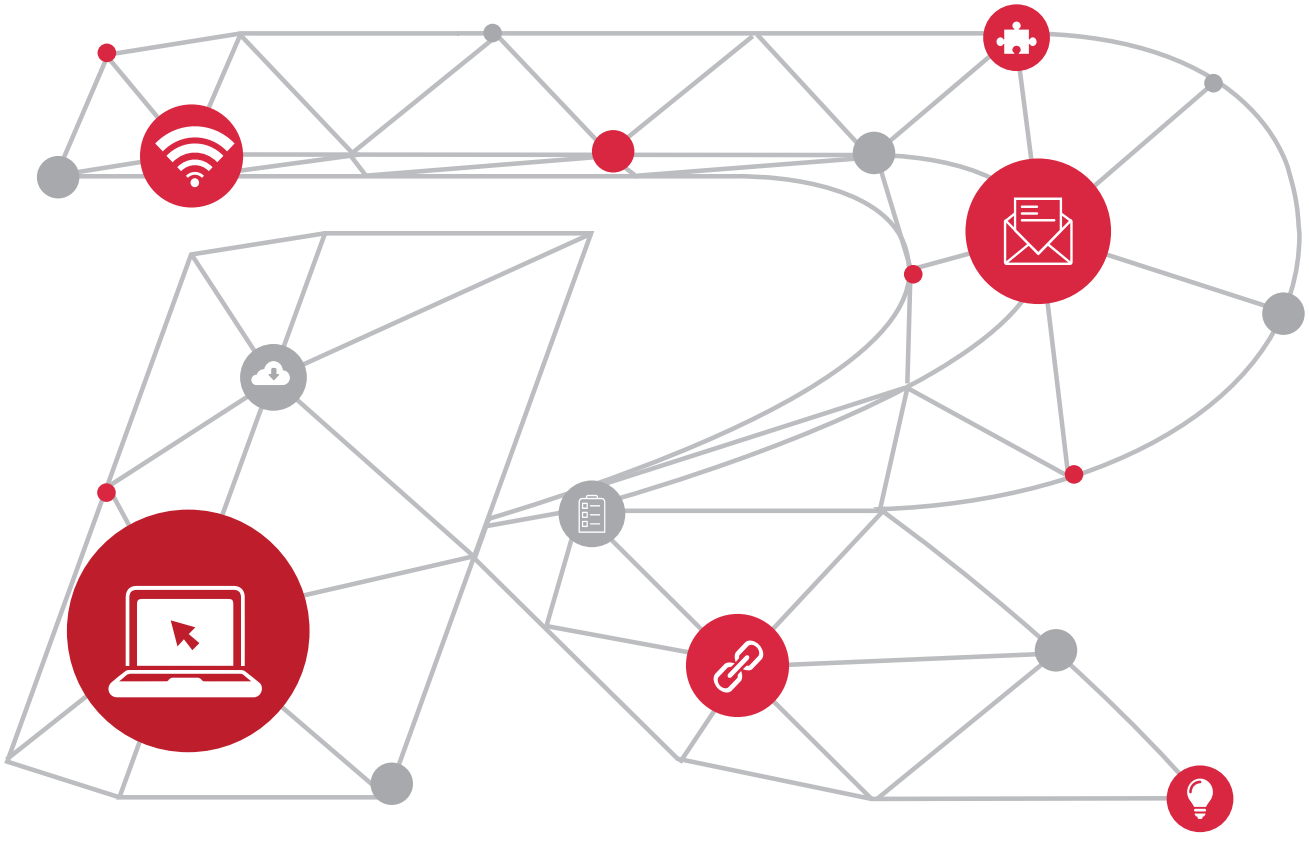
Ruijie Stacking Technology

White Paper



Contents

Introduction

Box switches are typically used at the convergence layer and access layer in a network. With the development of network scale, and the density of information points increases. However, the port quantity of a box switch is relatively fixed, the switches can no longer meet the requirements by common cascading. The disadvantages, such as management difficulty and forwarding bottleneck, are exposed. To address the foregoing problem, the stacking technology emerges.

