Huawei Certification

HCNA-HNTD
ENTRY

Huawei Networking Technology and Device
Lab Guide

Huawei Technologies Co.,Ltd.

Huawei Certification

HCNA-HNTD Huawei Networking Technology and Device

Entry Lab Guide

Version 2.2

Huawei Certification System

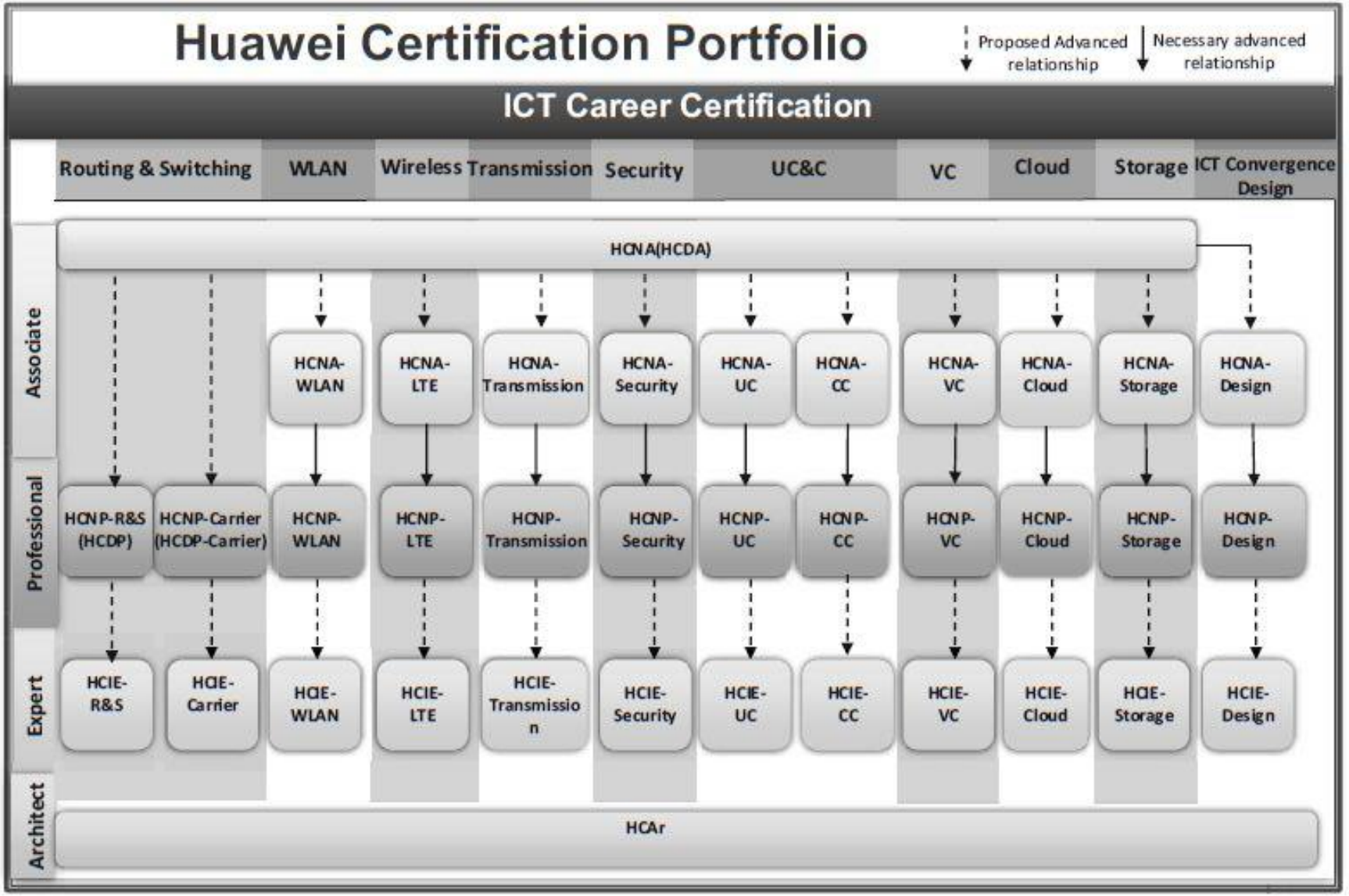
Relying on its strong technical and professional training and certification system and in accordance with customers of different ICT technology levels, Huawei certification is committed to providing customers with authentic, professional certification, and addresses the need for the development of quality engineers that are capable of supporting Enterprise networks in the face of an ever changing ICT industry. The Huawei certification portfolio for routing and switching (R&S) is comprised of three levels to support and validate the growth and value of customer skills and knowledge in routing and switching technologies.

The Huawei Certified Network Associate (HCNA) certification level validates the skills and knowledge of IP network engineers to implement and support small to medium-sized enterprise networks. The HCNA certification provides a rich foundation of skills and knowledge for the establishment of such enterprise networks, along with the capability to implement services and features within existing enterprise networks, to effectively support true industry operations.

HCNA certification covers fundamentals skills for TCP/IP, routing, switching and related IP network technologies, together with Huawei data communications products, and skills for versatile routing platform (VRP) operation and management.

The Huawei Certified Network Professional (HCNP-R&S (HCDP)) certification is aimed at enterprise network engineers involved in design and maintenance, as well as professionals who wish to develop an in depth knowledge of routing, switching, network efficiency and optimization technologies. HCNP-R&S consists of three units including Implement Enterprise Switch Network (IESN), Implement Enterprise Routing Network (IERN), and Improving Enterprise Network Performance (IENP), which includes advanced IPv4 routing and switching technology principles, network security, high availability and QoS, as well as application of the covered technologies in Huawei products.

The Huawei Certified Internet Expert (HCIE-R&S) certification is designed to imbue engineers with a variety of IP network technologies and proficiency in maintenance, for the diagnosis and troubleshooting of Huawei products, to equip engineers with in-depth competency in the planning, design and optimization of large-scale IP networks.


Huawei Certification Portfolio
Proposed Advanced relationship
Necessary advanced relationship
ICT Career Certification
Routing & Switching
WLAN
Wireless
Transmission
Security
UC&C
VC
Cloud
Storage
ICT Convergence Design
Associate
Professional
Expert
Architect
HCNA(HCDA)
HCNA-WLAN
HCNA-LTE
HCNA-Transmission
HCNA-Security
HCNA-UC
HCNA-CC
HCNA-VC
HCNA-Cloud
HCNA-Storage
HCNA-Design
HCNP-R&S (HCDP)
HCNP-Carrier (HCDP-Carrier)
HCNP-WLAN
HCNP-LTE
HCNP-Transmission
HCNP-Security
HCNP-UC
HCNP-CC
HCNP-VC
HCNP-Cloud
HCNP-Storage
HCNP-Design
HCIE-R&S
HCIE-Carrier
HCIE-WLAN
HCIE-LTE
HCIE-Transmission
HCIE-Security
HCIE-UC
HCIE-CC
HCIE-VC
HCIE-Cloud
HCIE-Storage
HCIE-Design
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Reference Icons

Lab Environment Specification

In order to ensure that that the configuration given in this lab is supported on all devices, it is recommended that the following device models and VRP versions be used:

Identifier	Device Model	VRP version
R1	AR 2220E	Version 5.160 (AR2200 V200R007C00SPC600)
R2	AR 2220E	Version 5.160 (AR2200 V200R007C00SPC600)
R3	AR 2220E	Version 5.160 (AR2200 V200R007C00SPC600)
S1	S5720-36C-EI-AC	Version 5.160 (S5720 V200R008C00SPC500)
S2	S5720-36C-EI-AC	Version 5.160 (S5720 V200R008C00SPC500)
S3	S3700-28TP-EI-AC	Version 5.70 (S3700 V100R006C05)
S4	S3700-28TP-EI-AC	Version 5.70 (S3700 V200R008C00SPC500)

CONTENTS

Module 1 Establishing Basic Networks with eNSP

Lab 1-1 Building Basic IP Networks

Learning Objectives

- As a result of this lab section, you should achieve the following tasks:
- Set up and navigate the eNSP simulator application.
- Establish a simple peer-to-peer network in eNSP
- Perform capture of IP packets using Wireshark within eNSP.

