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1 Configuring RLDP

1.1 Introduction

The Rapid Link Detection Protocol (RLDP) is an Ethernet link failure detection protocol, which is used to rapidly detect unidirectional link failures, bidirectional link failures, and downlink loop failures. When a failure is found, RLDP automatically shuts down relevant ports or asks users to manually shut down the ports according to the configured failure handling methods, to avoid wrong forwarding of traffic or Ethernet L2 loops.

1.1.1 Basic Concepts

1. Unidirectional Link Failure

A unidirectional link failure occurs when one end of the receiving or transmission link in an optical fiber is disconnected or not connected, one line in a twisted-pair cable is disconnected, or unidirectional disconnection occurs on an intermediate device between two devices. A unidirectional link failure can lead to wrong forwarding of traffic or the failure of a loop protection protocol such as Spanning Tree Protocol (STP).

2. Bidirectional Link Failure

A bidirectional link failure occurs when two optical fibers are disconnected, two lines in a twisted-pair cable are disconnected, or bidirectional disconnection occurs on an intermediate device between two devices. A bidirectional link failure can lead to the wrong forwarding of traffic.

3. Loop Failure

A loop failure occurs when a downlink port of a device is wrongly connected to another device and a loop forms. A loop failure can result in a broadcast storm.

4. Protocol Packets

RLDP defines the following three types of packets:

- Prob packets: L2 multicast packets used for neighbor negotiation, and unidirectional or bidirectional link detection. The default encapsulation format of the packets is of the Subnetwork Access Protocol (SNAP) type, which automatically changes to EthernetII if a neighbor sends EthernetII packets.
- Echo packets: L2 unicast packets in response to prob packets and used for unidirectional or bidirectional link detection. The default encapsulation format is of the SNAP type, which automatically changes to EthernetII if a neighbor sends EthernetII packets.
- Loop packets: L2 multicast packets for downlink loop detection. They can only be received by senders. The default encapsulation format of the packets is of the SNAP type.

5. Detection Interval

A detection interval and the maximum detection count can be configured for RLDP. A detection interval determines the period of sending prob packets and loop packets. When a device receives a prob packet, it replies with an echo packet immediately. A detection interval and the maximum detection count determine the maximum detection time (Detection interval × Maximum detection count + 1) for unidirectional or bidirectional

link detection. If neither a prob nor an echo packet from a neighbor is correctly received within the maximum detection time, the handling of unidirectional or bidirectional failures is triggered. The timers involved are described in [Table 1-1](#).

Table 1-1 Description of RLDP Timers

Timer Name	Timer Description
Send timer	After the link detection function is enabled, the send timer is started and the prob packets or loop packets are sent regularly. The time interval of the send timer is the configured detection interval.
Timeout timer	<ul style="list-style-type: none"> • If a unidirectional or bidirectional link failure is detected, the timeout timer is started after the prob packet is sent, and the timeout time is the maximum detection time (Detection interval × Maximum detection count + 1). • In unidirectional link detection, when the detection timeout time expires and a port can only receive the prob packet or response packet from the neighbor, it is considered that a unidirectional link failure occurs. • In bidirectional link detection, when the detection timeout time expires and a port fails to receive the prob packet and response packet from the neighbor, it is considered that a bidirectional link failure occurs.

6. Neighbor Negotiation

When configured with unidirectional or bidirectional link detection, a port can learn a peer device as its neighbor. One port can learn only one neighbor, which is changeable. If the negotiation function is enabled, unidirectional or bidirectional link detection starts after a port finds a neighbor through negotiation. Negotiation is considered successful if the port receives a prob packet from the neighbor. However, if RLDP is enabled on a port after a failure already occurs, the port fails to learn a neighbor and detection fails to be started. In this case, you are advised to rectify the link failure first.

7. Associated Actions

The associated actions and recovery methods after a RLDP port failure are described in [Table 1-1](#).

