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1 Configuring REUP

Rapid Ethernet Uplink Protection (REUP) provides a rapid uplink protection function. In the dual uplink networking, REUP is used to ensure normal communication between links, block redundant links, avoid link loops, and implement fast backup.

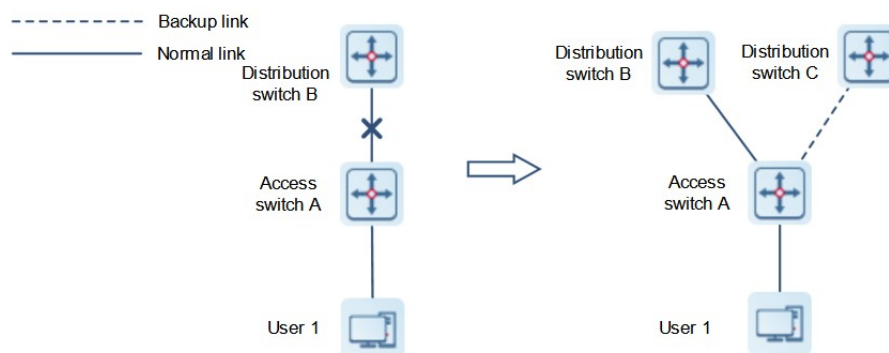
1.1 Introduction

1.1.1 Topology

The left topology in [Figure 1-1](#) shows single uplink networking, where there is only one link between the user and the distribution switch to implement communication. When the link between access switch A and distribution switch B fails, the link between the user and switch B is disconnected, which interrupts all external services of the user.

The topology can be transformed into REUP dual uplink deployment topology, as shown in the right topology in [Figure 1-1](#). In this topology, one link functions as the active link for normal communication, and the other link functions as a backup link and is not used for communication. When the active link fails, traffic is switched to the backup link. This helps reduce the impact of a single link failure on the network and improve reliability.

Figure 1-1 REUP Topology



REUP and the Spanning Tree Protocol (STP) are mutually exclusive on ports. Generally, a device runs STP in the downlink direction and runs REUP in the uplink direction to implement uplink backup and data protection in the case of faults. REUP can still provide basic link redundancy when STP is disabled. It also provides millisecond-level fault recovery faster than STP. Its main features are as follows.

- The uplink ports of REUP are configured in pairs, namely, an uplink port pair includes a forward port and a standby port. The standby port does not forward data packets. When the forward port fails, the standby port immediately becomes the forward port to forward data.
- REUP sends an address update packet to the upstream device so that the upstream device can update the MAC address information immediately. This function ensures that L2 data streams are restored rapidly after a link gets faulty.

1.1.2 Basic Concepts

1. REUP Pair

You can specify a port as the backup port of another port to configure an REUP pair, in which one port is the active port and the other is the backup port. When both ports are normal, one port is configured as the forward port and the other as the standby port.

2. MAC Address Update Message

According to the MAC address learning principle, before L2 link switching a user's MAC address entry exists on the forwarding link, and no packet is forwarded by the blocked link, so there is no user's MAC address entry on the blocked link. After switching, packets cannot be forwarded because they are still forwarded according to the existing MAC address entry of the user. MAC address update messages refer to FLUSH packets sent to an uplink device through private multicast packets. When an uplink device, on which the function of receiving MAC address update messages is enabled, receives a MAC address update message, the device updates the MAC entry on the relevant interface.

3. MAC Address Update Group

Multiple ports can be added to a group. If one port in the group receives a MAC address update message, the MAC address entries on other ports in the group are updated at the same time. In this case, the group is called a MAC address update group.

4. MAC Address Update Packet

MAC address update packets are sent to uplink devices of other manufacturers to ask them to update their MAC address entries, so as to implement compatibility with them.

5. Link State Tracking Group

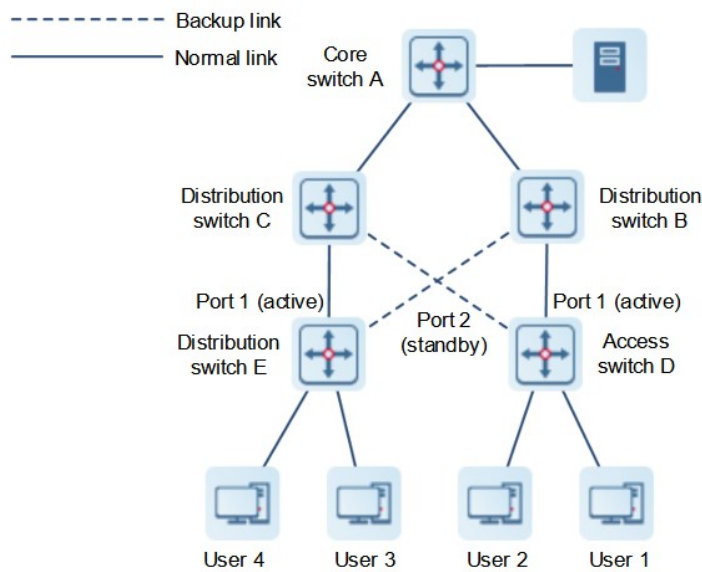
The uplink and downlink ports of a device can be added to a group at the same time, which is called a link state tracking group. If all uplink ports in the group are down, all downlink ports in this group are forced down.

1.1.3 Dual-Link Backup

When an active link is faulty, the link in the backup state will rapidly switch to the forward state and start to forward data, to minimize the service interruption caused by the link failure. REUP adopts the real-time backup and batch backup mechanisms to ensure that the configuration and operating status of the standby device are completely consistent with those of the active device. When the master/slave switching occurs in a virtual switch unit (VSU) scenario, the data flow is not cut off, the operating status of REUP is consistent with that before the switching, and link switching is not performed again.

