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## Chapter21:BackupLinkConfiguration



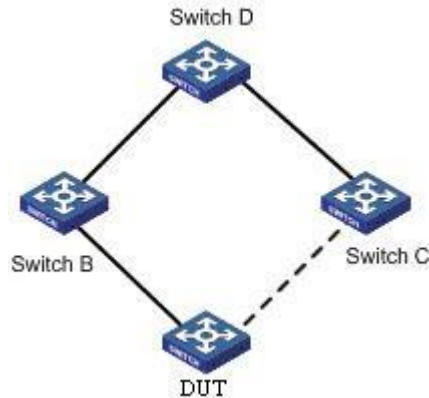
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# Chapter 1 Introduction of Backup Link

## 1.1 Overview

Dual-uplink networking is a common form of networking. As is shown below, DUT goes upstream to Switch D dually through Switch B and Switch C.



Dual-Uplink Networking

Although the dual-uplink networking can provide link backup, the loops in the network will cause the broadcast storms; therefore, it is necessary to take measures to avoid loops. In general, the loops can be eliminated by STP; but as the STP convergence consumes longer time, more traffic will be lost. So, STP does not apply to networking environment with higher demands for convergence time.

BackupLink provides link backup through a pair of link-layer interfaces while solving the STP problem of slow convergence. In one group of BackupLink ports, one is configured as primary port and the other as the alternate port. These ports can be exchange ports or aggregate ports. In the case that the user does not use STP protocol, BackupLink can ensure the redundancy and backup of link.

## 1.2 BackupLink Port Backup

### 1.2.1 Setting the Backup Port

For BackupLink, its basic function is to configure another switch port for one switch port as the backup; meanwhile, in two backup ports, only one port is in the forwarding state. Two backup ports can be connected with the same device or different devices.

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Note:

1. Two ports which can backup each other may be two physical ports, two aggregate ports or one physical port and one aggregate port;
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2. The backup port cannot be configured on the ports which have been configured with link aggregation, port security or EAPS or other network protections;
  3. If one port has already been configured with backup, it can no longer become the backup of other ports;
  4. The port which has been configured with backup cannot be configured with link aggregation, port security or EAPS or other network protection;
  5. On the port which has been configured with BackupLink, the link status detection optimization of the physical layer can be enabled in order to improve the convergence performance.
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## 1.2.2 Status Control of the Port

The ports which are configured with backup function must be deleted from STP module; BackupLink is responsible for setting the status of port in all VLANs [1-4094]; these VLANs can belong to different MST (STG).

## 1.2.3 Port Roles and Status

Configuration commands must be able to specify the default role for two ports which backup each other: Active and Backup.

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Note:

1. In the initial case, if the link status of Active and Backup ports is Linkup, the Active port is in the forwarding state, the Backup port is in the blocking state;
  2. In the initial case, if one port is in the link status of Linkdown, the other port enters the forwarding state regardless of whether it is the Active role;
  3. At one moment, the Backup port is in the forwarding state, the Active port is in the blocking state; if the backup port configuration is repeated on the port, it is necessary to force the Backup port to be in the blocking state and recover the forwarding status of Active port.
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## 1.2.4 Link Status Change Processing

In basic port backup functions, link status changes processing must meet the following requirements:

- If the Active port is in the state of Linkdown and the Backup port is in the state of Linkdown, the link breaks, which is unable to forward the data frame;
- If the Active port is in the state of Linkdown and the Backup port is in the state of Linkup but not in the forwarding state, the Backup port enters the forwarding state;
- If the Active port is in the state of Linkup and the Backup port is in the link status of Linkdown, the Active port enters the forwarding state;
- If the Active port is in the state of Linkup and the Backup port is in the state of Linkup and in the forwarding state, the Active port is still in blocking state and the data frame is forwarded from the Backup port without enabling the preemption mode.

- If the Active port is in the state of Linkup and the Backup port is in the state of Linkup and in the forwarding state, the forwarded port and blocked port will be decided according to different strategies in the case of enabling the preemption mode. [See 1.2.5](#).

### 1.2.5 Pre-emption of Backup Port

BackupLink needs to support port preemption: A and B are a pair of backup ports; Port A is in the forwarding state, Port B recovers from LinkDown state and is in blocking state; if Port B meets the conditions of preemption, Port B enters the forwarding state instead of Port A.

The port preemption must be enabled through the command; by default, the preemption is disabled.