Table 1-1 Description of RLDP Port Failure Handling

Type	Associated Action/ Recovery Method	Description
Associated actions after a failure	warning	Only the relevant system log is printed to indicate the failed port and the failure type.
	Shutdown SVI	A system log is printed. If the failed port is a physical switching port or member port of an L2 aggregate port (AP), a switch virtual interface (SVI) is queried based on the access VLAN or native VLAN of the port, and then the SVI is shut down.
	Port errdisable	A system log is printed, the failed port is set in errdisable state, and the port enters the linkdown state physically.
	Block	A system log is printed, the forwarding state of the failed port is

Type	Associated Action/ Recovery Method	Description
		set to blocked, and the port does not forward received packets.
Recovery methods after a failure	Manual reset	Manually reset all the failed ports to the initialized state to restart link detection.
	Manual or automatic errdisable recovery	Recover all the failed ports to the initialized state manually or regularly (30 seconds by default and configurable) and restart link detection.
	Automatic recovery	Under unidirectional or bidirectional link detection, if the handling method specified for failed ports does not enable the ports to enter the errdisable state, the ports can automatically recover to the initialized state based on prob packets exchanged with the neighbor, and link detection is restarted.
	Manual or automatic execution of the rldp error-recover interval command	All the failed ports recover to the initialized state regularly (configurable) and link detection is restarted.

8. RLDP Port State

RLDP ports can be in two states:

- Normal: Indicates the state of a port, on which link detection is enabled.
- Error: Indicates the state of a port, on which a unidirectional or bidirectional link failure or a loop failure is detected.

1.1.2 Detection Principles

A typical Ethernet link detection mechanism detects physical link connectivity through auto-negotiation at the physical layer. However, this detection mechanism has limitations. In some cases, devices are connected and work normally at the physical layer but L2 link communication fails or is abnormal. RLDP recognizes a neighbor device and detects whether a link failure exists by exchanging prob packets, echo packets, or loop packets with the neighbor device. [Figure 1-1](#) shows the protocol states.

Figure 1-1 RLDP Protocol State Diagram

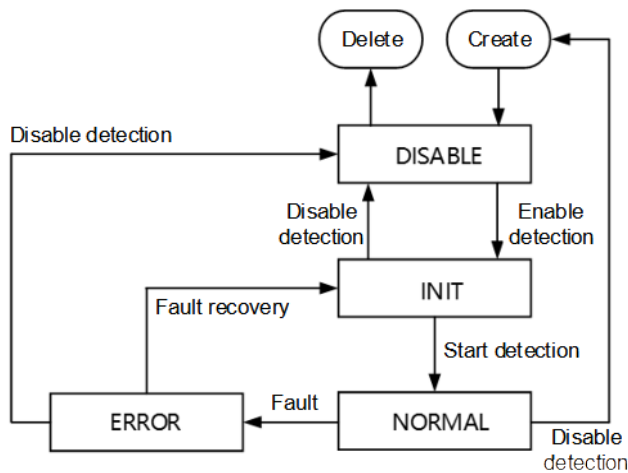


Figure 1-1 shows the detection logic of RLDP, which can be mainly in four states. The four states are described in Table 1-1.

Table 1-1 Description of RLDP States

State	Description
DISABLE	After the global RLDP function is enabled, all ports enter the disable state. Now, unidirectional link detection, bidirectional link detection, or downlink loop detection is not enabled on the ports. If the RLDP is disabled in any state, a port enters this state.
INIT	It refers to the initialized state after RLDP is just configured and enabled or a failure is rectified. Now, unidirectional link detection, bidirectional link detection, or downlink loop detection is enabled on ports, and the corresponding link failure handling methods are specified, or the links can recover from unidirectional failures, bidirectional failures, or loop failures automatically.
NORMAL	It refers to the state after detection is enabled for RLDP. For downlink loop detection, RLDP enters the state directly after enabled. For unidirectional or bidirectional link detection, RLDP enters the state directly or enters the state only after negotiation with a specified neighbor succeeds.
ERROR	It refers to the state after RLDP detects a failure. In this case, a unidirectional link failure or bidirectional link failure is detected on a port. The failure will be handled according to the specified failure handling method.

1.1.3 RLDP Detection

RLDP provides unidirectional link detection, bidirectional link detection, and downlink loop detection.