Stacking Modes

• Daisy Chain Stacking

Daisy chain stacking is to connect the switches using stacking cables.

Classification of Daisy Chain Stacking

1. Simplex stacking and duplex stacking

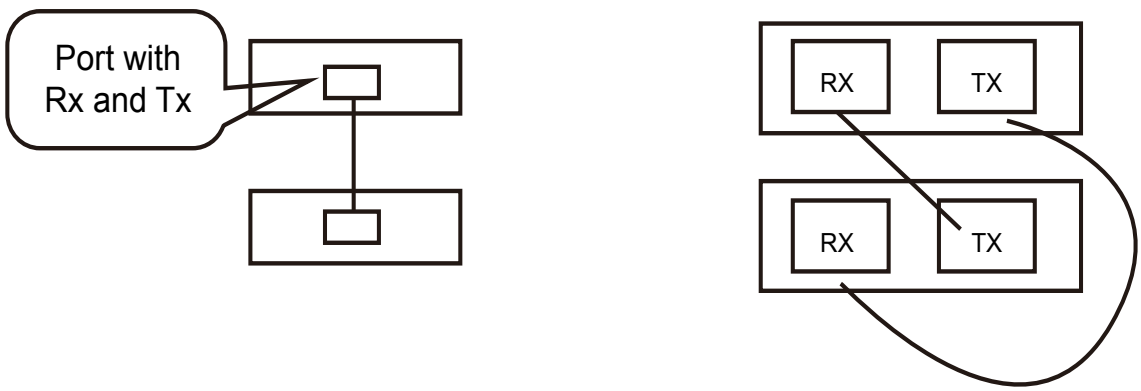
Based on the operating mode of the stacking module, daisy chain stacking can be classified into simplex stacking and duplex stacking (or called half-duplex stacking and full-duplex stacking). The simplex stacking refers to that one stacking port can either receive or transmit data at a time. Therefore, two ports need to be connected to form simple stacking: one Rx port and one Tx port. The stacking port that supports duplex stacking can receive and transmit data simultaneously. Therefore, only one port needs to be connected to form duplex stacking.

It should be noted that in the simplex stacking, because each port can only receive or transmit data at a time, so when two devices are connected, the Tx port of one device must be connected to the Rx port of the other device.

As shown in Figure 1, if the Rx and Tx ports in the figure on the right are deemed as one port, the two figures are the same.

Note that the figure on the right shows simplex stacking, the connection method can only ensure that the two devices can communicate with each other. If the link that connects the Rx port on the lower device and the Tx port on the upper device, the packets of the upper device cannot be transmitted to the lower device. Please remember this and do not get confused with this link and the link in ring stacking. The two figures in Figure 1 show linear stacking.

Figure 1 Duplex Stacking and Simplex Stacking



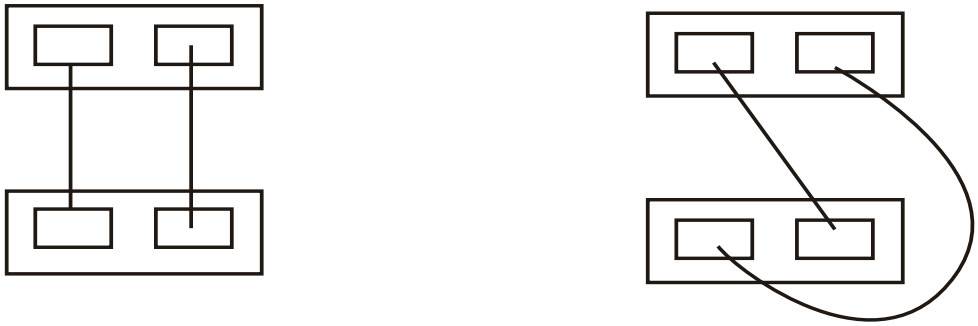
2. Ring stacking and linear stacking

Based on the connection mode, daisy chain stacking can be classified into ring stacking and linear stacking. The ring stacking refers to that the devices are connected to form a ring, as shown in Figure 2. In this case, the switches are stacked to form a ring. In linear stacking, the devices are connected in the linear stacking method,as shown in Figure 1.