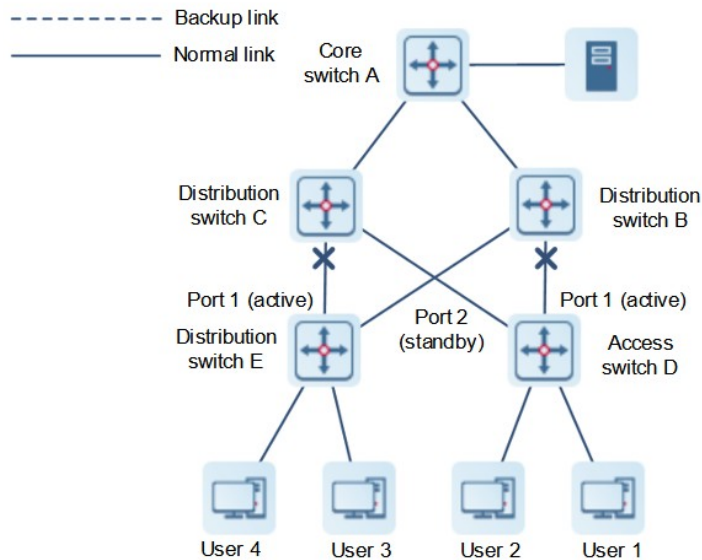
- You can specify a port as the backup port of another port to configure an REUP pair. When the two ports are normal, one link is in the forwarding state (forwarding data packets) and the other link is in the backup state (not forwarding data packets).
- When the active link is faulty, the link in the backup state rapidly switches to the forwarding state and starts to forward data.
- When the faulty link recovers, it enters the backup state and does not forward data packets.
- The preemption mode can be configured to specify whether the link recovering from a fault preempts to become the link in the forwarding state.

Figure 1-1 Topology with Two Normal Links



As shown in [Figure 1-1](#), ports 1 and 2 of switch D (switch E) are connected to uplink switches B and C (switches C and B) respectively, and REUP is configured on ports 1 and 2. When the links are normal, port 1 is in the forwarding state and forwards data packets and port 2 is in the backup state and does not forward data packets.

Figure 1-2 Topology with Faulty Port 1 of Switch D (Switch E)



As shown in [Figure 1-2](#), once port 1 fails, port 2 immediately starts to forward data packets and restores uplink transmission of the switch. In the non-preemption mode, when the link of port 1 recovers, port 1 is in the backup state and does not forward data packets, and port 2 continues forwarding data packets. You must enable the REUP dual-link backup function on a port so that the port undertakes the REUP link switching when the port is faulty.

Note

- REUP, Ethernet Ring Protection Switching (ERPS), and Rapid Ethernet Ring Protection (RERP) do not share ports.
- On devices enabled with REUP, the storm control function must be disabled on all L2 ports.

1.1.4 MAC Address Update

During link switching, the MAC address entries on a port are updated to speed up packet convergence. As shown in [Figure 1-1](#), the MAC address update process is analyzed as follows:

- Ports 1 and 2 of switch D (switch E) have the REUP dual-link backup enabled. Port 1 works as the active port. During normal communication, switch A learns the MAC addresses of users 1 and 2 (users 3 and 4) from the port connecting to switch B (switch C).
- When port 1 of switch D (switch E) fails, port 2 quickly changes to the forwarding state and starts to forward data packets. In this case, switch A has not learned the MAC addresses of users 1 and 2 (users 3 and 4) from the port connecting to switch B (switch C). The data packets sent by the server to users 1 and 2 (users 3 and 4) are forwarded to switch C (B) by switch A, causing loss of the packets from the server to users 1 and 2 (users 3 and MAC 4).

The following measures can be taken to avoid the above problem:

- Enable the MAC address update function on switch D (switch E). When port 2 starts to forward packets, switch D (switch E) sends a MAC address update message to port 2.
- After receiving the MAC address update message from port 2, switch A updates the MAC address entries on the port of switch A. In this way, switch A forwards the packets sent by the server to the users, to the port connecting to switch C (switch B) to speed up packet transmission convergence.
- In addition, a MAC address update group can be configured, that is, multiple ports can be classified into the same group. When a port in this group receives a MAC address update message, the MAC address entries on other ports in the group are updated, to reduce the side effect of flooding caused by MAC address update.
- To be compatible with upstream devices not supporting MAC address update messages, switch D (switch E) sends MAC address update packets for users 1 and user 2 (users 3 and 4) upstream when port 2 switches to the forwarding state. In this way, switch A updates the MAC addresses of users 1 and 2 (users 3 and 4) to the corresponding port and the downstream data transmission of switch A is restored.

Based on the above process analysis, the relevant configuration to be involved includes the following items:

Table 1-1 Description of MAC Address Update Configuration Items

Configuration Item	Description
Sending MAC address updates	If the function of sending MAC address update messages is not enabled, no MAC address update message is sent when REUP dual-link backup switching is performed.
Receiving MAC address updates	If the function of receiving MAC address update messages is not enabled, a device cannot receive MAC address update messages from downlink devices during REUP dual-link backup switching and

Configuration Item	Description
	will not update the MAC addresses.
Specifying a VLAN for sending MAC address updates	If the VLAN in which an interface sends MAC address update messages is configured, the messages are sent in the configured VLAN; otherwise, the messages are sent in the default VLAN to which the interface belongs.
Specifying a VLAN for receiving MAC address updates	If no VLAN in which an interface receives MAC address update messages is configured, MAC address update messages are received in all the configured VLANs; otherwise, MAC address update messages are received in the specified VLAN.
MAC address update group	If no MAC address update group is configured, MAC address update is not performed when MAC address update packets are received.
Maximum number of MAC address update messages sent per second	A greater number of messages configured indicates more CPU time used for sending messages and fewer downstream packets to be lost.

