SNR-S2970G-48S Fast Protection Mechanism of Ethernet Ring

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Chapter 1   Fast Protection Mechanism of Ethernet Ring

1.1   Overview

BDCOM Ethernet ring protection protocol is a special protocol applied in the link layer. It is specifically designed for the ring topology of Ethernet. 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 restarts the link that is previously shut down. In this way, the nodes among the ring network can communicate with each other.

Both the ring-network protection protocol and the spanning-tree protocol are used to control the link-layer topology. The spanning-tree protocol is used in multiple complicated networks and it transmits the change if network topology through the hop-to-hop method. The ring-network protection protocol is used in the ring topology and it transmits the change of ring topology through the diffusion method. Therefore, the convergence of the ring-network protection protocol in the ring network is much better than that of the spanning-tree protocol. In good network conditions, the ring-network protection protocol can resume network communication within 50 ms.

Note:
The ring-network protection protocol can configure one switch as the node for multiple physical ring networks. Therefore, a more complicated topology can be established.

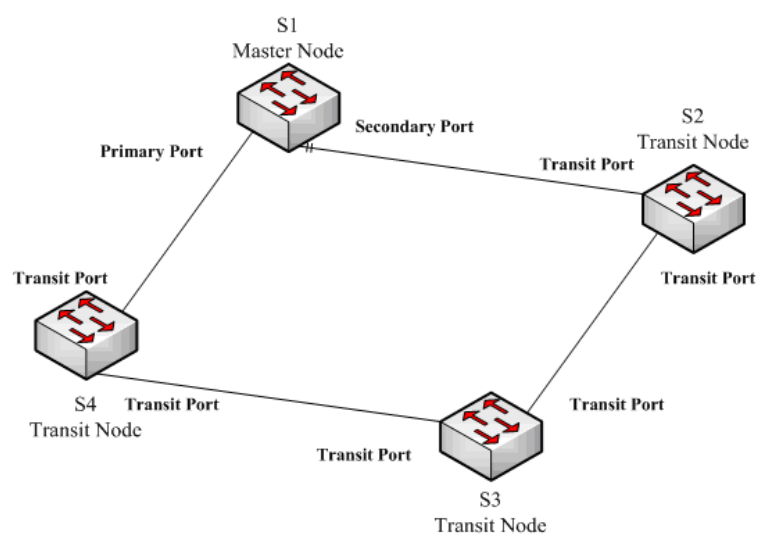## 1.2   Relative Concepts About Ethernet ring

Figure 1.1 Ethernet ring

1.2.1 Role of the Ring-Network Node

Each switch in an Ethernet ring is a node in the Ethernet ring. The ring-network node can be classified into Master Node and Transit Node. One switch in the ring network is used as Master Node. Other switches are used as Transit Nodes.

Master Node: it is to know whether the ring topology is complete, remove loops and control other switches when they update their topologies.

Transit Node: it is to detect the state of the local port of the ring network and inform the master node when a link becomes invalid.

The role of each node is designated by the user. Each switch can be configured as only one role. In figure 1.1, switch S1 is the master node of the ring network. Switches S2, S3 and S4 are Transit Nodes.

1.2.2 Role of the Ring Network's Port

The Ethernet ring protection protocol demands that each switch has two ports to connect the ring network. The role of each port need be designated through configuration. The port roles that the protocol supports include the following classes:

Primary Port: it is configured only at the master node. The master node sends the ring-network detection message through the primary port.

Secondary Port: it is configured only at the master node. The master node receives the ring-network detection message and then judges whether the ring topology is complete. If the ring topology is complete, the master node blocks the data message on the secondary port. If a link is broken in the ring topology, the master node enables the secondary port to forward the data message.

Transit Port: it is configured only at the transit node. The two ports of the transit node can be used as transmission ports.

Each port of the ring network can be configured as only one port role. The port role can be configured only after the node role of the switch is configured and the VLAN is controlled. As shown in figure 1.1, the port where master node S1 connects S4 is a primary port. The port where S1 connects S2 is the secondary port. The ports where other switches connects the ring network are transit ports.

Note:
If a same switch requires to be configured in multiple rings, the switch must connects different rings through different physical ports.

1.2.3 Control VLAN and Data VLAN

The master node and the transit node exchange the protocol message through a private control VLAN. You can designate the control VLAN through configuration. You need add the ports of the ring network to the control VLAN to assure that the protocol message can be normally received and sent. Normally, each port of the ring network is in the forwarding state in the control VLAN. The non-ring port cannot forward the message from the data VLAN.

