Huawei E9000 Server

V100R001

Smart Channel Technical White Paper

Issue   **01**

Date   **2016-12-23**

HUAWEI TECHNOLOGIES CO., LTD.

Copyright © Huawei Technologies Co., Ltd. 2016. All rights reserved.

No part of this document may be reproduced or transmitted in any form or by any means without prior written consent of Huawei Technologies Co., Ltd.

Trademarks and Permissions

and other Huawei trademarks are trademarks of Huawei Technologies Co., Ltd.
All other trademarks and trade names mentioned in this document are the property of their respective holders.

Notice

The purchased products, services and features are stipulated by the contract made between Huawei and the customer. All or part of the products, services and features described in this document may not be within the purchase scope or the usage scope. Unless otherwise specified in the contract, all statements, information, and recommendations in this document are provided "AS IS" without warranties, guarantees or representations of any kind, either express or implied.

The information in this document is subject to change without notice. Every effort has been made in the preparation of this document to ensure accuracy of the contents, but all statements, information, and recommendations in this document do not constitute a warranty of any kind, express or implied.

Huawei Technologies Co., Ltd.

Address: Huawei Industrial Base
             Bantian, Longgang
             Shenzhen 518129
   People's Republic of China

Website: http://e.huawei.com

Contents

1 Overview

E9000 servers connect to a data center network through four rear switch modules. The data center network and servers may be planned by different departments or teams at different time. Servers may be used in an existing data center network. A data center network may connect to different servers or servers provided by different vendors. These situations require network modules in blade servers to adapt to different data center networks. In most enterprises, institutions, and governments, networks and computing are handled by different departments or teams. Computing personnel have limited knowledge about networks. Therefore, network deployment of blade servers must be simple and automatic. The Smart Channel technology is invented to meet these demands and simplify network deployment.

An E9000 blade server chassis supports four switch modules, each of which supports multiple planes. Usually, two switch modules in slots 2X and 3X or slots 1E and 4E form a redundant network on the same plane during network deployment. The Ethernet networks of two switch modules can be stacked or independent from each other when connected to data center network devices, which are called TOR switches. In a data center network, TOR switches support multiple connection modes, such as cascade, stack, and virtual port channel (vPC).

Figure 1-1 Smart Channel application
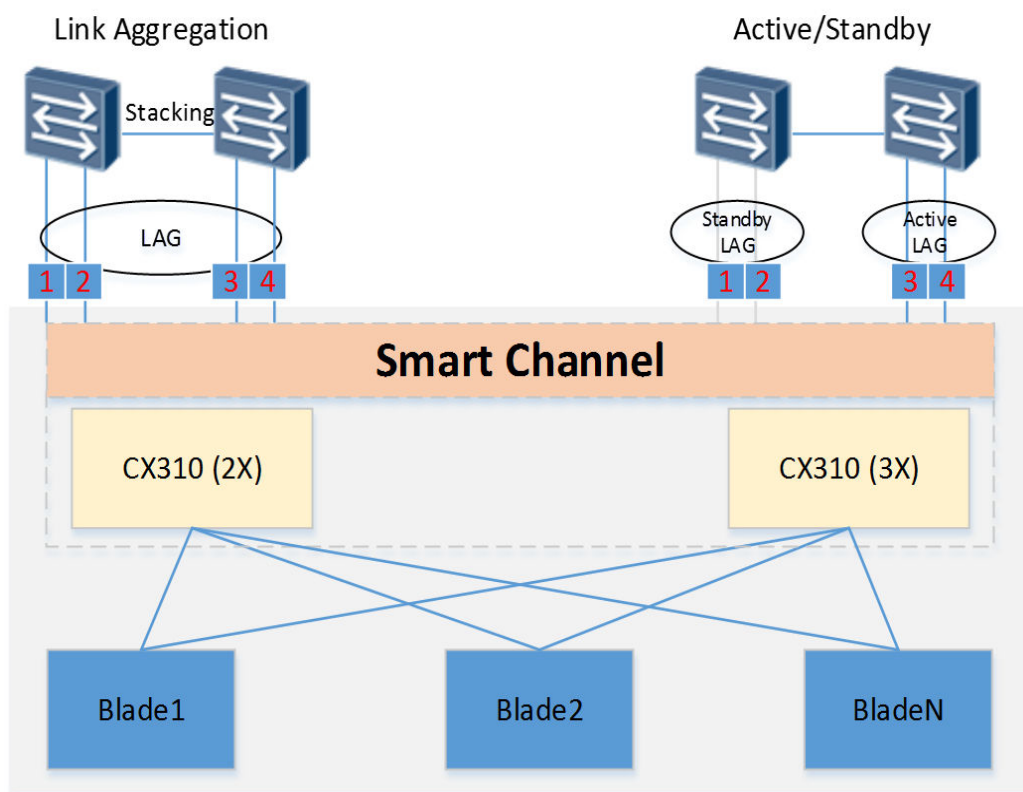
E9000 blade servers can connect to a data center in link aggregation or active/standby mode. The Smart Channel technology supports both modes, as shown in **Figure 1-1**.

Link Aggregation

Set the working mode of switch modules in the E9000 to the stack mode, set the working mode of data center switches to the stack or vPC mode, and add the four links between the switch modules and data center switches to a Smart Channel. The four links are marked with 1 to 4 in the preceding figure. Create a LAG for the data center switches and add the four links to the LAG, which works in LACP mode. The Smart Channel automatically creates a LAG based on the LACP information of the four links and adds the four links to the LAG. Different vendors use different names and working modes for LAGs. LAGs of Huawei switches and switch modules are called Eth-Trunks. LAGs of Cisco switches are called port channels. **Table 1-1** lists the commands for configuring the working modes of Huawei and Cisco LAGs.

Table 1-1 Commands for configuring the working modes of Huawei and Cisco LAGs

	Eth-Trunk	**Port Channel**
manual	mode manual	channel-group 1 mode on
lacp	mode lacp static	channel-group 1 mode active
	mode lacp static	channel-group 1 mode passive

You can use the **lacp priority** command to set the LACP priority of switch modules. By default, the priority value is 32768 in Switch mode, and 65535 in Channel mode. A low priority value indicates a high priority. When the Cisco port channel is in active mode, the Cisco switches have a high priority and are responsible for activating LAG members into forwarding state.

Active/Standby Mode

Set the working mode of switch modules in the E9000 to the stack mode and cascade two data center switches through one or more links. Add the four links connecting switch modules and data center switches to a Smart Channel. Create a LAG for each of the two data center switches. Add two links to each LAG, which works in LACP mode. The Smart Channel automatically creates two LAGs based on the link status of data center switches, adds the corresponding two links to each LAG, and sets one of the LAGs to the active state. Ports in the active LAG forward data, while those in the standby LAG are blocked and discard all data packets.

The Smart Channel technology enables different blade servers to adapt to a data center network using the same Smart Channel configuration. Also, the technology improves network reliability by preventing loops no matter the blade servers connect to the data center network in what ways. You do not need to use the STP, RSTP, or MSTP protocol to prevent loops.

2 Principles

This topic describes the basic concepts and principles of Smart Channel.
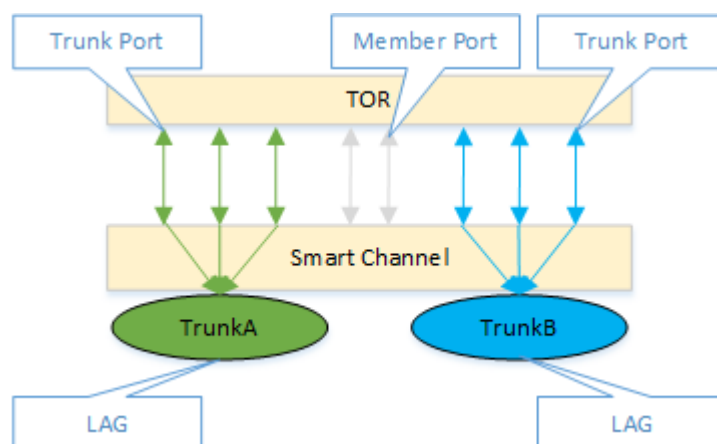
2.1 Basic Concepts

Smart Channel is a technology used by switch modules in the E9000 to simplify data center Ethernet networking. Smart Channel simplifies network configuration during blade server deployment, enables blade servers to automatically adapt to different networks, and enhances data center network reliability.