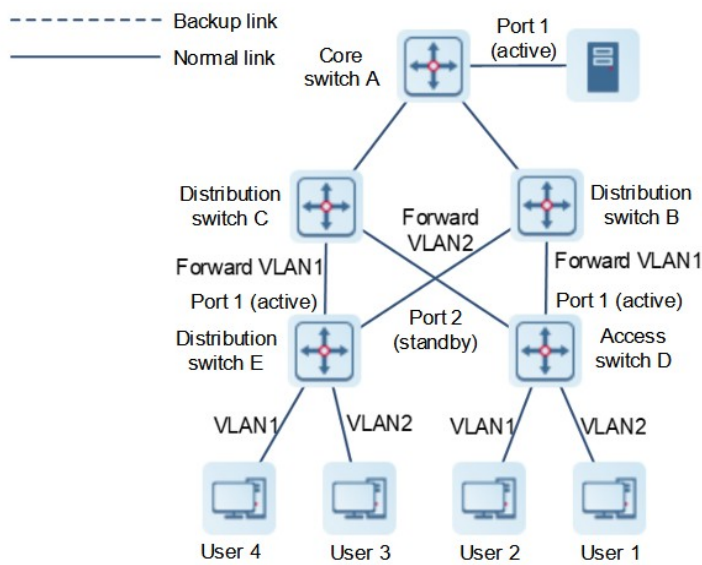
1.1.5 VLAN Load Balancing

The VLAN load balancing function allows the two ports of a REUP pair to forward data packets of mutually exclusive VLANs so as to make full use of the link bandwidth.

As shown in [Figure 1-1](#), the MAC address update process is analyzed as follows:

- Configure REUP dual-link backup and enable the VLAN load balancing of REUP on ports 1 and 2 of switch D, and map VLAN 1 to instance 1 and VLAN 2 to instance 2. Data of VLAN 1 (instance 1) is transmitted through port 1 and data of VLAN 2 (instance 2) is transmitted through port 2. Perform the same configuration on switch E.
- When a port is faulty, the other port takes over the transmission of all VLAN data.
- When the faulty port recovers and works properly within the preemption delay, the transmission of VLAN data in the charge of the faulty port is switched back to the recovered port.

Figure 1-1 Load Balancing Topology with Two Normal Links



Therefore, the VLAN load balancing function needs to be enabled on the ports to make full use of the link bandwidth for packet forwarding when both links are normal.

⚠ Caution

- The instance mapping of REUP VLAN load balancing is controlled by the Multiple Spanning Tree Protocol (MSTP) module in a unified manner. For details about how to configure the instances, see "Configuring MSTP" in *Ethernet Switching Configuration Guide*.
- The VLAN load balancing function can be configured only on trunk, uplink, or hybrid ports.

1.1.6 Link State Tracking

Link state tracking means that, when an upstream link is faulty, the downstream link switches services to the backup upstream link so that the backup port can continue to forward packets. Link state tracking provides the function of notifying a downlink device to perform link switching when all the upstream links are faulty. You can configure the upstream and downstream ports of a link state tracking group and bind the link states of multiple downstream ports to multiple uplink ports to implement link state synchronization. When all uplinks in a tracking group are faulty, the downlink ports are shut down forcibly to ensure that the downlink transmission is switched from the active link to the backup link.

As shown in [Figure 1-1](#), when the uplink of switch B is faulty, link state tracking rapidly shuts down the downstream port of switch B so that the upstream transmission of switch D is switched to switch C.

Figure 1-1 Topology with the Active Uplink Faulty

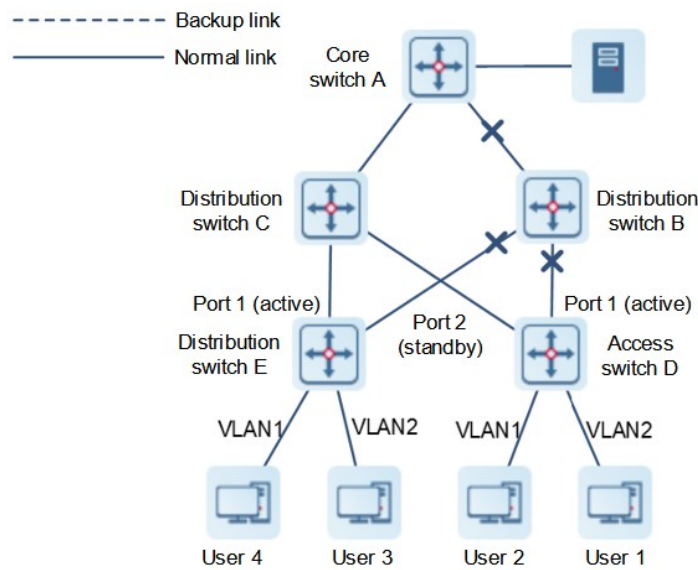


Table 1-1 Description of Link State Tracking Configuration Items

Configuration Item	Description
Link state tracking function	If the link state tracking function is not enabled, the state of a corresponding uplink port cannot be detected and packet forwarding switching cannot be implemented in time.
Downlink up delay function for a link state tracking group	By enabling the downlink up delay function, you can avoid frequent downlink switching caused by uplink flapping in a link state tracking group. That is, when the uplink becomes up, the downlink becomes up after a delay.
Adding a port to a link state tracking group	If a port is not added to a link state tracking group, the state of a corresponding uplink port cannot be detected and packet forwarding switching cannot be implemented in time.