Compared with the linear stacking, the ring stacking provides redundant links (as shown in Figure 2), so as to ensure stable and reliable operation of the system even if one link fails.

Note: Ring stacking can be implemented by using two methods, as shown below. The figure on the right in Figure 2 looks like the figure on the right in Figure 1. However, each port in Figure 1 operates in simplex mode, whereas each port in Figure 2 operates in duplex mode. That is, each link in Figure 2 can implement bidirectional transmission, and one of the two links is used for redundancy purpose. However, each link in Figure 1 can transmit data in only one direction at a time, that is, the two links together function as one link in Figure 2.

Figure 2 Two Connection Methods of Ring Stacking



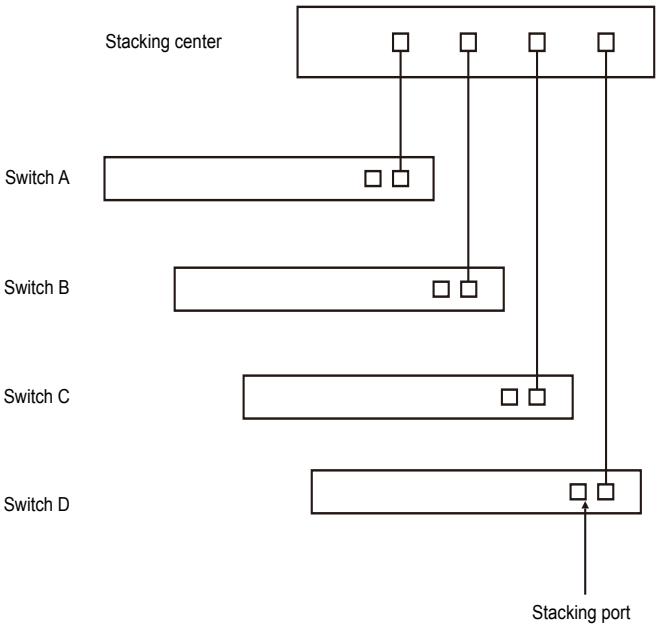
• Star Stacking

Star stacking is rarely used. In start stacking, multiple switches are connected to a same switching center (called core/matrix). That is, all the stacked switches are connected to a stacking center through high-speed stacking ports.

As shown in Figure 3, four switches are connected to the stacking center, and the stacking center ensures that switching bandwidth is available. The stacking center can be integrated with switch A to serve as both a switch and a stacking center. Compared with the daisy chain stacking, the star stacking provides a shorter forwarding path from one switch to another switch and does not span multiple switches. However, the cost of star stacking is higher, a dedicated stacking center is required and the role of the stacking center is same as that of a chassis switch.

Disadvantage of the star stacking: If the stacking center fails, all the devices will be disconnected from the network.

Figure 3 Star Stacking



Terminology

CPP technology: performs scheduling and rate limiting on the data to be sent to the CPU in a network environment with high data traffic, so as to prevent overloading of the CPU, thereby significantly ensuring the stability of core devices.

SSHvl/v2: provides functions such as encrypted login and management. It encrypts the data sent for remote device login, so as to prevent potential threats due to transmission of management information as plaintext.

Limiting source IP address for Telnet/Web login: permits terminals with valid IP addresses to log in to the management device, so as to prevent unauthorized operators from managing network devices.

SNMPv3: provides functions such as encryption and authentication. It ensures that data is sent from authorized data sources, and prevents data from being changed during transmission. In addition, it encrypts packets to ensure data security.