Port preemption must be configured independently for each pair of backup ports; different backup port groups can use different preemptive modes:

- Preemption based on port role. Preemption is based on the roles specified at the time of configuring backup ports; if the Backup port in the forwarding state and the Active port is in the link status of UP, the Backup port is blocked and the Active port is set as the forwarding state.
- Preemption based on port bandwidth. Backup ports must support the preemption of the forwarding state based on the bandwidth; the port with small bandwidth is always blocked.

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Note:

The preemption configuration on the same group of backup ports must meet the following requirements:

1. The preemption function takes effect after it is configured on any port in the backup group; but if this configuration is deleted, the function is invalid;
  2. The preemption function can be configured on two ports in the backup group, but the preemption mode and delay parameters must be consistent;
  3. Two ports which are inconsistent in the preemption parameters cannot be configured as the backup ports.
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### 1.2.6 Delay Preemption

For port preemption, the delay-time preemption is required: If Port B can preempt the forwarding state of Port A, the preemption is completed after the delay-time.

The delay-time preemption must be configured through the command; "0" needs to be taken as the legitimate delay-time preemption, indicating immediate preemption.

## 1.3 VLANLoad Balancing

BackupLink VLAN load balancing enables two ports on the BackupLink port group to simultaneously forward traffic for different VLANs. For example, the BackupLink port group is configured with the forwarding traffic of VLAN 1 ~ 100, where one port forwards

the traffic of VLAN1 ~ VLAN50 while the other port forwards the traffic of VLAN51 ~ VLAN100. If one port is in the state of Linkdown, then the other port will forward all the traffic.

### 1.3.1 Configuration of Load balancing

VLAN load balancing is only configured on the backup port; the user specifies a set of VLAN through the command, and the backup port has the priority to enter the forwarding state in this VLAN group. Therefore, VLAN traffic sharing takes effect only after the backup function is configured on the port.

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**Note:**

For different BackupLink groups, the same group VLAN can be configured, or they have overlapping VLAN segments. If there are overlapped VLAN segments, the system will classify these VLANs into different MSTs (STGs) and conduct operations toward a group of ports, the statuses of these ports in different MSTs vary. So, typically, when the load balancing VLAN group is configured, it is better to select the VLAN group without overlapping.

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### 1.3.2 Port Status Control in Traffic Sharing

- Create the new MST (STG) for the designated VLAN

In order to achieve the differentiated setting of port status in different VLANs, it is necessary to assign the VLAN specified by the user in the traffic sharing command to a new MST (STG).

BackupLink must check the user-specified VLAN through the interface provided by L2 module; if the specified VLAN has already been used by other protocol modules (for example, in MSTP, it is assigned to some MST, or it is configured as control VLAN of EAPS), this VLAN can no longer be used as VLAN traffic sharing. Such case needs to be handled as the user configuration error.

- The same VLAN is used by multiple backup port groups.

BackupLink must be able to handle the case that different backup port groups are configured with the same VLAN. For example: P1 and P2 are mutually backed up, and the VLAN v traffic sharing is configured on P2; P3 and P4 are mutually backed up, and VLAN v is configured on P4. At this time:

1. In the process of loading the configuration, only need to make a distribution operation of the MST in the VLAN v;
2. After the VLAN v traffic sharing is deleted from all the backup port groups, VLAN v needs to be restored to the default MST.

- Refresh port status after MST is created

The modification of the MST of VLAN may cause incorrect status of some ports in the system STG table; at this time:

1. L2 is responsible for notifying the protocol module except BackupLink of refreshing port status setting;

2. For each set of backup ports in BackupLink module, the module actively refreshes their status in all VLANs.

- Port status setting

After configuring the VLAN traffic sharing, the status setting of backup ports must comply with the following rules:

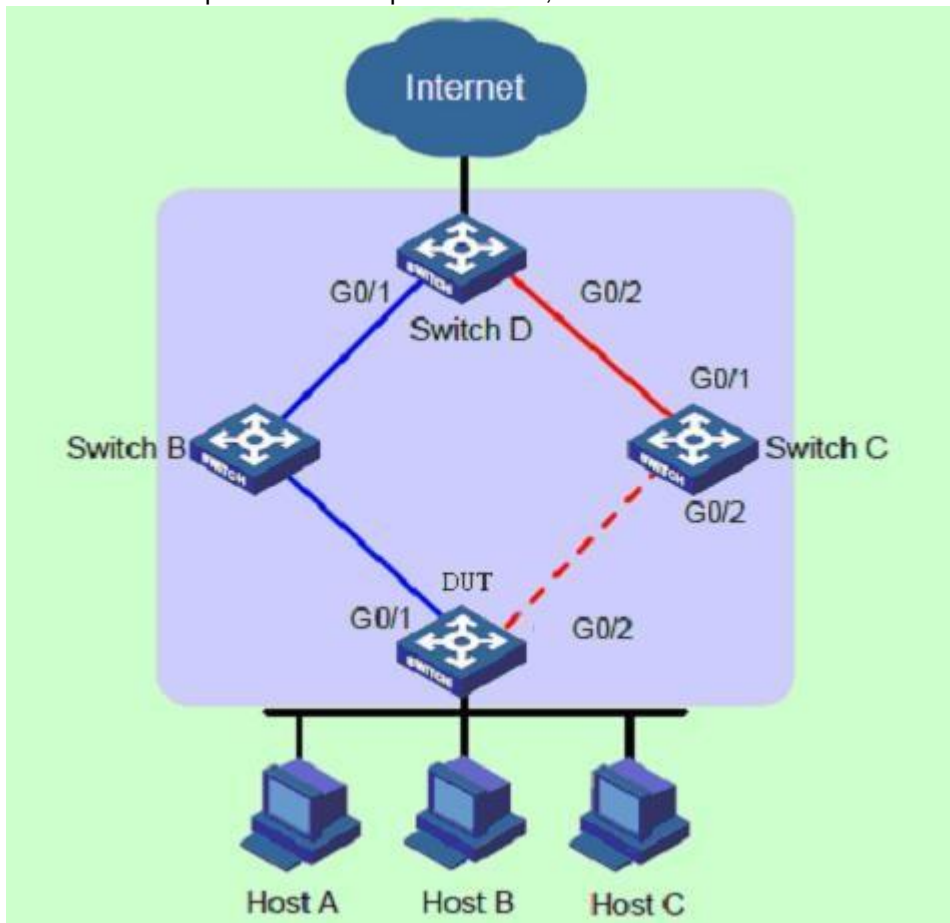
1. If two ports which are mutually backed up are in the link status of DOWN, their status in all VLANs [1-4094] is set as Blocking;

2. If only one of two ports is in the state of UP, the status of this port in all VLANs is set as Forwarding;

3. If two ports are both in the state of UP, the port which is selected as Active role is set as the Blocking state in traffic sharing VLAN and the Forwarding state in other VLANs; the port which is selected as Backup role is set as the Forwarding state in traffic sharing VLAN and the Blocking state in other VLANs.

## 1.4 MAC Address Aging Operation

BackupLink must support the topology change notifications for the uplink to deal with the case that loops exist in the uplink network, as is shown below:



BackupLink Address Aging Mechanism

### 1.4.1 Normal Work Mechanism of the Link

As is shown above, DUT port “GigaEthernet1 / 1” is the primary; Port “GigaEthernet1/ 2” is a backup port. When dual uplinks are in normal work condition, the primary port is in the forwarding state and its link is the primary link; the secondary port is blocked and its link is the secondary link. The data are transmitted along the link represented by blue line; no loop exists in the network to avoid broadcast storm.

### 1.4.2 Downlink Fault Handling Mechanism

When the DUT's primary link fails, the primary port “GigaEthernet0/ 1” is switched to the standby state, the secondary port “GigaEthernet0/ 2” is switched to the forwarding state. At this time, MAC address forwarding table entries and ARP table entries on the devices in the network may have been wrong, so it is necessary to provide a mechanism for MAC and ARP updating to complete the quick switch of traffic, avoiding traffic loss. Currently, there are two kinds of updating mechanism:

- Notify the device of updating table entries through the link updating packet MMU.

In this way, the upstream device (such as Switch D, Switch B and Switch C (optional) in the above figure) can support the MMU function of BackupLink and identify the situation of MMU packet. To achieve fast link switch, it is necessary to enable the MMU packet sending function on the DUT and enable MMU packet receiving and processing function on the port of upstream device on the dual uplink network.

After the DUT link switch occurs, the MMU packet will be sent from new primary link, that is, from Port “MMU GigaEthernet0/ 2”. When the upstream device receives the MMU packet, it will judge whether the sending control VLAN of this MMU packet is in the receiving control VLAN list configured by the port receiving the packet. If it is not in the receiving control VLAN list, the device will directly forward the MMU packet without processing; if it is in the receiving control VLAN list, the device will extract the VLAN Bitmap data in the MMU packet and the MAC and ARP entries learned by the device in these VLANs are deleted.