1.2 Configuration Task Summary

REUP configuration includes the following tasks:

- (1) [Configuring Basic Features of REUP](#)
- (2) (Optional) [Configuring the Preemption Function of REUP](#)
- (3) [Configuring the MAC Address Update Function](#)
- (4) (Optional) [Configuring VLAN Load Balancing](#)
- (5) [Configuring Link State Tracking](#)

1.3 Configuring Basic Features of REUP

1.3.1 Overview

When a link is faulty, another normal link switches to the forward state immediately to forward packets.

1.3.2 Restrictions and Guidelines

- One port belongs to only one REUP pair. Each active link has only one backup link. A backup link can be used as the backup link of only one active link. The active and backup links must use different ports.
- REUP supports L2 physical ports and L2 aggregate ports (APs), but does not support AP member ports.
- The active and backup ports may be of different types and have different rates. For example, an AP can be used as the active port and a physical port can be configured as the backup port.
- Ports configured with REUP are not involved in STP calculation.
- Each device can be configured with a maximum of 16 REUP pairs.
- Ports successfully configured with REUP cannot be configured as L3 ports or added to an AP.

1.3.3 Procedure

- (1) Enter the privileged EXEC mode.

enable

- (2) Enter the global configuration mode.

configure terminal

- (3) Enter the interface configuration mode.

interface *interface-type interface-number*

- (4) Configure a REUP dual-link backup port.

switchport backup interface *interface-type interface-number*

No REUP dual-link backup port is configured by default.

1.4 Configuring the Preemption Function of REUP

1.4.1 Overview

- If the active link needs to always forward packets or the link for forwarding packets needs to be determined based on the link bandwidth, the preemption mode and delay time must be configured.
- You can determine the link to be used by configuring the preemption mode. If the preemption mode is set to bandwidth mode, a link with a greater bandwidth is used. The value of the bandwidth attribute of an AP is the actual bandwidth of the AP, equal to the number of link up member ports of the AP multiplied by the speed attribute value of an AP member port. You can also set the preemption mode to forced mode to select a stable and reliable link forcibly.
- To avoid frequent active/backup link switching caused by faults, REUP provides a preemption delay function. After the two links recover, link switching is delayed (**35** seconds by default) for the faulty link to become stable. A smaller delay means more frequent preemption switching after the faulty link recovers. When STP is enabled on an uplink, the preemption delay time of REUP should be greater than 35 seconds.

- The preemption mode can be set to three modes: forced, bandwidth, and off. In the bandwidth mode, a port with a greater bandwidth is selected to transmit data; in the forced mode, the active port is selected to transmit data; in the off mode, no preemption is performed.

1.4.2 Restrictions and Guidelines

REUP dual-link backup must be configured.

1.4.3 Procedure

- (1) Enter the privileged EXEC mode.

enable

- (2) Enter the global configuration mode.

configure terminal

- (3) Enter the interface configuration mode.

interface *interface-type interface-number*

- (4) Configure the preemption mode of REUP.

switchport backup interface *interface-type interface-number* **preemption mode** { **bandwidth** | **forced** | **off** }

The default link preemption mode of REUP is off mode.

- (5) Configure the preemption delay time of REUP.

switchport backup interface *interface-type interface-number* **preemption delay** *interval*

The default preemption delay time of REUP is **35** seconds.

1.5 Configuring the MAC Address Update Function

1.5.1 Overview

- The MAC address update function can rapidly delete and update MAC address information on interfaces during link switching to make packet convergence faster.
- To reduce data loss in downstream data stream during link switching, you need to enable the function of sending MAC address update messages on a switch that performs switching.
- During link switching, REUP sends a certain number of MAC address update packets to an uplink device per second to recover the downstream data transmission of the uplink device.
- When dual-link backup switching occurs, downstream data streams may be lost because the MAC address table of the uplink switch is not updated in time. In order to reduce loss of L2 data streams, you need to update the MAC address table of the uplink switch. In this case, you need to enable the function of receiving MAC address update messages on the uplink switch.
- To reduce massive flooding caused by MAC address update, which may affect normal data transmission of the switch, you can configure a MAC address update group. Only after all ports in a switching path are added to the same MAC address update group, can transmission of downstream data be rapidly recovered.
- For a VLAN in which the function of processing MAC address update messages is disabled, MAC address update packets can be used to recover the downlink transmission of uplink devices; however, the convergence performance will be decreased in the case of link faults.

- After the function of sending MAC address update messages is enabled, MAC address update messages are sent to uplink devices during link switching.

1.5.2 Restrictions and Guidelines

- REUP dual-link backup must be configured.
- A maximum of eight address update groups can be configured on each device. Each address update group can contain a maximum of eight member ports and a port can belong to multiple address update groups.

1.5.3 Procedure

- (1) Enter the privileged EXEC mode.

enable

- (2) Enter the global configuration mode.

configure terminal

- (3) Enable the function of sending MAC address update private multicast messages.

mac-address-table move update transit

No MAC address update private multicast message is sent by default.

- (4) (Optional) Configure the maximum rate for sending MAC address update broadcast packets.

mac-address-table move update max-update-rate *packet-per-second*

The default maximum rate for sending MAC address update broadcast packets is **150** packets/second.

- (5) On an uplink device, enable the function of receiving MAC address update private multicast messages.

mac-address-table move update receive

No MAC address update private multicast message is received by default.

- (6) (Optional) On an uplink device, configure the VLAN ID range, in which MAC address update private multicast messages are received.

mac-address-table move update receive vlan *vlan-range*

The MAC address update private multicast messages in all the VLAN ID ranges are received by default.

- (7) Enter the interface configuration mode.

interface *interface-type interface-number*

- (8) Configure the MAC address update group ID for the interface.

mac-address-table update group [*group-id*]

No MAC address update group is configured by default.

