S Series Switches

CSS Technology White Paper

Issue 01

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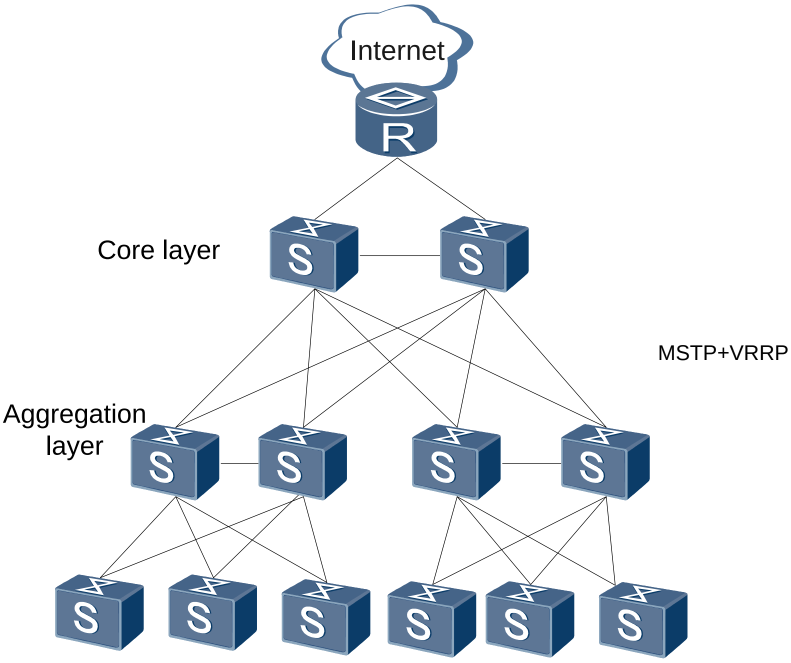
1 Feature Introduction

1.1 CSS Overview

Dual-node redundancy design is often used at the network core layer and aggregation layer to improve network reliability, as shown in Figure 1-1.

Figure 1-1 Network structure using dual-node redundancy design



The redundancy design improves network reliability but complicates network structure and interconnection. This design requires Layer 2 loop prevention protocols such as the Spanning Tree Protocol (STP), Rapid Spanning Tree protocol (RSTP), Multiple Spanning Tree Protocol (MSTP), or Ethernet Ring Protection Switching (ERPS) to be deployed to eliminate loops and requires protocols such as the Virtual Router Redundancy Protocol (VRRP) to support node redundancy backup.

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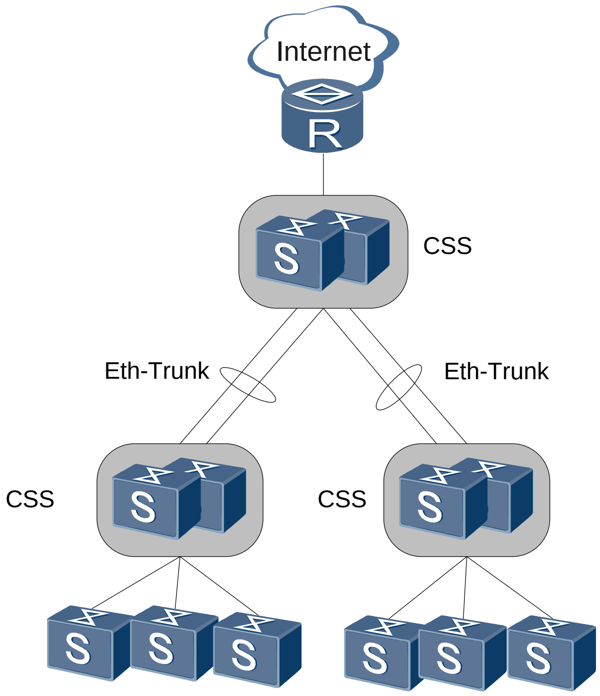
The cluster switch system (CSS) combines multiple cluster-capable physical switches into one logical switch as shown in Figure 1-2. The CSS is also called cluster. Currently, a CSS contains at most two Huawei physical switches.

Figure 1-2 CSS networking



CSS can combine the control and forwarding planes of two switches, bringing the following advantages:

- High reliability

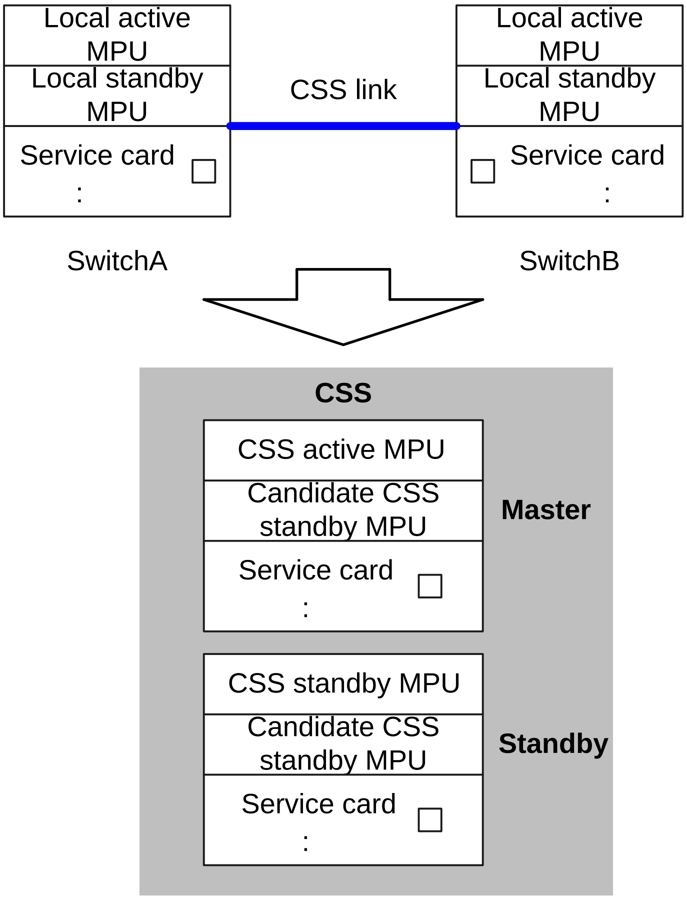
  Redundancy backup is implemented between multiple member devices in a CSS. Additionally, the CSS supports inter-device link aggregation for inter-device link redundancy backup.
- Simplified network structure and protocol deployment

  CSS technology can simplify the complicated network topology into the network structure with clear hierarchy and simple interconnections. In this network structure, loops are eliminated between network devices at each layer through link aggregation, removing the need to deploy protocols such as MSTP and VRRP.
- Simplified configuration and management

  After a CSS is set up, multiple physical devices are virtualized into one logical device. You can log in to the CSS to uniformly configure and manage all the member devices.

A CSS contains a master switch and a standby switch. On the control plane, the active MPU of the master switch functions as the active MPU of the CSS to manage the CSS, and the active MPU of the standby switch functions as the standby MPU of the CSS to provide backup to the active MPU of the CSS. The standby MPUs of the master and standby switches become the candidate standby MPUs of the CSS and act only as cold standby MPUs.

Figure 1-3 Cluster competition



1.2 CSS Advantages

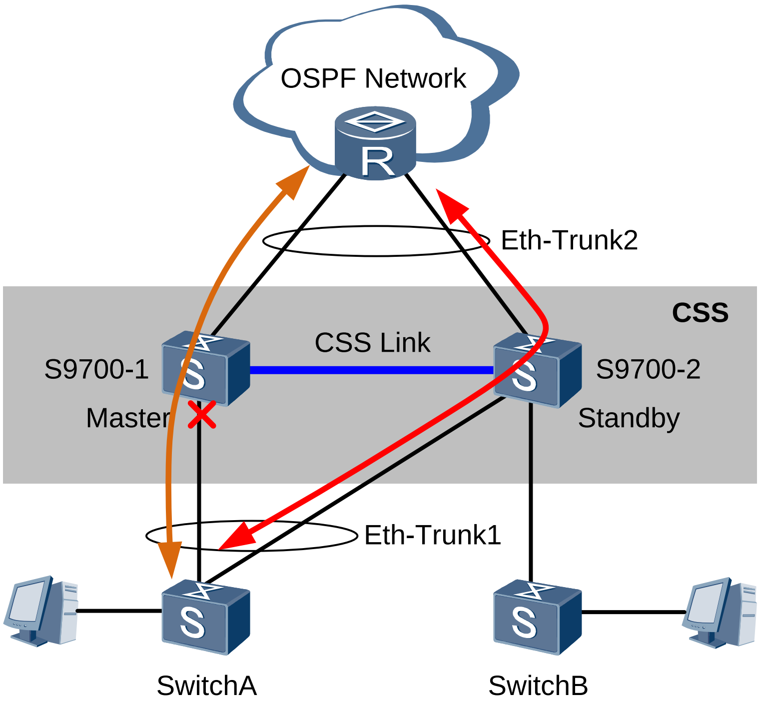
1.2.1 Simplified Configuration and Management

After a CSS is set up, multiple physical devices are virtualized into one logical device. You can log in to the CSS to uniformly configure and manage all the member devices.

1.2.2 Inter-Chassis Link Redundancy Backup

Inter-chassis Eth-Trunk allows you to configure physical Ethernet ports on different member devices into an aggregation port. Even if faults occur on some of the member devices, the aggregation link does not fail because other working member devices will continue to manage and maintain the remaining Eth-Trunk member ports. This implementation increases device capacity, achieves service backup between devices, and improves reliability.

Figure 1-4 Typical CSS networking



As shown in Figure 1-4, S9700-1 and S9700-2 form a CSS, and users connect to SwitchA and SwitchB. SwitchA connects to the CSS through inter-chassis Eth-Trunk1. The CSS connects to an OSPF network through inter-chassis Eth-Trunk2. On this networking, if a device or physical port is faulty, service traffic is automatically transferred to another device. This networking increases device capacity, achieves service backup between devices and inter-chassis link backup, and improves reliability.

1.2.3 Port Redundancy Backup

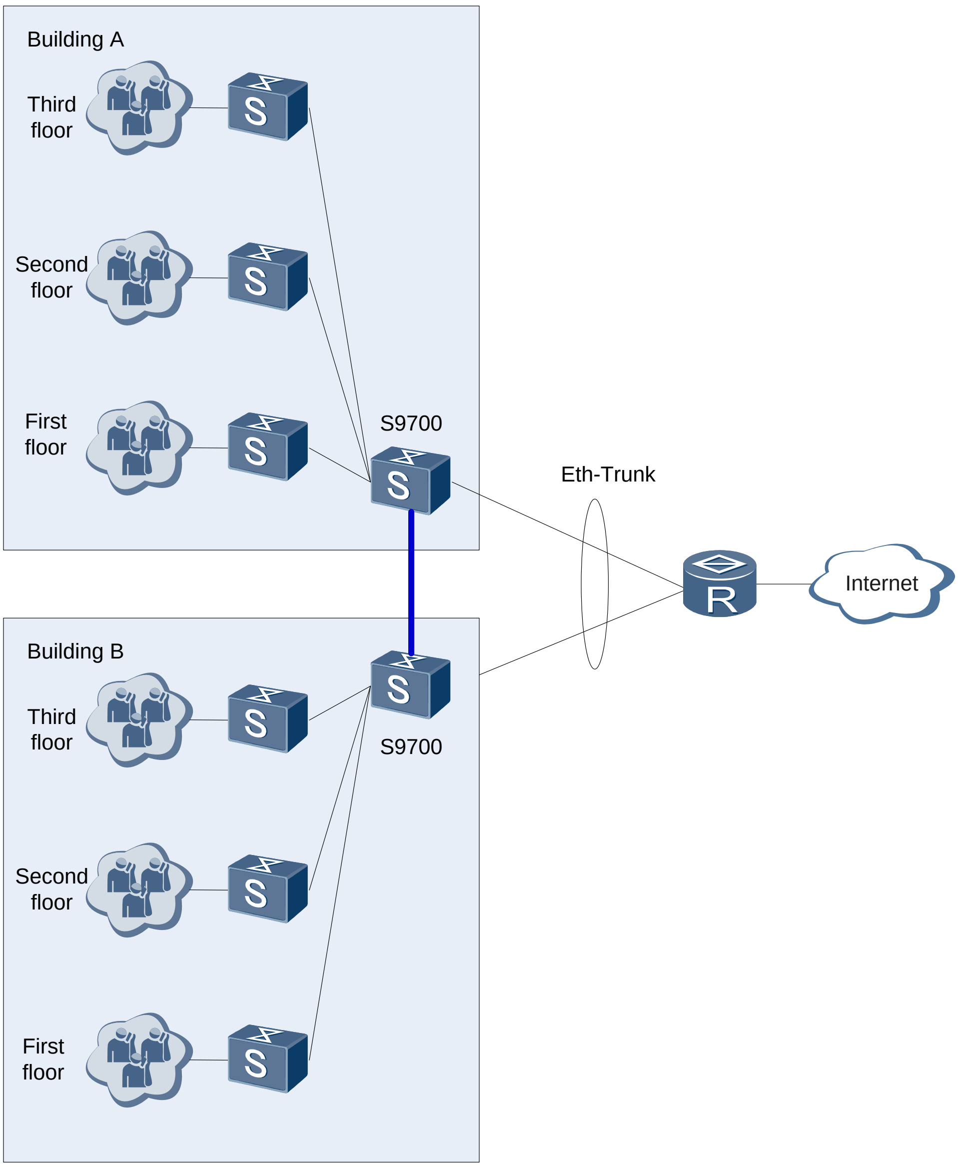
CSS connection modes include CSS card connection and service port connection. In CSS card connection mode, CSS ports on CSS cards are connected to set up a CSS. In service port connection mode, service ports on service cards (LPUs) are connected to set up a CSS.

- CSS card connection: Each MPU can have a CSS card installed, and each CSS card has several CSS ports. When each of two member devices has two MPUs, CSS ports on CSS cards are connected through cluster cables according to certain rules. These CSS ports are bundled into a link aggregation group, in which data load balancing and link backup can be implemented. When several cables become faulty, service traffic can still be forwarded through the other cables. The only disadvantage is that inter-chassis forwarding capacity is decreased.
- Service port connection: Service ports on specific LPUs are added to logical CSS ports, which are then connected through optical modules and fibers or through cluster cables. Multiple physical member ports can be added to the same logical CSS port. These physical member ports are bundled into a link aggregation group for data load balancing and link backup. When several cables become faulty, service traffic can still be forwarded through the other cables. In this case, inter-chassis forwarding capacity is decreased but local forwarding capacity is not affected.