1. Unidirectional Link Detection

After unidirectional link detection is enabled, a port sends prob packets and receives echo packets from a neighbor regularly. It also receives prob packets from the neighbor and replies with echo packets to the

neighbor. If the port receives only prob packets but no echo packets, or none of them from the neighbor within the maximum detection time, handling of a unidirectional failure is triggered and the detection stops.

2. Bidirectional Link Detection

After bidirectional link detection is enabled, a port sends prob packets and receives echo packets from a neighbor regularly. It also receives prob packets from the neighbor and replies with echo packets to the neighbor. If the port receives neither prob packets nor echo packets from the neighbor within the maximum detection time, handling of a bidirectional failure is triggered and the detection stops.

3. Downlink Loop Detection

After downlink loop detection is enabled, a port sends loop packets regularly. After the same port or different ports on a device receive loop packets, a loop failure is triggered if any of the following cases occurs: The transmission and receiving ports of the packets are the same routed ports or L3 AP member ports; the transmission and receiving ports of packets are exchange ports or L2 AP member ports, the default VLANs of the ports are the same, and forwarding states of the ports are forward. The failure is handled according to the corresponding method and the detection stops.

1.2 Configuring Basic Features of RLDP

1.2.1 Overview

- You can enable RLDP unidirectional link detection, bidirectional link detection, or downlink loop detection to discover unidirectional, bidirectional, or loop failures.
- After global RLDP detection is enabled, the RLDP detection is started on each port normally.
- After the function is enabled in global configuration mode, RLDP detection on a port is started after successful neighbor negotiation.
- If loop detection latency interval is configured in global configuration mode, the downlink port loop cannot be detected in this period of time.
- In interface configuration mode, you can configure unidirectional RLDP detection, bidirectional RLDP detection, or downlink loop detection, and specify a failure handling method.
- You can restore all the failed ports and restart detection.

1.2.2 Restrictions and Guidelines

- Loop detection configured on an AP member port takes effect on all the member ports of the AP. Unidirectional link detection and bidirectional link detection take effect on an AP member port directly.
- The loop detection configuration of a physical port added to an AP must be the same as that of the other member ports of the AP. There are two cases. (1) If loop detection is not configured on the new member port but on the existing member ports, the new port adopts the configuration and detection results of the existing ports. (2) If the new member port and the existing member ports have different loop detection configurations, the new port adopts the configuration and detection results of the existing ports.
- When configuring the RLDP on an AP member port, you can configure only the "shutdown-port" and "warning" handling methods. If the failure handling method is not set to "shutdown-port" or "warning", it is modified to "shutdown-port" and takes effect.
- After the "shutdown-port" handling method is configured on a port, the port cannot resume RLDP detection

in the case of a failure. After confirming that the failure is rectified, you can run the **rldp reset** or **errdisable recovery** command to restore the port and restart detection. For the description and configuration of **errdisable recovery**, see "Configuring Ethernet Interface" in *Interface Configuration Guide*.

1.2.3 Procedure

- (1) Enter the privileged EXEC mode.

enable

- (2) Enter the global configuration mode.

configure terminal

- (3) Enable the global RLDP detection function.

rldp enable

The global RLDP detection function is disabled by default.

- (4) (Optional) Configure global neighbor negotiation.

rldp neighbor-negotiation

The neighbor negotiation function is disabled by default.

- (5) (Optional) Configure the global RLDP detection interval.

rldp detect-interval *interval*

The default interval for sending RLDP packets by a port is **3** seconds.

- (6) (Optional) Configure a time interval for RLDP to recover failed ports.

rldp error-recover interval *interval*

No time interval for RLDP to recover failed ports regularly is configured by default.

- (7) (Optional) Configure the maximum detection count of RLDP.

rldp detect-max *max-detect-number*

The default maximum detection count of RLDP is **2**.

- (8) (Optional) Configure the global loop detection latency interval.

rldp detect-latency *interval*

The default latency interval for global RLDP loop detection is **0** seconds.