- (9) (Optional) Configure the ID of a VLAN, in which a port sends MAC address update private multicast messages.

mac-address-table move update transit vlan *vlan-id*

By default, the ID of the VLAN, in which a port sends MAC address update private multicast messages is the local default VLAN of the port.

1.6 Configuring VLAN Load Balancing

1.6.1 Overview

- This function is used to maximize the utilization of link bandwidth.
- You can modify the mapping between instances and VLANs by using the instance mapping function of MSTP.
- The VLAN load balancing function allows the two ports of a REUP pair to forward data packets of mutually exclusive VLANs so as to make full use of the link bandwidth. That is, it allows some VLAN data packets to be forwarded through the backup link, but the active link does not forward these VLAN data packets. In this way, the active link and backup link forward different VLAN data packets and achieve load sharing.
- The VLAN load balancing of REUP relies on the mappings between VLANs and MSTP instances, and the instance mappings are controlled by the MSTP module in a unified manner. For details about how to configure the instances, see the description in "Configuring MSTP."

1.6.2 Restrictions and Guidelines

- REUP dual-link backup must be configured.
- VLAN load balancing cannot be configured on an access port but can share a port with STP.
- For ports successfully configured with VLAN load balancing, you cannot modify the port attributes but can modify the VLAN attributes of the ports.

1.6.3 Procedure

- (1) Enter the privileged EXEC mode.

enable

- (2) Enter the global configuration mode.

configure terminal

- (3) Create a group of VLANs.

vlan { *vlan-id* | **range** *vlan-range* }

Only VLAN 1 exists by default.

- (4) Return to the global configuration mode.

exit

- (5) Enter the MST configuration mode.

spanning-tree mst configuration

- (6) Configure the mappings between instances and VLANs, and add the VLAN group to one MST instance.

instance *instance-id* **vlan** *vlan-range*

Only instance 0 exists and all VLANs belong to instance 0 by default.

- (7) Enter the interface configuration mode.

interface *interface-type* *interface-number*

- (8) Configure the VLAN load balancing function.

switchport backup interface *interface-type* *interface-number* **prefer instance** *instance-range*

The VLAN load balancing function is not configured by default.

1.7 Configuring Link State Tracking

1.7.1 Overview

- After detecting that the uplink is disconnected, REUP forcibly disconnects the downlink so that link switching can be performed.
- You must create a link state tracking group first and then add a port to the tracking group.
- You must enable the delay function so that the downlink can be up after the delay.

1.7.2 Restrictions and Guidelines

- REUP dual-link backup must be configured.
- For the link state tracking function, each port belongs to only one link state tracking group and each device can be configured with up to two link state tracking groups. Each link state tracking group can have 8 upstream ports and 256 downstream ports.

1.7.3 Procedure

- (1) Enter the privileged EXEC mode.

enable

- (2) Enter the global configuration mode.

configure terminal

- (3) Enable a link state tracking group.

link state track [*track-number*]

All the link state tracking groups are disabled by default.

- (4) Configure the downlink recovery delay time for the link state tracking group.

link state track *track-number* **up-delay** *interval*

The downlink of a link state tracking group recovers without delay by default.

- (5) Enter the interface configuration mode.

interface *interface-type* *interface-number*

- (6) Add a port to the link state tracking group, and specify it as the uplink port of the group.

link state group *track-number* **upstream**

No port is added to a link state tracking group by default.

- (7) Add a port to the link state tracking group and specify it as the downlink port of the group.

link state group *track-number* **downstream**

No port is added to a link state tracking group by default.

1.8 Monitoring

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

Run the **debug** command to output debugging information.

⚠ Caution

- The output debugging information occupies system resources. Therefore, disable the debugging function immediately after use.

Table 1-1 REUP Monitoring

Command	Purpose
show interfaces [<i>interface-type interface-number</i>] switchport backup [detail]	Displays the REUP dual-link backup information.
show mac-address-table update group [detail]	Displays the configurations of a MAC address update group.
show mac-address-table move update	Displays the statistics on MAC address update messages sent by an REUP pair.
show link state group	Displays the information about a link state tracking group.
debug reup all	Debugs all functions of REUP.
debug reup process	Debugs the normal running process of REUP.
debug reup packet	Debugs MAC address update messages of REUP.
debug reup macupdt	Debugs MAC address update packets of REUP.
debug reup ha	Debugs hot backup.
debug reup error	Debugs errors occurring in REUP running.
debug reup event	Debugs received events.
debug reup status	Debugs statistics displayed when a show command is executed.

1.9 Configuration Examples

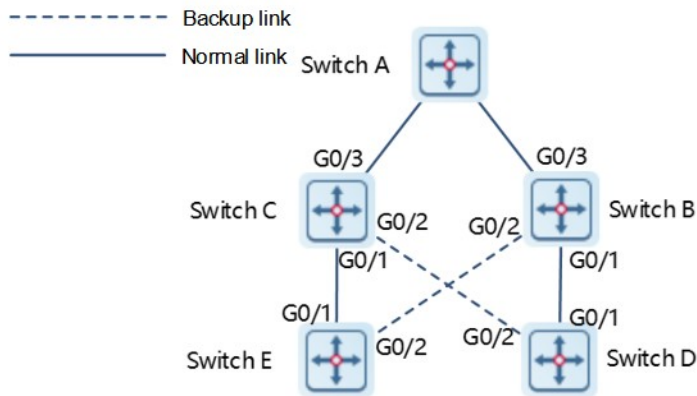
1.9.1 Configuring Basic Features of REUP

1. Requirements

An L3 device networking topology need to be built to simulate the scenario, in which there are two interconnection links between the access devices and the core devices.