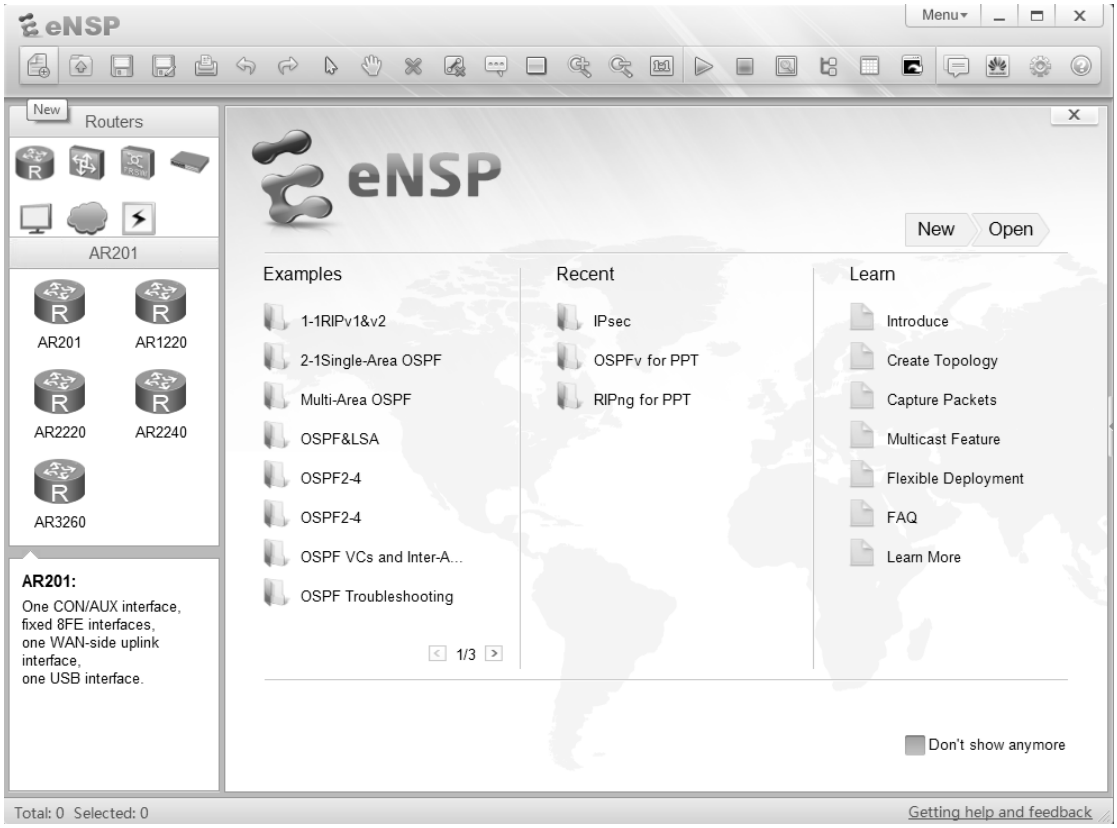
The fundamental network behavior can be understood through the application of packet capture tools to the network. The use of Huawei’ s simulator platform eNSP is capable of supporting both the implementation of technologies and the capture of packets within the network to provide a comprehensive knowledge of IP networks.

Tasks

Step 1 **Initiate eNSP.**

This step introduces how to start and navigate the eNSP simulator application for rapid development of TCP/IP knowledge and familiarity with network operation. If eNSP is not available, please inform the course instructor

After launching eNSP, the following application user interface will be presented. The left panel houses the icons that represent the various products and devices that are supported within eNSP, while the central panel provides lab examples for practice scenarios.

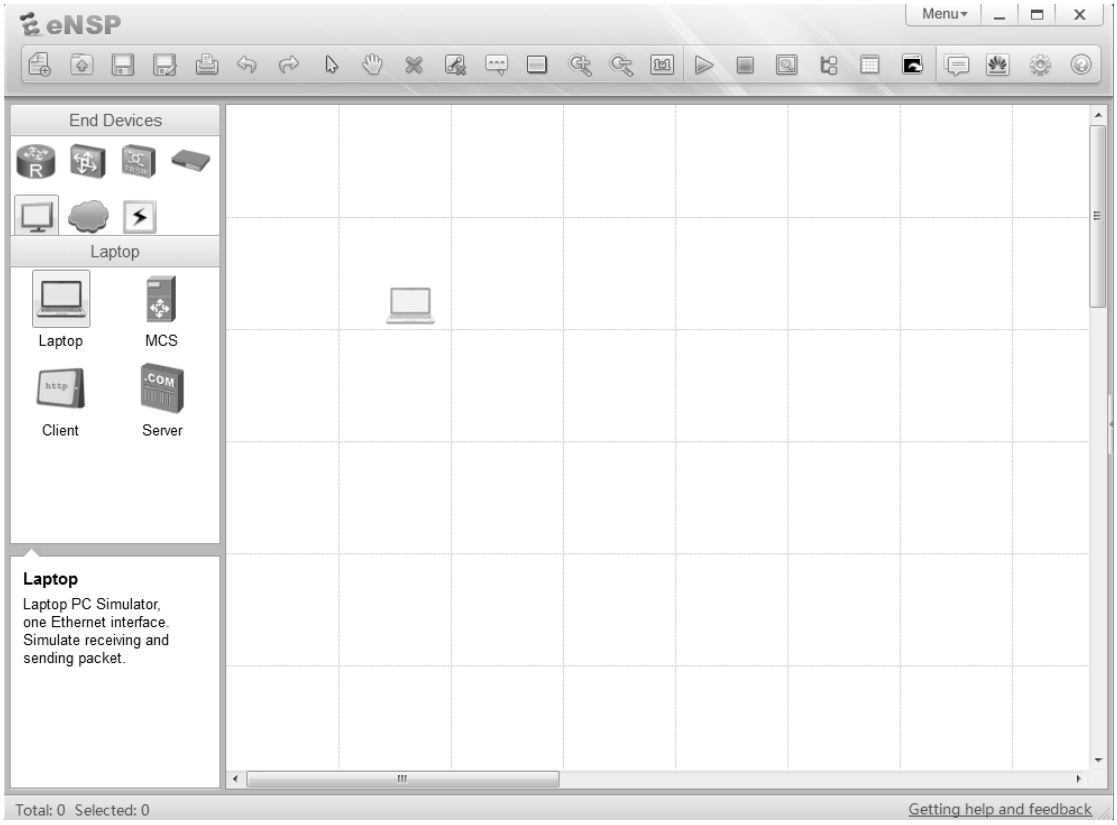


After launching eNSP, users should select the New operator in the top left corner of the application window to begin a new lab session.

The user will be presented with a canvas on which to establish a network topology for practice and analysis of network behavior. In this example a simple peer-to-peer network using two end systems is to be established.

Step 2 **Build a Topology**

Select the End Devce icon in the top left panel to reveal a list of end devices that can be applied. Select the Laptop icon and drag it to the canvas, release the icon to place it on the canvas.

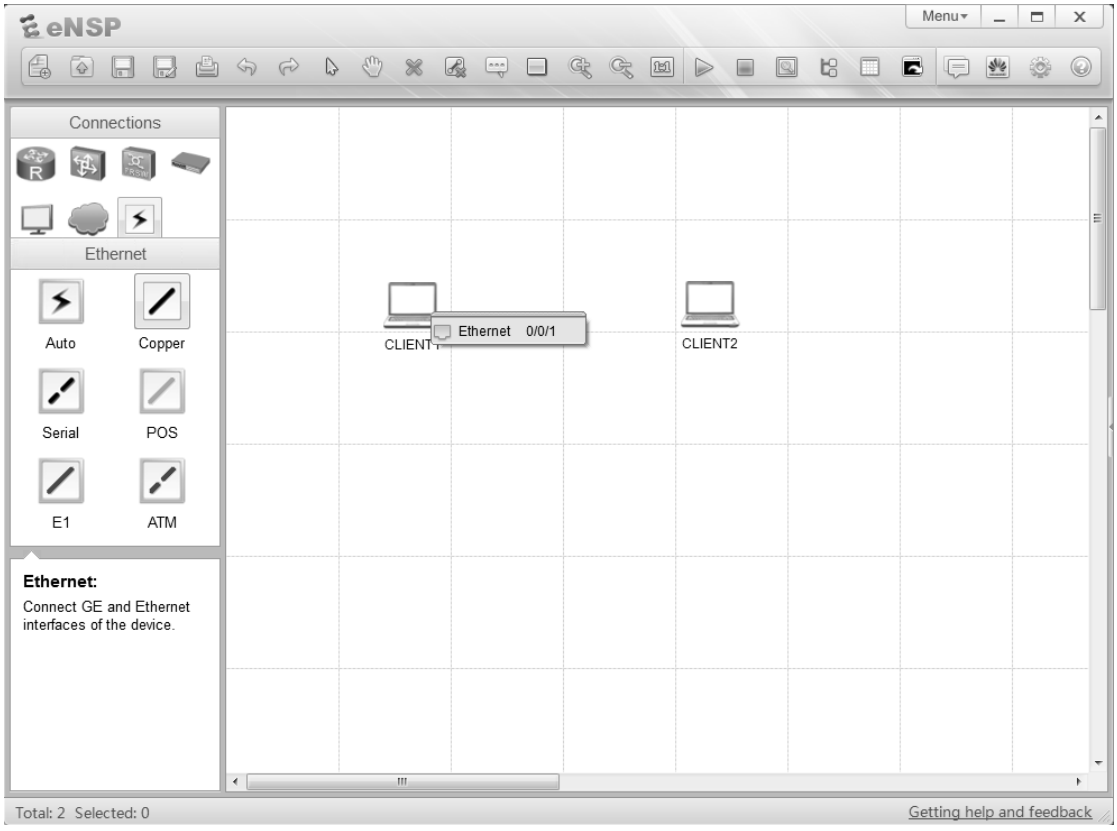


The same action should be taken to position a second laptop on the canvas for establishing the peer-to-peer network topology.

The devices on the canvas represent simulated end systems that can be used to emulate real world operations.

Step 3 **Establish a physical medium**

Select the connections icon from the upper left panel to reveal a list of media that can be applied to the topology. Select the copper (Ethernet) medium from the list. Once the icon has been clicked, the cursor will represent a connector to show the current role of the cursor as a connector. Click on the client device to reveal a list of port interfaces supported by the simulated device. For the client click the option for Ethernet 0/0/1 to apply the connection.