1.2.4 Long-Distance Cluster

Long-distance cluster enables devices far from each other to form a CSS. As shown in Figure 1-5, users at each floor connect to the external network through switches deployed at the corridors and connect to the Internet through aggregation switches. On this networking, there seems to be one aggregation switch between the two buildings, simplifying network structure, improving network robustness, and reducing management and maintenance costs. CSS card connection provides a maximum of 150 m (QSFP+optical module+fiber) transmission distance because of cluster cable limitations. Service port connection provides a maximum of 80 km transmission distance using optical modules. The maximum transmission distance depends on the optical module and cable length and can be increased using an optical repeater.

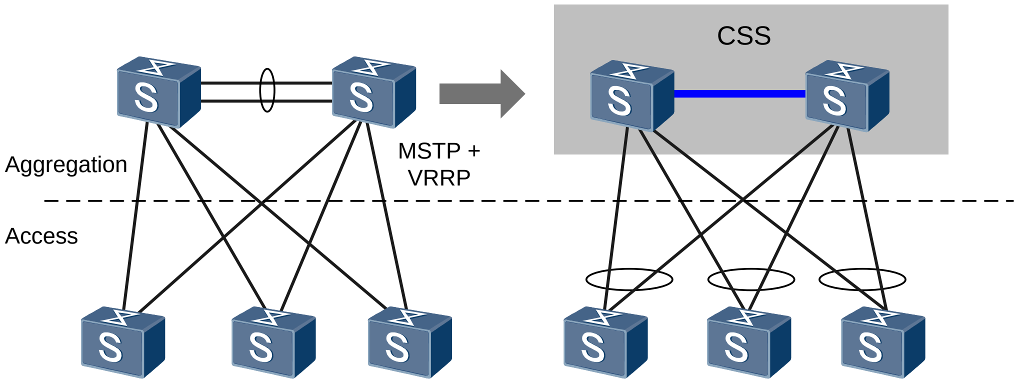
Figure 1-5 Long-distance cluster networking



1.2.5 Simplified Networking

As shown in Figure 1-6, multiple devices at the aggregation layer are virtualized into a logical device through CSS technology. This simplified network does not require MSTP or VRRP, so network configuration is much simpler. Inter-device link aggregation also speeds up network convergence and improves network reliability.

Figure 1-6 Simplified networking



2 Technology Description

2.1 Concepts

- Roles in a CSS
  - Master switch/cluster master: a switch competes to be the master. A CSS has only one master switch. The master switch manages the CSS, collects cluster topology information, and notifies the topology information to all member switches.
  - Standby switch/cluster standby: a switch competes to be the standby and provides backup to the master switch. A CSS has only one standby switch. When the master switch fails, the standby switch takes over all the services of the master switch.
  - CSS active MPU: active MPU of the master switch.
  - CSS standby MPU: active MPU of the standby switch.
  - Chassis active MPU: active MPU of a single chassis.
  - Chassis standby MPU: standby MPU of a single chassis.
  - Cold standby MPU: an MPU that does not participate in control management.
  - CSS card: a card that is exclusively used for setting up a cluster. It is a subcard installed on an MPU.
  - Cluster card: an LPU on which CSS ports are configured in service port connection mode.
- Cluster ID

  A cluster ID uniquely identifies a member switch in a CSS. It is also called a member ID.
- Interface number

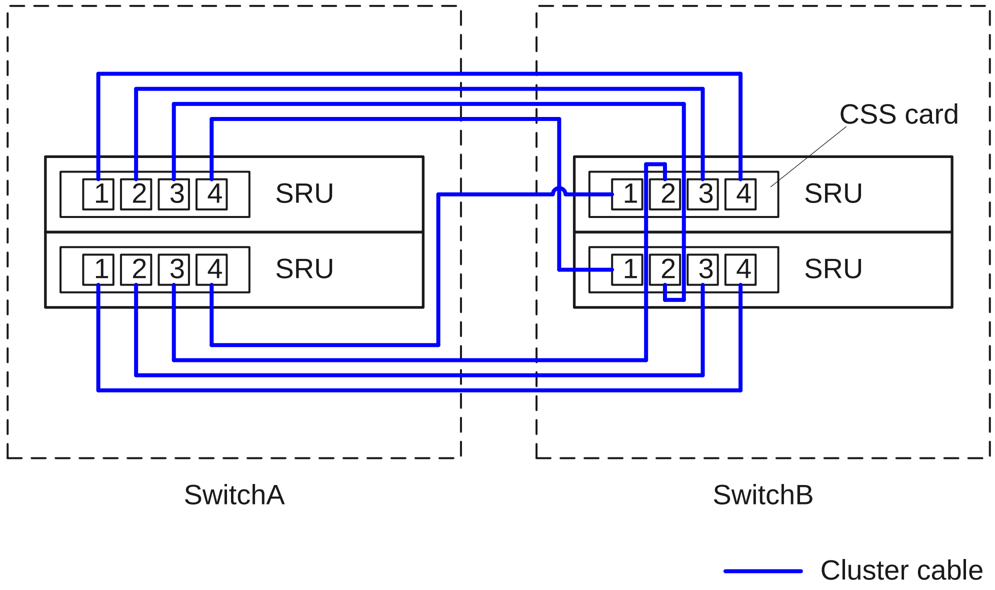
  On a single chassis, the physical interface number is in the format of interface type slot ID/interface card ID/interface sequence number. In a CSS, the physical interface number is in the format of interface type chassis ID/slot ID/interface card ID/interface sequence number.

2.2 Cable Connection for CSS Cards

2.2.1 Cable Connection for SRUA/SRUB

Each SRUA/SRUB can have a VSTSA card installed, and each VSTSA card provides four CSS ports. Install two SRUs on each member switch and connect the CSS ports through cluster cables according to Figure 2-1.

Figure 2-1 Cable connection for SRUA/SRUB



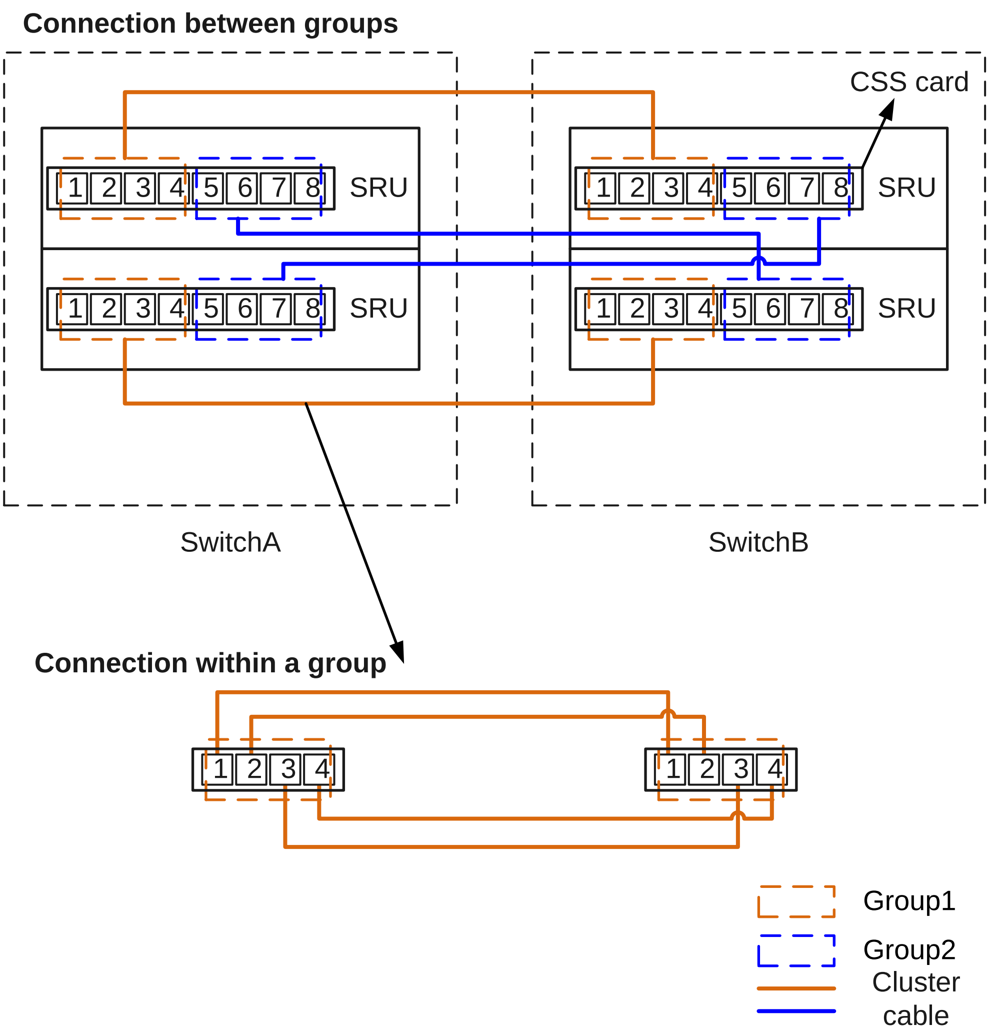
Pay attention to the following points:

- A CSS port must be connected to a certain port. The ports cannot be connected randomly.
- Each member switch in a CSS must be equipped with two SRUs of the same type, SRUA or SRUB. Two member switches in a CSS can have different types of SRUs installed.

2.2.2 Cable Connection for SRUC

Each SRUC can have one VS08 card installed, and each VS08 card provides eight CSS ports numbered from 1 to 8. Ports numbered from 1 to 4 belong to Group1, and ports numbered from 5 to 8 belong to Group2. Install two SRUs on each member switch and connect the CSS ports according to Figure 2-2.

Figure 2-2 Cable connection on SRUC



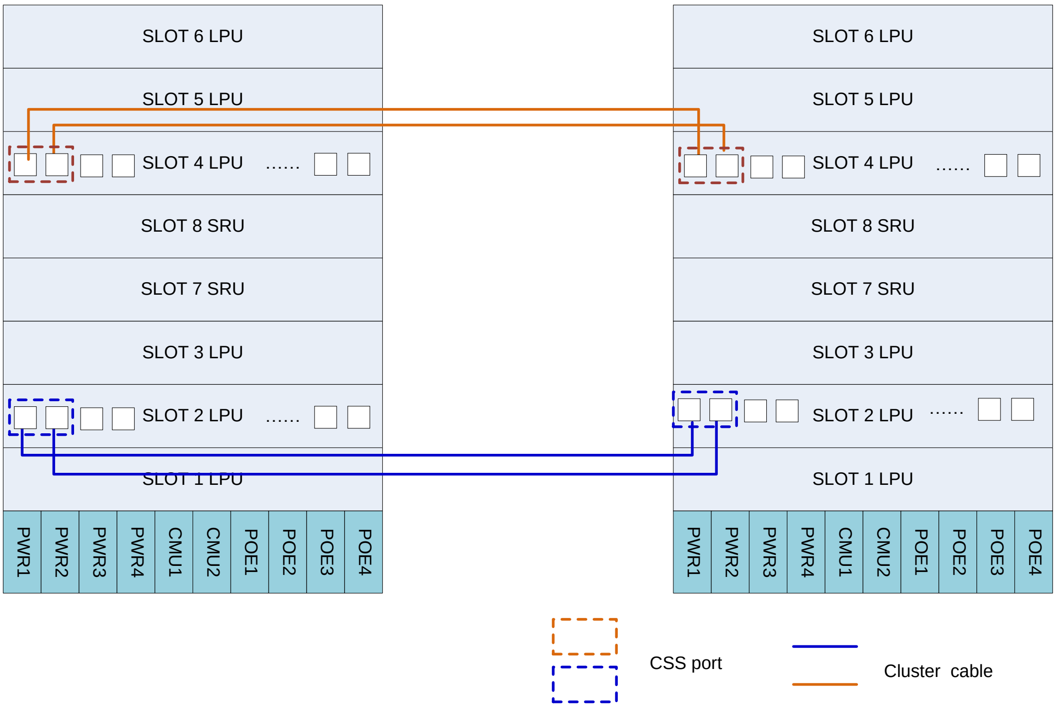
Pay attention to the following points:

- Ports in Group1 on one chassis must be connected to ports in Group1 on the other chassis. Ports in Group2 on one chassis must be connected to ports in Group2 on the other chassis.
- Ports in Group1 and Group2 on the same CSS card must be connected to different CSS cards on the other chassis.
- A port in a group can be connected to any port in the peer group. For example, port 1 can be connected to port 2 in the peer group.

2.3 Cable Connection for Service Ports

Configure a logical CSS port, configure service ports on a specific LPU as physical member ports, and add the physical member ports to the logical CSS port. Connect physical member ports through optical modules and fibers or through cluster cables according to Figure 2-3 to form a service port CSS. Service port connection has flexible networking without being limited by the numbers of logical CSS ports and CSS links.

Figure 2-3 Cable connection for service ports



Service ports are connected in two ways according to link distribution:

- 1+0 networking: Configure one logical CSS port and connect physical member ports on one LPU through the CSS link on the LPU for connection.
- 1+1 networking: Configure two logical CSS ports and connect physical member ports on two LPUs through the CSS links on the LPUs for link backup.