2. Topology

Figure 1-1 Topology for Configuring Basic Features of REUP



3. Notes

- Configure REUP dual-link backup (GigabitEthernet 0/1 is the active port and GigabitEthernet 0/2 is the backup port) on access switch D (switch E).

4. Procedure

Perform the following configuration on switch D.

```
SwitchD> enable
SwitchD# configure terminal
SwitchD(config)# interface gigabitethernet 0/1
SwitchD(config-if-GigabitEthernet 0/1)# switchport mode trunk
SwitchD(config-if-GigabitEthernet 0/1)# switchport backup interface
gigabitethernet 0/2
SwitchD(config-if-GigabitEthernet 0/1)# exit
```

Perform the following configuration on switch E.

```
SwitchE> enable
SwitchE# configure terminal
SwitchE(config)# interface gigabitethernet 0/1
SwitchE(config-if-GigabitEthernet 0/1)# switchport mode trunk
SwitchE(config-if-GigabitEthernet 0/1)# switchport backup interface
gigabitethernet 0/2
SwitchD(config-if-GigabitEthernet 0/1)# exit
```

5. Verification

Run the **show interfaces switchport backup detail** command to verify that the configuration is correct.

Check the configuration of switch D.

```
SwitchD#show interfaces switchport backup detail
Switch Backup Interface Pairs:
Active Interface      Backup Interface      State
-----
```



```

Gi0/1                Gi0/2                Active Up/Backup Standby

Interface Pair : Gi0/1, Gi0/2
Preemption Mode : off
Preemption Delay : 35 seconds
Bandwidth : Gi0/1(100000 Mbits), Gi0/2(100000 Mbits)

```

Check the configuration of switch E.

```

SwitchE#show interfaces switchport backup detail
Switch Backup Interface Pairs:
Active Interface      Backup Interface      State
-----
Gi0/1                Gi0/2                Active Up/Backup Standby

Interface Pair : Gi0/1, Gi0/2
Preemption Mode : off
Preemption Delay : 35 seconds
Bandwidth : Gi0/1(100000 Mbits), Gi0/2(100000 Mbits)

```

6. Configuration Files

- Switch D configuration file

```

hostname SwitchD
!
interface GigabitEthernet 0/1
  switchport mode trunk
  switchport backup interface GigabitEthernet 0/2
!
end

```

- Switch E configuration file

```

hostname SwitchE
!
interface GigabitEthernet 0/1
  switchport mode trunk
  switchport backup interface GigabitEthernet 0/2
!
end

```

7. Common Errors

- When a port is added to an REUP pair, the port has been configured to belong to another REUP pair.
- A configured port is not an L2 physical port or L2 AP.

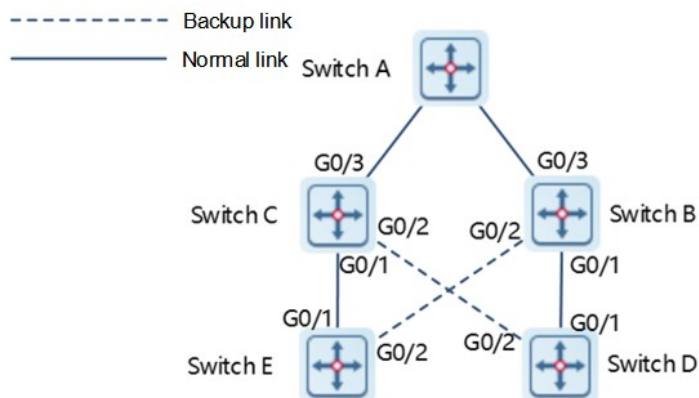
1.9.2 Configuring the MAC Address Update Function

1. Requirements

An L3 device networking topology need to be built to simulate the scenario, in which there are two interconnection links between the access devices and the core devices.

2. Topology

Figure 1-1 Topology for Configuring the MAC Address Update Function



3. Notes

- Enable the function of sending MAC address update messages on access switch D (switch E).
- Enable the function of receiving MAC address update packets on switch B (switch C).
- Add all ports in the REUP switching path to the same MAC address update group.
- Gi0/1 and Gi0/3 of switch B are the ports in the uplink switching path of switch D, and Gi0/3 and Gi0/2 are the ports in the uplink switching path of switch E. You can add ports Gi0/1, Gi0/2, and Gi0/3 to the same address update group. Similarly, you can perform the configuration on switch C.
- Enable the function of receiving MAC address update packets on switch A.
- Add all ports in the REUP switching path of switch A to the same MAC address update group.

4. Procedure

Perform the following configuration on switch D.

```
SwitchD> enable
SwitchD# configure terminal
SwitchD(config)# mac-address-table move update transit
```

Perform the following configuration on switch E.

```
SwitchE> enable
SwitchE# configure terminal
SwitchE((config)# mac-address-table move update transit
```

Perform the following configuration on switch B.

```
SwitchB> enable
SwitchB# configure terminal
```

```
SwitchB(config)# mac-address-table move update receive
SwitchB(config)# interface range gigabitethernet 0/1-3
SwitchB(config-if-range)# switchport mode trunk
SwitchB(config-if-range)# mac-address-table update group 1
```

Perform the following configuration on switch C.

```
SwitchC> enable
SwitchC# configure terminal
SwitchC(config)# mac-address-table move update receive
SwitchC(config)# interface range gigabitethernet 0/1-3
SwitchC(config-if-range)# switchport mode trunk
SwitchC(config-if-range)# mac-address-table update group 1
```

Perform the following configuration on switch A.

```
SwitchA> enable
SwitchA# configure terminal
SwitchA(config)# mac-address-table move update receive
SwitchA(config)# interface range gigabitethernet 0/1-2
SwitchA(config-if-range)# switchport mode trunk
SwitchA(config-if-range)# mac-address-table update group 1
```