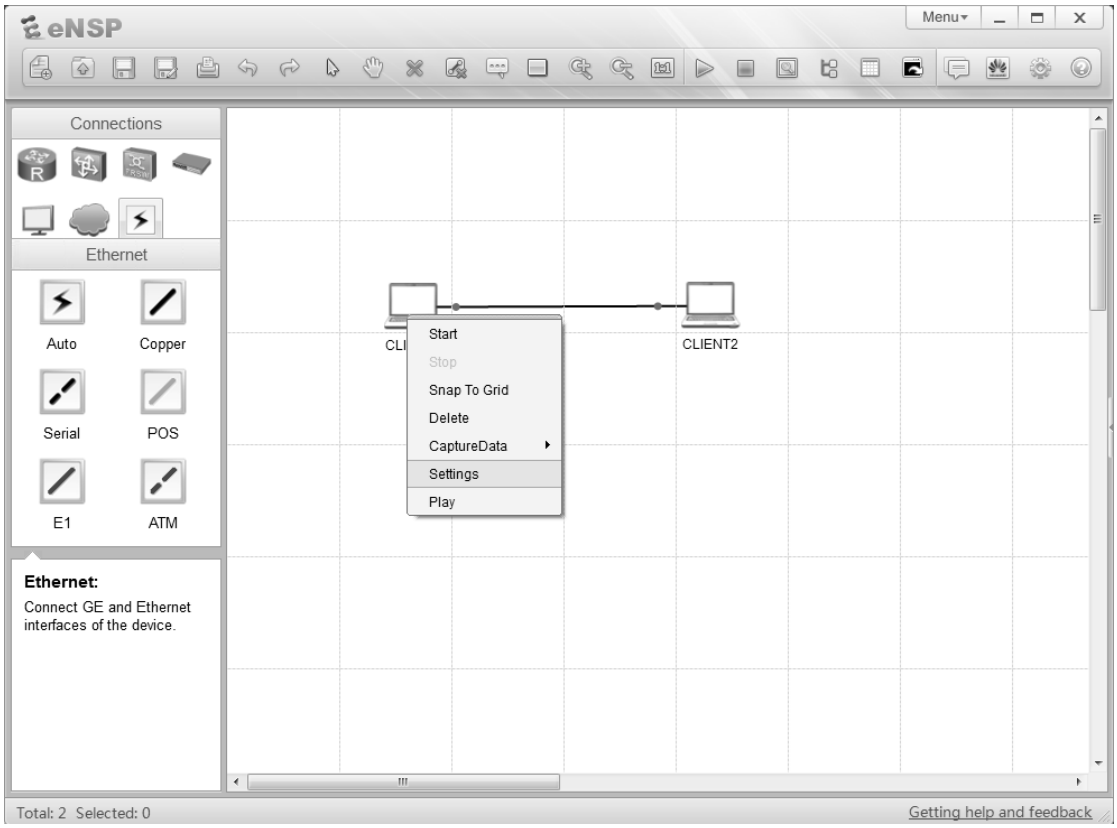


Once this has been achieved, click on the peering device to apply the opposite end of the medium to the end system. Again select the interface Ethernet 0/0/1 to establish the medium between the two devices and complete the construction of a peer-to-peer topology.

The establishment of a point-to-point network reveals a connection with two red dots on the medium that represent the current state of the interfaces to which the medium connects as down.

Step 4 **Access the end system settings.**

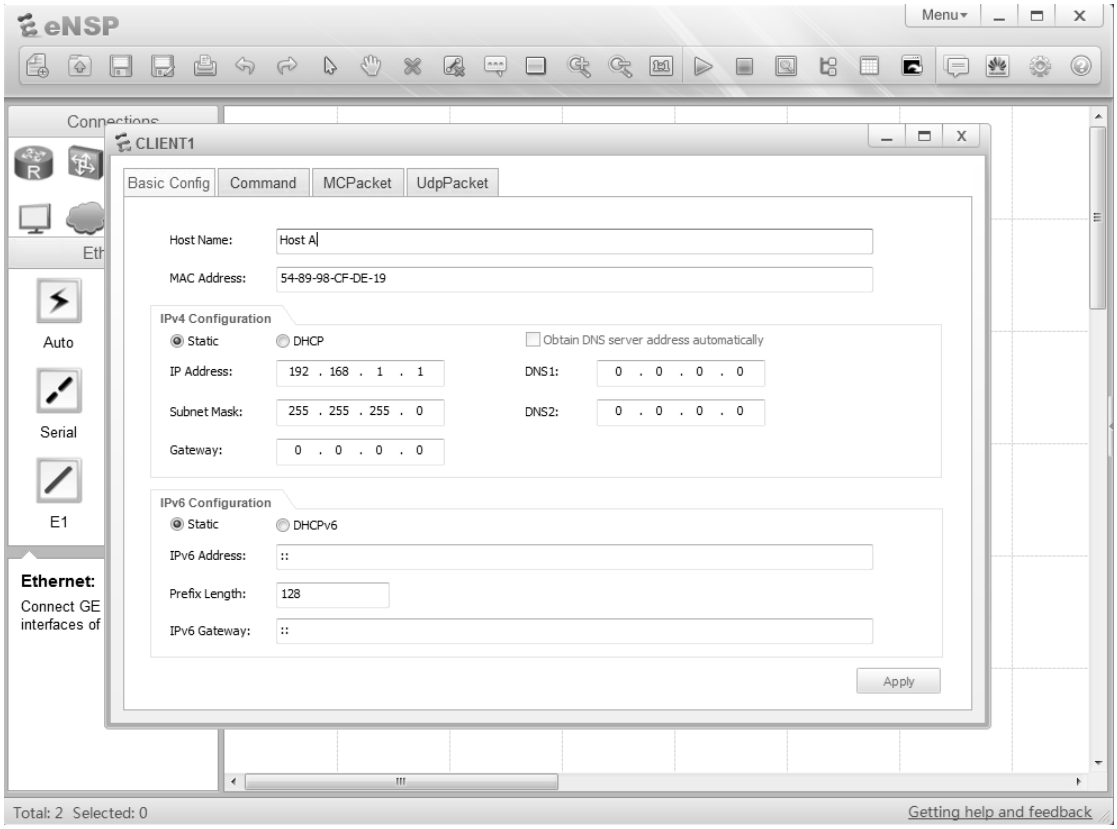
Select the end system and use the right click option to display a properties menu. The settings option should be selected in order to display the current system settings for the end system devices.



The settings option in the properties window reveals a set of four tabs for establishment of basic configuration, the device command line interface, multicast traffic generator configuration, and UDP packet generator configuration.

Step 5 **Configure the end system.**

Ensure the Basic Config tab is selected and enter a host name in the Host Name field window. Ensure the IPv4 configuration is currently set to static and configure an IP address in the IP address window. It is recommended that the address (together with the subnet mask) be configured as shown in the below example. Once this has been configured, click the Apply button in the bottom left corner of the window before closing with the x in the top left corner of the CLIENT 1 window.



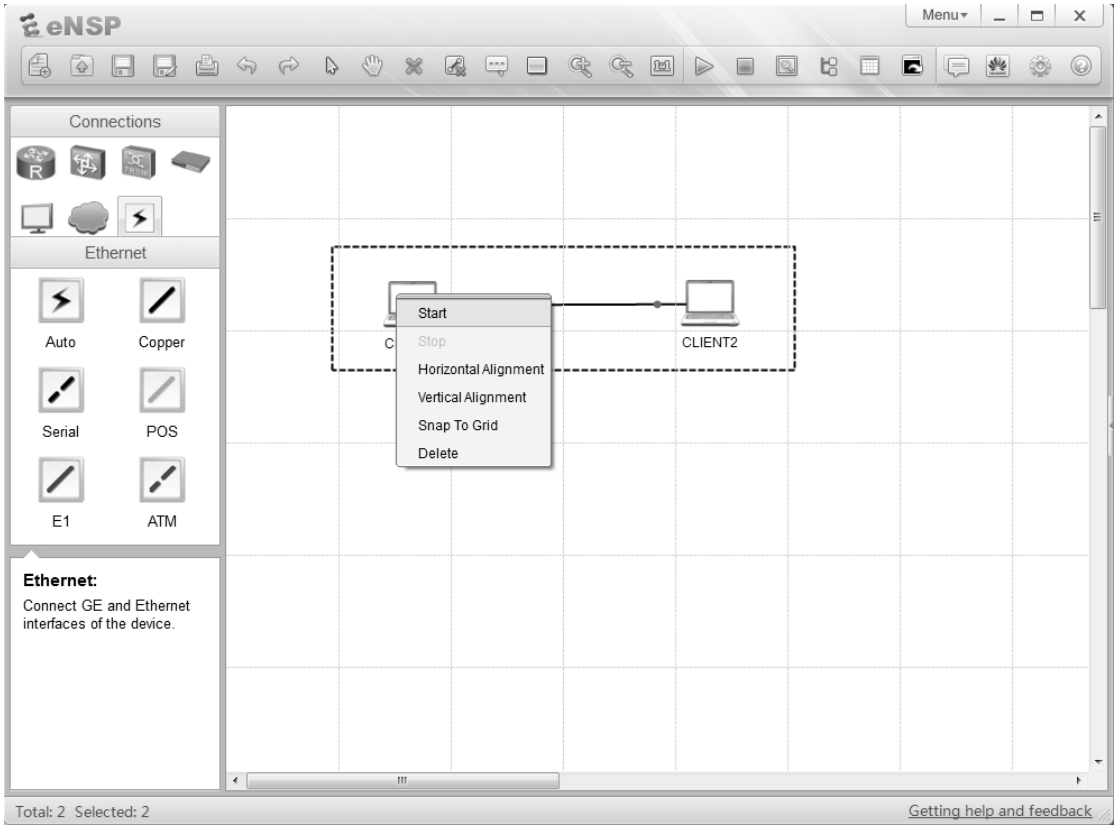
The same process is required for CLIENT2. It is recommended that initially the IP address 192.168.1.2 be configured, with a subnet mask of 255.255.255.0.