- (9) Enter the interface configuration mode.

interface *interface-type interface-number*

- (10) Configure RLDP detection on the port.

rldp port { **bidirection-detect** | **loop-detect** | **unidirection-detect** } { **block** | **shutdown-port** | **shutdown-svi** | **warning** }

RLDP detection is not configured on a port by default.

1.3 Monitoring

Run the **show** commands to check the running status of a configured function to verify the configuration effect.

Table 1-1 RLDP Monitoring

Command	Purpose
<code>show rldp [interface <i>interface-type interface-number</i>]</code>	Displays the RLDP running state.

1.4 Configuration Examples

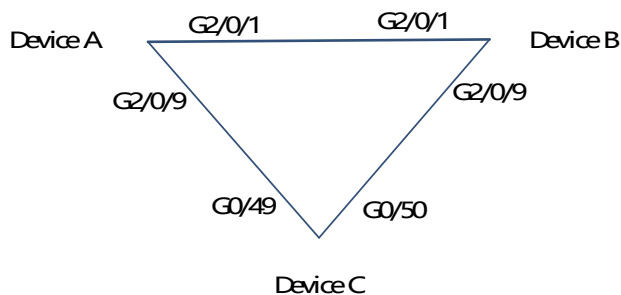
1.4.1 Configuring Basic Features of RLDP

1. Requirements

The aggregation and access devices form a ring topology. STP is enabled on all devices to prevent loops and provide redundancy protection. To avoid a unidirectional or bidirectional link failure resulting in an STP failure, RLDP unidirectional link detection and bidirectional link detection are enabled between aggregation devices as well as between the aggregation devices and the access device. To avoid loops due to wrong connection in the downlink direction of the aggregation devices, RLDP downlink loop detection is enabled on the downlink ports of the aggregation devices and the access device. To avoid loops due to wrong connection in the downlink direction of the access device, RLDP downlink loop detection is enabled on all the downlink ports of the access device.

2. Topology

Figure 1-1 Topology for Configuring Basic Features of RLDP



3. Notes

- Devices A and B are aggregation devices, and device C is an access device. User devices can be connected to downlink ports of device C. Devices A, B, and C are structured in a ring topology, and STP is enabled on each of them. For STP configuration, refer to the relevant configuration guide.
- Enable RLDP on device A, enable unidirectional and bidirectional link detection on the two ports, and enable loop detection on the downlink port.
- Enable RLDP on device B, enable unidirectional and bidirectional link detection on the two ports, and enable loop detection on the downlink port.
- Enable RLDP on device C, enable unidirectional and bidirectional link detection on the two uplink ports, and enable loop detection on the two downlink ports.

4. Procedure

Perform the following configuration on device A.

```
Device A# configure terminal
Device A(config)# rldp enable
Device A(config)# interface GigabitEthernet 2/0/1
Device A(config-if-GigabitEthernet 2/0/1)# rldp port unidirection-detect
shutdown-port
Device A(config-if-GigabitEthernet 2/0/1)# rldp port bidirection-detect shutdown-
port
Device A(config-if-GigabitEthernet 2/0/1)# exit
Device A(config)# interface GigabitEthernet 2/0/9
Device A(config-if-GigabitEthernet 2/0/1)# rldp port unidirection-detect
shutdown-port
Device A(config-if-GigabitEthernet 2/0/1)# rldp port bidirection-detect shutdown-
port
Device A(config-if-GigabitEthernet 2/0/1)# rldp port loop-detect shutdown-port
```

Perform the following configuration on device B.

```
Device B# configure terminal
Device B(config)# rldp enable
Device B(config)# interface GigabitEthernet 2/0/1
Device B(config-if-GigabitEthernet 2/0/1)# rldp port unidirection-detect
shutdown-port
Device B(config-if-GigabitEthernet 2/0/1)# rldp port bidirection-detect shutdown-
port
Device B(config-if-GigabitEthernet 2/0/1)# exit
Device B(config)# interface GigabitEthernet 2/0/9
Device B(config-if-GigabitEthernet 2/0/1)# rldp port unidirection-detect
shutdown-port
Device B(config-if-GigabitEthernet 2/0/1)# rldp port bidirection-detect shutdown-
port
Device B(config-if-GigabitEthernet 2/0/1)# rldp port loop-detect shutdown-port
```