Note:
You need to designate a different control VLAN for each ring. The control VLAN is only used to forward the ring-network control message. The control VLAN cannot be used for the layer-2 or layer-3 communication. For example, after the VLAN interface of the control VLAN is created, you cannot ping the IP address of the interface through other devices.

The VLANs except control VLANs are data VLAN. The data VLAN is used to forward common service messages or the switch management message. The Ethernet ring protection protocol can decide whether the ring-network port can forward the message from the data VLAN. All the non-ring-network ports forward the message from the data VLAN.

Note:
The data VLAN can be used for the layer-2 or layer-3 communication. For example, the corresponding VLAN interface of the data VLAN can be created and the dynamic routing protocol can be configured.

1.2.4   MAC Address Table Aging

The Ethernet ring protection protocol can control the MAC address table of the switch to assure that the data message can be sent to the right link after the topology is changed. Normally, the MAC address begins to age in the MAC address table after 300 seconds. The Ethernet ring protection protocol can control that the MAC address of the switch ages in a shortest time.

1.2.5   COMPLETE State of the Ring Network

The master node and the transit node can display whether the current ring network is in the complete state through the COMPLETE logo. As to the master node, when all links of the current ring network are in the normal state, the primary port is in the forwarding state and the secondary port is in the congestion sate, the COMPLETE logo is true. As to the transit node, only when two transit ports of the secondary node are in the forwarding state can the COMPLETE logo be true.

The ring-network state logo can help you to judge the topology state if the current network.

1.3 Message Types Used by the Ethernet Ring Protection Protocol

The message types used by the Ethernet ring protection protocol are shown in table 1.1.

Table 1.1 Message types for the Ethernet ring protection protocol

Message Type	Description
Loop detection (HEALTH)	It is sent by the master node to detect whether the ring-network topology is complete.
Link interruption (LINK-DOWN)	It is sent by the transit node to indicate that the link breakdown

	occurs in the ring network.
Aging address table for ring network breakdown (RING-DOWN-FLUSH-FDB)	It is sent by the master node after the breakdown of the ring network is detected, indicating the aging MAC address table of the transit node.
Aging address table for ring network restoration (RING-UP-FLUSH-FDB)	It is sent by the master node after the restoration of the ring network is detected, indicating the aging MAC address table of the transit node.

1.4   Protection Mechanism of Ethernet Ring

1.4.1   Loop Detection and Control for Master Node

The master node sends the HEALTH message to the control VLAN through the primary port in a configurable period. Normally, the HEALTH message can be sent to the secondary port of the master node after passing all other nodes in the ring network.

The secondary port blocks all data VLANs by default. In case the HEALTH message is continuously received, the secondary port remains to block the data VLAN to avoid the loop. If the secondary port does not receive the HEALTH message from the primary port after the configured time limitation, the ring network is considered to be invalid. The master node then enables its secondary port not to block the data VLAN, ages the local MAC address table and sends the RING-DOWN-FLUSH-FDB message to notify other nodes.

If the master node receives the HEALTH message through its secondary port that is open to the data VLAN, the ring network is restored. In this case, the master node blocks the data VLAN through its secondary port, updates its local topology and inform other nodes of the aging address table through the RING-UP-FLUSH-FDB message.

You can modify the interval for the primary port to send the HEALTH message and the time limitation for the secondary port to wait for the HEALTH message by configuring commands on the hello-time node and the fail-time node.

1.4.2   Link-Down Message of the Transit Node

After the link of a transit port for a transit node becomes invalid, the transit node immediately sends the LINK-DOWN message through another transit port. Normally, the LINK-DOWN message is sent to a port of the master node after passing other transit nodes.

After the master node receives the LINK-DOWN message, the ring network is considered to be invalid. The master node then enables its secondary port not to block the data VLAN, ages the local MAC address table and sends the RING-DOWN-FLUSH-FDB message to notify other nodes.

1.4.3   Link Restoration of the Transit Node

After the transit port is restored, it enters the pre-forwarding state. The transit port only forwards and receives the control message from the control VLAN when it is in the pre-forwarding state.

If only one transit port is invalid in the ring network, the secondary port of the master node then can receive the HEALTH message from the primary port again. In this case, the master node blocks the data VLAN again at its secondary port and sends the notification about the MAC address table aging to other nodes. The nodes whose transit ports are in the pre-forwarding state then change their transit ports to the forwarding state and age their local MAC address tables.

If a transit node does not receive the address aging notification from the master node after a configurable time limitation, the link between the transit node and the master node is considered to be broken. In this case, the transit node automatically changes its port state from the pre-forwarding state to the forwarding state.