Figure 2-1 Basic concepts

Smart Channel

A Smart Channel contains one or more ports on switch module panels, and connects to data center TOR switches through these ports. Unlike Eth-Trunk, a Smart Channel can contain ports of different rates. In Channel mode, Smart Channel 1 is automatically created after the system is started. All panel ports are added to Smart Channel 1. You can also create or delete Smart Channels using the CLI. When a Smart Channel is created, two link aggregation groups (LAGs), Trunk A and Trunk B, are automatically created. You can manually add physical ports in the Smart Channel to the LAGs, or the Smart Channel automatically adds the ports to the LAGs based on priority rules.

LAG

Trunk A and Trunk B are LAGs automatically created when a Smart Channel is created. The LAGs are Eth-Trunks of switch modules. You can enter the trunk view and set parameters such as the port type, VLAN, and QoS. You can add panel ports to a Smart Channel as required. You can use commands to add the ports to Trunk A or Trunk B, or enable the ports to be added automatically based on the port LACP status and port priority rules. Trunk A and Trunk B work in active/standby mode by default. VLANs of the active LAG forward data, while those of the standby LAG are blocked and can only receive and send LACP BPDU packets. When the active LAG fails (that is, Eth-Trunk status is down), a switchover occurs. The standby LAG becomes active and starts forwarding data.

Member Port

Smart Channel ports that are not assigned to Trunk A or Trunk B are member ports. All member ports are blocked and can only receive and send LACP BPDU packets. If you specify a LAG (Trunk A or Trunk B) when adding a port to a Smart Channel, the port becomes a

trunk port. When a member port goes from down to up, it may be added to Trunk A or Trunk B based on port priority rules (port LACP status, port rate, and port number) and become a trunk port.

Trunk Port

Ports can be added to Trunk A or Trunk B in two ways: manual assignment or automatic assignment based on port priority rules (port LACP status, port rate, and port number). A trunk port is in the same forwarding status as the LAG where it resides.

Smart Channels simplify the networking between switch modules of the E9000 and a data center. Only switch module panel ports can be added to Smart Channels. When a switch module in Channel mode is started, Smart Channel 1 is created by default and includes all panel ports on the switch module. Even if all the ports are connected to the same switch, only one port forwards data and the other ports are blocked. In this way, network loops and broadcast storms are prevented. From the user perspective, Smart Channels provide the following functions:

1. Automatic link aggregation: Physical ports added to a Smart Channel can be added automatically to LAGs (Eth-Trunks) based on the link aggregation configuration of the connected TOR switch that works in LACP mode. Ports not added to LAGs are blocked to prevent network loops.

2. Quick switchover: When the active LAG is faulty, the standby LAG immediately starts forwarding data in place of the active LAG. Also, the standby LAG sends gratuitous ARP packets to update the external L2 switch forwarding table to implement quick switchover.

3. Fault detection: If a Smart Channel fails, switch module ports connected to blades are disabled in related VLANs. Blade NICs switch over traffic after detecting the fault, reducing service interruption time.

2.2 Functions

2.2.1 Automatic Link Aggregation

Automatic link aggregation enables ports to be added to LAGs through LACP. LAGs of TOR switches connected to switch modules must be in the LACP mode, which is the static LACP mode for Eth-Trunks of Huawei switches or active/passive mode for port channels of Cisco switches. The Smart Channel determines the ports to be added to LAGs based on the Actor_System and Actor_Key properties of LACP. Trunk A and Trunk B of a Smart Channel are Eth-Trunks of switch modules. Eth-Trunks support three working modes:

Manual Link Aggregation

In this mode, you need to manually create Eth-Trunks, and manually add ports to LAGs. LACP is not involved. This mode is also called load balancing mode because all active links forward data and traffic is distributed using the specified hash algorithm. If an active link is faulty, the remaining active links evenly share the traffic.

Static LACP Link Aggregation

The LACP protocol defined by Institute of Electrical and Electronics Engineers (IEEE) 802.3ad implements dynamic link aggregation and de-aggregation. LACP communicates with peer devices using the link aggregation control protocol data units (LACPDUs). After ports are added to an Eth-Trunk, the ports send LACPDUs to inform the peer devices of their system priorities, MAC addresses, port priorities, port numbers, and operation keys (used to determine whether the peer devices are in the same LAG and whether the port bandwidths are the same). After receiving the information, the peer devices compare the information with their own port information, determine the ports that can be aggregated and supported by the local ports, and form active links. IEEE802.3ad defines the following two priorities:

1. System LACP priority: A smaller value indicates a higher priority. The end with a higher priority determines the active ports. The end with a lower priority accepts the determined active links.

2. Port LACP priority: indicates the priority of ports in the same Eth-Trunk. A larger value indicates a higher priority. A port with a higher priority will be selected as the active port.

After a port is added to an Eth-Trunk, the port status changes from **Down** to **Up** and LACP negotiation starts. **Figure 2-2** shows the negotiation process.

Figure 2-2 LACP negotiation process
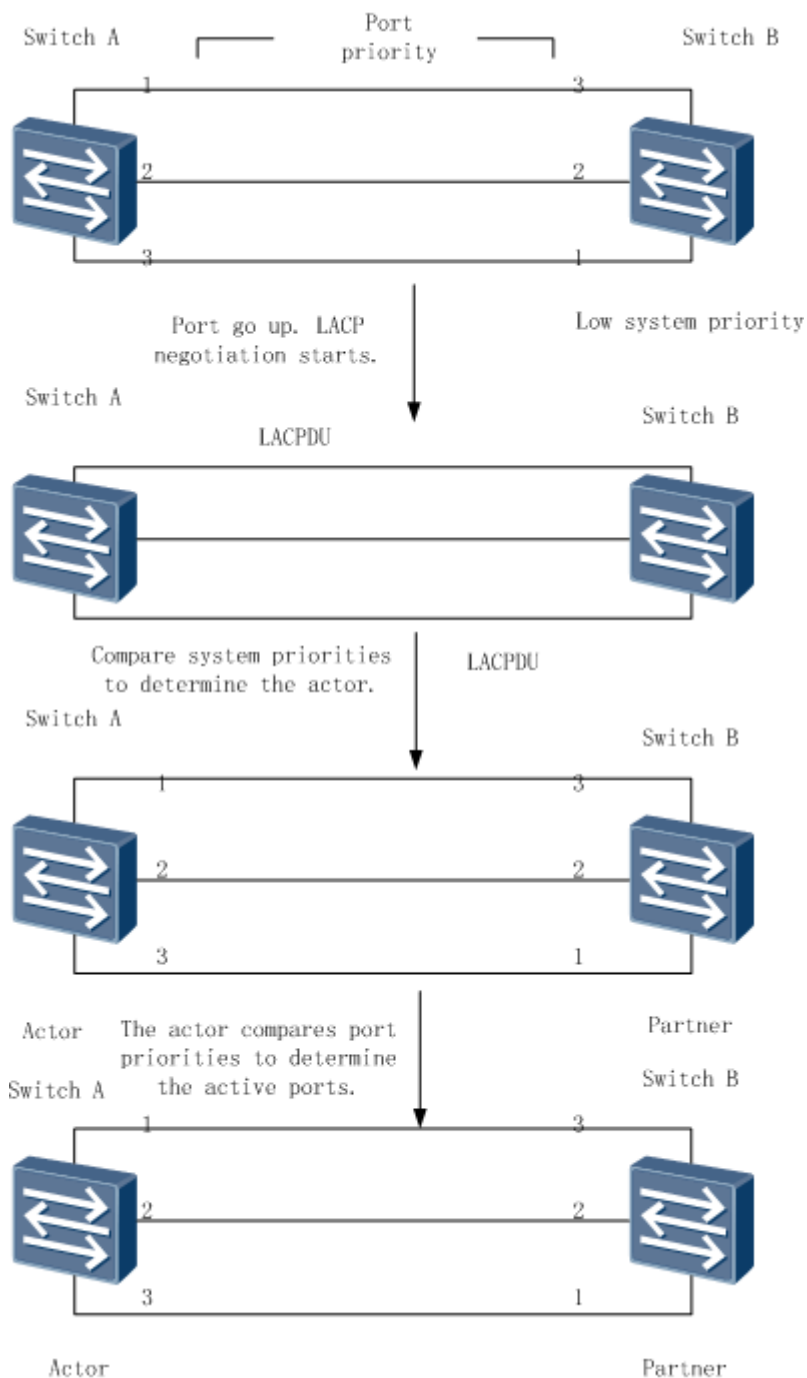
If the LACP negotiation succeeds, the port starts forwarding Eth-Trunk data with its status changed from **inactive** to **active**. **Figure 2-3** shows the LACP BPDU packet format, which is defined by IEEE802.3ad.