The basic configuration enables peer-to-peer communication to be supported between the two end systems.

Step 6 **Initiate the end system devices.**

The devices can be activated using one of two methods. The first involves using the right click option to open the properties menu and select start for the individual icons. The alternative involves dragging the cursor over the icons (as shown) to

highlight multiple devices and using the right click settings option start multiple devices simultaneously.

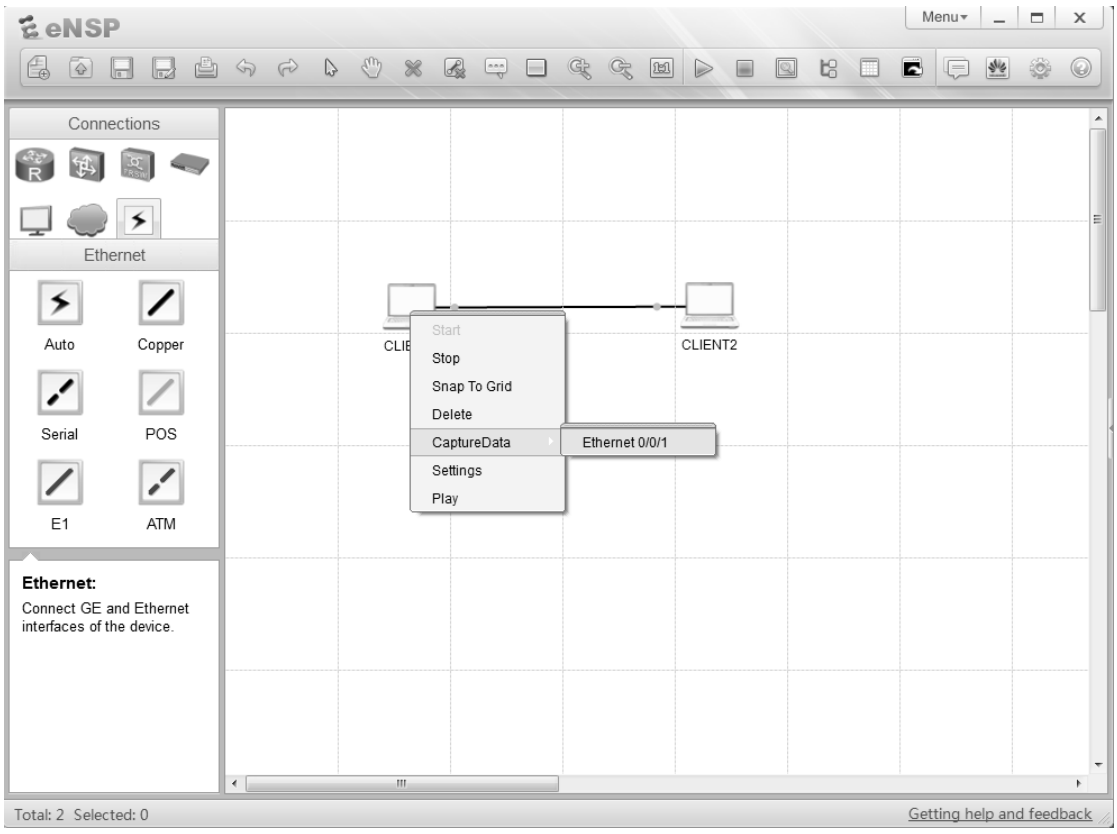


Once the devices are online and active, it is common to notice a change in the status of the connectors through a switch in the colour of the red dot on the medium to green, highlighting that the status of the connectors is now up.

Once the devices within the network topology are operational, it is possible to begin to monitor the flow of traffic that is carried over the medium and the interfaces via which the devices have established a physical peering.

Step 7 **Implement the capture of packets on an interface.**

Select the device to for whose interface is to be monitored and use the right click option to display the settings menu. Highlight the capture data option to reveal a list of interfaces that belong to the device and are available for observation by the packet capture tool. Select the interface from the list that is to be monitored.



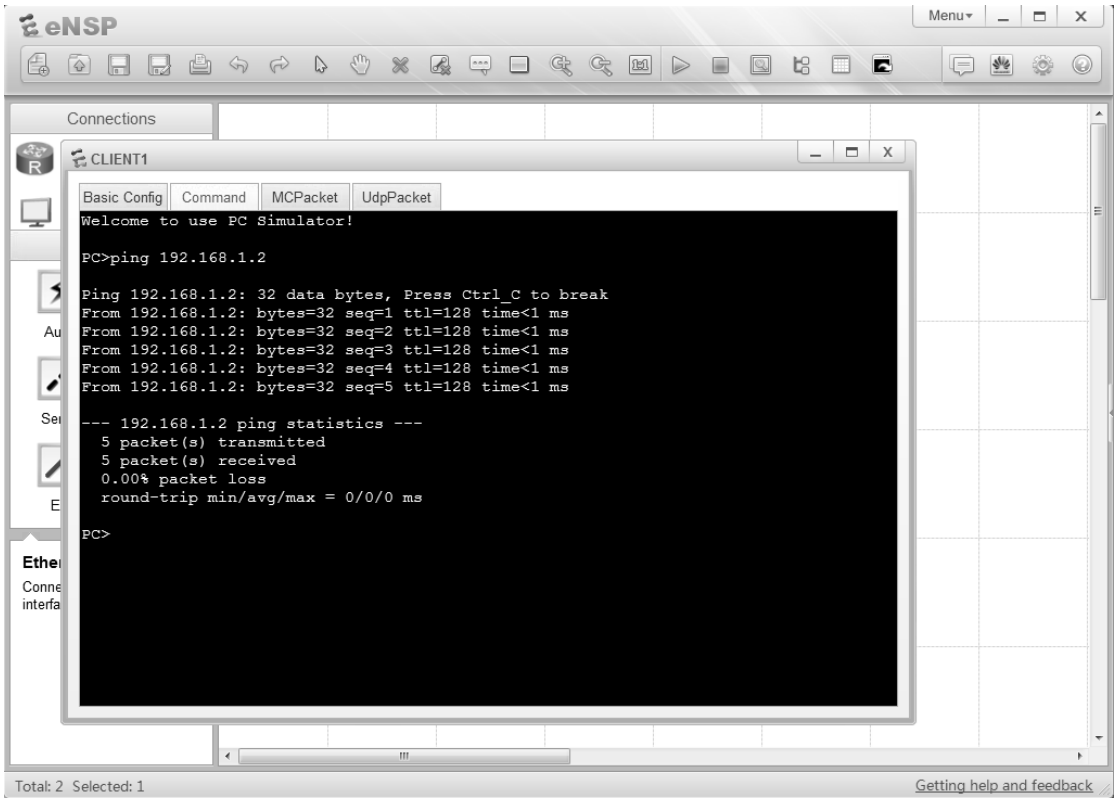
The selection of an interface will result in the activation of the Wireshark packet capture tool for the selected interface. If additional interfaces are to be monitored, separate instances of the same packet capture tool will be activated.

Depending on the devices being monitored, the packet capture tool may or may not begin to generate packet capture results for all traffic that passes through the selected interface. In the case of the peer-to-peer relationship, it will be necessary to generate some traffic.

Step 8 **Generate traffic on the interface.**

Open the command window on the client by either double clicking the client icon and selecting the Command tab, or alternatively use the right click option to enter the properties menu and select settings from which point the Command tab can be selected.

The most basic means for generating traffic is through the ping command. This can be achieved by entering ping <ip address> where the IP address refers to the address of the peer.

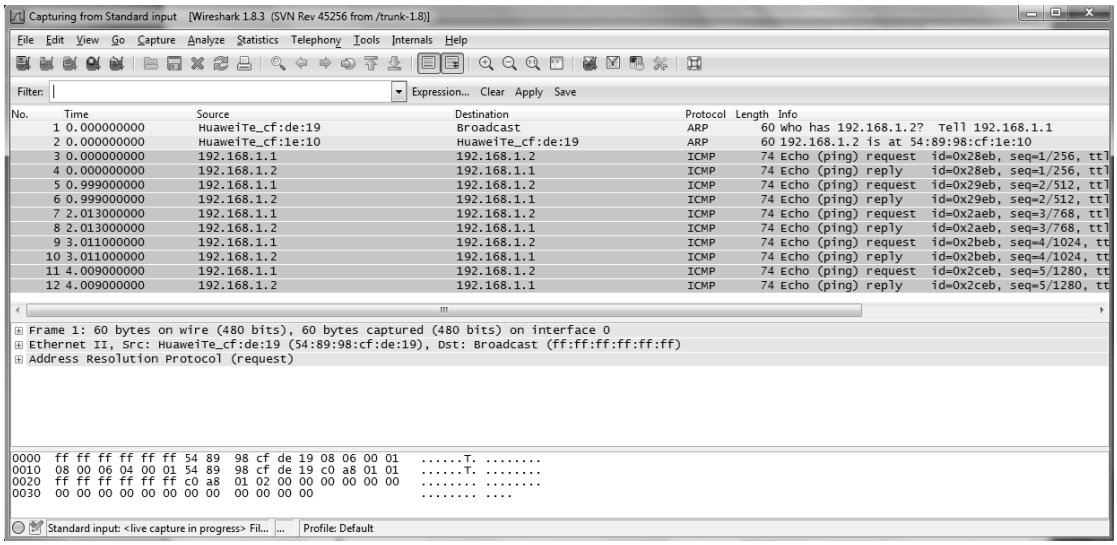


The generation of traffic will be confirmed by the resulting output in which case the number of packets transmitted are shown to also be received.