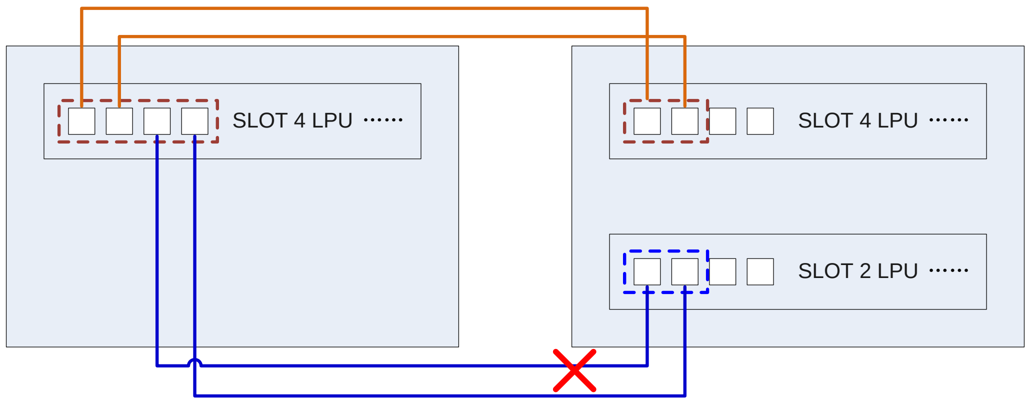
NOTE

To prevent loops during packet forwarding, the system blocks one logical CSS port when forwarding unknown unicast, multicast, and broadcast packets. You can run the **display css css-port all** command to check the blocked CSS port.

To ensure CSS stability, pay attention to the following points in service port connection mode:

- Physical member ports in a logical CSS port on one chassis must connect to physical member ports in a logical CSS port on the other chassis. Figure 2-4 shows the incorrect service port connection.

Figure 2-4 Incorrect cable connection for service ports



- In 1+1 networking, two cards must have the same number of CSS links and use ports with the same rate as physical member ports. If a CSS needs to be set up between two S9712s or S7712s, deploy two LPUs symmetrically on both sides of the MPU, for example, deploy two LPUs in slots 6 and 7, slots 5 and 8, or slots 1 and 12 respectively. This requirement does not apply to the S9706 or S7706.
- In 1+0 networking, if a fault occurs on the LPU where physical member ports reside, the CSS splits. Therefore, 1+1 networking is recommended.

Table 2-1 lists the LPUs supporting service port CSS.

Table 2-1 LPUs supporting service port CSS

LPU	Port Type	Number of Ports on the LPU	Maximum Number of Physical Member Ports in a Logical CSS Port	Recommended Configuration	Remarks
X12SSA	SFP+	12	1 to 12	7(140G)	-
X40SFC	SFP+	40	1 to 32	7(140G)	-
X16SFC	SFP+	16	1 to 16	7(140G)	-
X08SED	SFP+	8	1 to 4	4(80G)	-
L08QFC	QSFP+	8	1 to 8	2(160G)	Supported only on the S9700.
L02QFC	QSFP+	2	1 to 2	2(160G)	

2.4 CSS Packets

A CSS involves the following packets:

- Competition packets
  - Token query
  - Token query response
  - Competition result notification
- Link detection packets
  - Link broadcast packet
- State maintenance packets
  - Hello packet
  - Cluster split notification
- Event notification packets
  - Switchover notification
  - Alarm notification
  - Card separation notification
  - Card separation recovery notification
  - Configuration recovery complete notification

2.5 CSS Setup

As shown in Figure 2-5, a CSS is set up automatically after two switches are connected through cluster cables and enabled with the CSS function. Then one switch competes to be the master switch, and the other becomes the standby switch.

The rules for electing the master switch are as follows:

- The switch that starts and runs the CSS first becomes the master switch.
- When two switches complete startup at the same time, the switch with the highest CSS priority becomes the master switch.
- If two switches complete startup at the same time and have the same CSS priority, the switch with the smallest MAC address becomes the master switch.

Before a CSS is set up, each switch is an independent entity and has its own IP address. You need to manage the switches separately. After a CSS is set up, the switches in the CSS form a logical entity, and you can use a single IP address to manage and maintain the switches uniformly. The IP address and MAC address of the CSS is the IP address and MAC address of the master switch when the CSS is set up for the first time.

All the cards in the CSS register with the active MPU of the CSS. After the registration, the configuration data is restored through the configuration file on the active MPU of the CSS. The configuration restoration process of the CSS is the same as that of a single switch.

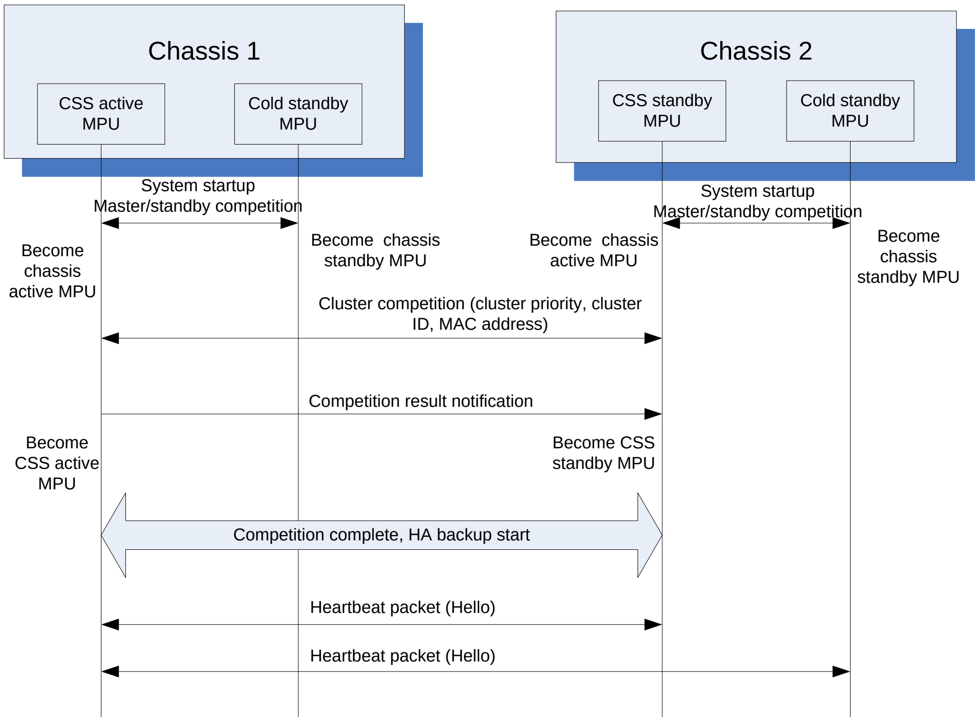
When a device enters the CSS state, it adds the file name extension .bak to the original configuration file to back up the original configuration file. This ensures that the device can restore its original configuration after the CSS function is disabled.

- If the original file name extension of the configuration file is .cfg, the file name extension of the backup configuration file is .cfg.bak.

- If the original file name extension of the configuration file is .zip, the file name extension of the backup configuration file is .zip.bak.

If you want to restore the original configuration after disabling the CSS function, change the extension of the backup configuration file and specify the file as the configuration file for next startup. Then restart the device to restore the original configuration.

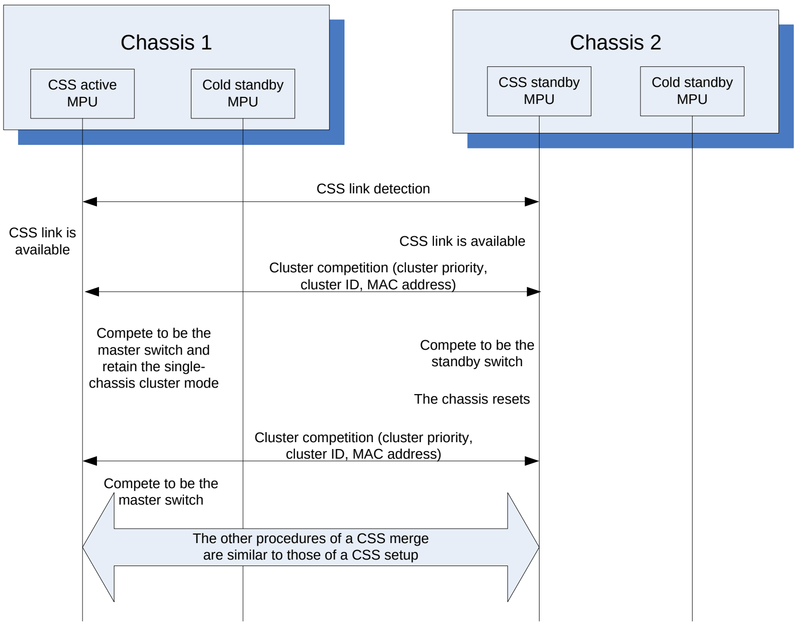
Figure 2-5 CSS setup process



2.6 CSS Merge

As shown in Figure 2-6, two stable CSS-capable switches (single-chassis CSS) can be merged into one new double-chassis CSS. The superior switch between the master switches of the two CSSs is selected as the master switch of the new CSS. On the master switch, the configuration remains unchanged, services are not affected, and the standby MPU restarts. The standby switch restarts and joins the new CSS as the cluster standby (the CSS merge fails if the standby switch has the same cluster ID as the master switch) and synchronizes the configuration with the master switch, but existing services on the standby switch are interrupted.

Figure 2-6 CSS merge process

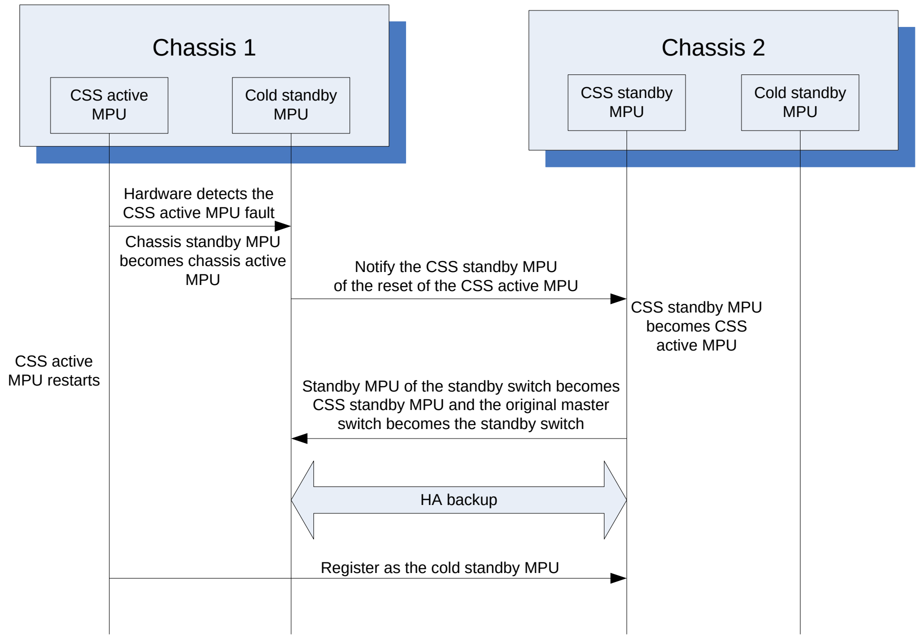


2.7 CSS Active/Standby Switchover

- When an active/standby switchover occurs on the master switch:
  - The original standby switch of the CSS becomes the new master switch, and the original CSS standby MPU becomes the new CSS active MPU.
  - The original master switch of the CSS becomes the new standby switch.
  - The original CSS active MPU restarts.
  - The standby MPU of the original master switch becomes the new CSS standby MPU and synchronizes data with the new CSS active MPU.
- When an active/standby switchover occurs on the standby switch:
  - The master and standby switches of the CSS do not change their roles.
  - The active MPU (original CSS standby MPU) of the standby switch restarts.
  - The standby MPU of the standby switch becomes the new CSS standby MPU and synchronizes data with the new CSS active MPU.
- If you run the **slave switchover** command to perform an active/standby switchover:
  - The original standby switch of the CSS becomes the new master switch, and the original CSS standby MPU becomes the new CSS active MPU.
  - The original master switch of the CSS becomes the new standby switch.
  - The original CSS active MPU restarts.
  - The standby MPU of the original master switch becomes the new CSS standby MPU and synchronizes data with the new CSS active MPU.

Figure 2-7 shows the process of an active/standby switchover on the master switch of the CSS.

Figure 2-7 Active/standby switchover on the master switch of the CSS



2.8 Fast CSS Upgrade

Fast CSS upgrade is a mechanism that upgrades the software versions of member switches in a CSS without interrupting service forwarding. This mechanism reduces the impact of device upgrade on services.

During fast CSS upgrade, the standby switch restarts using the new version, and the master switch forwards data traffic. If the upgrade fails, the standby switch restarts and rolls back to the previous version. After the standby switch is upgraded, it becomes the master switch and forwards data traffic. The previous master switch restarts using the new version. After the upgrade, the switch becomes the standby switch

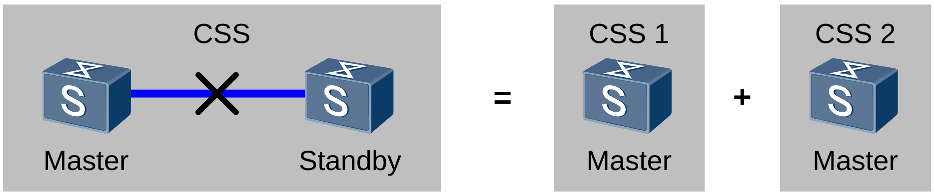
NOTE

A device connected to the CSS must be connected to the two member switches in the CSS, and the function that forwards traffic preferentially through a local port is configured. Otherwise, data traffic may be interrupted.