Figure 2-3 LACP BPDU packet format
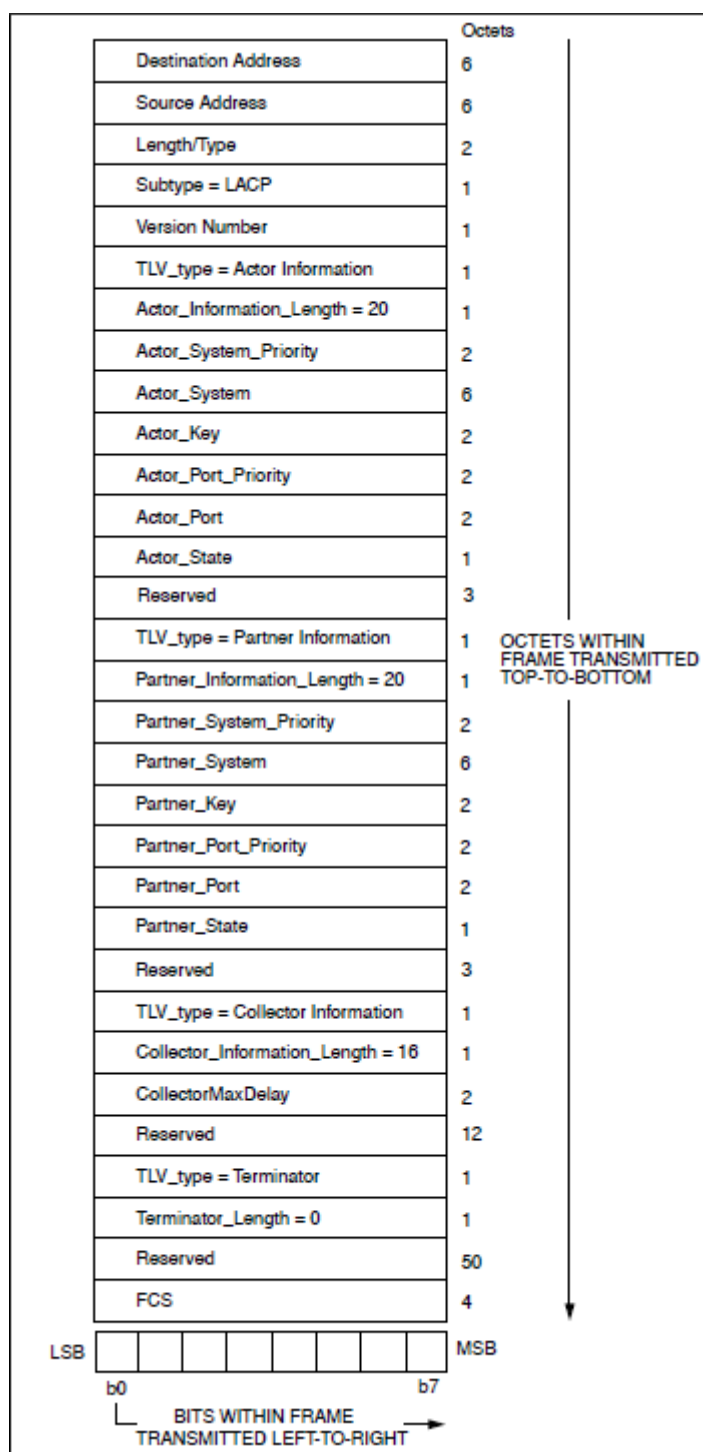
The Actor_System field is a system ID, which is usually the local system MAC address. The Actor_System is a port key generated based the port configuration and is a key factor determining whether a port is added to a LAG. The key is affected by the trunk ID, port rate, and duplex mode. The Smart Channel uses these two fields to determine the ports to be added to the same LAG.

Dynamic LACP Link Aggregation

Dynamic LACP behavior defined by IEEE802.3ad: LACP negotiation is used to create LAGs, add ports to LAGs, and select active ports. Therefore, on two directly interconnected devices with dynamic LACP enabled, you do not need to manually create LAGs or add ports to LAGs. The two devices perform link aggregation automatically through LACP negotiation. However, this mode is too flexible and causes management and maintenance risks, so it has not been fully implemented by any vendors. Switch module Eth-Trunks use dynamic LACP to enable blade servers to use PXE boot. Dynamic LACP mainly differs from static LACP as follows: If LACP negotiation fails in static LACP mode, the port remains inactive and does not forward data. If LACP negotiation fails in dynamic LACP mode, the port inherits the VLAN information of the Eth-Trunk, enters the **Indep** state, and independently forwards L2 data.

The automatic link aggregation function of Smart Channels is different from dynamic LACP defined by IEEE802.3ad or implemented by Eth-Trunks or static LACP. Their differences are as follows:

1. Unlike dynamic LACP defined by IEEE802.3ad, a Smart Channel creates LAGs when it is created.

2. LAG members are added based on the LACP mode of the peer device, while ports are manually added for static LACP and dynamic LACP of Eth-Trunks.

3. Unlike dynamic LACP defined by IEEE802.3ad, Smart Channel ports that are not added to LAGs are blocked and do not forward data, so they do not cause loops or storms.

The automatic link aggregation function of Smart Channels simplifies network configuration, enables the E9000 to adapt to different networks, and ensures system reliability and maintainability.

2.2.1.1 Adding Member Ports to LAGs

When a physical port is added to a Smart Channel, it becomes a member port. A member port can be added to a LAG (Trunk A or Trunk B) manually using a CLI or automatically.

Adding a Port to a LAG Using the CLI

In the Smart Channel view of the CLI, run the following command to add a Smart Channel port to Trunk A or Trunk B.

[~HUAWEI-smart-channel1]port member 10GE 2/17/1 trunkA

The preceding command adds port 10GE 2/17/1 to Trunk A. After this command is executed, Trunk A automatically enters the manual mode. The other Smart Channel ports can only be added to Trunk A manually.

Adding a Port to a LAG Automatically

If you run the **port member** command on the Smart Channel view of the CLI without specifying a LAG, the Smart Channel adds the port to a LAG based on the LAG status, port LACP status, port rate, and port number. If both LAGs in a Smart Channel do not contain ports, both LAGs are down. The Smart Channel adds qualified member ports to the standby LAG. When the standby LAG is up, an active/standby switchover occurs. For newly created LAGs without ports, Trunk A is standby and Trunk B is active by default. For an existing LAG, its active/standby status is the status of the last port that exits the LAG. Only member ports in the up state can be added to LAGs. The following are priority rules for adding ports to LAGs:

1. High-bandwidth port first: ports with a higher bandwidth are added first.
2. LACP port first: Ports with LACP enabled are added first.
3. Small-number port first: Ports with a smaller port number are added first. The system compares the slot numbers, subcard numbers, and port numbers in sequence. For example, port 10GE 2/17/1 has a higher priority than port 10GE 3/17/2.

The preceding rules are used in sequence to determine the ports to be added first. For example, if the Smart Channel member ports in the up state include an LACP port and a common port, the LACP port is added to a LAG first. If Trunk A or Trunk B already includes an LACP port, the ports to be added must have the same Actor_System and Actor_Key as the added port, and the LAG must be in static LACP mode to perform LACP negotiation. If LACP is disabled for the peer device of a local LAG port, the Smart Channel sets the LAG working mode to the manual mode, and the LAG can contain only one port.

If both LAGs contain ports, if a new member port has a higher priority than a port in the standby LAG, the port in the standby LAG can be replaced, that is, the new member port is added to the standby LAG, and the standby LAG port becomes a member port.

Usually, ports added to the same Smart Channel are of the same type. The high-bandwidth port first policy is rarely used. The small-number port first policy is used so that the selected forwarding ports are relatively fixed, which facilitates network troubleshooting. In practice, 1+1 redundancy is usually used and 1+N redundancy is rarely used. LAG port replacement is also rarely used. Two LAGs can meet the requirements of most scenarios.

2.2.1.2 Removing a Port from a LAG

A trunk port is removed from the trunk (LAG) if any of the following occurs: the trunk port status goes from up to down; the trunk port is deleted using the CLI; the trunk port is replaced. If a trunk port becomes inactive (unselected) due to a low LACP priority, it will not be removed from the LAG.

2.2.1.3 LAG Working Modes

Eth-Trunk modes are configured manually, while the working modes of two Smart Channel LAGs are set automatically as follows:

1. If a trunk port is added manually to a LAG using the CLI, the LAG working mode is manual.
2. If a trunk port is added automatically to a LAG but LACP is not enabled for the peer device, the LAG can contain only one port and works in the manual mode.
3. If a trunk port is added automatically and LACP is enabled for the peer device, the LAG works in static LACP mode.