Following the generation of traffic, the resulting traffic flow shall be captured by the packet capture tool and can be used for observation of the behavior of protocols within the IP network along with details of the various layers as referenced in the OSI reference model.

Step 9 **Observe the captured traffic flow**

An instance of the Wireshark packet capture tool should currently be active following the action to capture data on the client interface. Maximize the active window to observe the results of the packet capture process.



The Wireshark application contains many functions for management of the packet capture process. One of the more common functions includes the filter function to isolate the packet capture display to a select group of packets or protocols. This can

be achieved using the filter field below the menu bar. The simplest filter method involves entering the protocol name (in lower case) and pressing Enter. In the given example packets for two protocols have been captured, entering either *icmp*, or *arp* into the filter window will result in only the protocol entered in the filter field being displayed in the output.

The packet capture tool consists of three panels, to show the list of packets, a breakdown of the content of each packet and finally display the equivalent data format of the packet. The breakdown is invaluable for understanding the format of protocol packets and displays the details for protocols as referenced at each layer of the OSI reference model.

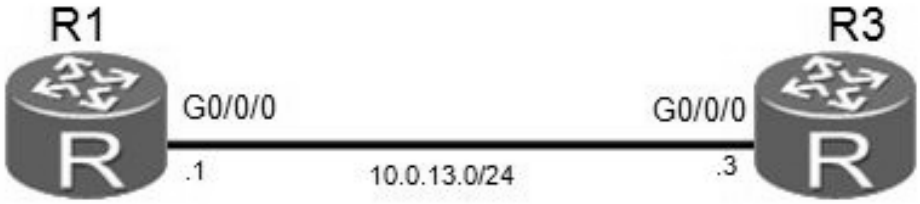
Module 2 Basic Device Navigation and Configuration

Lab 2-1 Basic Device Navigation and Configuration

Learning Objectives

As a result of this lab section, you should achieve the following tasks:

- Configure device system parameters including device name, the system time, and the system time zone.
- Configure the console port idle timeout duration.
- Configure the login information.
- Configure the login password
- Save configuration files.
- Configure IP addresses for router interfaces.
- Test the connectivity between two directly connected routers.
- Restart a device using VRP.



Topology

Figure 2.1 Lab topology for basic VRP navigation and operation.

Scenario

A company has purchased two AR G3 routers that require commissioning before they can be used in the enterprise network. Items to be commissioned include setting device names, the system time, and password management.

Tasks

Step 1 View the system information.

Run the **display version** command to view the software version and hardware information for the system.

```
<Huawei>display version
Huawei Versatile Routing Platform Software
VRP (R) software, Version 5.160 (AR2200 V200R007C00SPC600)
Copyright (C) 2011-2013 HUAWEI TECH CO., LTD
Huawei AR2220E Router uptime is 0 week, 3 days, 21 hours, 43 minutes
BKP 0 version information:
......output omitted......
```

The command output includes the VRP operating system version, device model, and startup time.

Step 2 Change the system time parameter.

The system automatically saves the time. If the time is incorrect, run the **clock timezone** and **clock datetime** commands in the user view to change the system time.

```
<Huawei>clock timezone Local add 08:00:00
<Huawei>clock datetime 12:00:00 2016-03-11
```

The keyword *Local* can be exchanged with the current regional timezone name, and

add replaced with **minus** where the timezone is west of UTC+0.

Run the **display clock** command to check that the new system time has taken effect.

```
<Huawei>display clock
2016-03-11 12:00:21
Sunday
Time Zone(Default Zone Name) : UTC+00:00
```

Step 3 **Help features & Auto-completion functions.**

The question mark (?) is a wildcard, and the Tab is used as a shortcut to enter commands.

```
<Huawei>display ?
    Cellular                Cellular interface
    aaa                     AAA
    access-user             User access
    accounting-scheme       Accounting scheme
    acl                     <Group> acl command group
    actual                  Current actual
    adp-ipv4                Ipv4 information
    adp-mpls                Adp-mpls module
    alarm                   Alarm
    antenna                 Current antenna that outputting radio
    anti-attack             Specify anti-attack configurations
    ap                      <Group> ap command group
    ap-auth-mode            Display AP authentication mode
  ......output omit......
```

To display all the commands that start with a specific letter or string of letters, enter the desired letters and the question mark (?). The system displays all the commands that start with the letters entered. For example, if the string **dis?** is entered, the system displays all the commands that start with **dis**.

If a space exists between the character string and the question mark (?), the system will identify the commands corresponding to the string and display the parameters of the command. For example, if the string **dis ?** is entered and only the **display** command matches the **dis** string, the system displays the parameters of the **display** command. If multiple commands start with **dis**, the system displays an error.

The **Tab** key can also be pressed to complete a command. For example, if **dis** is entered followed by **Tab,** the system completes the **display** command. If multiple

commands start with **dis**, the appropriate command can be selected.

If there are no other commands starting with the same letters, **dis** or **disp** can be entered to indicate **display**, and **int** or **inter** to indicate **interface**.

Step 4 **Access the system view.**

Run the **system-view** command to access the system view to configure interfaces and protocols.

```
<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]
```

Step 5 **Change device names.**

To more easily identify devices, set device names during the device configuration. Change device names based on the lab topology, as shown below:

Change the name of the R1 router to **R1**.

```
[Huawei]sysname R1
[R1]
```

Change the name of the R3 router to **R3**.

```
[Huawei]sysname R3
[R3]
```

Step 6 **Configure the login information.**

Configure the login information to indicate the login result.

```
[R1]header shell information "Welcome to the Huawei certification lab."
```

Run the preceding command to configure the login information. To check whether the login information has been changed, exit from the router command line interface, and log back in to view the login information.

```
[R1]quit
<R1>quit
```

```
  Configuration console exit, please press any key to log on
Welcome to the Huawei certification lab.
<R1>
```

Step 7 **Configure console port parameters.**

The console port by default does not have a login password. Users must configure a password for the console port before logging in to the device.

The password can be changed in the password authentication mode to **huawei** in plain text.

If there is no activity on the console port for the period of time specified by the timeout interval, the system will automatically log out the user. When this occurs, log in to the system again using the configured password.

The default timeout interval is set to 10 minutes. If a 10 minutes idle period is not a reasonable amount of time for the timeout interval, change the timeout interval to a more suitable duration, here this is set to 20 minutes.

```
[R1]user-interface console 0
[R1-ui-console0]authentication-mode password
[R1-ui-console0]set authentication password cipher huawei
[R1-ui-console0]idle-timeout 20 0
```

Run the **display this** command to check the configuration results.

```
[R1-ui-console0]display this
[V200R007C00SPC600]
#
user-interface con 0
 authentication-mode password
 set authentication password cipher %$%$fIn'6>NZ6*~as(#J:WU%,#72Uy8cVlN^NXkT51E
^RX;>#75,%$%$
 idle-timeout 20 0
```

Log out of the system and log back in, using the password set. It should be noted that this password is required to be set when the router is first initialized.

```
[R1-ui-console0]return
<R1>quit

  Configuration console exit, please press any key to log on
```

```
Welcome to Huawei certification lab
<R1>
```

Step 8 **Configure interface IP addresses and descriptions.**

Configure an IP address for the Gigabit Ethernet 0/0/0 interface of R1. The subnet mask can be configured using a dotted decimal format (255.255.255.0), or based on the subnet mask prefix length.

```
[R1]interface GigabitEthernet 0/0/0
[R1-GigabitEthernet0/0/0]ip address 10.0.13.1 24
[R1-GigabitEthernet0/0/0]description This interface connects to R3-G0/0/0
```

Run the **display this** command to check the configuration results at the current interface view.

```
[R1-GigabitEthernet0/0/0]display this
[V200R007C00SPC600]
#
interface GigabitEthernet0/0/0
 description This interface connects to R3-G0/0/0
 ip address 10.0.13.1 255.255.255.0
#
Return
```

Run the **display interface** command to view the interface description.

```
[R1]display interface GigabitEthernet0/0/0
GigabitEthernet0/0/0 current state : UP
Line protocol current state : UP
Last line protocol up time : 2016-03-11 04:13:09
Description:This interface connects to R3-G0/0/0
Route Port,The Maximum Transmit Unit is 1500
Internet Address is 10.0.13.1/24
IP Sending Frames' Format is PKTFMT_ETHNT_2, Hardware address is 5489-9876-830b
Last physical up time   :   2016-03-10 03:24:01
Last physical down time :   2016-03-10 03:25:29
Current system time: 2016-03-11 04:15:30
Port Mode: FORCE COPPER
Speed :  100,  Loopback: NONE
Duplex: FULL,  Negotiation: ENABLE
Mdi   : AUTO
Last 300 seconds input rate 2296 bits/sec, 1 packets/sec
```

```
Last 300 seconds output rate 88 bits/sec, 0 packets/sec
Input peak rate 7392 bits/sec,Record time: 2016-03-10 04:08:41
Output peak rate 1120 bits/sec,Record time: 2016-03-10 03:27:56
Input:  3192 packets, 895019 bytes
  Unicast:              0,      Multicast:             1592
  Broadcast:            1600,   Jumbo:                 0
  Discard:              0,      Total Error:           0
  CRC:                  0,      Giants:                0
  Jabbers:              0,      Throttles:             0
  Runts:                0,      Symbols:               0
  Ignoreds:             0,      Frames:                0
Output:  181 packets, 63244 bytes
  Unicast:              0,      Multicast:             0
  Broadcast:            181,    Jumbo:                 0
  Discard:              0,      Total Error:           0
  Collisions:           0,      ExcessiveCollisions:   0
  Late Collisions:      0,      Deferreds:             0
    Input bandwidth utilization threshold : 100.00%
    Output bandwidth utilization threshold: 100.00%
    Input bandwidth utilization  : 0.01%
    Output bandwidth utilization :   0%
```

The command output shows that the physical status and protocol status of the interface are **UP**, and the corresponding physical layer and data link layer are functional.