5. Verification

Run the **show running** command to check the information about the address update groups on switches D, E, C, B, and A.

```
SwitchD# show run | incl mac-ad
mac-address-table move update transit
```

```
SwitchE# show run | incl mac-ad
mac-address-table move update transit
```

```
SwitchB# show mac-address-table update group detail
show mac-address-table update group detailMac-address-table Update Group:1
Received mac-address-table update message count:0
```

Group member	Receive Count	Last Receive	Switch-ID	Receive Time
Gi0/1	0	0000.0000.0000		
Gi0/2	0	0000.0000.0000		
Gi0/3	0	0000.0000.0000		

```
SwitchC# show mac-address-table update group detail
Mac-address-table Update Group:1
Received mac-address-table update message count:0
```

Group member	Receive Count	Last Receive	Switch-ID	Receive Time
Gi0/1	0	0000.0000.0000		

Gi0/2	0	0000.0000.0000
Gi0/3	0	0000.0000.0000

```
SwitchA# show mac-address-table update group detail
Mac-address-table Update Group:1
Received mac-address-table update message count:0
Group member          Receive Count    Last Receive Switch-ID    Receive Time
-----
Gi0/1                 0               0000.0000.0000
Gi0/2                 0               0000.0000.0000
```

6. Configuration Files

- Switch A configuration file

```
hostname SwitchA
!
interface GigabitEthernet 0/1
  switchport mode trunk
  mac-address-table update group 1
!
interface GigabitEthernet 0/2
  switchport mode trunk
  mac-address-table update group 1
!
mac-address-table move update receive
end
```

- Switch B configuration file

```
hostname SwitchB
!
interface GigabitEthernet 0/1
  switchport mode trunk
  mac-address-table update group 1
!
interface GigabitEthernet 0/2
  switchport mode trunk
  mac-address-table update group 1
!
interface GigabitEthernet 0/3
  switchport mode trunk
  mac-address-table update group 1
!
mac-address-table move update receive
end
```

- Switch C configuration file

```
hostname SwitchC
!
interface GigabitEthernet 0/1
  switchport mode trunk
  mac-address-table update group 1
!
interface GigabitEthernet 0/2
  switchport mode trunk
  mac-address-table update group 1
!
interface GigabitEthernet 0/3
  switchport mode trunk
  mac-address-table update group 1
!
mac-address-table move update receive
end
```

- Switch D configuration file

```
hostname SwitchD
!
mac-address-table move update transit
end
```

- Switch E configuration file

```
hostname SwitchE
!
mac-address-table move update transit
end
```

7. Common Errors

- A configured port is not an L2 physical port or L2 AP.

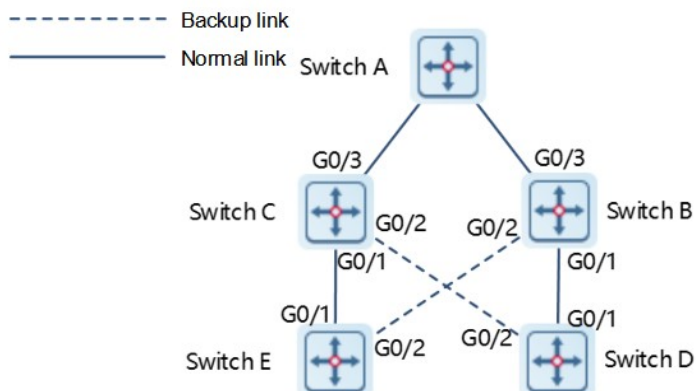
1.9.3 Configuring VLAN Load Balancing

1. Requirements

An L3 device networking topology need to be built to simulate the scenario, in which there are two interconnection links between the access devices and the core devices.

2. Topology

Figure 1-1 Topology for Configuring VLAN Load Balancing



3. Notes

- Configure instance mappings on switch D (switch E) to map VLAN 1 to instance 1, VLAN 2 to instance 2, VLAN 3 to instance 3, and VLAN 4 to instance 4. For details about how to configure the mappings, see "Configuring MSTP" in *Ethernet Switching Configuration Guide*.
- Configure the VLAN load balancing function on switch D (switch E).

4. Procedure

Perform the following configuration on switch D.

```
SwitchD> enable
SwitchD# configure terminal
SwitchD(config)# interface gigabitEthernet 0/1
SwitchD(config-if-GigabitEthernet 0/1)# switchport mode trunk
SwitchD(config-if-GigabitEthernet 0/1)# switchport backup interface
gigabitEthernet 0/2 prefer instance 2
SwitchD(config-if-GigabitEthernet 0/1)# exit
```

Perform the following configuration on switch E.

```
SwitchE> enable
SwitchE# configure terminal
SwitchE(config)# interface gigabitEthernet 0/1
SwitchE(config-if-GigabitEthernet 0/1)# switchport mode trunk
SwitchD(config-if-GigabitEthernet 0/1)# switchport backup interface
gigabitEthernet 0/2 prefer instance 4
SwitchD(config-if-GigabitEthernet 0/1)# exit
```

5. Verification

Run the **show interfaces switchport backup detail** command to check the dual-link backup information configured on switch D (switch E).

```
SwitchD# show interfaces switchport backup detail
Switch Backup Interface Pairs:
```

```

Active Interface      Backup Interface      State
-----
Gi0/1                 Gi0/2                 Active Up/Backup Up

Instances Preferred on Active Interface: Instance 0-1,3-64
Mapping VLAN 1,3-4094

Instances Preferred on Backup Interface: Instance 2
Mapping VLAN 2

Interface Pair : Gi0/1, Gi0/2
Preemption Mode : balance
Preemption Delay : 35 seconds
Bandwidth : Gi0/1(800 kbits), Gi0/2(100000 kbits)