2.2.1.4 Active/Standby Switchover

If both LAGs in a Smart Channel contain ports and the active LAG fails, a switchover occurs. The standby LAG becomes active and forwards data. The active LAG becomes standby and is blocked. If a port of the original active LAG goes down, the port exits the LAG and changes from a trunk port to a member port. If all ports of the original active LAG become inactive, the ports remain in the LAG.

Besides the switchover triggered by a failure, a switchover also occurs if the standby LAG is higher priority than the active LAG. In the Smart Channel view of the CLI, you can set the

switchover delay time using the **switch delay** command. You can also disable switchovers caused by high standby LAG priority so that switchovers occur only when the active LAG fails. LAG switchovers adopt priority rules similar to adding ports to LAGs. The system compares the LAG bandwidths, LACP enablement status, and smallest port numbers in sequence.

2.2.1.5 Automatic Link Aggregation Scenarios

Automatic link aggregation enables the blade servers to connect to different data center networks using the same Smart Channel configuration, simplifying network configuration. The following uses a Smart Channel with four links to describe the scenarios.

Single-LAG Networking

Figure 2-4 Single-LAG networking
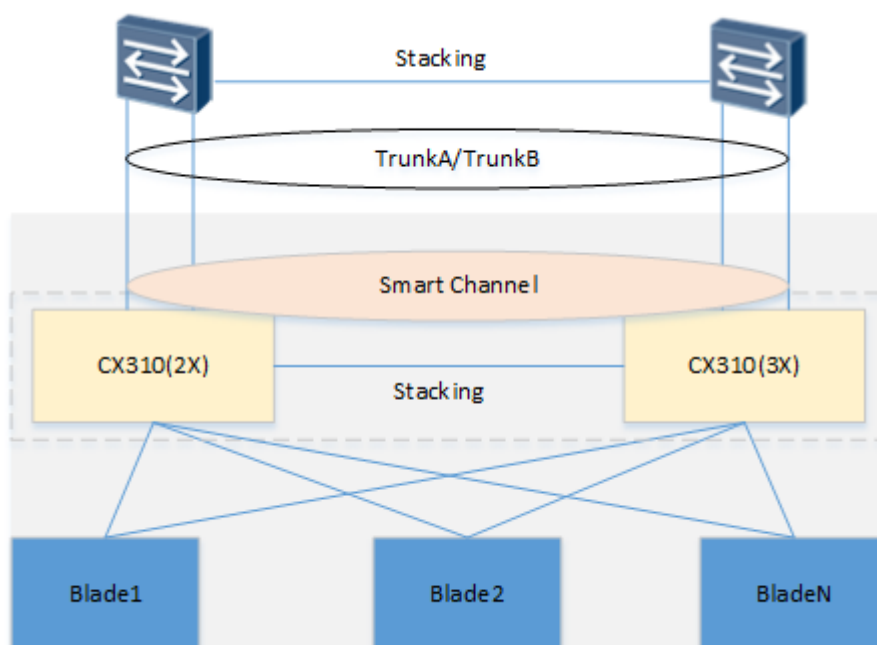
The switch modules in slots 2X and 3X of the E9000 are in the stack mode. The two data center TOR switches are also in the stack mode. Each switch module connects to a TOR switch through two links. The four links are added to the same LACP LAG on the TOR switches. The four links are also added to the same Smart Channel (Smart Channel 1 by default). The LACP negotiation result is as follows: The four ports are added to Trunk A, which forwards data.
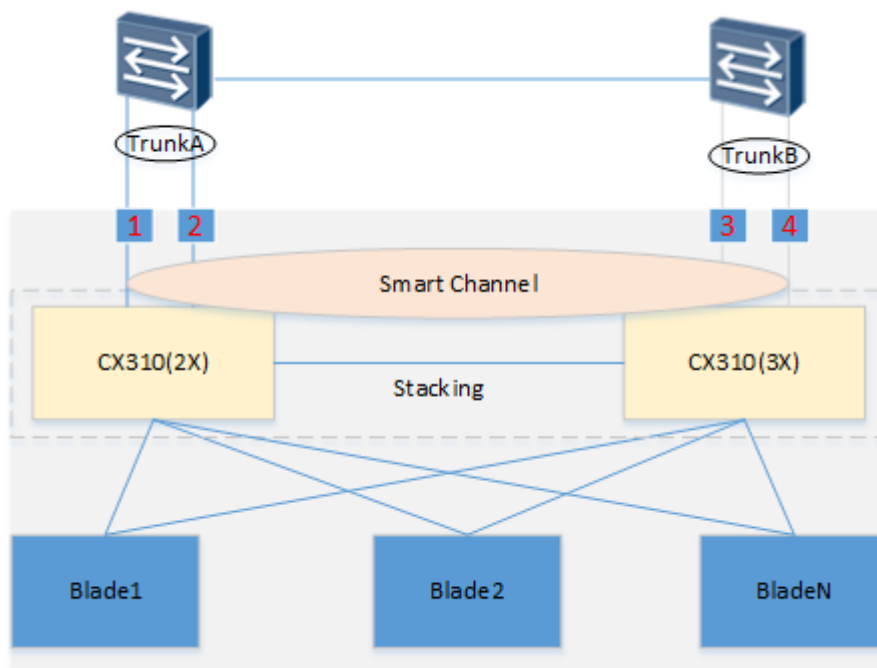
Dual-LAG Networking

Figure 2-5 Dual-LAG networking

The switch modules in slots 2X and 3X of the E9000 are in the stack mode. The two data center TOR switches are cascaded through a link or LAG. Each switch module connects to a TOR switch through two links. The two links of each TOR switch are added to the corresponding LACP LAG. The four links are also added to the same Smart Channel. The LACP negotiation result is as follows: Links 1 and 2 are added to Trunk A and forward data. Links 3 and 4 are added to Trunk B, which is blocked. This configuration ensures network connectivity and reliability (active/standby links and without network loops).

Single-Link Networking

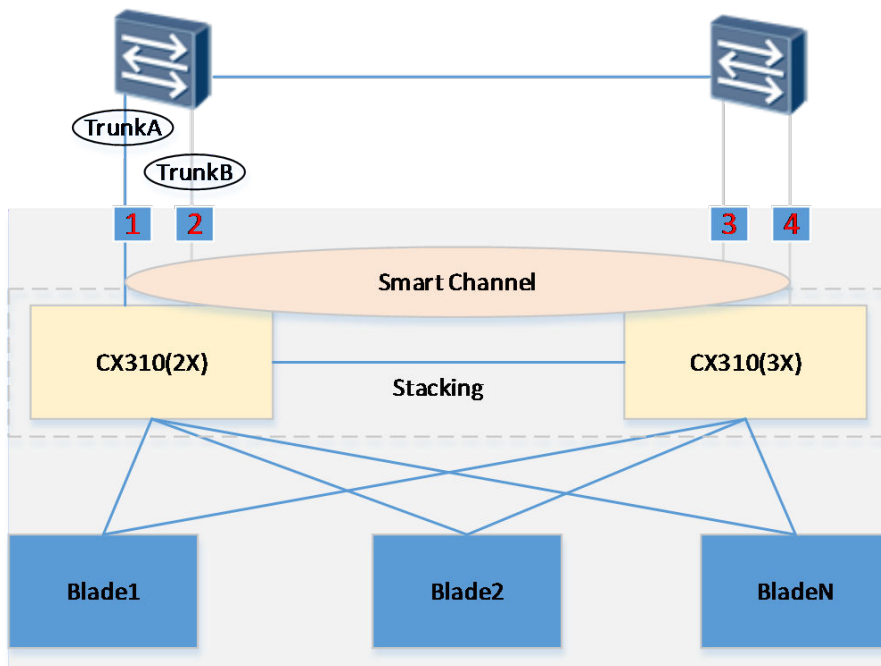**Figure 2-6** Single-link networking

The switch modules in slots 2X and 3X of the E9000 are in the stack mode. The two data center TOR switches are cascaded through a link or LAG. Each switch module connects to a TOR switch through two links. The four links are added to the same Smart Channel. LACP is not enabled for the TOR switches, so only one link of the Smart Channel forwards data. The negotiation result is as follows: Link 1 is in Trunk A and forwards data. Link 2 is in Trunk B and blocked. Links 3 and 4 are member ports and blocked. Only one link forwards data, but this networking ensures connectivity and reliability by preventing network loops and storms. If port 1 goes from up to down, Trunk A becomes standby and blocked. Port 1 exits Trunk A and becomes a member port. Trunk B becomes active and forwards data. The Smart Channel also adds link 3 to Trunk A so that a switchover is available if link 2 fails.