2.9 CSS Split

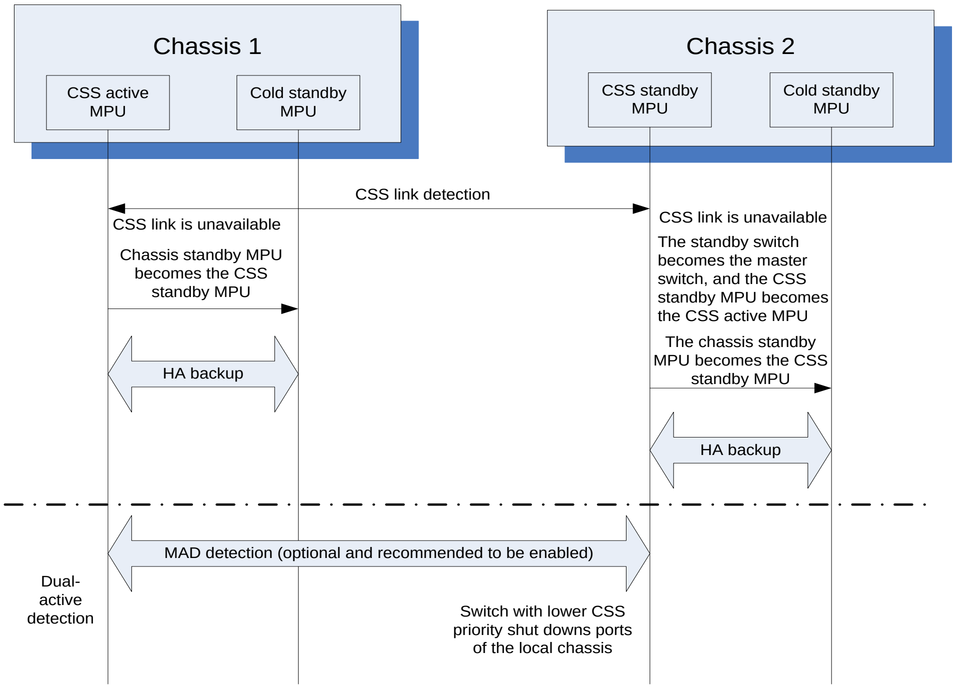
After a CSS is set up, the CSS active and standby MPUs periodically send heartbeat packets to each other to maintain the CSS status. If faults occur on cluster cables, CSS cards, or MPUs, communication between two switches may fail, causing the timeout of heartbeat packets transmitted between the two switches. The CSS is then split into two independent switches, as shown in Figure 2-8.

Figure 2-8 CSS split



If the two switches run properly after the CSS splits, they use the same IP address and same MAC address to communicate with other devices on the network because their global configurations are the same. This causes conflicts of IP addresses and MAC addresses and faults on the entire network.

Figure 2-9 CSS split process



2.10 Address Conflict Detection After a CSS Split

All the switches in a CSS use the same IP address and MAC address. A CSS split during network operation can result in the conflict of IP addresses and MAC addresses. After a CSS splits, IP address and MAC address conflict detection must be performed.

Multi-active detection (MAD) is a protocol that can detect CSS split and multiple-master situations and take recovery actions to minimize impact of a CSS split on services. Two MAD modes are available: direct mode and relay mode.

When a CSS is split into two CSSs, the two CSSs send MAD competition packets to each other over the MAD link. If the local switch competes to be the master switch, the switch forwards service packets properly. If the local switch competes to be the standby switch, the switch shuts down all the service ports except reserved ports and stops forwarding service packets.

When the faulty CSS link recovers, the CSS in which service ports are shut down restarts and restores the shutdown ports to Up state. The entire CSS then recovers.

2.10.1 MAD Packet Format

MAD uses Bridge Protocol Data Units (BPDUs) to carry master/standby competition information about two chassis. The MAD packet format is as follows:

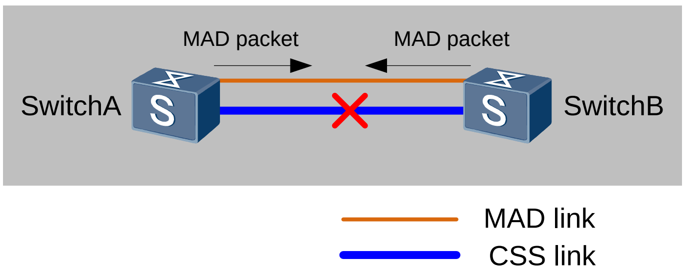
DA_MAC (6 bytes)	SA_MAC (6 bytes)	ProtocolType (2 bytes)	Payload (variable)

- DA_MAC: 01-80-C2-00-00-0A
- SA_MAC: chassis system MAC address
- ProtocolType: 0x9997
- Payload: competition information about the two chassis, including the chassis ID, MPU slot ID, cluster priority, and chassis system MAC address

2.10.2 Direct Mode

In direct mode, member switches do not send MAD packets when the CSS is running properly, to reduce loads of their CPUs. When the CSS splits, member switches send MAD packets over the MAD link at an interval of 1s. If a member switch receives a MAD packet from the other member switch, a dual-active scenario occurs.

Figure 2-10 MAD in direct mode



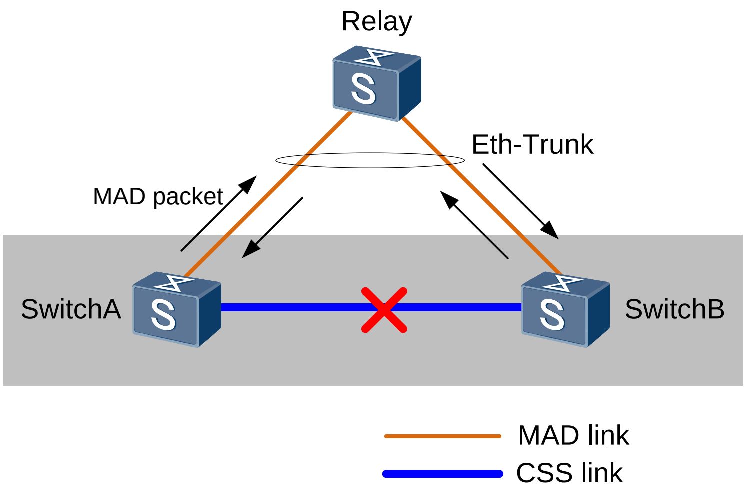
The MAD process in direct mode is as follows:

1. When the CSS is running properly, member switches do not send MAD packets.
2. After the CSS splits, member switches send MAD packets to each other at an interval of 1s. The MAD packets carry competition information including the chassis ID, MPU slot ID, cluster priority, and chassis system MAC address.
3. After a member switch receives a MAD packet from the other member switch, a dual-active scenario occurs, and master/standby competition must be performed. The switch that competes to be the standby switch shuts down all the service ports except reserved ports.

2.10.3 Relay Mode

In relay mode, when the CSS is running properly, member switches send MAD packets over the MAD links at an interval of 30s, and they do not process the received MAD packets. After the CSS splits, member switches send MAD packets at an interval of 1s. If a member switch receives a MAD packet from the other member switch, a dual-active scenario occurs.

Figure 2-11 MAD in relay mode



The MAD process in relay mode is as follows:

1. When the CSS is running properly, member switches send MAD packets over an Eth-Trunk at an interval of 30s.
   - Switch A sends MAD packets that carry competition information including the chassis ID, MPU slot ID, cluster priority, and chassis system MAC address.
   - The relay receives MAD packets, learns the outbound interface to establish the forwarding table, and forwards MAD packets within the Eth-Trunk to the other member switch.
   - SwitchB does not process the MAD packets received from SwitchA.
   - SwitchB sends MAD packets in a similar manner to SwitchA.
2. After the CSS splits, member switches send MAD packets at an interval of 1s.
   - Member switches send MAD packets immediately after detecting the CSS split. SwitchA and SwitchB send MAD packets immediately after detecting the CSS split.
   - The relay forwards MAD packets.
   - SwitchA and SwitchB receive MAD packets. They determine that the CSS splits and compare their cluster priorities. The switch that competes to be the standby switch shuts down all the service ports except reserved ports.

NOTE

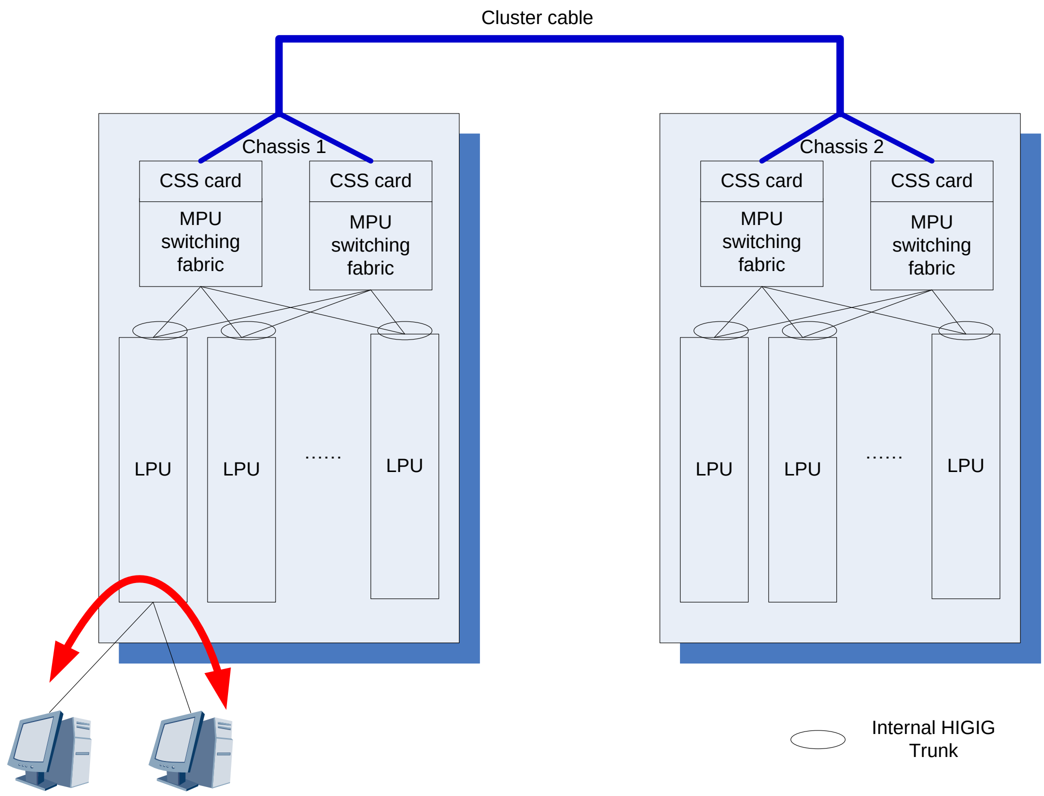
In a CSS, you can only configure MAD in direct mode or MAD in relay mode but cannot configure both MAD in direct mode and MAD in relay mode.

2.11 Packet Forwarding in CSS Card Connection Mode

2.11.1 Intra-LPU Unicast Packet Forwarding

Unicast packets transmitted within an LPU are forwarded within the LPU and do not need to be forwarded by the switching fabric.

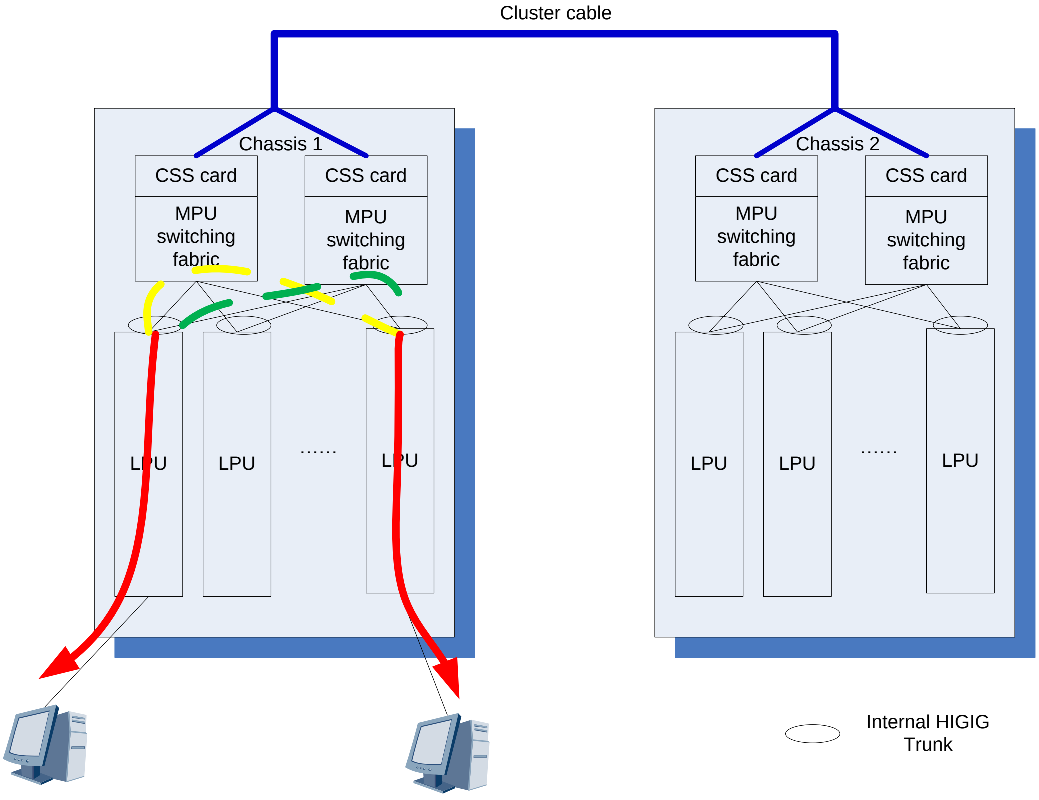
Figure 2-12 Intra-LPU unicast packet forwarding



2.11.2 Inter-LPU Unicast Packet Forwarding Within the Same Chassis

Unicast packets transmitted between different LPUs within the same chassis are forwarded by the local switching fabric but do not need to be forwarded between chassis.

