_ring1# exit
S1_config# interface fastEthernet 0/1
S1_config_f0/1# ether-ring 1 transit-port
S1_config_f0/1# exit
S1_config# interface fastEthernet 0/3
S1_config_f0/3# ether-ring 1 transit-port
S1_config_f0/3# exit
S1_config# vlan 2
S1_config_vlan2# exit
S1_config# interface range fastEthernet 0/1 , 3
S1_config_if_range# switchport mode trunk
S1_config_if_range# exit

Chapter 4   ERPS Introduction
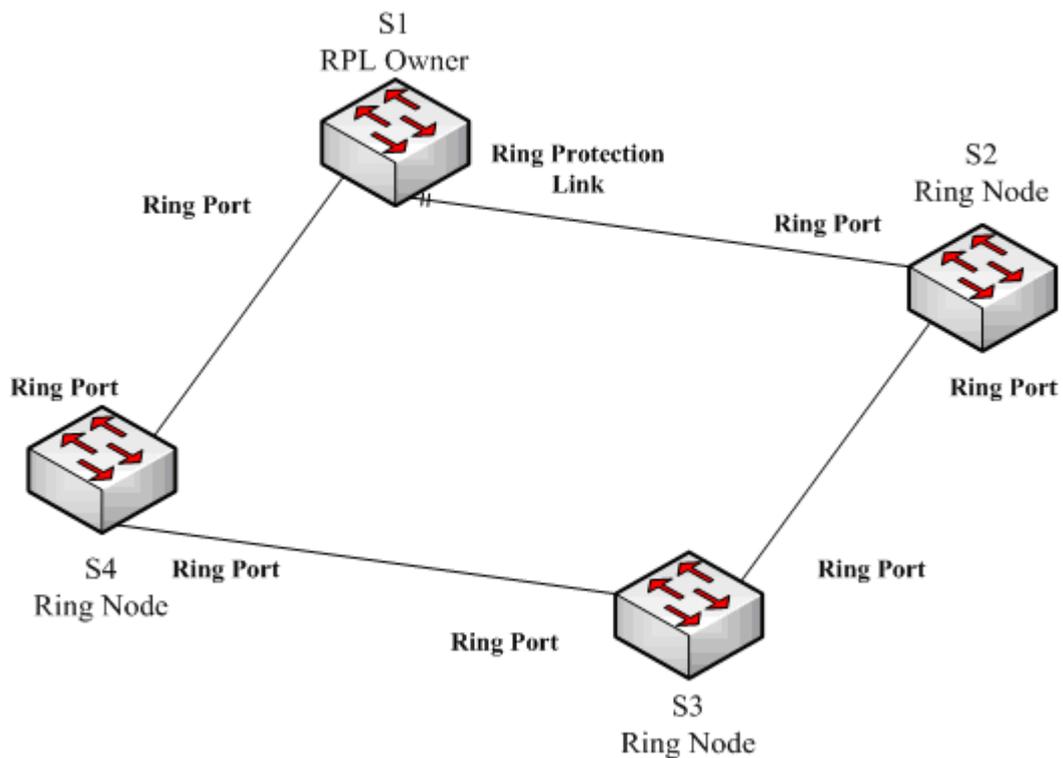
4.1   Related Concepts of ERPS

Figure 4.1 ERPS Ethernet Ring

4.1.1   Roles of Ether-Ring Nodes

Each switch on an Ethernet ring is a node on the Ethernet ring.. The nodes of Ethernet ring can be classified into RPL owner and common nodes. Only one switch on the Ethernet ring can serve as a mere RPL owner and other switches are worked as common nodes.

The node type of ERPS does not need the display configuration. By default, all devices on Ethernet ring determine the node with highest priority through the automatic discovery mechanism of ERPS as the RPL owner, one of whose ports is also automatically set as the ring protection link (RPL).

If a port of one device is set through a command to RPL, the priority of the device will be automatically modified so that the device can be the protection node.

The RPL owner is functionally same to a common node, that is, it is used to check the state of the ports of local Ethernet ring and send out the notifications in case of link

breakdown. The difference between RPL owner and common node is that RPL owner blocks the RPL link in normal case.

Note:
The RPL owner is greatly different from the master node of EAPS on the functionality: the RPL owner will not check the completeness of Ethernet ring positively, nor control the MAC address ageing of other nodes.

Note:
In the case that the automatic discovery mechanism of Ethernet ring is enabled, a port of a device is set to RPL through related command. Its functions are equivalent to setting the smallest priority value for the device. In this case, if other devices also have the lowest priority, the RPL owner of Ethernet ring still needs selection.

4.1.2   Role of the Ring's Port

ERPS demands that each node has two ports to connect Ethernet ring and each port is called as the ring port. Additionally, the whole Ethernet ring has a ring port as RPL.