• Primary Stacking Device and Secondary Stacking Device

In the stacking system, a device must be designated as the primary stacking device which can be managed by user access through a serial port. In addition, a management IP address needs to be configured on the primary stacking device, so as to manage the switch stacking system by Telnet, Web, or SNMP.

A secondary stacking device is a switch except the primary stacking device. The serial port of the secondary stacking device cannot be used for user access management. Instead, the serial port of the secondary stacking device can be used by the technical engineers to locate faults.

• Hybrid Stacking

Generally, only a same series of switches can be stacked. Switches of different models in a same series can be stacked. That is, they can be stacked in a hybrid method.

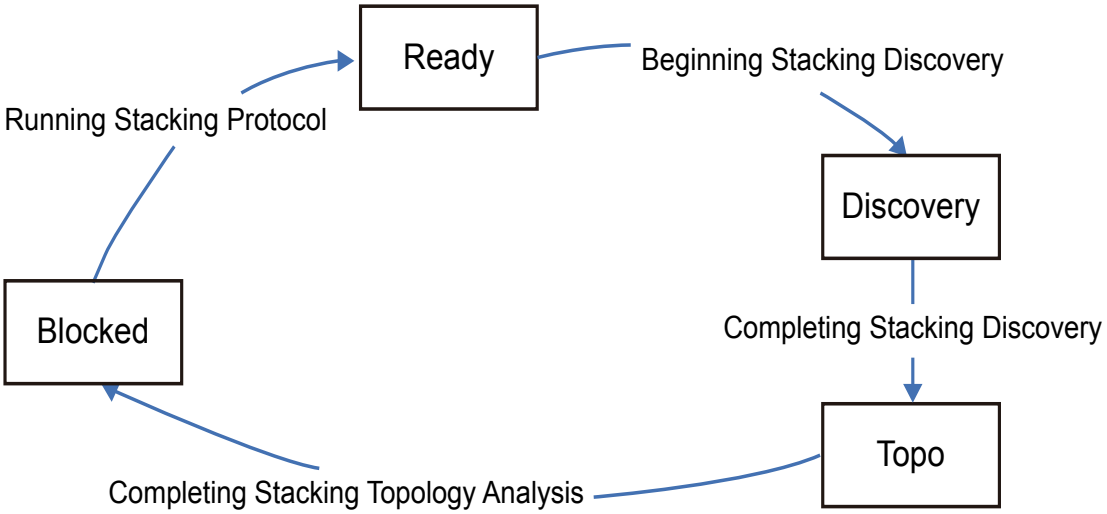
Technical Principle

Ruijie products support only daisy chain stacking. This chapter introduces the operation mode of the stacking protocol based on the daisy chain stacking. After the switches are connected through stacking cables and powered on, the stacking process is implemented by stacking discovery, device detection, and topology analysis, so as to establish the stacking system and designate the primary and secondary stacking devices. Then the configuration data is delivered to ensure proper operation of the system.

• Operation of the Stacking Protocol

Each switch in the stacking system runs a stacking protocol. As every stacking process is implemented, the stacking state machine transits from a state to another state, as shown in Figure 4.

Figure 4



The states include:

* **Blocked: The stacking detection state machine is suspended. The device is powered on, works in standalone mode or completes stacking detection.**

* **Ready: The device begins stacking detection.**

* **Discovery: The device is searching for the information about the stacking members.**

* **Topo: The primary device is configuring the stacking topology.**

The basic process from the powering on of the switch in the stacking system to the ending of system stacking covers:

* **Initialization of a local stacking database**

* **Stacking topology discovery**

* **Stacking topology analysis**

* **System initialization after stacking**

The following sections describe the basic process.

Initialization of a Local Stacking Database

Before the stacking system begins to run, each switch in the stacking system needs to initialize the local stacking-related database, so as to provide stacking information to be exchanged with the other switches in the stacking system during topology detection when the stacking protocol runs.