2.2.2 Quick Switchover

Figure 2-7 Quick switchover
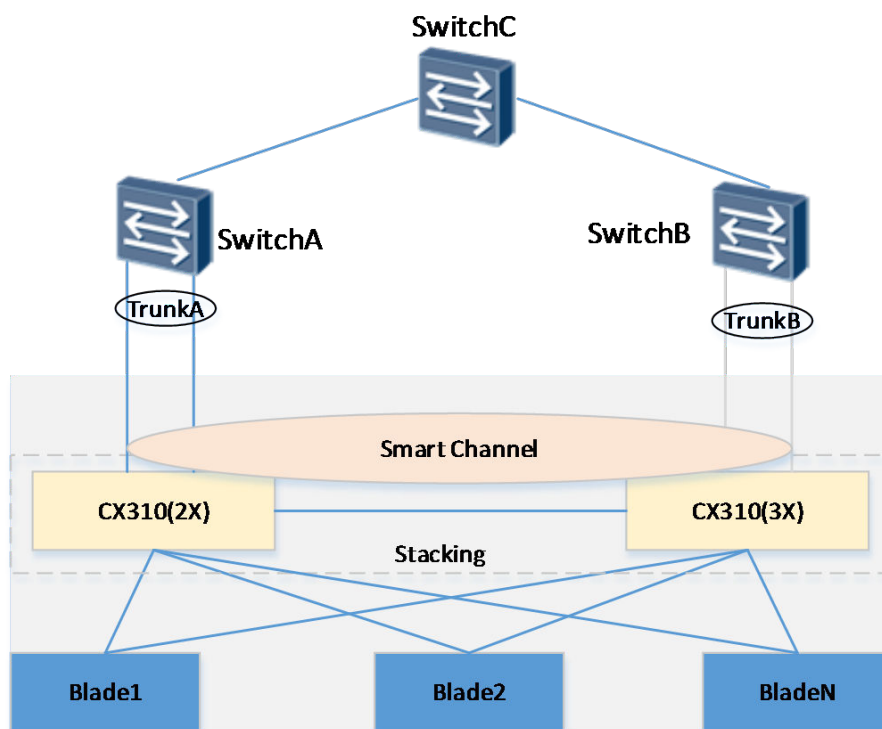
In the preceding figure, Trunk A connects to switch A, and trunk B connects to switch B in a data center. Switch A and Switch B connect to Switch C. When Trunk A between Switch A and the switch module in slot 2X fails, a quick switchover occurs, that is, Trunk B becomes active and forwards data. Data packets sent from blades are quickly switched over to Trunk B, but Switch C cannot detect the fault of Trunk A and still sends packets to Switch A. Users have to wait for blades to send data packets through Trunk B to update the MAC address forwarding table of Switch B and Switch C, or wait for the MAC address forwarding table of Switch C to expire. The service interruption time is long and unpredictable. Therefore, a mechanism independent of protocols is needed to inform Switch C to switch over traffic to Switch B.

The quick switchover mechanism is based on VLANs of Smart Channel LAGs. Switch B sends the learned blade MAC addresses as gratuitous ARP packets through Trunk B. The source and sender MAC addresses carried in ARP packets are the blade MAC addresses. The destination address is a broadcast address. The sender and destination IP addresses are 0.0.0.0, which is invalid. Gratuitous ARP packets are broadcast from Switch B to Switch C, which then updates its blade MAC address forwarding table to implement quick traffic switchover.

Quick switchover uses the standard ARP protocol, which is supported by all Ethernet switches. Also, the switchover time is short, so service interruption time is reduced.

2.2.3 Fault Detection

In a non-stack mode, two switch modules in slots 2X and 3X or slots 1E and 4E work independently. When the link connecting a switch module and a TOR switch is faulty or the

TOR switch is faulty, the blade NICs detect the fault and perform traffic switchover based on the NIC bonding mode.

Figure 2-8 Fault Detection
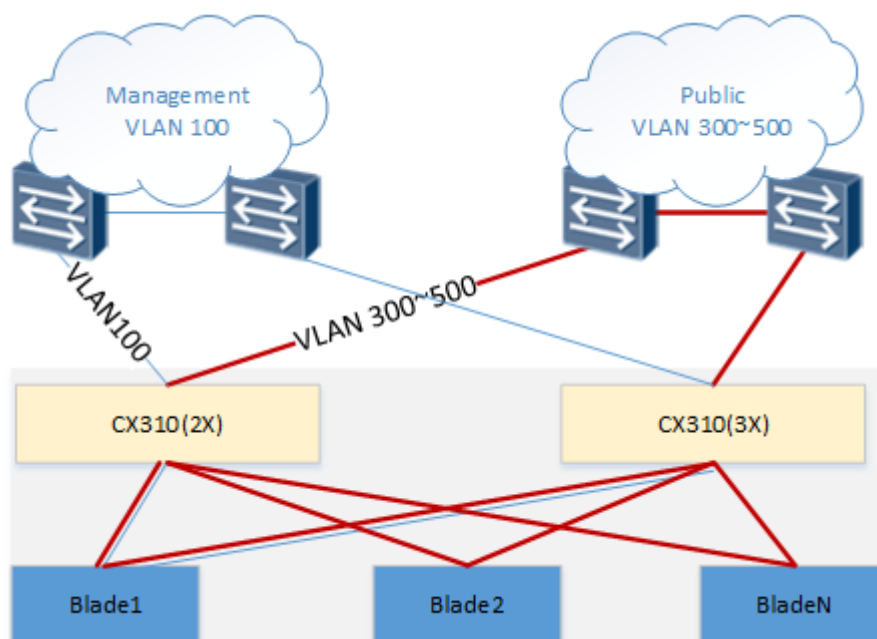
The blades in the preceding figure connect to both the management and public networks, which are layer-2 networks isolated from each other. Blades or VMs can access both networks at the same time. Two switch modules work independently. Each switch module connects to both networks through Smart Channels. Fault detection enables a faulty Smart Channel to inform the blade servers that reside in the same VLAN as the Smart Channel. The blade servers perform traffic switchover based on the NIC bonding mode to ensure network connectivity. In the preceding figure, the Smart Channel connecting the CX310 in slot 2X with the management network resides in VLAN 100. If the Smart Channel fails, the Smart Channel technology finds all blades (blade1) in VLAN 100 and disables all switch module ports connected to the blades. The operating systems on the blades detect the NIC link status and perform traffic switchover. After the faulty Smart Channel recovers, the disabled ports are enabled again, and the NICs decide whether to switch back the traffic based on the NIC bonding mode.

Fault detection is disabled globally by default and can be enabled by running the **smart-channel link-down trigger error-down** command. After a Smart Channel fails, blades in the VLANs served by the Smart Channel cannot communicate with each other. If blades in a VLAN only need to communicate with each other, do not assign Smart Channels to the VLAN.

2.3 Channel Mode

Smart Channel can be used only in Channel mode. When the system is started, Smart Channel 1 is created by default and cannot be deleted. All panel ports are added to the default Smart Channel, ensuring connectivity between blade servers and data center networks and preventing loops. You can create new Smart Channels to add panel ports to them. In the user view of the CLI, you can use the **working mode channel | switch** command to enable the

Channel or Switch mode. The setting takes effect after a restart of the switch module. In Switch mode, a switch module functions as a normal switch and usually uses Spanning Tree Protocol (STP) to prevent loops because Smart Channel cannot be used.

Channel and Switch modes mainly differ in whether switch module panel ports can be added to Smart Channels. In the two modes, switch module ports connected to blades behave in the same way. Both modes have configuration files on the management module, so the configurations can be restored in case of mode switching.

In Channel mode, switch module panel ports cannot be used as stack or FCoE ports. To use stack or FCoE ports, enable the Switch mode.

2.4 CLI Command Configuration

Table 2-1 describes the CLI commands related to the Smart Channel technology.

Table 2-1 Commands related to the Smart Channel technology

CLI Command	View	Description
smart channel	System view	Creates or deletes a Smart Channel.
working mode	User view	Sets the working mode to the Channel or Switch mode.
port member	Smart Channel view	Adds panel ports to a Smart Channel.
display smart channel	All views	Displays Smart Channel information.
smart-channel link-down trigger error-down	System view	Enables or disables fault detection.
switch delay	Smart Channel view	Sets the switchover delay time.