Once the status has been verified, configure the IP address and description for the interface of R3.

```
[R3]interface GigabitEthernet 0/0/0
[R3-GigabitEthernet0/0/0]ip address 10.0.13.3 255.255.255.0
[R3-GigabitEthernet0/0/0]description This interface connects to R1-G0/0/0
```

After completing the configuration, run the **ping** command to test the connection between R1 and R3.

```
<R1>ping 10.0.13.3
  PING 10.0.13.3: 56  data bytes, press CTRL_C to break
    Reply from 10.0.13.3: bytes=56 Sequence=1 ttl=255 time=35 ms
    Reply from 10.0.13.3: bytes=56 Sequence=2 ttl=255 time=32 ms
    Reply from 10.0.13.3: bytes=56 Sequence=3 ttl=255 time=32 ms
    Reply from 10.0.13.3: bytes=56 Sequence=4 ttl=255 time=32 ms
    Reply from 10.0.13.3: bytes=56 Sequence=5 ttl=255 time=32 ms
  --- 10.0.13.3 ping statistics ---
    5 packet(s) transmitted
```

```
    5 packet(s) received
    0.00% packet loss
round-trip min/avg/max = 32/32/35 ms
```

Step 9 View the file list stored on the current device.

Run the **dir** command in the user view to display the list of files in the current directory.

```
<R1>dir
Directory of flash:/

  Idx  Attr  Size(Byte)  Date        Time(LMT)   FileName
    0  -rw-   1,738,816  Mar 10 2016 11:50:24    web.zip
    1  -rw-  68,288,896  Mar 10 2016 14:17:58    ar2220E-V200R007C00SPC600.cc
    2  -rw-         739  Mar 10 2016 16:01:17    vrpcfg.zip
1,927,476 KB total (1,856,548 KB free)

<R3>dir
Directory of flash:/

  Idx  Attr  Size(Byte)  Date        Time(LMT)   FileName
    0  -rw-  1,738,816   Mar 10 2016 11:50:58    web.zip
    1  -rw-  68,288,896  Mar 10 2016 14:19:02    ar2220E-V200R007C00SPC600.cc
    2  -rw-         739  Mar 10 2016 16:03:04    vrpcfg.zip

1,927,476 KB total (1,855,076 KB free)
```

Step 10 Manage device configuration files.

Attempt to display the saved-configuration file.

```
<R1>display saved-configuration
    There is no correct configuration file in FLASH
```

Since no save-configuration file exists, save the current configuration file.

```
<R1>save
  The current configuration will be written to the device.
  Are you sure to continue? (y/n)[n]:y
  It will take several minutes to save configuration file, please wait.............
  Configuration file had been saved successfully
```

```
  Note: The configuration file will take effect after being activated
```

Run the following command again to view the saved configuration information:

```
<R1>display saved-configuration
[V200R007C00SPC600]
#
 sysname R1
 header shell information "Welcome to Huawei certification lab"
#
 board add 0/1 1SA
 board add 0/2 1SA
……output omit……
```

Run the following command to view the current configuration information:

```
<R1>display current-configuration
[V200R007C00SPC600]
#
 sysname R1
 header shell information "Welcome to Huawei certification lab"
#
 board add 0/1 1SA
 board add 0/2 1SA
 board add 0/3 2FE
……output omit……
```

A router can store multiple configuration files. Run the following command to view the configuration file to currently be used after the next startup:

```
<R3>display startup
MainBoard:
  Startup system software:                flash:/ar2220E-V200R007C00SPC600.cc
  Next startup system software:           flash:/ar2220E-V200R007C00SPC600.cc
  Backup system software for next startup: null
  Startup saved-configuration file:       null
  Next startup saved-configuration file:  flash:/vrpcfg.zip
  Startup license file:                   null
  Next startup license file:              null
  Startup patch package:                  null
  Next startup patch package:             null
  Startup voice-files:                    null
  Next startup voice-files:               null
```

Delete configuration files from the flash memory.

```
<R1>reset saved-configuration
This will delete the configuration in the flash memory.
The device configurations will be erased to reconfigure.
Are you sure? (y/n)[n]:y
 Clear the configuration in the device successfully.

<R3>reset saved-configuration
This will delete the configuration in the flash memory.
The device configurations will be erased to reconfigure.
Are you sure? (y/n)[n]:y
 Clear the configuration in the device successfully.
```

Step 11 **Device restart procedure.**

Use the **reboot** command to restart the router.

```
<R1>reboot
Info: The system is now comparing the configuration, please wait.
Warning: All the configuration will be saved to the next startup configuration. Continue ?
[y/n]:n
System will reboot! Continue ? [y/n]:y
Info: system is rebooting ,please wait...

<R3>reboot
Info: The system is now comparing the configuration, please wait.
Warning: All the configuration will be saved to the next startup configuration. Continue ?
[y/n]:n
System will reboot! Continue ? [y/n]:y
```

The system asks to save the current configuration. It is necessary to determine whether the current configuration should be saved based on the requirements for the lab. If unsure as to whether the current configuration should be saved, do not save.

Final Configuration

```
[R1]display current-configuration
[V200R007C00SPC600]
```

```
#
 sysname R1
 header shell information "Welcome to Huawei certification lab"
#
interface GigabitEthernet0/0/0
 description This interface connects to R3-G0/0/0
 ip address 10.0.13.1 255.255.255.0
#
user-interface con 0
 authentication-mode password
 set authentication password cipher %$%$4D0K*-E"t/I7[{HD~kgW,%dgkQQ!&|;XTDq9SFQJ.27M%dj,%$%
$
 idle-timeout 20 0
#
return

[R3]display current-configuration
[V200R007C00SPC600]
#
 sysname R3
#
interface GigabitEthernet0/0/0
 description This interface connect to R1-G0/0/0
 ip address 10.0.13.3 255.255.255.0
#
user-interface con 0
 authentication-mode password
 set authentication password cipher %$%$M8\HO3:72:ERQ8JLoHU8,%t+lE:$9=a7"8%yMoARB]$B%t.,%$%
$
user-interface vty 0 4
#
return
```

Module 3 STP and RSTP

Lab 3-1 Configuring STP

Learning Objectives

As a result of this lab section, you should achieve the following tasks:

- Enable and disable STP.
- Change the STP mode that is used by a switch.
- Change the bridge priority to control root bridge election.
- Change the port priority to control election of the root port and designated port.
- Change the port cost to control election of the root port and designated port.
- Configure an edge port.

Topology

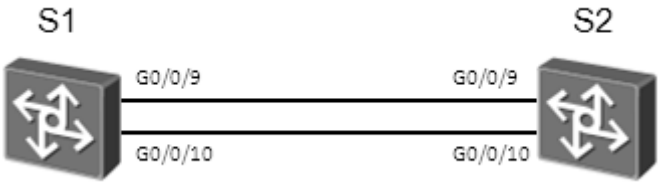


Figure 3.1 STP topology

Scenario

Assume that you are a network administrator of a company. The company network consists of two layers: core layer and access layer. The network uses a design that

supports network redundancy. STP will be used to prevent loops. The STP network should include setting the bridge priority to control STP root bridge election, and configuration of features to speed up STP route convergence.

Tasks

Step 1 Configure STP and verify the STP configuration.

Irrelevant interfaces must be disabled to ensure test result accuracy.

Shut down port interfaces Ethernet 0/0/1 on S3, Ethernet 0/0/13 and Ethernet 0/0/7 on S3, as well as Ethernet 0/0/14 and Ethernet 0/0/6 on S4 before starting STP configuration. Ensure that the devices start without any configuration files. If STP is disabled, run the **stp enable** command to enable STP.

```
<Quidway>system-view
[Quidway]sysname S3
[S3]interface Ethernet 0/0/1
[S3-Ethernet0/0/1]shutdown
[S3-Ethernet0/0/1]quit
[S3]interface Ethernet 0/0/13
[S3-Ethernet0/0/13]shutdown
[S3-Ethernet0/0/13]quit
[S3]interface Ethernet 0/0/7
[S3-Ethernet0/0/7]shutdown

<Quidway>system-view
[Quidway]sysname S4
[S4]inter Ethernet 0/0/14
[S4-Ethernet0/0/14]shutdown
[S4-Ethernet0/0/14]quit
[S4]interface Ethernet 0/0/6
[S4-Ethernet0/0/6]shutdown
```

In the lab,S1 and S2 are connected through two links, and STP is used. Enable STP on S1 and S2 and set S1 as the root.

```
<Quidway>system-view
Enter system view, return user view with Ctrl+Z.
[Quidway]sysname S1
[S1]stp mode stp
[S1]stp root primary
```

```
<Quidway>system-view
Enter system view, return user view with Ctrl+Z.
[Quidway]sysname S2
[S2]stp mode stp
[S2]stp root secondary
```