In normal case, all ports on Ethernet ring except RPL are in forwarding state, while the RPL port is blocked to avoid loopback. In case that the link of Ethernet ring is invalid, the RPL owner cancels the blocking of the RPL owner for recovering network communication.

Only one RPL owner can be configured on each ring node on a switch.

Note:
1. ERPS supports setting an aggregation port to be a ring port.
2. To configure a same switch to belong to multiple rings, the switch must connect different rings through different physical ports.

4.1.3   Control VLAN and Data VLAN

ERPS has no need to distinguish control VLAN and data VLAN.

When ERPS runs together with EAPS, the state of the ring port of ERPS will affect all VLANs on this port.

When ERPS and EAPS are configured at the same time, the state of the ring port of ERPS will affect all EAPS data VLANs on this port.

Note:
ERPS always transmits its packets to the default VLAN of a port, so user needs to confirm that the default VLANs of all ports are same.

4.1.4   Automatic Discovery and Consistence Checkup of Ring Port

The automatic discovery mechanism of ERPS is used to determine a node on Ethernet ring as the protection node. Compared with EAPS, automatic discovery makes the deployment of Ethernet-ring devices much easier.

The automatic discovery mechanism uses the priority value and the MAC address to identify a ring node. The smaller the priority value and the MAC address are, the higher the priority is.

After the automatic discovery flow is started, the device begins to transmit the discovery packets to the ring port. In these packets, the local two-tuple information of the device is carried. When a discovery packet is found, please compare the information in the packet and judge whether it is more prior than the local information. If the packet's information is more prior, the device will not function as the RPL owner. If a device has not received a more prior packet before the end of a discovery flow, the device will become the RPL owner.

The **discovery time** command can be used to configure the time of the operation of the discovery flow, while the **discovery disable** command can be used to disable automatic discovery.

The automatic discovery mechanism is used for checking the consistence of the ring port at the same time to prevent incorrect or omitted settings, or incorrect network cable connection from affecting the running of the protocol.

ERPS guarantees that the discovery packets are transmitted only to t he ring port and these packets carry the ID of Ethernet ring. Suppose port P of a device receives a discovery packet and the discovery packet carries an **ID1** ID, it will be regarded, in the following two cases, that port P has the error of consistence and then port P will be set to the **Error-Disable** state.

- Port P has already been set to the ring port, but its ID is not equal to ID1.

- Port P has not been configured to be the ring port, but there are two other ports that have been configured to be ring ports whose IDs are both ID1.

In global configuration mode, the **no erps inconsistence-check** command can be used to forbid the consistence checkup of the ring port, while the **error-disable-recovery** command can be used to configure the time of port recovery.

4.2 Types of the ERPS Packets

The ERPS packets can be classified into the following types, as shown in table 4.1.

Table 4.1 Types of ERPS packets

Type of the packet	Description
Signal Fail（SF）	The ring node (including RPL owner) notifies other nodes after the local link is found to be invalid.
No Request（NR）	The ring node notifies other nodes after it detects that all local links are recovered.
No Request, RPL Blocked（NR-RB）	The RPL owner notifies other nodes of the recovery of ring protection shift.

4.3 ERPS Ring Protection Mechanism

4.3.1 Stable State

In stable state, the ring protection node blocks the RPL port and transmits the NR-RB packets in a configurable period.

All common nodes that receive NR-RB packets set the local ring ports to be in forwarding state. In stable state the common nodes do not transmit the protocol packets.

You can run the **send-time** command to modify the cycle time for the protection node to transmit the NR-RB packets.

4.3.2 Handling the Invalid Local Link

After a ring node checks an invalid local link, it first cancels the blocking state of the valid local ports (including the RPL port or the common ring ports that are not in forwarding state), then begins to transmit the SF protocol packets and conducts the ageing of the local MAC address table.

Other nodes that receive the SF packets first stop the transmission of local packets, and then cancel the blocking state of the valid local ports and conduct the ageing of MAC address table.

The node whose link is invalid transmits the SF packets every period of send-time. During the process, if a port of another node is resumed, the node will recover the port to the forwarding state after it receives the SF packets.

4.3.3 Handling the Recovery of Local Link

When the ring node detects that the local ring port recovers from the invalid state, it will maintain the blocking state of the port and begins to transmit the NR packets continuously.

When the NR packets are being transmitted, if the node receives the SF packets from other nodes, it means that the invalid link exists in the network, and the local node will stop the transmission of the NR packets and restore to the forwarding state.

If the local node does not receive new SF packets, it will start shift recovery WTR after the RPL owner receives the NR packets; after WTR times out, the RPL owner blocks the RPL port again, transmits the NR-RB packets and then conducts the ageing of the MAC address table; in this way, the network communication recovers the initial stable state.