Thereafter, if Switch D receives the data packet of DUT as the destination device, for the packet requiring the layer-2 forwarding, Switch D will forward it in the way of Layer-2 broadcasting; for the packet requiring the layer-3 forwarding, the device will first update ARP entries through using the ARP detection method and then forward the packet out. Thus, the data traffic can be transmitted correctly.

- Automatically update entries through traffic

This approach applies to the case of butting with the devices not supporting BackupLink (including other vendors' devices) under the premise that the upstream traffic is triggered.

If there is no upstream traffic from the DUT to trigger the updating of MAC and ARP entries of Switch D, when Switch D receives the data packet of DUT as the destination device, it will still forward it via the port “GigaEthernet0/ 1”; but the packet cannot reach the DUT, the traffic breaks until its MAC or ARP entries age automatically.

In the case that the DUT has upstream traffic to send, because MAC and ARP entries of the DUT are also wrong, the traffic will not be sent out until their entries automatically age and re-learn. When the upstream traffic reaches the device “Switch D” through the



port “GigaEthernet0/ 2”, Switch D will update its own MAC and ARP entries; then when Switch D receives the data packet of the DUT as the destination device again, Switch D will forward it out through Port “GigaEthernet0/ 2” , and the packet can reach DUT via Switch C.

Note:

For the updating of the mechanism which notifies the device of updating through MMU packet, there is no need to wait until the entries age; the time of entry updating can be dramatically reduced.

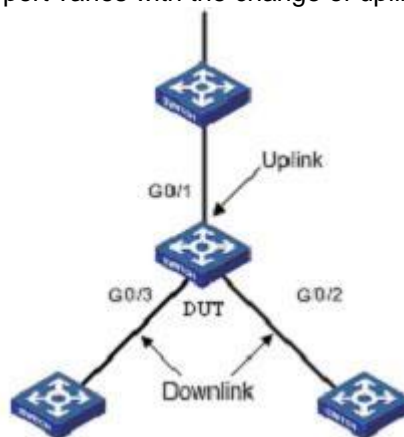
### 1.4.3 Uplink Fault Handling Mechanism

In the networking environment shown in the above figure, the BackupLink function is used for the link redundancy backup on the DUT; GigaEthernet0/ 1 is the primary port; GigaEthernet0/ 2 is the secondary port. When the primary link where the port “GigaEthernet0/ 1” is faulty, the traffic is switched to the the secondary link where the port “GigaEthernet0/ 2” is in the period of milliseconds, achieving the efficient and reliable link backup and fast convergence performance.

However, when the link where the uplink port “GigaEthernet0/ 1” of Switch B fails, for the device “DUT” configuring the BackupLink group, as the link where its primary port GigaEthernet1/ 1 is not faulty, the link switch in the BackupLink group will not occur at this time. But in fact, the traffic on the DUT cannot uplink to Switch D through the link of the port “GigaEthernet1/ 1”, so the traffic is interrupted. To solve this problem, BackupLink must support the “MonitorLink” mechanism which changes the local link based on the uplink topology changes. “MonitorLink” is used to monitor the uplink to achieve the purpose of making the downlink synchronize with the uplink, improving the backup role of BackupLink.

- Introduction of MonitorLink Concepts

MonitorLink group is composed of one or more upstream and downstream ports. The status of downstream port varies with the change of uplink port status.



MonitorLink Group Concepts Introduction

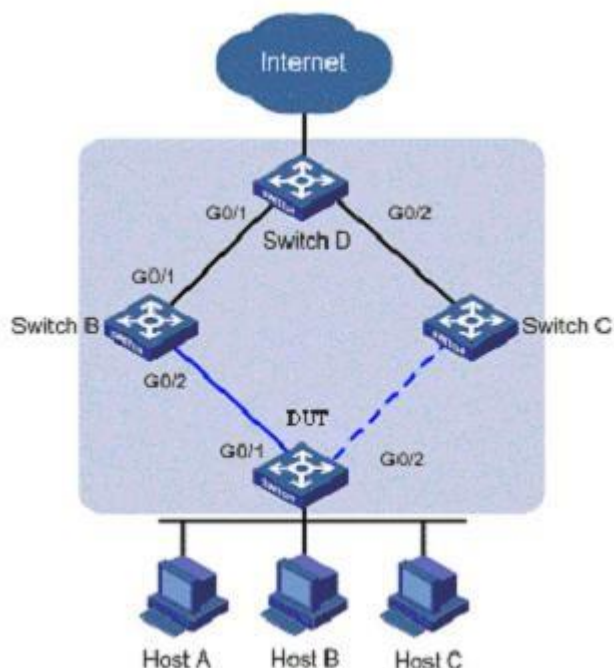
As is shown above, three ports of DUT (GigaEthernet0/ 1, GigaEthernet0/ 2 and GigaEthernet0/ 3) form a MonitorLink group.