You can modify the time limitation for the transit port to keep the pre-forwarding state by configuring commands on the pre-forward-time node.

Chapter 2   Fast Ethernet-Ring Protection Configuration

2.1   Default Configuration of Fast Ethernet-Ring Protection

Note:

The fast Ethernet-ring protection protocol and the spanning-tree protocol cannot be configured together.

After the spanning-tree protocol is enabled, you are suggested to configure the function spanning-tree bpdu-terminal to avoid the storm caused by BPDU forwarding on the ring node.

Table 2.1 shows the default configuration of the Ethernet-ring protection protocol and the spanning-tree protocol.

Table 2.1 Default settings of the fast Ethernet-ring protection protocol and the spanning-tree protocol

Spanning-tree protocol (STP)	**spanning-tree mode sstp**
fast Ethernet-ring protection protocol	No configuration

2.2   Notes to the Fast Ethernet-Ring Protection Protocol Configuration

Before configuring the Ethernet-ring protection protocol , read the following items carefully:

- The broadcast storm prevention is an important function of the Ethernet-ring protocol. Make sure that all ring nodes are configured before connecting the ring link. For example, after the master node and all transit nodes are configured, connect the network cable for the secondary port of the master node. If you connect the network cable before all nodes are configured, the broadcast storm is easily to occur.

- Disable the spanning-tree protocol of the switch before you configure the Ethernet-ring protection protocol. After running the **no spanning-tree** command, configure the **spanning-tree bpdu-teminal** function immediately to avoid the bad influence caused by the BPDU forwarding of all ring nodes.

- After the ring network node instances are configured, you cannot enable the STP protocol unless you delete the configuration of all ring-network nodes.

- The Ethernet-ring protection protocol supports configuring multiple ring-network node instances on a switch.

- The corresponding systematic VLAN cannot be automatically established after the ring-network control VLAN is configured. You need to manually establish the VLAN by running the global VLAN configuration command.

- Only the ring-network port can forward the message in the control VLAN of the ring. Other ports cannot do this even if it is configured as the trunk mode.

- By default, the Fail-Time of the master node is three times of the Hello-time of the master node. Hence, the shock of the Ethernet-ring protection protocol caused by the message delay can be avoided. After modifying the Hello-time, you need to modify the Fail-time correspondingly.

- By default, the Pre-Forward-Time of the **transit** node is three times of the Hello-time of the master node. The default settings ensures that the master node can detect the ring network recovery before the transit port enters the forwarding state. If the hello-time configured for the master node is bigger than the Pre-Forward-Time of the transit node, the broadcast storm may easily occur at the ring.

- By default, the nodes of **S6800** and **S8500** all work under the distribution mode, which can get better convergence. You can run the commands **distributed-mode** and **centralized-mode** to modify the working mode of the Ethernet ring protection protocol.

- Only the physical ports such as Interface FastEthernet and Interface GigaEthernet can be configured as the ports of the ring network. The summary port cannot be configured as the ring-network port. If the link convergence, 802.1X or port security has already been configured on the physical port, the port cannot be configured as the ring-network port too.

2.3 Tasks for Fast Ethernet-Ring Protection Configuration

- Configuring the master node

- Configuring the transit node

- Configuring the ring-network port

- Checking the state of the ring-network protection protocol

2.4 Fast Ethernet-Ring Protection Configuration

2.4.1 Configuring the Master Node

Run the following commands to configure the switch as the master node of the ring network.

Command	Purpose
Switch#**configure**	Enters the switch configuration mode.
Switch_config#**no spanning-tree**	Disables the current STP protocol.
Switch_config#**spanning-tree bpdu-terminal**	Forbids the switch to forward the STP BPDU.
Switch_config#**ether-ring** id	Configures the node instance and enters the node configuration mode. id: instance number of the node

Switch_config_ring#**control-vlan** *vlan-id*	Configures the control VLAN. vlan-id: number of the control VLAN
Switch_config_ring#**master-node**	Sets the node type to **master**.
Switch_config_ring#**hello-time** *value*	Configures the period for the master node to transmit the detection message, which is optional. Value: 1-10 seconds Default value: 1s
Switch_config_ring#**fail-time** *value*	Configures the time limit for the secondary port to wait for the detection message, which is optional. Value: 3-30 seconds Default value: 3s
Switch_config_ring#**distributed-mode**	Configures the working mode of the Ethernet-ring protection protocol to **distributed**, which is optional. The operation is only applied to S6800 and S8500.
Switch_config_ring#**centralized-mode**	Configures the working mode of the Ethernet-ring protection protocol to **centralized**, which is optional. The operation is only applied to S6800 and S8500.
Switch_config_ring#**exit**	Saves the current configuration and exits the node configuration mode.
Switch_config#**vlan** *vlan-id*	Establishes the corresponding control VLAN.