Figure 2-13 Inter-LPU unicast packet forwarding within the same chassis

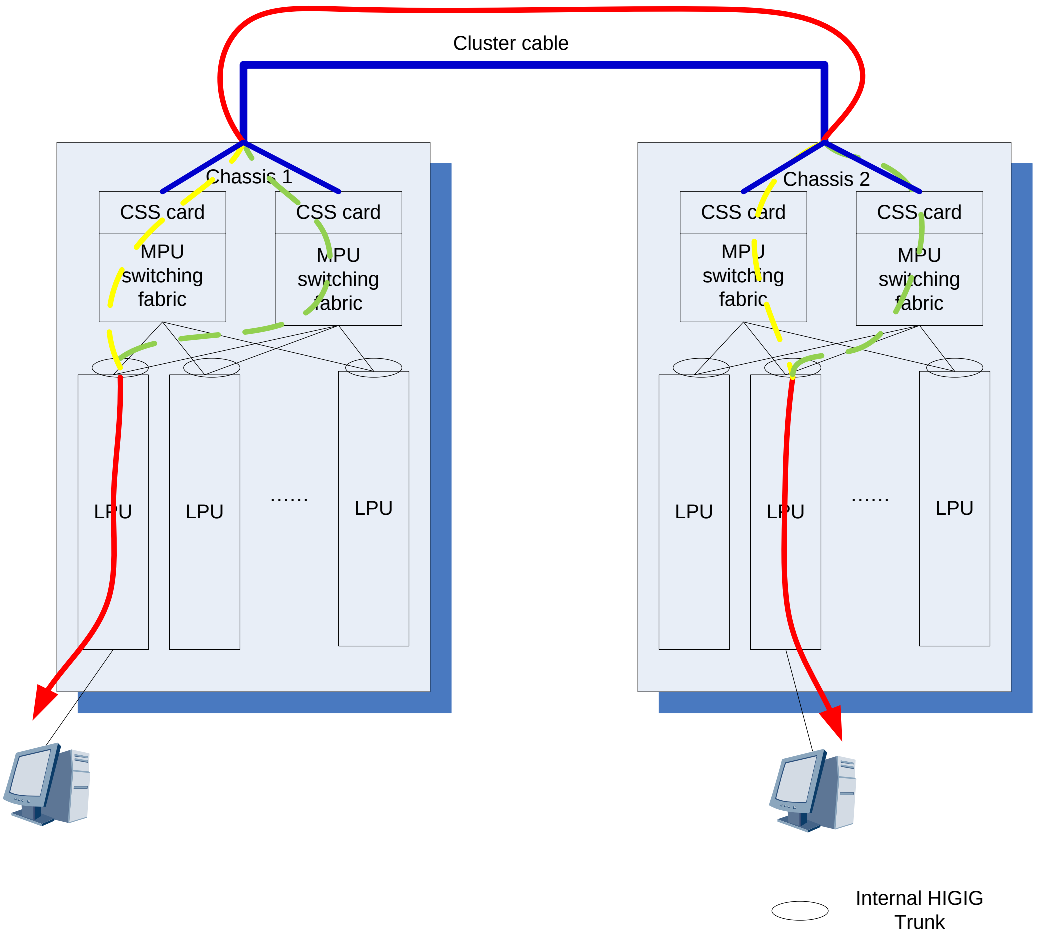


In Figure 2-13, the dashed line in yellow and dashed line in green indicate the possible paths for unicast data. Path selection depends on the HIGIG link aggregation path selection.

2.11.3 Inter-Chassis Unicast Packet Forwarding

Unicast packets transmitted between two chassis are switched by the switching fabric of the local chassis to the switching fabric of the remote chassis through the cluster cable and are switched to the specific LPU, and then to the specific port.

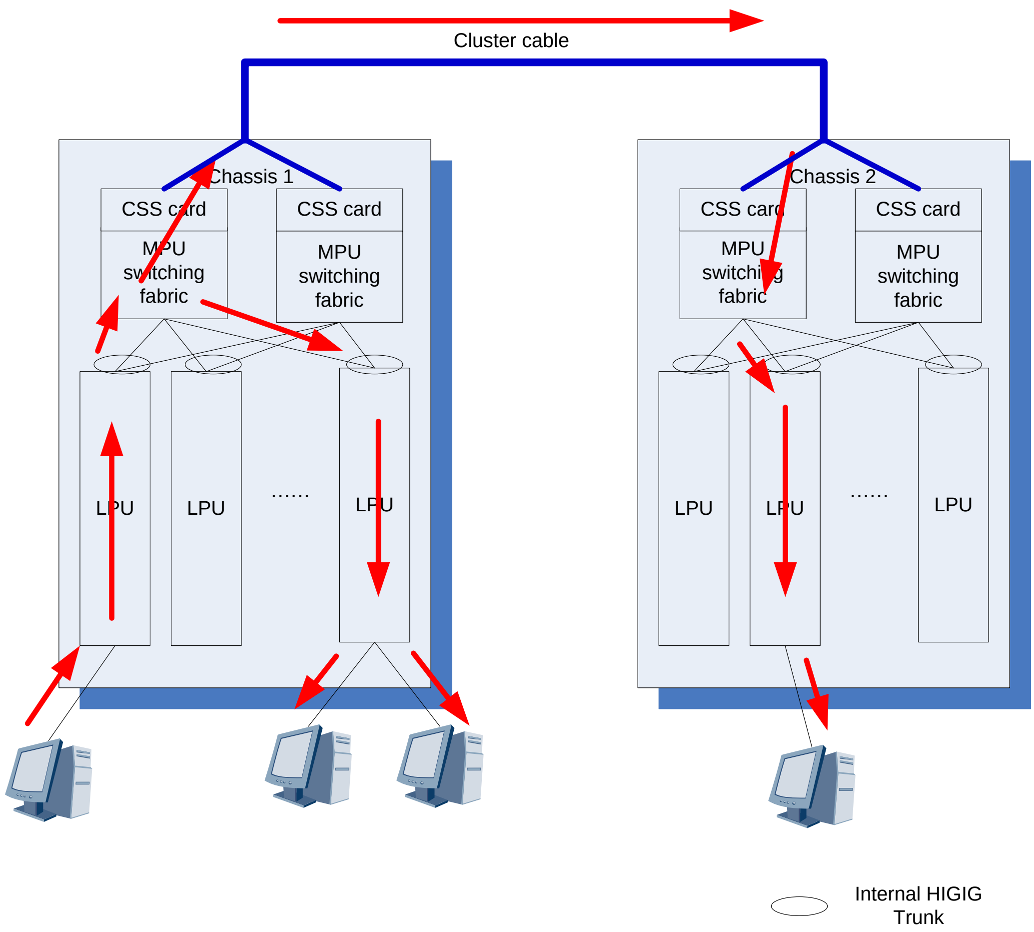
Figure 2-14 Inter-chassis unicast packet forwarding



2.12 Unknown Unicast, Multicast, and Broadcast Packet Forwarding

Unknown unicast, multicast, and broadcast packets are broadcast within a VLAN. If the remote chassis has ports that are added to the VLAN, the packets are broadcast to the remote chassis.

Figure 2-15 Unknown unicast, multicast, and broadcast packet forwarding



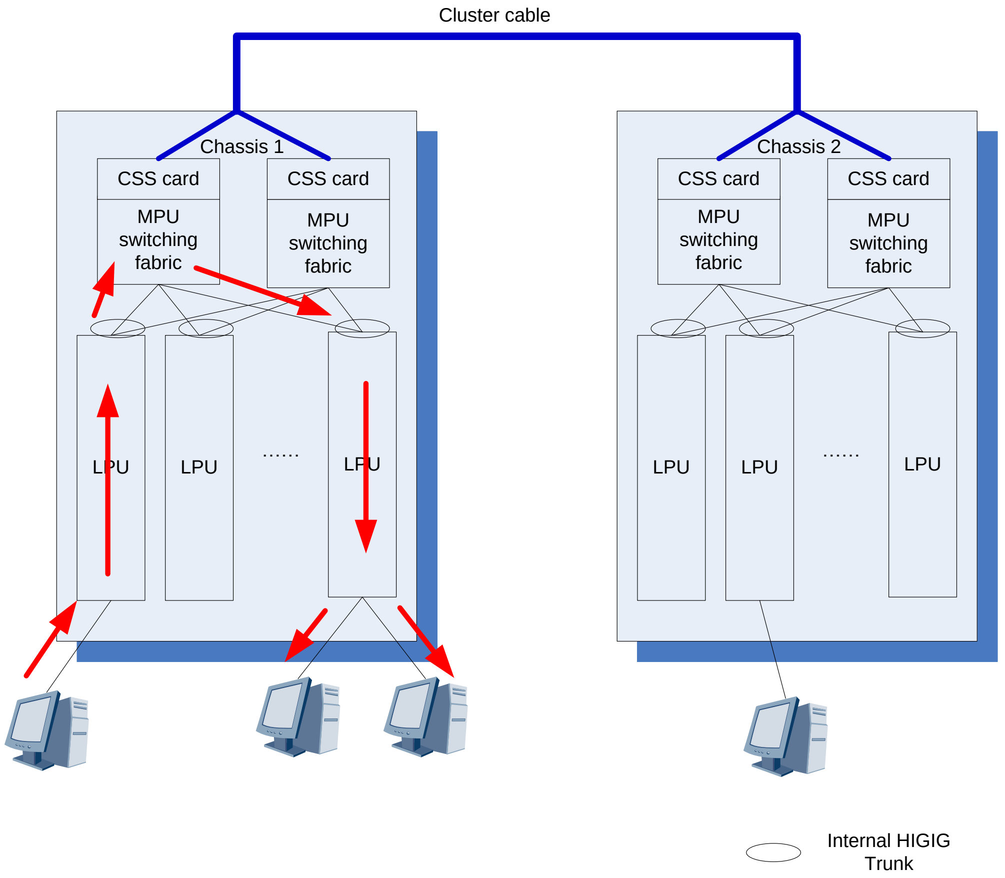
2.13 Multicast Packet Forwarding

Known multicast packets are replicated according to multicast entries.

- Inter-LPU multicast replication of the local chassis

  Packets are replicated to the switching fabric, which then replicates the packets to the specific LPU. The packets are replicated on the LPU. If inter-chassis traffic replication is not performed, cluster cable bandwidth is not used.

Figure 2-16 Inter-LPU multicast packet forwarding of the local chassis

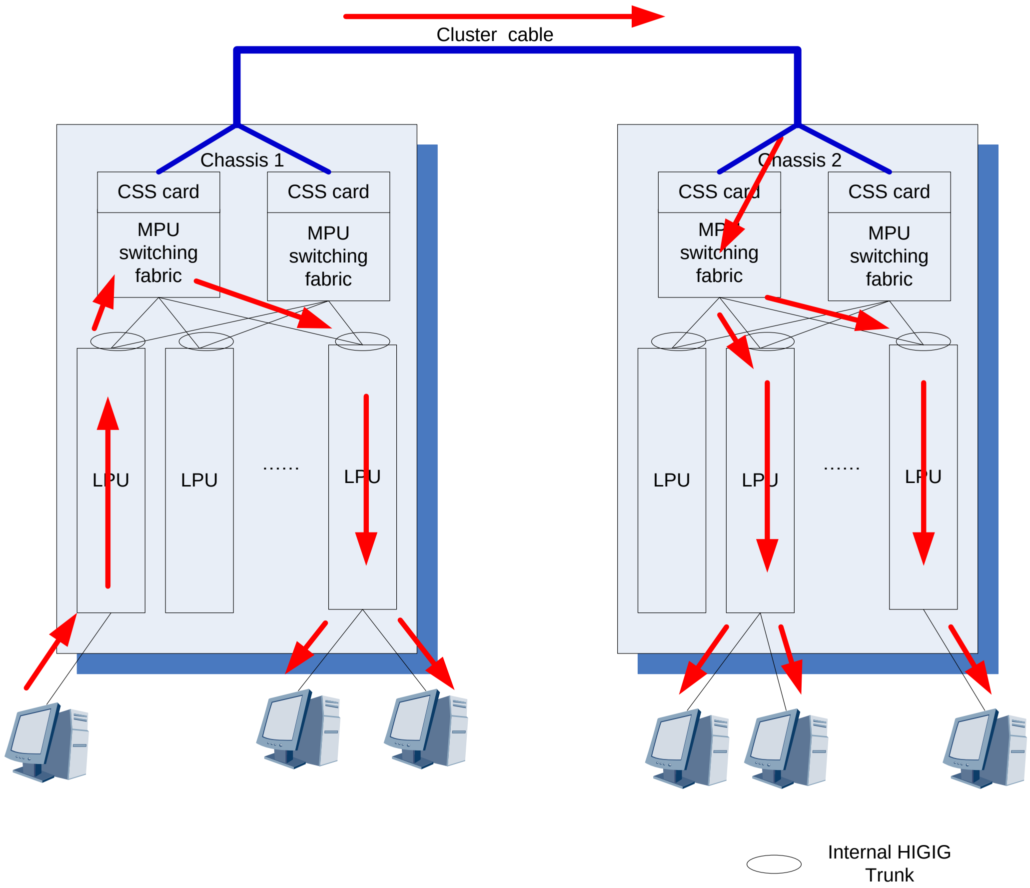


- Inter-chassis multicast replication

  Packets are replicated to the switching fabric, which then replicates the packets to the remote switching fabric through the cluster cable. The remote switching fabric replicates the packets to the specific LPU. The packets are replicated on the LPU.

  Inter-chassis multicast packet forwarding requires inter-chassis traffic replication and occupies cluster cable bandwidth.

Figure 2-17 Inter-chassis multicast packet forwarding



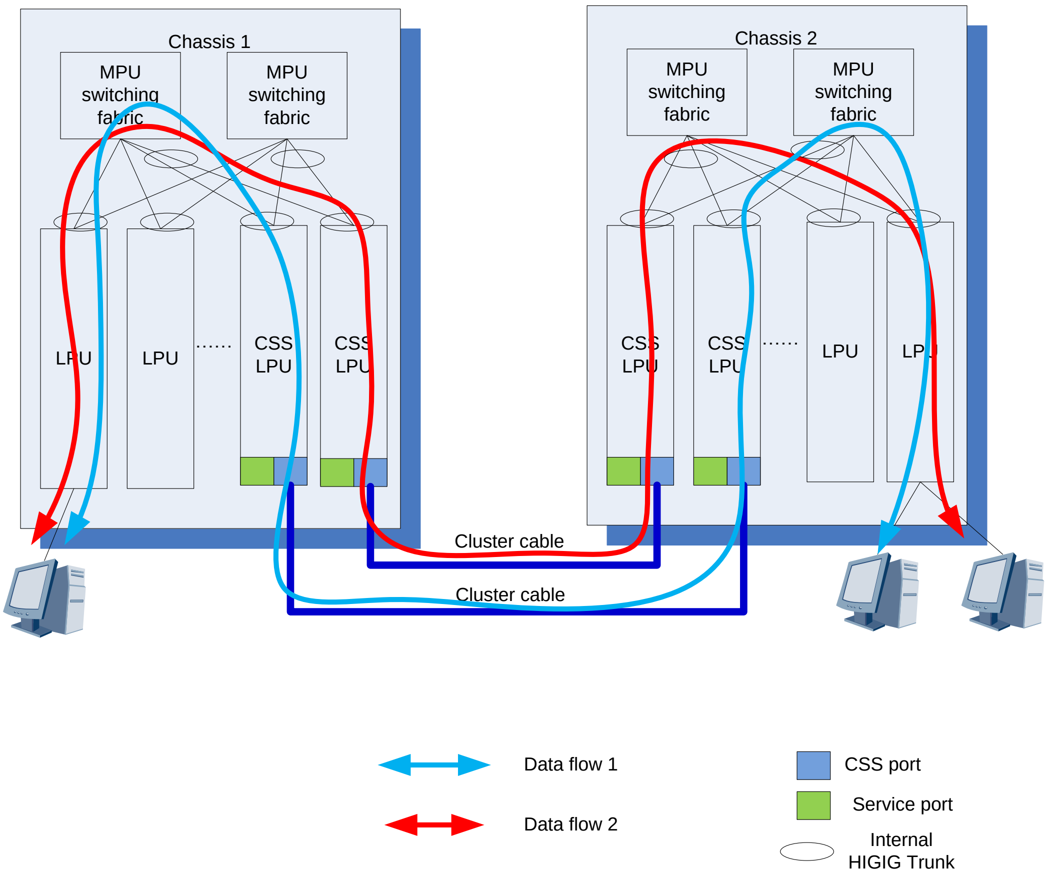
2.14 Packet Forwarding in Service Port Connection Mode

Unicast packet forwarding within an LPU or a chassis in service port connection mode is similar to that in CSS card connection mode.