“Uplink Port” is a monitored object in MonitorLink group, which is a port role of the MonitorLink group specified through the command line. The Uplink port of MonitorLink group can be an Ethernet port (electrical or optical), or aggregate interface. As is shown in Figure 3.3, GigaEthernet 1/ 1, a port of the DUT, is the uplink port of MonitorLink group configured on the device. When the uplink port of MonitorLink group fails, the MonitorLink group is in the status of DOWN and all the downlink ports will be disabled. When the uplink port of MonitorLink group is not specified, then it is considered that the uplink port fails and that all the downlink ports will be disabled.

“Downlink Port” is a monitor in MonitorLink group, which is another port role of the MonitorLink group specified through the command line. The downlink port of MonitorLink group can be an Ethernet port (electrical or optical), or aggregate interface. As is shown in the above figure, two ports of the DUT, GigaEthernet 0/2 and GigaEthernet 0/3, are two downlink ports of MonitorLink group configured on the device.

- MonitorLink Operating Mechanism

In the networking environment shown below, BackupLink group is configured on the DUT in order to achieve reliable access to the Internet from the host. GigaEthernet0/ 1 as the primary port is in the forwarding state; GigaEthernet0/ 2 is the secondary port.



MonitorLink operating mechanism

In order to prevent the phenomenon that DUT traffic cannot uplink because of the failure of the link where the port of Switch B, “GigaEthernet 0/ 1”, is, MonitorLink group is configured on Switch B, and the port “GigaEthernet0/ 1” is specified as the uplink port and “GigaEthernet0/ 2” is specified as downlink port.

When the link where the uplink port of Switch B, GigaEthernet0/ 1, is fails, MonitorLink group will forcibly shut down this group's downlink port “GigaEthernet0/ 2”, triggering the link switch of BackupLink group on the DUT.

When the link where the uplink port of Switch B, GigaEthernet0/ 1, is recovers from the failure, the downlink port “GigaEthernet0/ 2” will also be enabled; if BackupLink group on the DUT is configured as role preemption mode, similarly, the link switch of BackupLink group on the DUT will be triggered; otherwise, it is necessary to wait for the next link switch. Thus, the combination of MonitorLink technology with BackupLink technology enables efficient and reliable link backup and fast convergence performance.

#### 1.4.4 Link Recovery Processing Mechanism

BackupLink group supports two modes: non-role preemption mode and role preemption mode. Link recovery mechanism is different in different modes. [1.2.4](#). For the non-role preemption mode, please see [1.2.4](#); for the role preemption mode, please see [1.2.5](#).

## Chapter 2 BackupLink Configuration

### 2.1 Guidance for BackupLink Configuration

Before configuring BackupLink protocol, please read the following guidance notes:

- Primary port (Ethernet port or aggregation port) can be configured with a BackupLink backup port; moreover, this backup port and primary port cannot be the same port;
- A port can only belong to one BackupLink group; a backup port can only taken as the backup port of one primary port; one primary port can not belong to other BackupLink groups;
- Any port within the BackupLink group cannot be a member of the aggregate ports. Aggregation port and physical port, physical port and physical ports, aggregation port and aggregation port can become the members of BackupLink group.
- BackupLink primary port and backup port may be different in type; they may be Fast Ethernet ports, Gigabit ports or aggregation ports, but both must have similar features. Thus, When the primary port fails, the backup port can forward its data traffic in similar way;
- VLAN load balancing and BackupLink preemption functions cannot be used simultaneously.

### 2.2 BackupLink Configuration Tasks

- [Configuring BackupLink group](#)
- [Configuring the preemption feature for BackupLink group](#)
- [Configuring load balancing for VLAN](#)
- [Configuring the MMU feature for BackupLink group](#)
- [Configuring MonitorLink group](#)

### 2.3 BackupLink Configuration

#### 2.3.1 Configuring Backup Link Group

Configure BackupLink group according to the following steps.