Perform the following configuration on device C.

```
Device C# configure terminal
Device C(config)# rldp enable
Device C(config)# interface GigabitEthernet 0/49
Device C(config-if-GigabitEthernet 0/49)# rldp port unidirection-detect shutdown-
port
Device C(config-if-GigabitEthernet 0/49)# rldp port bidirection-detect shutdown-
port
Device C(config-if-GigabitEthernet 0/49)# exit
Device C(config)# interface GigabitEthernet 0/50
Device C(config-if-GigabitEthernet 0/50)# rldp port unidirection-detect shutdown-
port
```

```

Device C(config-if-GigabitEthernet 0/50)# rldp port bidirection-detect shutdown-
port
Device C(config-if-GigabitEthernet 0/50)# exit
Device C(config)# interface GigabitEthernet 0/1
Device C(config-if-GigabitEthernet 0/1)# rldp port loop-detect shutdown-port
Device C(config-if-GigabitEthernet 0/1)# exit
Device C(config)# interface GigabitEthernet 0/2
Device C(config-if-GigabitEthernet 0/2)# rldp port loop-detect shutdown-port

```

5. Verification

Check the RLDP state information on devices, A, B, and C. Device A is taken as an example. Run the **show rldp** command to check whether the configuration is correct.

```

Device A# show rldp
rldp state           : enable
rldp hello interval: 3
rldp max hello       : 2
rldp local bridge    : 00d0.f822.33aa
-----
Interface GigabitEthernet 2/0/1
port state           : normal
neighbor bridge      : 00d0.f800.51b1
neighbor port        : GigabitEthernet 2/0/1
unidirection detect information:
  action: shutdown-port
  state  : normal
bidirection detect information:
  action: shutdown-port
  state  : normal

Interface GigabitEthernet 2/0/9
port state           : normal
neighbor bridge      : 00d0.f800.41b0
neighbor port        : GigabitEthernet 0/49
unidirection detect information:
  action: shutdown-port
  state  : normal
bidirection detect information:
  action: shutdown-port
  state  : normal
loop detect information:
  action: shutdown-port
  state  : normal

```

6. Common Errors

- RLDP is enabled together with private multicast address authentication or TPP.
- Neighbor negotiation is not enabled when unidirectional or bidirectional link detection is configured. RLDP

must be enabled on a neighbor device in global or interface configuration mode; otherwise a unidirectional or bidirectional failure is detected.

- If neighbor negotiation prior to RLDP detection is specified when unidirectional or bidirectional link detection is configured, normal detection fails because no neighbor is learned in the case of an existing link failure. In this situation, you are advised to rectify the link failure first.
- You are not advised to specify Shutdown SVI as the failure handling method on a routed port.
- You are not advised to specify Block as the failure handling method for a port, on which a loop protection protocol such as STP is enabled.

1.4.2 Configuring Unidirectional Link Detection

1. Requirements

As shown in [Figure 1-1](#), device A is connected to device B through an optical fiber. The two lines are the Tx and Rx lines of the optical fiber. Unidirectional link detection is enabled on devices A and B. If a fault occurs on either the Tx end of device A or Rx end of device B or on either the Rx end of device A or Tx end of device B, RLDP can detect the unidirectional failure and handle it. If the failure is eliminated, the administrator can manually restore the RLDP state on devices A and B and restart detection.

2. Topology

Figure 1-1 Topology for Configuring Unidirectional Link Detection



3. Notes

- Enable global RLDP.
- Configure unidirectional link detection of RLDP on ports and define a method for handling unidirectional failures.