The stacking database stores stacking-related information for a switch, including the following basic information:

* **Serial number of the local device**
* **MAC address of the local device**
* **Stacking priority, which is 1 by default**
* **Quantity of stacking ports**
* **Port number of the stacking ports**
* **Version information about the local device, including BOOT version, CTRL version, main program version, and hardware version**

During the stacking topology detection, information about the stacking database of the local device will be packed as packets and sent to each switch in the stacking system. After the stacking detection is complete, information about the stacking databases of all the switches is available in each switch.

Stacking Topology Discovery

After the initialization of the stacking database of the local device is complete, the stacking topology discovery (or called topology detection) task begins. The stacking discovery includes three phases:

* **Probe: Use the probe packets, which are used to determine the connections of the stacking ports, to search for information about the peer stacking ports.**
* **Routing: Use the routing packets to transmit the locally detected information about stacking ports to all neighbors.**
* **Config: Use the config packets to synchronize the completion state of stacking detection between the switches.**

Probe

To support simplex and duplex stacking modes, the probe packets are available to record the Tx and Rx connection information of the stacking ports. The probe packets sent by the local device record the information about the detected stacking ports on the local device. After receiving the probe packets, other devices add information about the local stacking ports on them to the information about the stacking ports, and all the information is updated to the stacking database.

Routing

The routing packets are used to exchange stacking information between the neighbor members (that is, the peer switches that are directly connected to the local switch). The routing packets are sent to the neighbor nodes only. They carry the detected stacking information, including the information about the stacking database of each node. In this way, the stacking information is quickly transmitted in the system.

Config

When the Rx and Tx information of the local stacking ports is collected, the stacking state flag of the local switch becomes "locally completed", indicating that the local device has completed stacking discovery. When the stacking state flag of each detected device becomes "locally completed" in the stacking database, each switch in the topology has completed stacking discovery. After that, the primary and secondary devices are elected based on their stacking databases.

The election depends on:

* **Stacking priority**

* **MAC address of the switch**

The stacking priorities range from 1 to 10, with a larger value indicating a higher priority. A smaller MAC address indicates a lower priority. Generally, the device with the highest user priority and the smallest MAC address will be elected as the primary device.

In the following examples, two switches are stacked. If 3 to 8 switches are stacked, the primary device can be elected by comparing the priorities of every two switches.

* **When different stacking priorities are configured, and a smaller MAC address indicates a higher priority.**

The MAC address of stacking device 1 is 00d0f8000001, and its stacking priority is set to 10;

the MAC address of stacking device 2 is 00d0f8000002, and its stacking priority is set to 9.

In this case, stacking device 1 will be elected as the primary device.

* **When different stacking priorities are configured, a smaller MAC address indicates a lower priority.**

The MAC address of stacking device 1 is 00d0f8000001, and its stacking priority is set to 9;

the MAC address of stacking device 2 is 00d0f8000002, and its stacking priority is set to 10.

In this case, stacking device 2 will be elected as the primary device.

* **A same stacking priority is configured.**

The MAC address of stacking device 1 is 00d0f8000001, and its stacking priority is set to 10;

the MAC address of stacking device 2 is 00d0f8000002, and its stacking priority is set to 10.

In this case, stacking device 1 will be elected as the primary device.

After a device is elected as the primary device, it sends the config packets to other members in the system. After all the members return a response, the system completes stacking discovery. If no response is received within a certain period of time, the stacking detection fails, and an error message is returned.

Stacking Topology Analysis

After the stacking topology discovery is complete, the primary device and the secondary devices in the stacking system have synchronized the stacking databases, the primary device is elected, and the stacking system enters the topology analysis process. The purposes of topology analysis are to allow the ports in the stacking system to communicate with each other, prevent a loop in the stacking system (that is, to remove the redundant stacking link), and ensure that the path between two stacking ports is the shortest.