A Smart Channel port inherits properties, such as the port type, VLAN, and QoS, from Trunk A or Trunk B, so you only need to set the properties for Trunk A and Trunk B. You can use the **display smart channel** command to view the trunk IDs of a Smart Channel.

```
[~HUAWEI]disp smart channel 2
Smart channel 2 detail information:
Link switch delay time: 30
Current state: up
TrunkA(standby Link) state information:
Eth-Trunk Id: 2,    Working Mode: manual,  Add Member Port Mode: auto
-----------------------------------------------------------------
PortName                 Link-status                  Lacp-status
-----------------------------------------------------------------
10GE2/17/1               up                               Selected
-----------------------------------------------------------------
TrunkB(active Link) state information:
Eth-Trunk Id: 3,    Working Mode: manual,  Add Member Port Mode: auto
```

```
------------------------------------------------------------------
PortName                  Link-status                Lacp-status
------------------------------------------------------------------
10GE2/17/2                up                         Selected
------------------------------------------------------------------
Member ports of smart channel 2:
------------------------------------------------------------------
PortName                  Link-status
------------------------------------------------------------------

------------------------------------------------------------------
Flow statistic:
Last 300 seconds input rate 0 bits/sec, 0 packets/sec
Last 300 seconds output rate 0 bits/sec, 0 packets/sec
Input: 0 packets, 0 bytes
       0 unicast, 0 broadcast, 0 multicast
       0 errors, 0 drops
Output:0 packets, 0 bytes
       0 unicast, 0 broadcast, 0 multicast
       0 errors, 0 drops
```

The trunk IDs of Trunk A and Trunk B are 2 and 3. You can use the **interface eth-trunk** command to access the LAG view and configure the LAGs. The LAG view of the Channel mode supports almost the same commands as the Switch mode, except that the **mode** and **trunkport** commands cannot be used. When the Smart Channel adds a member port to a LAG, the LAG (Trunk A or Trunk B) selected is not fixed, so you need to configure both LAGs. In active/standby mode, Trunk A and Trunk B must have the same configuration, so that network functions are not changed when a switchover occurs.

3 Application Scenarios

This topic describes the application scenarios supported by the Smart Channel technology.
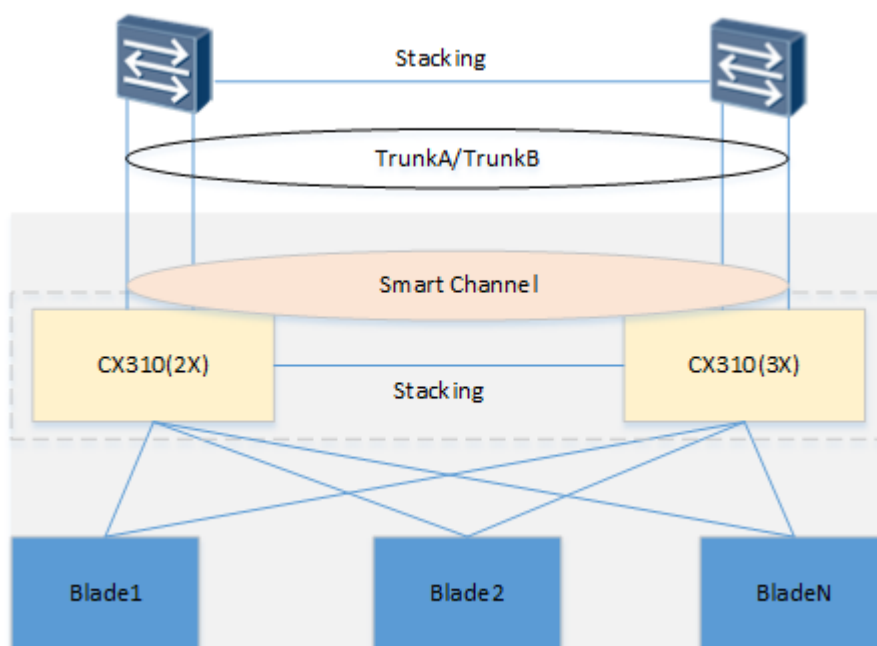
3.1 Single-LAG Networking

Network Description

Data center switches connected to the E9000 work in stack mode (or vPC mode for Cisco switches), that is, the E9000 connects to the network through one LAG. A LAG works in manual mode or LACP mode.

Figure 3-1 Single-LAG Networking

Configuration Description

1. Set the working mode of switch modules in slots 2X and 3X to the stack mode, create a new Smart Channel, determine the switch module ports to be connected to TOR switches, and add the ports to the Smart Channel.

2. If the TOR switch LAG is a manual LAG, select Trunk A when adding ports to the Smart Channel.

3. If the TOR switch LAG is an LACP LAG, do not specify a LAG when adding ports to the Smart Channel.

4. Enter the LAG views of Trunk A and Trunk B and run configuration commands as required.

In Channel mode, the default LACP priority of switch modules is 65535. If the TOR switch LAG is an LACP LAG, you can set a higher LACP priority for the TOR switches so that they will select ports to be activated. The Smart Channel performs negotiation through LACP and all switch module ports in the Smart Channel are in the same LAG. If a link or switch fails, the LAG performs a traffic switchover, and the Smart Channel is not affected.

3.2 Dual-LAG Networking (Stacked Switch Modules)

Network Description

The E9000 connects to two cascaded data center switches through two LAGs that work in active/standby mode. Only the active LAG forwards data.

Figure 3-2 Dual-LAG networking (stacked switch modules)

Configuration Description

1. Set the working mode of switch modules in slots 2X and 3X to the stack mode, create a new Smart Channel, determine the switch module ports to be connected to TOR switches, and add the ports to the Smart Channel.

2. If the TOR switch LAG is a manual LAG, select Trunk A or Trunk B when adding ports to the Smart Channel.

3. If the TOR switch LAG is an LACP LAG, do not specify a LAG when adding ports to the Smart Channel.

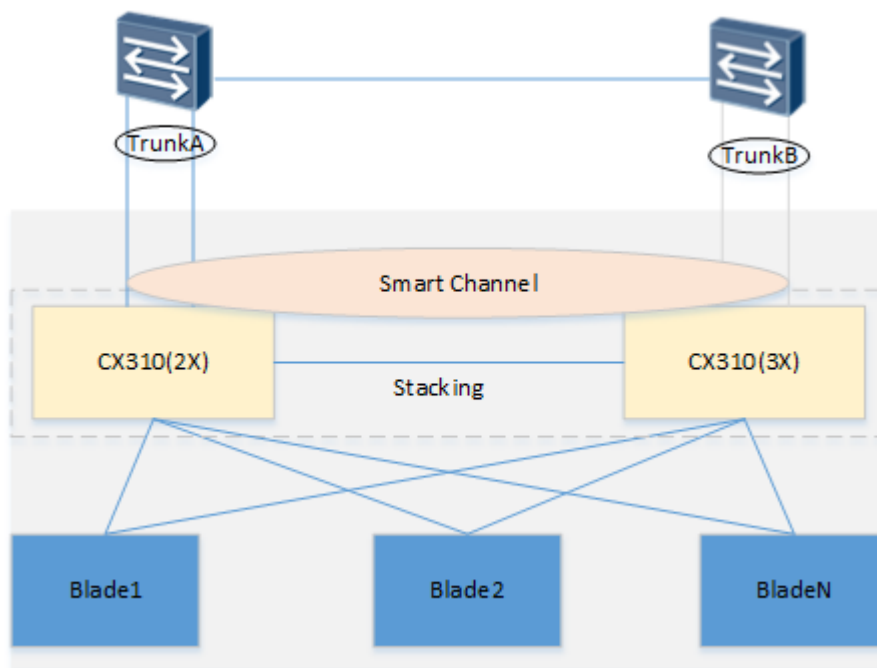4. Enter the LAG view of Trunk A and Trunk B and run configuration commands as required.
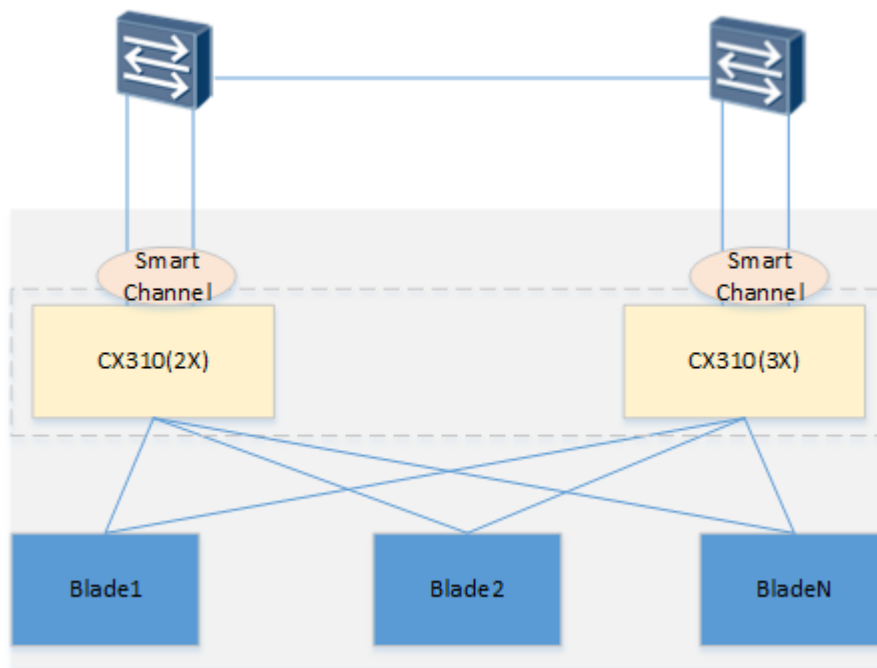
If the LAGs are LACP LAGs, the Smart Channel performs negotiation through LACP. The switch module ports connected to the two TOR switches are added to Trunk A or Trunk B. Trunk A and Trunk B are LAGs that work in active/standby mode. The active LAG forwards data while the standby LAG is blocked. When the active LAG fails, the Smart Channel performs a quick switchover.