2.14.1 Inter-Chassis Unicast Packet Forwarding

Different unicast data flows are load balanced on two CSS LPUs. In Figure 2-18, data flow in red and data flow in green are load balanced on two CSS LPUs.

Figure 2-18 Inter-chassis unicast packet forwarding

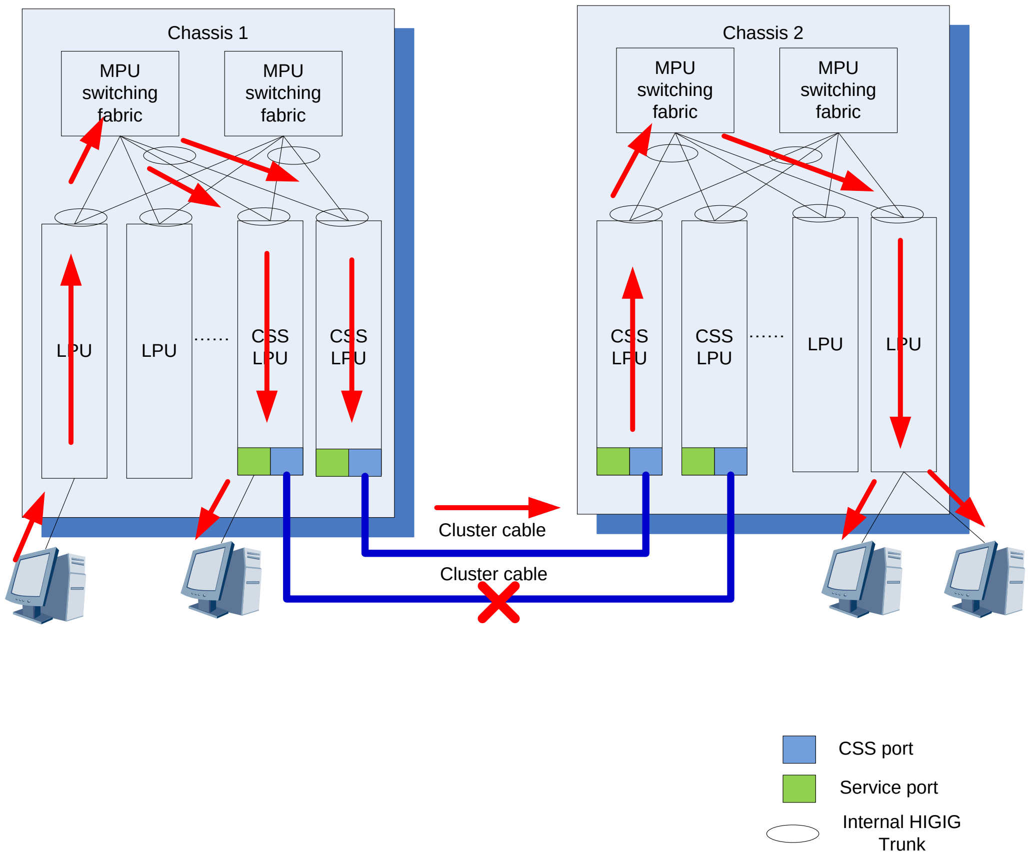


Known unicast traffic received by a CSS LPU is directly forwarded by the CSS LPU.

2.14.2 Unknown Unicast, Multicast, and Broadcast Packet Forwarding

Unknown unicast, multicast, and broadcast packets cannot be load balanced on two CSS LPUs. To prevent data packet loops, the system blocks one of the two CSS links.

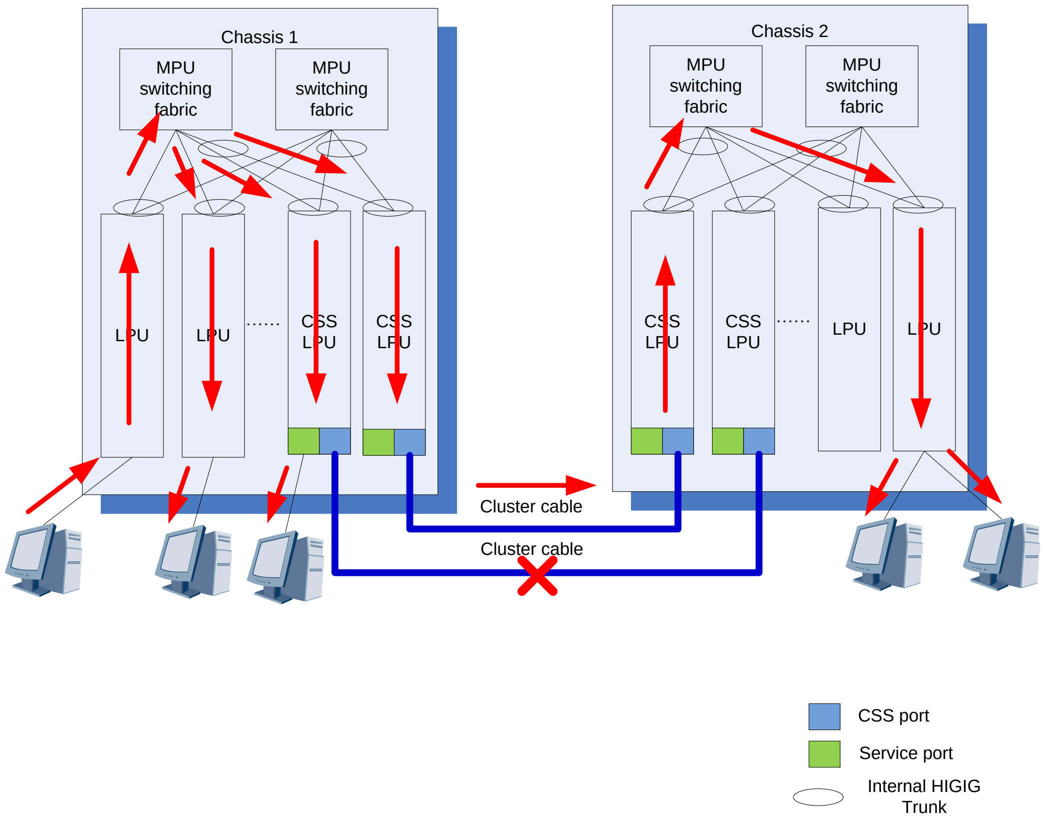
Figure 2-19 Unknown unicast, multicast, and broadcast packet forwarding



2.14.3 Multicast Packet Forwarding

Known multicast packets are replicated according to multicast entries. Multicast packet forwarding of the local chassis in service port connection mode is similar to that in CSS card connection mode. Inter-chassis multicast packet forwarding in service port connection mode is different from that in CSS card connection mode. In CSS card connection mode, inter-chassis multicast replication is performed by the switching fabric; in service port connection mode, inter-chassis multicast replication is performed by the LPU.

Figure 2-20 Multicast packet forwarding

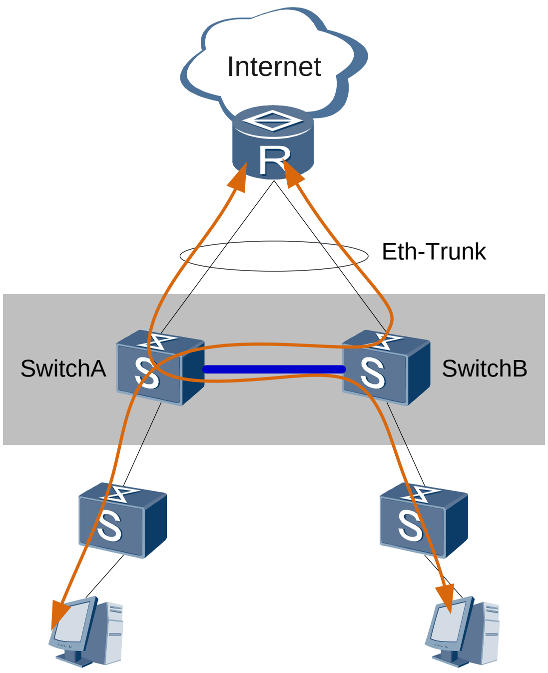


2.15 Eth-Trunk Preferentially Forwarding Local Traffic

The cluster cable bandwidth is limited. To improve forwarding efficiency and reduce inter-chassis forwarded traffic, you need to configure an Eth-Trunk to preferentially forward local traffic. Then traffic received by the local chassis is first forwarded from the interface of the local chassis. If the interface becomes faulty or the traffic reaches the line rate of the interface, the traffic is forwarded from the interface of the remote chassis.

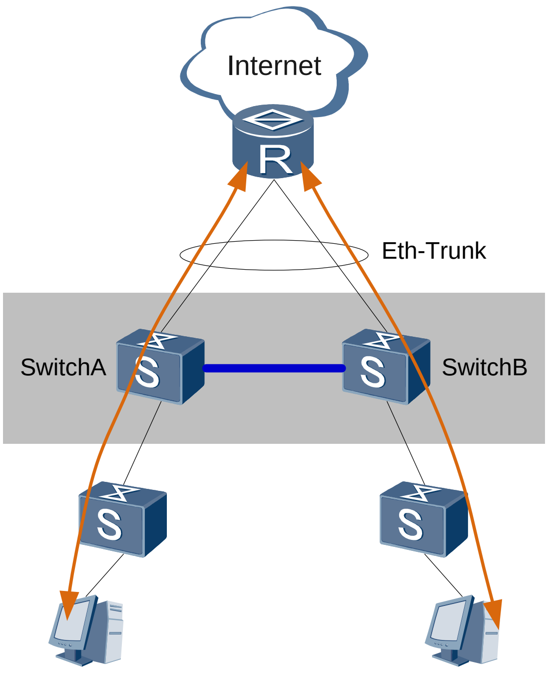
As shown in Figure 2-21, SwitchA and SwitchB form a CSS, and their uplink interfaces are added to an Eth-Trunk. If preferential local traffic forwarding is not configured, traffic received by a member switch is forwarded from the physical interface of the other member switch through the cluster cable. However, the limited cluster cable bandwidth restricts traffic forwarding performance.

Figure 2-21 Non-preferential forwarding of local traffic



After preferential forwarding of local traffic is configured, traffic received by a member switch is first forwarded from the interface of the local chassis without passing through the cluster cable.

Figure 2-22 Preferential local traffic forwarding



NOTE

The function that preferentially forwards local traffic applies only to unicast data flows but not to broadcast, multicast, or unknown unicast data flows.

3 Product Capabilities

NOTE

The product capabilities in this section are subject to change without notice because of version upgrades. For details about product capabilities, see the specifications lists of products.

3.1 Hardware Cluster Parameters

Table 3-1 Cluster parameters supported by S series switches

Parameter	S9706/S9712	S7706/S7712
Start version supporting CSS	CSS card connection: V200R003C00 Service port connection: V200R003C00	CSS card connection: V100R006C00 Service port connection: V200R002C00
Maximum number of member switches	2	2
Cluster bandwidth	Bidirectional 160G*2 (CSS card connection) 640G*2 (service port connection)	Bidirectional 128G*2 (CSS card connection) 240G*2 (service port connection)
Cluster cable	CSS card connection: The SRUC provides 10GE interfaces, which use the same cable type as 10GE interfaces in service port connection mode. Service port connection: 10GE interface: • 1 m and 3 m SFP+ passive cables (including optical-to-electrical	CSS card connection: QSFP+ passive cable (including optical-to-electrical modules) with the length of 10 m QSFP+ optical module + fiber with the maximum length of 150 m Service port connection: 10GE interface: • 1 m and 3 m SFP+ passive cables (including optical-to-electrical

Parameter	S9706/S9712	S7706/S7712
	modules) • 10 m SFP+ passive cables (including optical-to-electrical modules) • All SFP+ optical modules supported by the device and fibers • 3 m and 10 m AOC fibers (including optical-to-electrical modules) 40GE interface: • 1 m, 3 m, and 5 m QSFP+ passive cables (including optical-to-electrical modules) • All QSFP+ optical modules supported by the device and fibers	modules) • 10 m SFP+ passive cables (including optical-to-electrical modules) • All SFP+ optical modules supported by the device and fibers • 3 m and 10 m AOC fibers (including optical-to-electrical modules) • 40GE interface: • 1 m, 3 m, and 5 m QSFP+ passive cables (including optical-to-electrical modules) • All QSFP+ optical modules supported by the device and fibers
SRU type	CSS card connection: SRUC Service port connection: SRUC and SRUD	CSS card connection: SRUA and SRUB Service port connection: SRUA and SRUB
Cluster card type	CSS card (in CSS card connection mode): VS08 card LPU (in service port connection mode) X12SSA (12*10G) X40SFC (40*10G) X16SFC (16*10G) X08SED (8*10G) L02QFC (2*40G) L08QFC (8*40G)	CSS card (in CSS card connection mode): VSTSA card LPU (in service port connection mode) X12SSA (12*10G) X40SFC (40*10G) X16SFC (16*10G) X08SED (8*10G) L02QFC (2*40G)
Whether switches of different models can form a CSS	Allows S9706 and S9712 to form a CSS.	Allows S7706 and S7712 to form a CSS.