System Initialization After Stacking

When the stacking protocol is running, the data packet transmission must be prohibited. Therefore, before the stacking protocol runs, all the ports on the switches must be set to the "shutdown" state. After the stacking topology analysis is complete, the system will set the ports to the "no shutdown" state.

Features of Ruijie Stacking Technology

• Different Stacking Modes for Ruijie Switches

Virtual Stacking

The switch hardware does not support stacking. However, in the software-based stacking, cross-stacking is not supported.

Standard Stacking

The switch hardware supports stacking, and the stacking is implemented with 1000 Mbps bandwidth. In addition, cross-device operation is supported.

Enhanced Stacking

The switch hardware supports stacking. Generally, dedicated stacking ports are provided, and common 1000 Mbps ports are not used. Compared with the stacking based on 1000 Mbps ports, the enhanced stacking consumes less CPU resources. In addition, the enhanced stacking generally provides a higher bandwidth: 2.5 Gbps for S26 series and 12 Gbps for S5750 series.

Comparison of Three Stacking Modes

	Virtual Stacking	Standard Stacking	Enhanced Stacking
Hardware support	No	Yes	Yes
Cross-device operation	No	Yes	Yes
Bandwidth	1000 Mbps	1000 Mbps	Greater than 1000 Mbps

Common Limitations for Stacking

*** The cross-stacking flow control does not work, so check whether cross-stacking is performed before configuring flow control.**

*** In cross-stacking mode, if the QoS mapping table is modified to a non-default value, the packets that are received from the stacking port will still be scheduled based on the default queue mapping relationship. If the CoS-to-queue mapping table is modified, the packets will enter different queues based on the mapping table. However, after the cross-stacking is performed, the packets that are received from the stacking port will still be scheduled based on the default queue mapping relationship. In this case, the cross-stacking QoS function may be abnormal. For specific configuration and default relationship, see the QoS configuration guide.**

Startup Time of the Stacking System

The startup time of two devices may be different due to factors such as different BOOT/CTRL running time, different device power-on time, and different file quantity in file systems. That is, the stacking detection time may be different. Currently, a certain time is provided for redundancy purpose, so that the stacking process is more stable. However, in the stacking system, if the time difference between the first device that starts and the last device that starts exceeds one minute during stacking detection, the stacking may fail.

Compared with ring stacking, the linear stacking requires less startup time. For a single device, no stacking module should be inserted, and no stacking-related data should be configured, so as to accelerate the startup.

Differences Between Ring Stacking and Linear Stacking

The main difference between ring stacking and linear stacking is as follows: In ring stacking, if a stacking link fails, the device will automatically start up, and the stack will be reestablished; whereas in linear stacking, if a stacking link fails, the stacking will fail.

Impact from Adding or Removing of a Stacking Device

It should be noted that if the stacking priority of a newly added device is relatively higher or its MAC address is smaller than all devices in the stacking system, the primary device may change. In this case, the configuration of the primary device may become ineffective. To avoid this problem, it is recommended to set a lower stacking priority for the device. After the device is added, the configuration data needs to be modified, because new ports are added.

Before removing a primary device from the stacking system, you need to export its configuration data. Before removing a secondary device, you need to modify the configuration on the primary device.

It is not recommended to add a device to or remove a device from a stacking system that is running, because hot swapping of a stacking cable may damage a stacking module or switch. Before adding or removing a device, you need to power off the stacking system, add or remove the device, and then power on the system so as to reestablish a stack.

Conclusion

After the box switches support stacking, the switches become highly scalable, because the port quantity can be easily increased by stacking. In addition, the entire system can be easily managed and configured through uniform serial ports or IP addresses. Because of benefits such as fast deployment, high scalability, and easy management, the stacking switches will become popular in the fast-growing network market.

Ruijie Networks Co.,Ltd

For further information,please visit our website **http://www.ruijienetworks.com**