4.3.4 Shift Recovery

The RPL owner realizes the ring shift recovery through a wait-to-restore timer (WTR).

WTR is used to avoid protection shift which occurs on Ethernet ring frequently. After the RPL owner receives the NR messages from other nodes, WTR is started; before

WTR times out, the RPL owner maintains the forwarding state of the RPL port and does not transmit the ring recovery notification. If the RPL owner receives the SF messages again, that means Ethernet ring is not fully recovered and in this case WTR is stopped.

After WTR times out, the RPL owner starts to block the RPL port again.

Chapter 5   ERPS Configuration

5.1   Reading Before ERPS Configuration

Before configuring ERPS, please read the following items carefully:

- ERPS can be configured along with EAPS or SSTP/RSTP, but not with MSTP, at the same time.

- The default VLAN for each ring port must be configured to be consistent so that ERPS packets can be normally forwarded.

- When ERPS and EAPS are running at the same time, the default VLAN of the ERPS ring port must be different from the control VLAN of EAPS. The ERPS packets cannot be forwarded in the control VLAN of EAPS.

- One port can not be used as the ERPS ring port and the EAPS ring port at the same time.

- ERPS can set a physical or aggregation port to be a ring port. However, the physical port where link aggregation, 802.1X or port security has been configured can not be set to be an ERPS ring port.

- ERPS chooses the RPL owner through automatic discovery mechanism by default; the automatic discovery mechanism can be forbidden through the **discovery disable** command in ERPS configuration mode. If automatic discovery is forbidden, please make sure that RPL has been configured and displayed on Ethernet ring; otherwise the broadcast storm may occur.

- In order to guarantee the ERPS ring port to recover from the error state, please run the **error-disable-recovery** command in global configuration mode to configure the automatic recovery time of the errable port.

- After the ring port is set to RPL, it has not become the RPL owner unless automatic discovery is forbidden. In the case that automatic discovery is enabled, setting the command is equivalent to setting the priority of the device to 0. Of cause, the RPL owner generates still through election.

5.2   ERPS Configuration Tasks

- Configuring the Ring Node

- Configuring the Ring Port

- Browsing the State of the Ring Protection Protocol

5.2.1   Configuring the Ring Node

In global mode, run the following commands to set a switch to the ERPS node:

Command	Purpose
Switch_config# **error-disable-recovery** *value*	Configures the automatic recovery time of the errable port.
Switch_config# **erps** *id*	Sets an ERPS ring node and enters the node configuration mode. id: ID of an Ethernet ring, which ranges between 0 and 7.
Switch_config# **discovery** [**enable** | **disable**]	Enables or disables the discovery mechanism.
Switch_config# **discovery time** *value*	Set the runtime for the automatic discovery of ERPS. Value: stands for the operation time of automatic discovery, which ranges from 15 to 300 seconds (30 seconds by default).
Switch_config# **discovery interval** *value*	Set the interval of transmission of the discovery packets. value：1-20 seconds (2 seconds by default)
Switch_config# **priority** *value*	Sets the priority of the local node. This value is used to confirm the ring protection node in the discovery mechanism. value：It ranges between 0 and 61440 and must be the integer times of 4096. The default value is 32768.
Switch_config_ring# **wtr-time** *value*	Sets the timeout time of the WTR timer. Value range: 10-720 seconds (300 seconds by default)
Switch_config_ring# **guard-time** *value*	Configures the timeout time of the Guard timer. When a port is recovered from an invalid state, the Guard timer is forbidden to handle the received protocol packets to avoid outdated packets from generating inaccurate protocols. Value: its unit is 10ms and it ranges between 1 and 200 (the default value is 50ms)
Switch_config_ring# **send-time** *value*	Sets the interval of transmission of the protocol packets. Value: the interval for the transmission of packets, which ranges between 1 and 10 and whose default value is 5 seconds.
Switch_config_ring# **exit**	Exits from the node configuration mode and starts the node.

Note:

The **no erps *id*** command is used to delete the node settings and port settings of the Ethernet ring.

5.2.2   Configuring the Ring Port

Configure a port of a switch to be the port of Ethernet ring according to the following steps:

Command	Purpose
Switch_config# **interface** *intf-name*	Enters the interface configuration mode.
	intf-name: Stands for the name of an interface.
Switch_config_intf# **erps** *id* **ring-port**	Set a port to be a common ring port of a designated node.
	id: ID of Ethernet ring
Switch_config_intf# **erps** *id* **rpl**	Set a port to be RPL of a designated node. In the case automatic discovery is enabled, the function of the command is as same as the priority value is modified to 10.
	id: ID of Ethernet ring
Switch_config_intf# **exit**	Exits from interface configuration mode.

Note:

The **no erps *id* rpl** command is used to set an RPL port to be a common ring port.