3.3 Dual-LAG Networking

Network Description

The E9000 connects to two cascaded data center switches through two LAGs, which work in active/active mode. Which Smart Channel forwards data depends on the NIC bonding mode.

Figure 3-3 Dual-LAG networking

Configuration Description

1. Switch modules in slots 2X and 3X work independently (default mode). Create a new Smart Channel for each switch module, determine the switch module ports to be connected to TOR switches, and add the ports to the two Smart Channels.

2. If the TOR switch LAG is a manual LAG, select Trunk A when adding ports to the Smart Channel.

3. If the TOR switch LAG is an LACP LAG, do not specify a LAG when adding ports to the Smart Channel.

4. Enter the Trunk A and Trunk B views of the switch module CLI and run configuration commands as required.
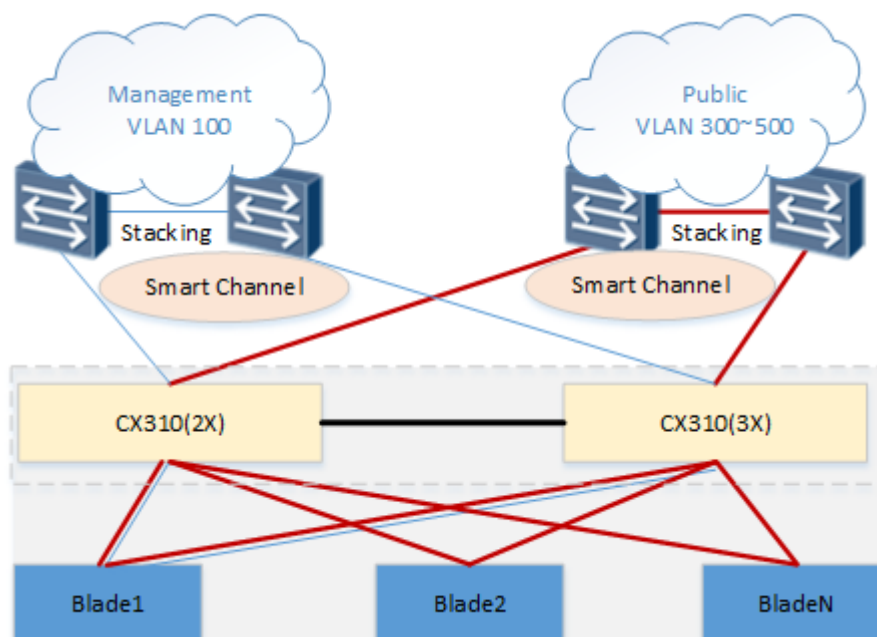
If the LAGs are LACP LAGs, the Smart Channels perform negotiation through LACP. Ports connected to the two TOR switches are added to Trunk A or Trunk B, only one of which forwards data. When a LAG of a Smart Channel fails, the Smart Channel informs the blades through fault detection. The blade NICs then perform a traffic switchover.

3.4 Multiple L2 Networks

Network Description

The E9000 connects to two L2 networks that are isolated from each other using VLANs. Blades or VMs can access both networks at the same time.

Figure 3-4 Multiple L2 networks

Configuration Description

1. Set the working mode of switch modules in slots 2X and 3X to the stack mode, create two Smart Channel, determine the switch module ports to be connected to the networks, and add the ports to the Smart Channels.

2. If an L2 switch LAG is a manual LAG, select Trunk A when adding ports to the Smart Channel.

3. If an L2 switch LAG is an LACP LAG, do not specify a LAG when adding ports to the Smart Channel.

4. Enter the LAG view of Trunk A and Trunk B of both Smart Channels and run configuration commands as required.

When the LAGs are LACP LAGs, the two Smart Channels perform negotiation through LACP. Ports connected to the L2 networks are added to Trunk A or Trunk B, only one of which forwards data.
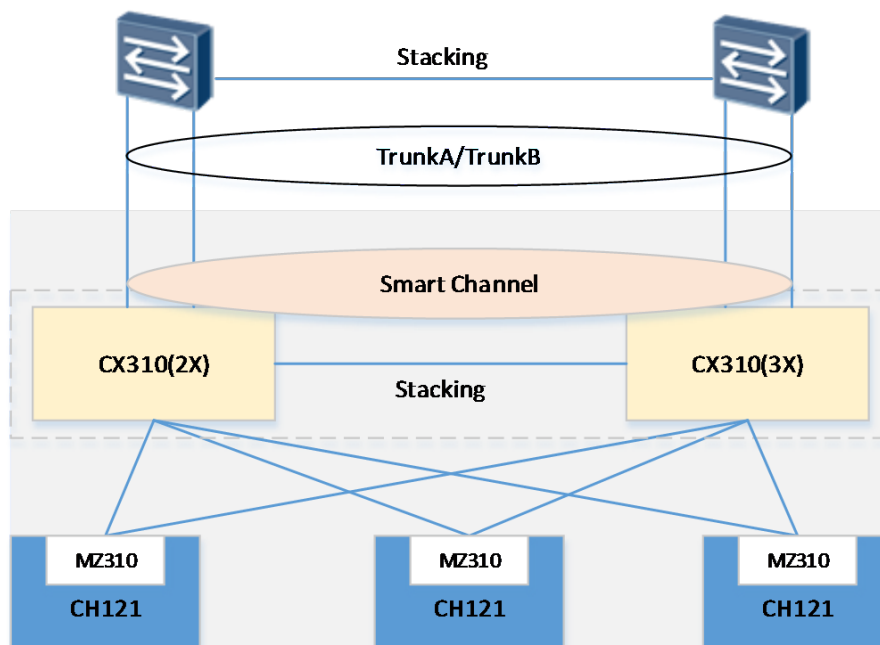
4 Configuration Example

This topic describes the network configuration for the single-LAG scenario.

4.1 Physical Networking

Figure 4-1 Single-LAG networking

- CX310 switch modules are configured in slots 2X and 3X. The four uplink 10GE ports connect to two Ethernet aggregation switches that work in stack mode. Add the four ports to the same LAG and set the LAG working mode to LACP.

- The two CX310 switch modules are stacked through their 40GE ports.

- Install CH121 servers in slots 1, 2, and 3 and install the MZ310 in slot MEZZ1 of each CH121. Each MZ310 communicates with each CX310 through two 10GE ports.

- 10GE ports 2/17/1, 2/17/2, 3/17/1, and 3/17/2 on the CX310 panels are connected to the Ethernet aggregation switches.

In Channel mode, all switch module panel ports are automatically added to Smart Channel 1. You can use Smart Channel 1 to connect to external switches, or create a new Smart Channel and add related ports (ports connected to the external switches) to it.

4.2 Configuration Procedure

Step 1 Configure the working mode.

Set the working mode to the Channel mode for switch modules in slots 2X and 3X. Then restart the switch modules.

```
<HUAWEI> working mode channel
Warning: To change working mode, system will reboot and then startup with another
configuration file for configured working mode. Continue? [Y/N]:Y
slot 2:
Next startup system software: flash:/OSCAV100R005C50B015D1027.cc
Next startup saved-configuration file: flash:/vrpcfg.zip
```

```
Next startup paf file: default
Next startup patch package: NULL

begin save working mode to SMM ...
slot 2: save working mode to SMM successfully.

begin synchronize configuration to SMM ...
slot 2: configuration is the same with SMM, needn't sync to SMM.
Warning: The system is going to reboot NOW!
```

After the restart, the switch modules enter the Channel mode. If the management module has a Channel mode configuration file, the file is automatically used to recover the configuration.