Command	Purpose
Switch# <b>config</b>	Enters the switch configuration mode.

Switch_config# <b>backup-link-group</b> <i>id</i>	Configuring backuplink group. <i>id</i> : backuplink group instance number.
Switch_config# <b>interface gigaEthernet</b> <i>intf-name</i>	Enters the interface configuration mode.
Switch_config_g0/1# <b>backup-link-group</b> <i>id</i> <b>active[backup]</b>	Configure backuplink group port role. <i>id</i> : backuplink group instance number.
Switch_config_g0/1# <b>exit</b>	Exits from interface configuration mode.
Switch_config#	

**Note:**

Use the "no backup-link-group *id*" command to delete backuplink group configuration and backuplink group port configuration.

**Note:**

If the backuplink group is not established, it will be automatically created when you configure the backuplink group on a port directly.

### 2.3.2 Configuring the Preemption Feature for Backuplink Group

Configure the preemption feature for BackupLink group according to the following steps.

Command	Purpose
<b>Switch#config</b>	Enters the switch configuration mode.
Switch_config# <b>backup-link-group</b> <i>id</i> { <b>preemption-mode</b> [ <b>forced</b>   <b>bandwidth</b> ] { <b>delay</b> <i>value</i> }}	Configure the preemption feature for BackupLink group. <i>id</i> : backuplink group instance number; <i>value</i> : delay-time
Switch_config#	

**Note:**

Use the "backup-link-group *id* {preemption-mode [**forced** | **bandwidth**] {**delay** *value*}} command to directly create BackupLink group.

### 2.3.3 Configuring Load Balancing for VLAN

Configure load balancing for VLAN according to the following steps.

Command	Purpose
Switch# <b>config</b>	Enters the switch configuration mode.
Switch_config# <b>interface gigaEthernet</b> <i>intf-name</i>	Enters the interface configuration mode.
Switch_config_g0/2# <b>share-load vlan</b> <i>vlanmap</i>	Configure load balancing for VLAN. <i>vlanmap: vlan value</i>
Switch_config_g0/2# <b>exit</b>	Exits from interface configuration mode.
Switch_config#	

**Note:**

This command can be set only on the backup port, that is, a port must be set to be a backup port before VLAN load balance is set on the port.

**Note:**

For different BackupLink groups, the same group VLAN can be configured, or they have overlapping VLAN segments. But after the overlapping VLAN segments are configured, the system will assign them to different MSTs (STG); therefore, when the port of some group is operated, its status in all MSTs (STG) will take change. So, typically, when the load balancing VLAN group is configured, it is better to select the VLAN group without overlapping.

### 2.3.4 Configuring the MMU Feature for BackupLink Group

Configure the MMU feature for BackupLink group according to the following steps.

Command	Purpose
Switch# <b>config</b>	Enters the switch configuration mode.
Switch_config# <b>interface gigaEthernet</b> <i>intf-name</i>	Enters the interface configuration mode.
Switch_config_g0/2# <b>backup-link-group</b> <b>mmu transmit</b> <b>[receive]</b>	Configure MMU sending (receiving) function.
Switch_config_g0/2# <b>exit</b>	Exits from interface configuration mode.
Switch_config#	

**Note:**

Only the ports of the backuplink group can be set to transmit, that is, the ports must be set to active or backup. The ports that are set to receive are not necessarily the ports of the backuplink group.

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### 2.3.5 Configuring MonitorLink Group

Configure MonitorLink group according to the following steps.

Command	Purpose
Switch# <b>config</b>	Enters the switch configuration mode.
Switch_config# <b>monitor-link-group</b> <i>id</i>	To set the MonitorLink group, run the following command: <i>id</i> : MonitorLink group instance number.
Switch_config# <b>interface gigaEthernet</b> <i>intf-name</i>	Enters the interface configuration mode.
Switch_config_g0/1# <b>monitor-link-group</b> <i>id</i> <b>uplink[downlink]</b>	Configures MonitorLink group port role. <i>id</i> : MonitorLink group instance number.
Switch_config_g0/1# <b>exit</b>	Exits from interface configuration mode.
Switch_config#	

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**Note:**

Use the "no monitor-link-group *id*" to delete *MonitorLink group port* configuration and *Monitor Link groupport* configuration

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**Note:**

If the MonitorLink group port role is directly configured for the port in the case that the MonitorLink group is not established, the system will automatically create the MonitorLink group.

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