```

```

SwitchE# show interfaces switchport backup detail
Switch Backup Interface Pairs:
Active Interface      Backup Interface      State
-----
Gi0/1                 Gi0/2                 Active Up/Backup Up

Instances Preferred on Active Interface: Instance 0-3,5-64
Mapping VLAN 1-3,5-4094

Instances Preferred on Backup Interface: Instance 4
Mapping VLAN 4

Interface Pair : Gi0/1, Gi0/2
Preemption Mode : balance
Preemption Delay : 35 seconds
Bandwidth : Gi0/1(800 kbits), Gi0/2(100000 kbits)

```

6. Configuration Files

- Switch D configuration file

```

hostname SwitchD
!
interface GigabitEthernet 0/1
 switchport mode trunk
 switchport backup interface gigabitethernet 0/2 prefer instance 2
!
end

```

- Switch E configuration file

```

hostname SwitchE
!

```

```

interface GigabitEthernet 0/1
  switchport mode trunk
  switchport backup interface gigabitethernet 0/2 prefer instance 2
!
end

```

7. Common Errors

- The mappings between VLAN IDs and instances are not configured.

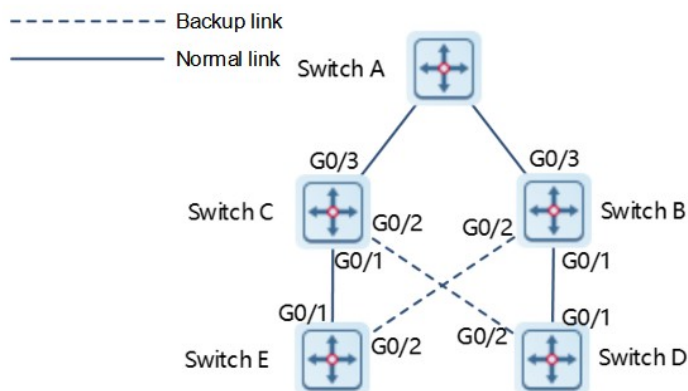
1.9.4 Configuring Link State Tracking

1. Requirements

An L3 device networking topology need to be built to simulate the scenario, in which there are two interconnection links between the access devices and the core devices.

2. Topology

Figure 1-1 Topology for Configuring Link State Tracking



3. Notes

- Create link state tracking group 1 on switch B (switch C).
- On switch B (switch C), add the ports GigabitEthernet 0/1 and GigabitEthernet 0/2 as downlink ports of the link state tracking group and add the port GigabitEthernet 0/3 as an uplink port of the link state tracking group.

4. Procedure

Perform the following configuration on switch B.

```

SwitchB> enable
SwitchB# configure terminal
SwitchB(config)# link state track 1
SwitchB(config)# interface GigabitEthernet 0/1
SwitchB(config-if-GigabitEthernet 0/1)# link state group 1 downstream
SwitchB(config-if-GigabitEthernet 0/1)# exit

```



```
SwitchB(config)# interface GigabitEthernet 0/2
SwitchB(config-if-GigabitEthernet 0/2)# link state group 1 downstream
SwitchB(config-if-GigabitEthernet 0/2)# exit
SwitchB(config)# interface GigabitEthernet 0/3
SwitchB(config-if-GigabitEthernet 0/3)# link state group 1 upstream
```

Perform the following configuration on switch C.

```
SwitchC> enable
SwitchC# configure terminal
SwitchC(config)# link state track 1
SwitchC(config)# interface GigabitEthernet 0/1
SwitchC(config-if-GigabitEthernet 0/1)# link state group 1 downstream
SwitchC(config-if-GigabitEthernet 0/1)# exit
SwitchC(config)# interface GigabitEthernet 0/2
SwitchC(config-if-GigabitEthernet 0/2)# link state group 1 downstream
SwitchC(config-if-GigabitEthernet 0/2)# exit
SwitchC(config)# interface GigabitEthernet 0/3
SwitchC(config-if-GigabitEthernet 0/3)# link state group 1 upstream
```

5. Verification

Run the **show link state group** command to check whether the configuration is correct.

```
SwitchB# show link state group
Link State Group:1  Status: enabled, Down
Upstream Interfaces :Gi0/3(Down)
Downstream Interfaces : Gi0/2(Down)

Link State Group:2  Status: Disabled, Down
Upstream Interfaces :
Downstream Interfaces :

(Up):Interface up   (Down):Interface Down   (Dis):Interface disabled
```

```
SwitchC# show link state group
Link State Group:1  Status: enabled, Down
Upstream Interfaces :Gi0/3(Down)
Downstream Interfaces : Gi0/2(Down)

Link State Group:2  Status: Disabled, Down
Upstream Interfaces :
Downstream Interfaces :

(Up):Interface up   (Down):Interface Down   (Dis):Interface disabled
```

6. Configuration Files

- Switch B configuration file

```
hostname SwitchB
```

```
!  
link state track 1  
interface GigabitEthernet 0/1  
  link state group 1 downstream  
!  
interface GigabitEthernet 0/2  
  link state group 1 downstream  
!  
interface GigabitEthernet 0/3  
  link state group 1 upstream  
!  
end
```

- **Switch C configuration file**

```
hostname SwitchC  
!  
link state track 1  
interface GigabitEthernet 0/1  
  link state group 1 downstream  
!  
interface GigabitEthernet 0/2  
  link state group 1 downstream  
!  
interface GigabitEthernet 0/3  
  link state group 1 upstream  
!  
end
```

7. Common Errors

- Ports are added to a link state tracking group before the link state tracking group is enabled.