Note:

You must run the **no ether-ring** *id* command to delete the configurations of the ring network and the port.

2.4.2   Configuring the Transit Node

Run the following commands to configure the switch as the **transit** node of the ring network.

Command	Purpose
Switch#**configure**	Enters the switch configuration mode.
Switch_config#**no spanning-tree**	Disables the current STP protocol.
Switch_config#**spanning-tree bpdu-terminal**	Forbids the switch to forward the STP BPDU.
Switch_config#**ether-ring** *id*	Configures the node instance and enters the node configuration mode. id: instance number of the node
Switch_config_ring#**control-vlan** *vlan-id*	Configures the control VLAN.

	vlan-id: number of the control VLAN
Switch_config_ring#**transit-node**	Sets the node type to **transit**.
Switch_config_ring#**pre-forward-time** *value*	Configures **pre-forward-time** of the **transit** port. The operation is optional. Value: 3-30 seconds Default value: 3s
Switch_config_ring#**exit**	Saves the current configuration and exits the node configuration mode.
Switch_config#**vlan** *vlan-id*	Establishes the corresponding control VLAN.

2.4.3   Configuring the Ring-Network Port

Run the following commands to configure the ports of the switch as the ring-network port.

Command	Purpose
Switch#**configure**	Enters the switch configuration mode.
Switch_config#**interface** *intf-name*	Enters the port configuration mode. intf-name: port name
Switch_config_intf#**ether-ring** *id* **primary-port** { **secondary-port** | **transit-port** }	Configures the type of the ring-network port. Id: instance number of the ring-network node
Switch_config_intf#**exit**	Exits the port configuration mode.

Note：

Run the command **no ether-ring** *id* **primary-port** { **secondary-port** \| **transit-port** } to delete the configuration of the ring-network port.

2.4.4   Checking the State of the Ring-Network Protection Protocol

Run the following commands to check the state of the ring-network protection protocol.

Command	Purpose
show ether-ring *id*	Checks the extract information about the ring-network protection protocol and the ring-network port. Id: instance number of the ring network
show ether-ring *id* **detail**	Checks the detailed information about the ring-network protection protocol and the ring-network port.
show ether-ring *id* **interface** *intf-name*	Checks the state information about the ring-network port and the common port.

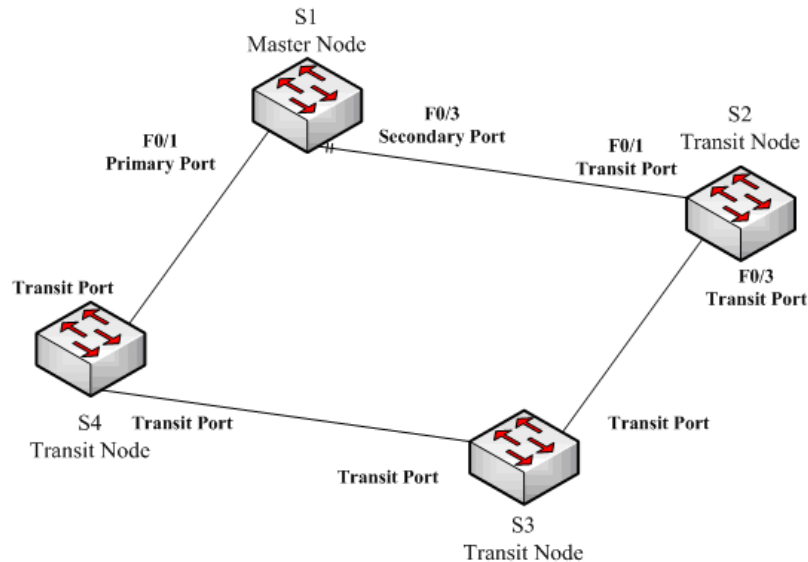## 2.5   Example to Fast Ethernet-Ring Protection

2.5.1   Example

Figure 2.1 Example to fast Ethernet-ring protection

As illustrated in figure 2.1, the master node S1 and the transit node S2 are configured as follows. Other nodes are configured the same as S2.

Configuring switch S1:

Disable the STP protocol and configure the ring-network node:

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

Configure the time parameter:

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

Exits the node configuration mode:

S1_config_ring1#exit

Configure 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

Establish 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