Run the **display stp brief** command to view brief information about STP.

```
<S1>display stp brief

    MSTID   Port                    Role    STP State   Protection
    0       GigabitEthernet0/0/9    DESI    FORWARDING  NONE
    0       GigabitEthernet0/0/10   DESI    FORWARDING  NONE

<S2>display stp brief
    MSTID   Port                    Role    STP State   Protection
    0       GigabitEthernet0/0/9    ROOT    FORWARDING  NONE
    0       GigabitEthernet0/0/10   ALTE    DISCARDING  NONE
```

Run the **display stp interface** command to view the STP status of a port.

```
<S1>display stp interface GigabitEthernet 0/0/10
----[CIST][Port10(GigabitEthernet0/0/10)][FORWARDING]----
 Port Protocol      :Enabled
 Port Role          :Designated Port
 Port Priority      :128
 Port Cost(Dot1T )   :Config=auto / Active=20000
 Designated Bridge/Port   :0.4c1f-cc45-aace / 128.10
 Port Edged         :Config=default / Active=disabled
 Point-to-point     :Config=auto / Active=true
 Transit Limit      :147 packets/hello-time
 Protection Type    :None
 Port STP Mode      :STP
 Port Protocol Type  :Config=auto / Active=dot1s
 BPDU Encapsulation  :Config=stp / Active=stp
 PortTimes          :Hello 2s MaxAge 20s FwDly 15s RemHop 20
 TC or TCN send     :17
```

```
 TC or TCN received  :33
 BPDU Sent          :221
        TCN: 0, Config: 221, RST: 0, MST: 0
 BPDU Received      :68
        TCN: 0, Config: 68, RST: 0, MST: 0
<S2>display stp interface GigabitEthernet 0/0/10
----[CIST][Port10(GigabitEthernet0/0/10)][DISCARDING]----
 Port Protocol      :Enabled
 Port Role          :Alternate Port
 Port Priority      :128
 Port Cost(Dot1T )   :Config=auto / Active=20000
 Designated Bridge/Port   :0.4c1f-cc45-aace / 128.10
 Port Edged         :Config=default / Active=disabled
 Point-to-point     :Config=auto / Active=true
 Transit Limit      :147 packets/hello-time
 Protection Type    :None
 Port STP Mode      :STP
 Port Protocol Type  :Config=auto / Active=dot1s
 BPDU Encapsulation  :Config=stp / Active=stp
 PortTimes          :Hello 2s MaxAge 20s FwDly 15s RemHop 0
 TC or TCN send     :17
 TC or TCN received  :17
 BPDU Sent          :35
        TCN: 0, Config: 35, RST: 0, MST: 0
 BPDU Received      :158
        TCN: 0, Config: 158, RST: 0, MST: 0
```

Step 2 **Control root bridge election.**

Run the **display stp** command to view information about the root bridge.

```
<S1>display  stp
-------[CIST Global Info][Mode STP]-------
CIST Bridge        :0    .4c1f-cc45-aace
Bridge Times       :Hello 2s MaxAge 20s FwDly 15s MaxHop 20
CIST Root/ERPC     :0    .4c1f-cc45-aace / 0
CIST RegRoot/IRPC   :0    .4c1f-cc45-aace / 0
CIST RootPortId    :0.0
BPDU-Protection    :Disabled
CIST Root Type     :Primary root
TC or TCN received  :108
TC count per hello  :0
```

```
STP Converge Mode   :Normal
Share region-configuration :Enabled
Time since last TC  :0 days 0h:9m:23s
……output omit……


<S2>display stp
-------[CIST Global Info][Mode STP]-------
CIST Bridge        :4096 .4c1f-cc45-aacc
Bridge Times       :Hello 2s MaxAge 20s FwDly 15s MaxHop 20
CIST Root/ERPC     :0    .4c1f-cc45-aace / 20000
CIST RegRoot/IRPC   :4096 .4c1f-cc45-aacc / 0
CIST RootPortId    :128.9
BPDU-Protection    :Disabled
CIST Root Type     :Secondary root
TC or TCN received  :55
TC count per hello  :0
STP Converge Mode   :Normal
Share region-configuration :Enabled
Time since last TC  :0 days 0h:9m:30s
……output omit……
```

Configure S1 as the root bridge and S2 as the backup root bridge using priority values. The device with the same value for the **CIST Bridge** and **CIST Root/ERPC** is the root bridge. A smaller bridge priority value indicates a higher bridge priority. Change the priorities of S1 and S2 to 8192 and 4096 respectively so that S2 becomes the root bridge.

```
[S1]undo stp root
[S1]stp priority 8192

[S2]undo stp root
[S2]stp priority 4096
```

Run the **display stp** command to view information about the new root bridge.

```
<S1>display stp
-------[CIST Global Info][Mode STP]-------
CIST Bridge        :8192 .4c1f-cc45-aace
Bridge Times       :Hello 2s MaxAge 20s FwDly 15s 0
CIST Root/ERPC     :4096 .4c1f-cc45-aacc / 20000
CIST RegRoot/IRPC   :8192 .4c1f-cc45-aace / 0
CIST RootPortId    :128.9
```

```
BPDU-Protection    :Disabled
TC or TCN received  :143
TC count per hello  :0
STP Converge Mode   :Normal
Share region-configuration :Enabled
Time since last TC  :0 days 0h:0m:27s
……output omit……
<S2>display  stp
-------[CIST Global Info][Mode STP]-------
CIST Bridge        :4096 .4c1f-cc45-aacc
Bridge Times       :Hello 2s MaxAge 20s FwDly 15s MaxHop 20
CIST Root/ERPC     :4096 .4c1f-cc45-aacc / 0
CIST RegRoot/IRPC  :4096 .4c1f-cc45-aacc / 0
CIST RootPortId    :0.0
BPDU-Protection    :Disabled
TC or TCN received  :55
TC count per hello  :0
STP Converge Mode   :Normal
Share region-configuration :Enabled
Time since last TC  :0 days 0h:14m:7s
……output omit……
```

The highlighted lines in the preceding information indicate that S2 has become the new root bridge.

Shut down interfaces Gigabit Ethernet 0/0/9 and Gigabit Ethernet 0/0/10 on S2 to isolate S2.

```
[S2]interface GigabitEthernet 0/0/9
[S2-GigabitEthernet0/0/9]shutdown
[S2-GigabitEthernet0/0/9]quit
[S2]interface GigabitEthernet 0/0/10
[S2-GigabitEthernet0/0/10]shutdown

[S1]display  stp
-------[CIST Global Info][Mode STP]-------
CIST Bridge        :8192 .4c1f-cc45-aace
Bridge Times       :Hello 2s MaxAge 20s FwDly 15s MaxHop 20
CIST Root/ERPC     :8192 .4c1f-cc45-aace / 0
CIST RegRoot/IRPC  :8192 .4c1f-cc45-aace / 0
CIST RootPortId    :0.0
BPDU-Protection    :Disabled
TC or TCN received  :146
TC count per hello  :0
```

```
STP Converge Mode   :Normal
Share region-configuration :Enabled
Time since last TC  :0 days 0h:0m:11s
……output omit……
```

The highlighted lines in the preceding information indicate that S1 becomes the root bridge when S2 is faulty.

Re-enable the interfaces that have been disabled on S2.

```
[S2]interface GigabitEthernet 0/0/9
[S2-GigabitEthernet0/0/9]undo shutdown
[S2-GigabitEthernet0/0/9]quit
[S2]interface GigabitEthernet 0/0/10
[S2-GigabitEthernet0/0/10]undo shutdown

<S1>display stp
-------[CIST Global Info][Mode STP]-------
CIST Bridge        :8192 .4c1f-cc45-aace
Bridge Times       :Hello 2s MaxAge 20s FwDly 15s 0
CIST Root/ERPC     :4096 .4c1f-cc45-aacc / 20000
CIST RegRoot/IRPC  :8192 .4c1f-cc45-aace / 0
CIST RootPortId    :128.9
BPDU-Protection    :Disabled
TC or TCN received  :143
TC count per hello  :0
STP Converge Mode   :Normal
Share region-configuration :Enabled
Time since last TC  :0 days 0h:0m:27s
……output omitted……

<S2>display  stp
-------[CIST Global Info][Mode STP]-------
CIST Bridge        :4096 .4c1f-cc45-aacc
Bridge Times       :Hello 2s MaxAge 20s FwDly 15s MaxHop 20
CIST Root/ERPC     :4096 .4c1f-cc45-aacc / 0
CIST RegRoot/IRPC  :4096 .4c1f-cc45-aacc / 0
CIST RootPortId    :0.0
BPDU-Protection    :Disabled
TC or TCN received  :55
TC count per hello  :0
STP Converge Mode   :Normal
Share region-configuration :Enabled
```

```
Time since last TC  :0 days 0h:14m:7s
……output omitted……
```

The highlighted lines in the preceding information indicate that S2 has been restored and has become the root bridge once again.

Step 3 **Control root port election.**

Run the **display stp brief** command on S1 to view the roles of the interfaces.

```
<S1>display stp brief
    MSTID   Port                    Role    STP State   Protection
    0       GigabitEthernet0/0/9    ROOT    FORWARDING  NONE
    0       GigabitEthernet0/0/10   ALTE    DISCARDING  NONE
```

The preceding information shows that G0/0/9 is the root port and G0/0/10 is the alternate port. You can change port priorities so that port interface G0/0/10 will become the root port and G0/0/9 will become the alternate port.

Change priorities of G0/0/9 and G0/0/10 on S2.