The **no erps** *id* **ring-port** command is used to delete a common ring port or an RPL port.

In the case that the ring nodes are not configured globally, both the **erps id ring-port** command and the **rpl** command are used to create the ring nodes at the same time.

5.2.3   Browsing the State of the Ring Protection Protocol

Run the following command to browse the state of the ring protection protocol:

Command	Purpose
show erps *id*	Browses the summary information about the ring protection protocol and the port of Ethernet ring.
	id: ID of Ethernet ring
show erps *id* **detail**	Browses the detailed information about the ring protection protocol and the ports.
show erps interface *intf-name*	Browses the state of the ring port.

5.3   ERPS Configuration Example

5.3.1   Example 1—Fixed RPL Settings
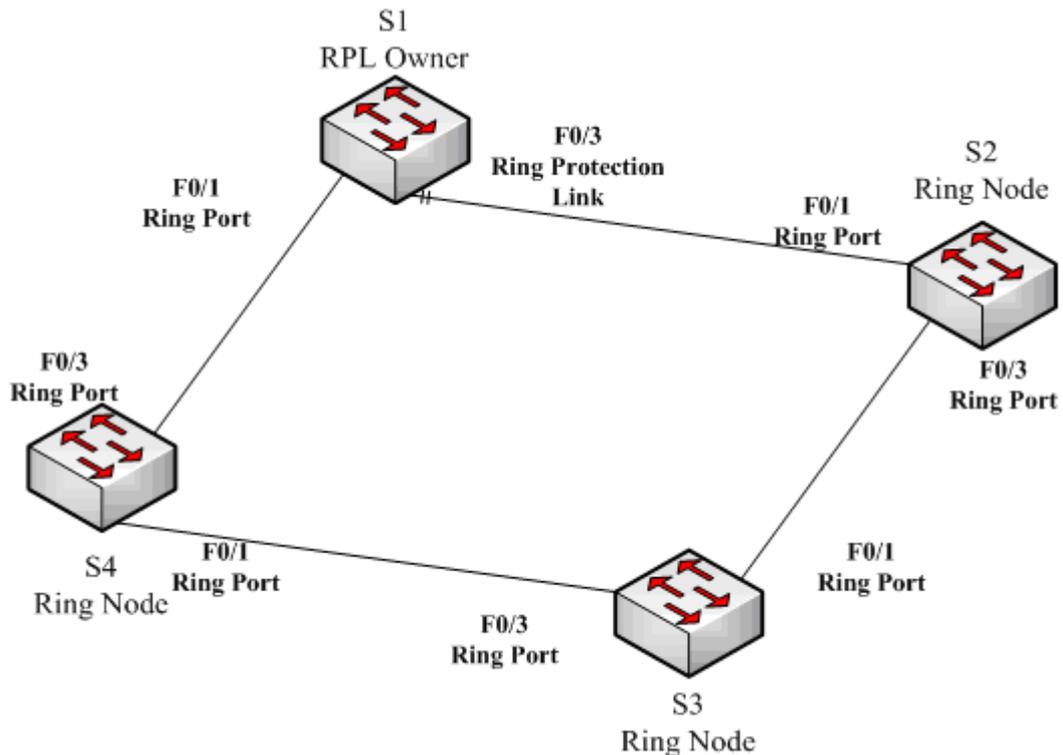

Figure 5.1 Fixed ERPS RPL settings

As shown in figure 5.1, the RPL node (S1) and the common node (S2) are configured.

Configuring switch S1:

The following commands are used to set the recovery time of the errable port:

Switch# config
Switch_config# error-disable-recovery 30

The following command is used to configure the ring node:

Switch_config# erps 1

The following commands are used to set the time related parameters:

Switch_config_ring1# wtr-time 15
Switch_config_ring1# send-time 5
Switch_config_ring1# exit

The following commands are used to set a common port:

Switch_config# interface f0/1
Switch_config_f0/1# erps 1 ring-port

The following commands are used to set the RPL port:

Switch_config_f0/1# interface f0/3
Switch_config_f0/3# erps 1 rpl

Configuring switch S2:

Switch_config# erps 1
Switch_config_ring1# send-time 5
Switch_config_ring1# exit
Switch_config_if_range# interface range fastEthernet 0/1 , 3
Switch_config_if_range# erps 1 ring-port
Switch_config_if_range# exit

5.3.2   Example 2 – Simple Settings for Applying Automatic Discovery

As shown in figure 5.1, all nodes are configured as follows:

The following commands are used to configure Ethernet ring and the ring port:

Switch_config# error-disable-recovery 30
Switch_config# interface range fastEthernet 0/1 , 3
Switch_config_if_range# erps 1 ring-port
Switch_config_if_range# exit

The following command is used to browse the state of ERPS:

Switch# show erps