Step 2 Configure the stacking.

Restore the switch modules in slots 2X and 3X to the default configuration if the default configuration is not in use.

Run the **reset saved-configuration** command to restore the default configuration of the switch module in slot 2X and restart the switch module.

```
<HUAWEI>reset saved-configuration
The action will delete the saved configuration in the device.     The
configuration will be erased to reconfigure.Continue? [Y/N]:Y Warning: Now
clearing the configuration in the
device.             ......

begin synchronize configuration to SMM ...
slot 2: upload configuration to SMM successfully.

Info: Succeeded in clearing the configuration in the device.
<HUAWEI>reboot fast
```

Run the **reset saved-configuration** command to restore the default configuration of the switch module in slot 3X and restart the switch module.

```
<HUAWEI>reset saved-configuration
The action will delete the saved configuration in the device.     The
configuration will be erased to reconfigure.Continue? [Y/N]:Y Warning: Now
clearing the configuration in the
device.             ......

begin synchronize configuration to SMM ...
slot 3: upload configuration to SMM successfully.

Info: Succeeded in clearing the configuration in the device.
<HUAWEI>reboot fast
```

Configure the stacking feature for the switch module in slot 2X.

Set the domain ID of the CX310_2 to 10 and priority to 150. The default stack ID of CX310_2 is 2.

```
<HUAWEI> system-view
[~HUAWEI] sysname CX310_2
[*HUAWEI] commit
[~CX310_2] stack
[*CX310_2-stack] stack member 2 priority 150
[*CX310_2-stack] stack member 2 domain 10
[*CX310_2-stack] quit
[*CX310_2] commit
```

Add service port 40GE 2/18/1 of the CX310_2 to stack port 2/1.

```
[~CX310_2] interface 40GE 2/18/1
[*CX310_2-40GE2/18/1] port mode stack
[*CX310_2-40GE2/18/1] quit
```

```
[*CX310_2] commit
[~CX310_2] interface stack-port 2/1
[*CX310_2-Stack-Port2/1] port member-group interface 40GE 2/18/1
[*CX310_2-Stack-Port2/1] quit
[*CX310_2] commit
```

Configure the stacking feature for the switch module in slot 3X.

Set the domain ID of the CX310_3 to 10 and priority to 100. The default stack ID of CX310_3 is 3.

```
<HUAWEI> system-view
[~HUAWEI] sysname CX310_3
[*CX310_3] commit
[~CX310_3] stack
[~CX310_3-stack] stack member 3 priority 100
[*CX310_3-stack] stack member 3 domain 10
[*CX310_3-stack] quit
[*CX310_3] commit
```

Add service port 40GE 3/18/1 of the CX310_3 to stack port 3/1.

```
[~CX310_3] interface 40GE 3/18/1
[~CX310_3-40GE3/18/1] port mode stack
[*CX310_3-40GE3/18/1] quit
[*CX310_3] commit
[~CX310_3] interface stack-port 3/1
[*CX310_3-Stack-Port3/1] port member-group interface 40GE 3/18/1
[*CX310_3-Stack-Port3/1] quit
[*CX310_3] commit
```

Enable the 40GE ports connecting the switch modules in slots 2X and 3X.

```
[~CX310_2] interface 40GE 2/18/1
[*CX310_2-40GE2/18/1] undo shutdown
[*CX310_2-40GE2/18/1] quit
[*CX310_2] commit
[~CX310_2] quit
<CX310_2> save

[~CX310_3] interface 40GE 3/18/1
[*CX310_3-40GE3/18/1] undo shutdown
[*CX310_3-40GE3/18/1] quit
[*CX310_3] commit
[~CX310_3] quit
<CX310_3> save
```

⚠ NOTICE

The switch modules in slots 2X and 3X must have the same domain ID. You need to manually restart the switch modules after configuring them. After the restart, verify that the stack configuration is correct and run the **save** command to save the stack configuration.

Verify the configuration.

Change the system name and view the stacking system information.

```
<CX310_2> system-view
[~CX310_2] sysname CX310_C
[*HUAWEI] commit
[~CX310_C] display stack
--------------------------------------------------------------------
MemberID Role     MAC            Priority Device Type Bay/Chassis
--------------------------------------------------------------------
```

```
2       Master  0004-9f31-b911 150     CX310       2X/1
3       Standby 0004-9f62-cf33 100     CX310       3X/1
------------------------------------------------------------------
[~CX310_C] quit
<CX310_C> save
```

Step 3   Create Smart Channel 2.

Create Smart Channel 2 for the links connecting the uplink Ethernet aggregation switch.

```
[~CX310_C] smart channel 2
[*CX310_C-smart-smart2] port member 10GE2/17/1 to 10GE2/17/2
[*CX310_C-smart-smart2] port member 10GE3/17/1 to 10GE3/17/2
[*CX310_C-smart-smart2] quit
[*CX310_C] commit
[~CX310_C] display smart channel 2
Smart channel 2 detail information:
Link switch delay time: 30s
Current state: up
TrunkA(active Link) state information:
Eth-Trunk Id: 0,Working Mode: static,  Add Member Port Mode: auto
------------------------------------------------------------------
PortName                 Link-status              Lacp-status
------------------------------------------------------------------
10GE2/17/1               up                       Selected
10GE2/17/2               up                       Selected
10GE3/17/1               up                       Selected
10GE3/17/2               up                       Selected
------------------------------------------------------------------

TrunkB(standby Link) state information:
Eth-Trunk Id: 1,Working Mode: manual,  Add Member Port Mode: auto
------------------------------------------------------------------
PortName                 Link-status              Lacp-status
------------------------------------------------------------------

Member ports of smart channel 2:
------------------------------------------------------------------
PortName                 Link-status
------------------------------------------------------------------

Flow statistic:
Last 300 seconds input rate 0 bits/sec, 0 packets/sec
Last 300 seconds output rate 317 bits/sec, 0 packets/sec
Input: 0 packets, 0 bytes
       0 unicast, 0 broadcast, 0 multicast
       0 errors, 0 drops
Output:98 packets, 12054 bytes
       0 unicast, 0 broadcast, 98 multicast
       0 errors, 0 drops
```

The output of the display command shows the following: the LACP negotiation between Smart Channel 2 and the aggregation switches succeeds; the four links are added to Trunk A; the IDs of the two Eth-Trunks automatically created are 0 and 1.

Step 4   Configure the VLAN.

Create VLAN 2011 and add the related switch module ports (ports connected to the MZ310 and those connected to Smart Channel 2) to VLAN 2001.

```
[~CX310_C] vlan batch 2001
```

Set the default VLAN of the MZ310 ports (connecting to switch modules) to VLAN 2001.

```
[~CX310_C] interface 10GE 2/1/1
[*CX310_C-10GE2/1/1] port default vlan 2001
[*CX310_C-10GE2/1/1] quit

[*CX310_C] interface 10GE 2/2/1
```

```
[*CX310_C-10GE2/2/1] port default vlan 2001
[*CX310_C-10GE2/2/1] quit

[*CX310_C] interface 10GE 2/3/1
[*CX310_C-10GE2/3/1] port default vlan 2001
[*CX310_C-10GE2/3/1] quit

[*CX310_C] interface 10GE 3/1/1
[*CX310_C-10GE3/1/1] port default vlan 2001
[*CX310_C-10GE3/1/1] quit

[*CX310_C] interface 10GE 3/2/1
[*CX310_C-10GE3/2/1] port default vlan 2001
[*CX310_C-10GE3/2/1] quit

[*CX310_C] interface 10GE 3/3/1
[*CX310_C-10GE3/3/1] port default vlan 2001
[*CX310_C-10GE3/3/1] quit
[*CX310_C] commit
```

Add Eth-Trunks 0 and 1 to VLAN 2001.

```
[~CX110_C] interface Eth-Trunk0
[~CX110_C-Eth-Trunk0] port default vlan 2001
[*CX110_C-Eth-Trunk0] quit
[*CX110_C] interface Eth-Trunk1
[*CX110_C-Eth-Trunk1] port default vlan 2001
[*CX110_C-Eth-Trunk1] quit
[*CX110_C] commit
```

Step 5 Save the switch module configuration.

```
[~CX310_C] quit
<CX310_C> save
```

----End

5 Conclusion

The Smart Channel technology greatly simplifies network deployment for the E9000, enables the E9000 to access different networks using the same configuration, reduces service interruption time in case of network faults through quick switchover, and improves data center network reliability by preventing loops and storms without using STP.