4. Procedure

Perform the following configuration on device A.

```
DeviceA> enable
DeviceA# configure terminal
DeviceA(config)# rldp enable
DeviceA(config)# interface GigabitEthernet 0/1
DeviceA(config-if-GigabitEthernet 0/1)# rldp port unidirection-detect shutdown-
port
```

Perform the following configuration on device B.

```
DeviceB> enable
DeviceB# configure terminal
DeviceB(config)# rldp enable
DeviceB(config)# interface GigabitEthernet 0/1
```

```
DeviceB(config-if-GigabitEthernet 0/1)# rldp port unidirection-detect shutdown-port
```

5. Verification

Check the RLDP state information on device A.

```
DeviceA> enable
DeviceA# show rldp
rldp state          : enable
rldp hello interval: 3
rldp max hello      : 2
rldp local bridge   : 00d0.f822.33aa
-----
Interface GigabitEthernet 0/1
port state          : normal
neighbor bridge     : 00d0.f800.51b1
neighbor port       : GigabitEthernet 0/1
unidirection detect information:
  action: shutdown-port
  state  : normal
```

Check the RLDP state information on device B.

```
DeviceB> enable
DeviceB# show rldp
rldp state          : enable
rldp hello interval: 3
rldp max hello      : 2
rldp local bridge   : 00d0.f800.51b1
-----
Interface GigabitEthernet 0/1
port state          : normal
neighbor bridge     : 00d0.f822.33aa
neighbor port       : GigabitEthernet 0/1
unidirection detect information:
  action: shutdown-port
  state  : normal
```

6. Common Errors

- Global RLDP is not enabled at the local end or peer end.
- The RLDP detection method configured at the local end is inconsistent with that at the peer end.
- RLDP negotiation is not enabled, so a link failure is judged by mistake when unidirectional link detection of RLDP is configured at a single end.

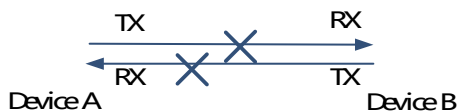
1.4.3 Configuring Bidirectional Link Detection

1. Requirements

As shown in [Figure 1-1](#), device A is connected to device B through an optical fiber. The two lines are the Tx and Rx lines of the optical fiber. Bidirectional link detection is enabled on devices A and B. If a fault occurs on the Tx end of device A and Rx end of device B or on the Rx end of device A and Tx end of device B, RLDP can detect a bidirectional failure and handle it. If the failure is eliminated, the administrator can manually restore the RLDP state on devices A and B and restart detection.

2. Topology

Figure 1-1 Topology for Configuring Bidirectional Link Detection



3. Notes

- Enable global RLDP.
- Configure bidirectional link detection of RLDP on ports and define a method for handling bidirectional failures.

4. Procedure

Perform the following configuration on device A.

```
DeviceA> enable
DeviceA# configure terminal
DeviceA(config)# rldp enable
DeviceA(config)# interface GigabitEthernet 0/1
DeviceA(config-if-GigabitEthernet 0/1)# rldp port bidirection-detect shutdown-
port
```

Perform the following configuration on device B.

```
DeviceB> enable
DeviceB# configure terminal
DeviceB(config)# rldp enable
DeviceB(config)# interface GigabitEthernet 0/1
DeviceB(config-if-GigabitEthernet 0/1)# rldp port bidirection-detect shutdown-
port
```

5. Verification

Check the RLDP state information on device A.

```
DeviceA> enable
DeviceA# show rldp
rldp state          : enable
rldp hello interval: 3
```

```
rldp max hello      : 2
rldp local bridge   : 00d0.f822.33aa
-----
Interface GigabitEthernet 0/1
port state          : normal
neighbor bridge     : 00d0.f800.51b1
neighbor port       : GigabitEthernet 0/1
bidirection detect information:
    action: shutdown-port
    state : normal
```

Check the RLDP state information on device B.

```
DeviceB> enable
DeviceB# show rldp
rldp state          : enable
rldp hello interval: 3
rldp max hello      : 2
rldp local bridge   : 00d0.f800.51b1
-----
Interface GigabitEthernet 0/1
port state          : normal
neighbor bridge     : 00d0.f822.33aa
neighbor port       : GigabitEthernet 0/1
bidirection detect information:
    action: shutdown-port
    state : normal
```

6. Common Errors

- Global RLDP is not enabled at the local end or peer end.
- The RLDP detection method configured at the local end is inconsistent with that at the peer end.
- If bidirectional link detection needs to be configured but RLDP negotiation is not enabled, a link failure will be detected at one end.