3.2 High-Speed Cluster Cable Type

Cable	S9706/S9712	S7706/S7712
1 m SFP+ passive	√	√
3 m SFP+ passive	√ Not supported by the X12SSA card	√ Not supported by the X12SSA
10 m SFP+ active	√	√
1 m QSFP+ passive	√	√
3 m QSFP+ passive	√	√
5 m QSFP+ passive	√	√
10 m QSFP+ passive (supported only by CSS cards)	×	√

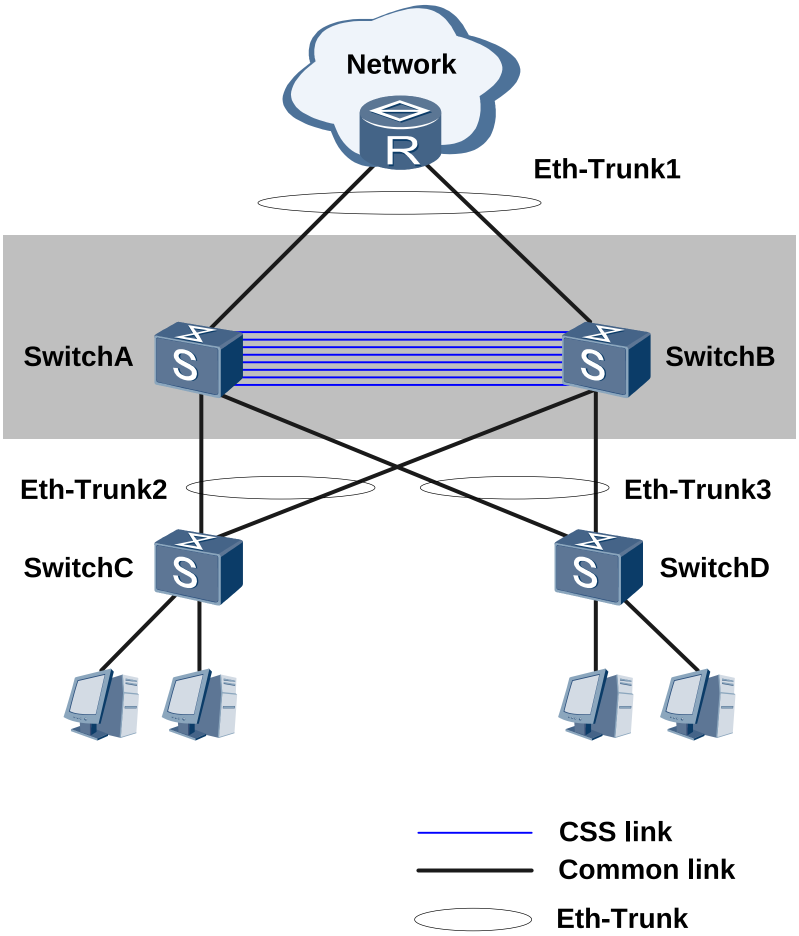
4 Application Scenarios

4.1 Configuring CSS Card Connection

As the network scale rapidly increases, the forwarding capability of a single core switch cannot meet service requirements. To meet these requirements, the network forwarding capability needs to be doubled without increasing the existing investment, device redundancy backup is required to improve network reliability, and the network must be easy to manage and maintain.

As shown in Figure 4-1, SwitchA and SwitchB form a CSS. Users connect to SwitchC and SwitchD, which connect to the CSS through Eth-Trunks 2 and 3 respectively. The CSS connects to the uplink network through Eth-Trunk 1.

Figure 4-1 Diagram of configuring CSS card connection



Configuration Roadmap

1. Configure the cluster ID, cluster priority, and CSS connection mode for switches to enable switches to form a CSS.
2. Enable the CSS function on the switches and restart the switches to make the configuration take effect and ensure that the CSS is set up successfully.

Configuration Procedure

Step 1 Connect switches through cables correctly.

Step 2 Set the cluster priority and cluster ID of SwitchA to 255 and 1 and set the CSS connection mode to CSS card connection. Set the cluster ID of SwitchB to 2 and the CSS connection mode to CSS card connection.

```
<Quidway> system-view
[Quidway] sysname SwitchA
[SwitchA] set css priority 255
[SwitchA] set css id 1
[SwitchA] set css mode css-card
<Quidway> system-view
[Quidway] sysname SwitchB
```

```
[SwitchB] set css id 2
[SwitchB] set css mode css-card
```

Step 3 Enable the CSS function on the switches. The configuration takes effect after the switches are restarted.

```
[SwitchA] css enable
Warning: The CSS configuration takes effect only after the system is rebooted. The next
CSS mode is css-card. Reboot now? [Y/N]: y
[SwitchB] css enable
Warning: The CSS configuration takes effect only after the system is rebooted. The next
CSS mode is css-card. Reboot now? [Y/N]: y
```

Step 4 Verify the configuration.

Check the CSS status.

```
<SwitchA> display css status all
Property Item        Property Value
Chassis ID          1
Priority             255
Enable switch         On
CSS master force       Off
CSS status           master
CSS mode           css-card
Property Item         Property Value
Chassis ID           2
Priority            1
Enable switch         On
CSS master force       Off
CSS status           backup
CSS mode           css-card
```

Check the CSS link status.

```
<Quidway> display css channel
             Chassis 1            ||            Chassis 2
================================================================================
Num [SRUB HG]    [VSTS Port(Status)]    ||    [VSTS Port(Status)]    [SRUB HG]
1   1/7  1/15 -- 1/7/0/1(UP 16G)    ---||--- 2/13/0/4(UP 16G)    -- 2/14 1/14
2   1/7  0/15 -- 1/7/0/3(UP 16G)    ---||--- 2/14/0/2(UP 16G)    -- 2/13 0/14
3   1/7  1/14 -- 1/8/0/4(UP 16G)    ---||--- 2/13/0/1(UP 16G)    -- 2/13 1/15
4   1/7  0/14 -- 1/8/0/2(UP 16G)    ---||--- 2/14/0/3(UP 16G)    -- 2/14 0/15
5   1/8  1/15 -- 1/8/0/1(UP 16G)    ---||--- 2/14/0/4(UP 16G)    -- 2/13 1/14
6   1/8  0/15 -- 1/8/0/3(UP 16G)    ---||--- 2/13/0/2(UP 16G)    -- 2/14 0/14
7   1/8  1/14 -- 1/7/0/4(UP 16G)    ---||--- 2/14/0/1(UP 16G)    -- 2/14 1/15
8   1/8  0/14 -- 1/7/0/2(UP 16G)    ---||--- 2/13/0/3(UP 16G)    -- 2/13 0/15
```

Step 5 Configure Eth-Trunks.

Configure uplink Eth-Trunk 1.

```
[SwitchA] interface Eth-Trunk 1
[SwitchA-Eth-Trunk1] port link-type trunk
[SwitchA-Eth-Trunk1] port trunk allow-pass vlan 100
[SwitchA-Eth-Trunk1] trunkport gigabitethernet 1/6/0/0
[SwitchA-Eth-Trunk1] trunkport gigabitethernet 2/6/0/0
```

Configure downlink Eth-Trunk 2 and Eth-Trunk 3. The configurations of Eth-Trunk 2 and Eth-Trunk 3 are similar to that of Eth-Trunk 1.

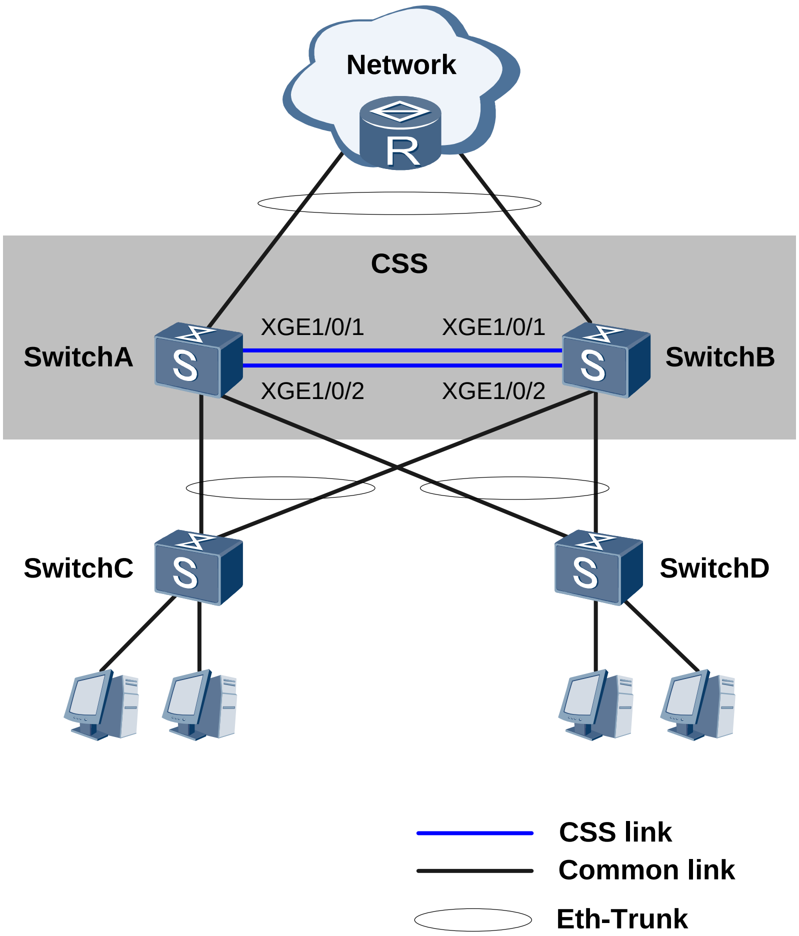
----End

4.2 Configuring Service Port Connection

As the network scale rapidly increases, the forwarding capability of a single core switch cannot meet service requirements. To meet these requirements, the network forwarding capability needs to be doubled without increasing the existing investment, device redundancy backup is required to improve network reliability, and the network must be easy to manage and maintain.

As shown in Figure 4-2, SwitchA and SwitchB form a CSS, and XGE1/0/1 and XGE1/0/2 are added to a CSS port.

Figure 4-2 Diagram of configuring service port connection



Configuration Roadmap

1. Configure the cluster ID, cluster priority, and CSS connection mode for switches to enable switches to form a CSS.

2. Configure CSS ports to enable data packets to be forwarded between member switches. Multiple physical member ports can be added to a CSS port to improve CSS link bandwidth and reliability.
3. Enable the CSS function on switches, connect the CSS ports of the switches using cables or optical fibers, and restart the switches to make the configuration take effect and ensure that the CSS is set up successfully.

Configuration Procedure

Step 1 Configure the cluster ID, cluster priority, and CSS connection mode for SwitchA and SwitchB.

Set the cluster ID and cluster priority of SwitchA to 1 and 200 and set the CSS connection mode to service port connection.

```
<Quidway> system-view
[Quidway] sysname SwitchA
[SwitchA] set css id 1
[SwitchA] set css priority 200
[SwitchA] set css mode lpu
```

Set the cluster ID and cluster priority of SwitchB to 2 and 100 and set the CSS connection mode to service port connection.

```
<Quidway> system-view
[Quidway] sysname SwitchB
[SwitchB] set css id 2
[SwitchB] set css priority 100
[SwitchB] set css mode lpu
```

Step 2 Configure CSS ports.

Configure service ports XGE1/0/1 and XGE1/0/2 of SwitchA as physical member ports and add them to a CSS port.

```
[SwitchA] interface css-port 1
[SwitchA-css-port1] port interface xgigabitethernet 1/0/1 to xgigabitethernet 1/0/2
enable
```

Configure service ports XGE1/0/1 and XGE1/0/2 of SwitchB as physical member ports and add them to a CSS port.

```
[SwitchB] interface css-port 1
[SwitchB-css-port1] port interface xgigabitethernet 1/0/1 to xgigabitethernet 1/0/2
enable
```

Step 3 Enable the CSS function.

Enable the CSS function on SwitchA and restart SwitchA.

```
[SwitchA] css enable
Warning: The CSS configuration takes effect only after the system is rebooted. The next
CSS mode is lpu. Reboot now? [Y/N]: y
```

Enable the CSS function on SwitchB and restart SwitchB.

```
[SwitchB] css enable
Warning: The CSS configuration takes effect only after the system is rebooted. The next
CSS mode is lpu. Reboot now? [Y/N]: y
```

Step 4 Verify the configuration.

View the CSS status.

```
<SwitchA> display css status all
Property Item         Property Value
Chassis ID           1
Priority             200
Enable switch         On
CSS master force      Off
CSS status           master
CSS mode             lpu
Property Item         Property Value
Chassis ID           2
Priority             100
Enable switch         On
CSS master force      Off
CSS status           backup
CSS mode             lpu
```

View CSS link information on service ports.

```
<SwitchA> display css channel
             Chassis 1            ||            Chassis 2
================================================================
Num [Css-port]      [Lpu Port]       ||    [Lpu Port]          [Css-port]
 1    1/1   XGigabitEthernet1/1/0/1     XGigabitEthernet2/1/0/1     2/1
 2    1/1   XGigabitEthernet1/1/0/2     XGigabitEthernet2/1/0/2     2/1
```

----End

5 Troubleshooting

5.1 A CSS Cannot Be Set Up Because of Incorrect Cluster Cable Connection

Fault Description

Two switches have the CSS function enabled, have correct chassis IDs configured, and are connected through cluster cables. However, they cannot set up a CSS.

Fault Analysis

1. Run the **display css status** command on one switch to check the CSS status. The command output shows that the switch is in single-chassis CSS state.

```
<Quidway> display css status
Property Item          Property Value
Frame ID              2
Priority              1
Enable switch          On
CSS master force        Off
CSS status            single
```

2. Run the **terminal monitor** and **terminal trapping** commands to enable the alarm function. Many alarm messages about incorrect cluster cable connections are displayed.

```
<Quidway> terminal monitor
<Quidway> terminal trapping
Info: Current terminal monitor is on.
Mar 31 2010 10:53:43 SYS-136 CSSM/4/STACKCONNECTERROR:OID
1.3.6.1.4.1.2011.5.25.183.1.22.11 Connect error, 2/13 CSS port 3 link to 1/14 port
2, this port should link to 1/13 port 2
Mar 31 2010 10:53:43 SYS-136 CSSM/4/STACKCONNECTERROR:OID
1.3.6.1.4.1.2011.5.25.183.1.22.11 Connect error, 2/13 CSS port 1 link to 1/13 port
4, this port should link to 1/14 port 4
Mar 31 2010 10:53:44 SYS-136 CSSM/4/STACKCONNECTERROR:OID
1.3.6.1.4.1.2011.5.25.183.1.22.11 Connect error, 2/13 CSS port 3 link to 1/14 port
2, this port should link to 1/13 port 2
Mar 31 2010 10:53:44 SYS-136 CSSM/4/STACKCONNECTERROR:OID
1.3.6.1.4.1.2011.5.25.183.1.22.11 Connect error, 2/13 CSS port 1 link to 1/13 port
4, this port should link to 1/14 port 4
```

```
Mar 31 2010 10:53:45 SYS-136 CSSM/4/STACKCONNECTERROR:OID
1.3.6.1.4.1.2011.5.25.183.1.22.11 Connect error, 2/13 CSS port 3 link to 1/14 port
2, this port should link to 1/13 port 2
Mar 31 2010 10:53:45 SYS-136 CSSM/4/STACKCONNECTERROR:OID
1.3.6.1.4.1.2011.5.25.183.1.22.11 Connect error, 2/13 CSS port 1 link to 1/13 port
4, this port should link to 1/14 port 4
```

The alarm messages indicate errors in cluster cable connections.

Procedure

Connect cluster cables correctly according to instructions in the alarm messages. After the cluster cables are connected correctly, one switch restarts, and the two switches then set up a CSS successfully. The fault is rectified.

Summary

To use the CSS function, connect cluster cables according to the connection rules.

5.2 A CSS Link Fails

Fault Description

Two switches have the CSS function enabled, have correct chassis IDs configured, and are connected through cluster cables. However, both ends of a CSS link are in Down state.

Fault Analysis

1. Run the **terminal monitor** and **terminal trapping** commands to enable the alarm function. Alarms are displayed, indicating that CSS ports are Down.

```
<Quidway> terminal monitor
<Quidway> terminal trapping
May 7 2012 21:08:00 Quidway CSSM/4/STACKLINKDOWN:OID
1.3.6.1.4.1.2011.5.25.183.3.3.2.1 1/14 CSS port 2 down.
```

2. Log in to the switches remotely and run the **display css channel** command to check the CSS link status.

```
<Quidway> display css channel
            Chassis 1             ||            Chassis 2
================================================================
Num [SRUA HG]   [VSTS Port(Status)]   ||   [VSTS Port(Status)]   [SRUA HG]
1   1/13 0/0  -- 1/13/0/1(UP 16G)   ---||--- 2/7/0/4(UP 16G)    -- 2/8  0/14
2   1/13 0/1  -- 1/13/0/3(UP 16G)   ---||--- 2/8/0/2(UP 16G)    -- 2/7  0/15
3   1/13 0/14 -- 1/14/0/4(UP 16G)   ---||--- 2/7/0/1(UP 16G)    -- 2/7  0/0
4   1/13 0/15 -- 1/14/0/2(DOWN NA)   ---||--- 2/8/0/3(DOWN NA)    -- 2/8  0/1
5   1/14 0/0  -- 1/14/0/1(UP 16G)   ---||--- 2/8/0/4(UP 16G)    -- 2/7  0/14
6   1/14 0/1  -- 1/14/0/3(UP 16G)   ---||--- 2/7/0/2(UP 16G)    -- 2/8  0/15
7   1/14 0/14 -- 1/13/0/4(UP 16G)   ---||--- 2/8/0/1(UP 16G)    -- 2/8  0/0
8   1/14 0/15 -- 1/13/0/2(UP 16G)   ---||--- 2/7/0/3(UP 16G)    -- 2/7  0/1
```

The alarm and CSS link status show that CSS link 4 fails. Check whether cluster cables and related modules are working properly to rectify the fault.

Procedure

Step 1 Check whether cluster cables, optical fibers, and optical modules are correctly connected. Remove and then install cluster cables, optical fibers, or optical modules at an interval longer than 5 seconds. If both ends of the CSS link are in Up state, the fault is rectified. Otherwise, go to step 2.

Step 2 Replace the cluster cable with the port status Down.

----End

Summary

When only one CSS link fails, services are not affected. If more CSS links fail, the CSS may split. To rectify the CSS link fault, check the CSS link status in time.

6 FAQ

6.1 Does V200R002 Support Service Port Connection?

Table 6-1 LPUs on S series switches in V200R002 supporting service port connection

LPU	S9703	S9706/S9712	S7703	S7706/7712
X12SSA	×	√	×	√
X40SFC	×	√	×	√
X16SFC	×	√	×	√
X08SED	×	√	×	√
2QFC	×	√	×	√
8QFC	×	√	×	×

6.2 How Do the Configurations of Two Devices Change After They Set Up a CSS?

The CSS starts with the master device's configuration. After the CSS starts, the standby device's configuration is lost.

6.3 How Do I Know Which Switch Is the Master in a CSS?

Method 1: Check the indictor.

- In CSS card connection mode, check the MASTER indicator on the CSS card to determine the master switch. If the MASTER indicator on a switch is steady on, the switch is the master switch.
- In service port connection mode, check the ACT indicator on the MPU to determine the master switch. If the ACT indicator on a switch is steady on, the switch is the master switch.

Method 2: Run a display command.

Run the **display device** or **display css status all** command to check which switch is the master switch.

6.4 Are Services Affected When One Member Device Leaves the CSS?

When one member device leaves the CSS, services on the device are interrupted.

6.5 Are Services Affected When One Device Joins the CSS?

When one device joins the CSS, the elected standby device will restart. As a result, the configuration of the standby device is lost and services on the standby device are interrupted.

6.6 Are Services Affected When a CSS Splits?

When a CSS splits, the standby device becomes the master device, the two devices work independently, and inter-chassis services are interrupted.

6.7 Are CSS Cards and Cluster Cables Hot Swappable?

CSS cards are not hot swappable; cluster cables are hot swappable, but the cluster bandwidth is affected when cluster cables are removed.

6.8 What Is a CSS Card's Bandwidth? Are Services Affected and Packets Are Lost When One Cluster Cable Is Removed?

A CSS card on the SRUA and SRUB provides four ports, and each cluster cable provides 16 Gbit/s bandwidth. Therefore, a CSS card provides 64 Gbit/s bandwidth (4*16 Gbit/s).

A CSS card on the SRUC provides eight ports, and each cluster cable provides 10 Gbit/s bandwidth. Therefore, a CSS card provides 80 Gbit/s bandwidth (8*10 Gbit/s).

Removing a cluster cable will reduce the cluster bandwidth and result in packet loss.

6.9 Does the CSS Function Require a License?

No independent license is required.

6.10 Which Member Device's MAC Address Is Used as the CSS MAC Address After a CSS Is Set Up? Does the CSS MAC Address Change if the CSS Splits?

After a CSS is set up, the master device's MAC address is used as the system MAC address. After the CSS splits, the master and standby devices use the same MAC address and IP address. To differentiate the two devices, shut down the connected interfaces between the two devices or restart the devices.

6.11 What Are the Limitations After CSS Is Enabled?

ISSU, PTP, and synchronous Ethernet clock features are not supported in a CSS. The interface number format changes to the four-dimensional format, for example, GE2/1/0/1, in which the value 2 indicates the cluster ID.

6.12 What Are the Cluster Bandwidths in Service Port Connection Mode?

LPU	S9700	S7700	
	SRUD	SRUA	SRUB
X12SSA	240 Gbit/s	128 Gbit/s	240 Gbit/s
X40SFC	480 Gbit/s	128 Gbit/s	256 Gbit/s
X16SFC	320 Gbit/s	128 Gbit/s	256 Gbit/s
X08SED	80 Gbit/s	64 Gbit/s	80 Gbit/s
2QFC	160 Gbit/s	64 Gbit/s	128 Gbit/s
8QFC	640 Gbit/s	-	-

6.13 Can Devices Form a CSS if They Use Different Types of SRUs (for Example, SRUA on One Device and SRUB on the Other)?

The two devices can form a CSS. However, the CSS forwarding performance depends on the SRU minimum capability.

In CSS card connection mode, an SRUA and an SRUB can form a CSS.

In service port connection mode, an SRUA and an SRUB can form a CSS, and an SRUC and an SRUD can form a CSS.

6.14 Can Devices of Different Models (S9700 and S7700 for Example) Form a CSS?

Devices of different models cannot form a CSS. When the standby device registers with the master device, the master device checks whether the standby device is the same model as itself. If the standby device is a different model, the standby device cannot register with the master device.

6.15 Can LPUs of Different Models but the Same Port Rate, for Example, X08SED and X12SSA, Set Up a CSS?

These LPUs can set up a CSS. In service port connection mode, the local chassis checks remote chassis information only according to the HIG type but not the LPU type.

6.16 Can Two Chassis Form a CSS When Chassis 1 Has Two LPUs with Different Port Rates, Chassis 2 Has the Same Two LPUs as Chassis 1, and the Two Chassis Connect Through Ports with the Same Rate?

When a local chassis has LPUs with different port rates installed, for example, the S9700 has 8*40G and 40*10G LPUs installed, a CSS can be set up when the remote chassis also has the LPUs with the same port rate as the LPUs of the local chassis.

6.17 Can a 40G Port Be Configured as a Physical Member Port After It Is Split into Four 10G Port?

A 40G port cannot be configured as a physical member port after it is split into four 10G port.

6.18 In Service Port Connection Mode, Can Two Chassis Form a CSS When FSUs Are Installed on One of the Two Chassis?

The two chassis cannot form a CSS when FSUs are installed on one of the two chassis. During the setup of a CSS in service port connection mode, the standby device cannot register with the master device if it has different subcard information than the master device.

6.19 In Service Port Connection Mode, Can Two Chassis Form a CSS When CSS Cards Are Installed on One of the Two Chassis?

The two chassis can form a CSS when CSS cards are installed on one of the two chassis. When the standby device registers with the master device, the master device does not check the CSS card configurations of the standby device. In service port connection mode, CSS cards are powered off.

6.20 Can S9706 and S9712 Form a CSS in Service Port Connection Mode?

The S9706 and S9712 can form a CSS in service port connection mode.

6.21 Does the Service Port Connection Mode Have Requirements on CSS-Purpose LPU Locations and Port Connection Sequence?

The service port connection mode does not have requirements on where CSS-purpose LPUs are installed. A CSS can be set up using service ports that support the CSS function regardless of locations of the service ports. Physical member ports in a logical CSS port on one chassis must connect to physical member ports in a logical CSS port on the other chassis.

6.22 How Many CSS Cards Does a CSS Support?

Each member device in a CSS supports a maximum of two CSS cards. A CSS supports a maximum of four CSS cards.

6.23 Can the CSS Card Connection Mode and Service Port Connection Mode Be Used Together?

You can only configure one of the two connection modes at a time.

6.24 How Does a CSS Merge Affect the Standby Chassis?

After a CSS merge, the following situations occur on the standby chassis:

- The standby chassis restarts. If the standby chassis is transmitting services, services are interrupted.

- After the standby chassis restarts, its system MAC address becomes the master chassis's system MAC address, and services bound to the standby chassis's system MAC address become unavailable.
- The standby chassis synchronizes its configuration with the master chassis. The original configuration file of the standby chassis is not restored.

6.25 How Does a Cluster Cable Fault Affect the Cluster Bandwidth?

- SRUA: Port connections on SRUA are in 1+1 backup mode. When a cluster cable is disconnected, the cluster bandwidth is reduced by 12.5%.
- SRUB: The cluster bandwidth is affected differently according to the cluster cable:
  - If a cluster cable that does not connect to the CSS active MPU is disconnected, the cluster bandwidth is reduced by 12.5%.
  - If a cluster cable that connects the cold standby MPU to the CSS active MPU is disconnected, the cluster bandwidth is reduced by 12.5%.
  - If a cluster cable that connects the CSS standby MPU to the CSS active MPU is disconnected, the cluster bandwidth is reduced by 25%.
- CSS card fault

  All the four cluster cables on the CSS card stop working. If SRUAs are used, the cluster bandwidth is reduced by 50%. If SRUBs are used, the cluster bandwidth is reduced by 62.5%.

6.26 Which MPUs Do Not Support CSS Card Connection?

The LE02SRUA VER.A and LE02SRUB VER.A are earlier MPUs and do not support the CSS function.

6.27 Why a CSS Port on the X08SED LPU Supports Four Physical Member Ports?

The X08SED LPU has double chips. A CSS port can contain only physical member ports on the same chip. XGigabitEthernet *slot* /0/0 to XGigabitEthernet *slot*/0/3 or XGigabitEthernet *slot* /0/4 to XGigabitEthernet *slot* /0/7 are ports on the same chip. You can only specify indexes for physical member ports according to the preceding range. (*slot* indicates the slot ID of the LPU.)

6.28 How Do I Specify a Member Device as the Master in a CSS?

Generally, the master switch of a CSS is elected when the CSS is set up. You can also run the **css master force** command to specify one device as the master switch of a CSS. The command configuration takes effect after the device restarts. In a non-CSS scenario, this configuration takes effect only on the local device. If the **css master force** command is executed on two devices before a CSS is set up, the command configuration becomes invalid after the CSS is set up. The master switch of the CSS is elected through competition. In a CSS scenario, if the **css master force** command is executed multiple times, only the latest configuration takes effect.

A Glossary

CSS	Cluster switch system (CSS), which is also called a cluster.
Eth-Trunk	A technology that binds multiple physical interfaces into a logical interface to increase bandwidth, also called link aggregation.
HIGIG	A data bus channel, which is a physical channel between two LPUs or between an LPU and an MPU.
Master switch	Cluster master elected after a competition.
Standby switch	Cluster standby elected after a competition.
CSS active MPU	Active MPU of the master switch, which functions as the active MPU of the CSS.
CSS standby MPU	Active MPU of the standby switch, which functions as the standby MPU of the CSS.
Candidate CSS standby MPU	Standby MPUs of the master and standby switches.