The default port priority is 128. A larger port priority value indicates a lower priority. The priorities of G0/0/9 and G0/0/10 on S2 are set to 32 and 16; therefore, G0/0/10 on S1 becomes the root port.

```
[S2]interface GigabitEthernet 0/0/9
[S2-GigabitEthernet0/0/9]stp port priority 32
[S2-GigabitEthernet0/0/9]quit
[S2]interface GigabitEthernet 0/0/10
[S2-GigabitEthernet0/0/10]stp port priority 16
```

Note that the port priorities are changed on S2, not S1.

```
<S2>display stp interface  GigabitEthernet 0/0/9
----[CIST][Port9(GigabitEthernet0/0/9)][FORWARDING]----
 Port Protocol      :Enabled
 Port Role          :Designated Port
 Port Priority      :32
 Port Cost(Dot1T )   :Config=auto / Active=20000
 Designated Bridge/Port   :4096.4c1f-cc45-aacc / 32.9
 Port Edged         :Config=default / Active=disabled
 Point-to-point     :Config=auto / Active=true
 Transit Limit      :147 packets/hello-time
 Protection Type    :None
```

```
 Port STP Mode      :STP
 Port Protocol Type  :Config=auto / Active=dot1s
 BPDU Encapsulation  :Config=stp / Active=stp
 PortTimes          :Hello 2s MaxAge 20s FwDly 15s RemHop 20
 TC or TCN send     :22
 TC or TCN received  :1
 BPDU Sent          :164
        TCN: 0, Config: 164, RST: 0, MST: 0
 BPDU Received      :2
        TCN: 1, Config: 1, RST: 0, MST: 0

<S2>display stp interface GigabitEthernet 0/0/10
----[CIST][Port10(GigabitEthernet0/0/10)][FORWARDING]----
 Port Protocol      :Enabled
 Port Role          :Designated Port
 Port Priority      :16
 Port Cost(Dot1T )   :Config=auto / Active=20000
 Designated Bridge/Port   :4096.4c1f-cc45-aacc / 16.10
 Port Edged         :Config=default / Active=disabled
 Point-to-point     :Config=auto / Active=true
 Transit Limit      :147 packets/hello-time
 Protection Type    :None
 Port STP Mode      :STP
 Port Protocol Type  :Config=auto / Active=dot1s
 BPDU Encapsulation  :Config=stp / Active=stp
 PortTimes          :Hello 2s MaxAge 20s FwDly 15s RemHop 20
 TC or TCN send     :35
 TC or TCN received  :1
 BPDU Sent          :183
        TCN: 0, Config: 183, RST: 0, MST: 0
 BPDU Received      :2
        TCN: 1, Config: 1, RST: 0, MST: 0
```

Run the **display stp brief** command on S1 to view the role of the interfaces.

```
<S1>display stp brief
    MSTID   Port                    Role    STP State   Protection
    0       GigabitEthernet0/0/9    ALTE    DISCARDING  NONE
    0       GigabitEthernet0/0/10   ROOT    FORWARDING  NONE
```

The highlighted lines in the preceding information indicate that G0/0/10 on S1 has become the root port and G0/0/9 has become the alternate port.

Shut down G0/0/10 on S1 and view the port roles.

```
[S1]interface GigabitEthernet 0/0/10
[S1-GigabitEthernet0/0/10]shutdown
<S1>display stp brief
    MSTID   Port                    Role    STP State   Protection
    0       GigabitEthernet0/0/9    ROOT    FORWARDING  NONE
```

The highlighted line in the preceding information indicates that G0/0/9 has become the root port. Resume the default priorities of G0/0/9 and G0/0/10 on S2 and re-enable the shutdown interfaces on S1.

```
[S2]interface GigabitEthernet 0/0/9
[S2-GigabitEthernet0/0/9]undo stp port priority
[S2-GigabitEthernet0/0/9]quit
[S2]interface GigabitEthernet 0/0/10
[S2-GigabitEthernet0/0/10]undo stp port priority


[S1]interface GigabitEthernet 0/0/10
[S1-GigabitEthernet0/0/10]undo shutdown
```

Run the **display stp brief** and **display stp interface** command on S1 to view the roles of interfaces.

```
<S1>display stp brief
    MSTID   Port                    Role    STP State   Protection
    0       GigabitEthernet0/0/9    ROOT    FORWARDING  NONE
    0       GigabitEthernet0/0/10   ALTE    DISCARDING  NONE


[S1]display stp interface GigabitEthernet 0/0/9
----[CIST][Port9(GigabitEthernet0/0/9)][FORWARDING]----
 Port Protocol      :Enabled
 Port Role          :Root Port
 Port Priority      :128
 Port Cost(Dot1T )   :Config=auto / Active=20000
 Designated Bridge/Port   :4096.4c1f-cc45-aacc / 128.9
 Port Edged         :Config=default / Active=disabled
 Point-to-point     :Config=auto / Active=true
 Transit Limit      :147 packets/hello-time
 Protection Type    :None
 Port STP Mode      :STP
 Port Protocol Type  :Config=auto / Active=dot1s
 BPDU Encapsulation  :Config=stp / Active=stp
```

```
 PortTimes          :Hello 2s MaxAge 20s FwDly 15s RemHop 0
 TC or TCN send     :4
 TC or TCN received  :90
 BPDU Sent          :5
        TCN: 4, Config: 1, RST: 0, MST: 0
 BPDU Received      :622
        TCN: 0, Config: 622, RST: 0, MST: 0

[S1]display stp interface GigabitEthernet 0/0/10
----[CIST][Port10(GigabitEthernet0/0/10)][DISCARDING]----
 Port Protocol      :Enabled
 Port Role          :Alternate Port
 Port Priority      :128
 Port Cost(Dot1T )   :Config=auto / Active=20000
 Designated Bridge/Port   :4096.4c1f-cc45-aacc / 128.10
 Port Edged         :Config=default / Active=disabled
 Point-to-point     :Config=auto / Active=true
 Transit Limit      :147 packets/hello-time
 Protection Type    :None
 Port STP Mode      :STP
 Port Protocol Type  :Config=auto / Active=dot1s
 BPDU Encapsulation  :Config=stp / Active=stp
 PortTimes          :Hello 2s MaxAge 20s FwDly 15s RemHop 0
 TC or TCN send     :3
 TC or TCN received  :90
 BPDU Sent          :4
        TCN: 3, Config: 1, RST: 0, MST: 0
 BPDU Received      :637
        TCN: 0, Config: 637, RST: 0, MST: 0
```

The greyed line in the preceding information indicates that G0/0/9 and G0/0/10 cost is 20000 by default.

Change the cost of G0/0/9 to 200000 on S1.

```
[S1]interface GigabitEthernet 0/0/9
[S1-GigabitEthernet0/0/9]stp cost 200000
```

Run the **display stp brief** and **display stp interface** command on S1 to view the roles of interfaces.

```
<S1>display stp interface GigabitEthernet 0/0/9
----[CIST][Port9(GigabitEthernet0/0/9)][DISCARDING]----
```

```
 Port Protocol      :Enabled
 Port Role          :Alternate Port
 Port Priority      :128
 Port Cost(Dot1T )   :Config=200000 / Active=200000
 Designated Bridge/Port   :4096.4c1f-cc45-aacc / 128.9
 Port Edged         :Config=default / Active=disabled
 Point-to-point     :Config=auto / Active=true
 Transit Limit      :147 packets/hello-time
 Protection Type    :None
 Port STP Mode      :STP
 Port Protocol Type  :Config=auto / Active=dot1s
 BPDU Encapsulation  :Config=stp / Active=stp
 PortTimes          :Hello 2s MaxAge 20s FwDly 15s RemHop 0
 TC or TCN send     :4
 TC or TCN received  :108
 BPDU Sent          :5
        TCN: 4, Config: 1, RST: 0, MST: 0
 BPDU Received      :818
        TCN: 0, Config: 818, RST: 0, MST: 0

<S1>display stp brief
    MSTID   Port                    Role    STP State   Protection
    0       GigabitEthernet0/0/9    ALTE    DISCARDING  NONE
    0       GigabitEthernet0/0/10   ROOT    FORWARDING  NONE
```

The highlighted lines in the preceding information indicates that G0/0/10 has become the root port.

Final Configuration

```
<S1>display current-configuration
#
!Software Version V200R008C00SPC500
 sysname S1
#
 stp mode stp
 stp instance 0 priority 8192
#
interface GigabitEthernet0/0/9
 stp instance 0 cost 200000
#
interface GigabitEthernet0/0/10
```

```
#
user-interface con 0
user-interface vty 0 4
#
return

<S2>display current-configuration
#
!Software Version V200R008C00SPC500
 sysname S2
#
 stp mode stp
 stp instance 0 priority 4096
#
interface GigabitEthernet0/0/9
#
interface GigabitEthernet0/0/10
#
user-interface con 0
user-interface vty 0 4
#
return

<S3>display current-configuration
#
!Software Version V100R006C05
 sysname S3
#
interface Ethernet0/0/1
 shutdown
#
 interface Ethernet0/0/7
 shutdown
#
interface Ethernet0/0/13
 shutdown
#
user-interface con 0
user-interface vty 0 4
#
return
```

```
<S4>display current-configuration
#
!Software Version V100R006C05
 sysname S4
#
 interface Ethernet0/0/6
 shutdown
#
interface Ethernet0/0/14
 shutdown
#
user-interface con 0
user-interface vty 0 4
#
return
```

Lab 3-2 Configuring RSTP

Learning Objectives

As a result of this lab section, you should achieve the following tasks:

- Enable and disable RSTP .
- Configuration of an edge port.
- Configuration of RSTP BPDU protection.
- Configuration of RSTP loop protection

Topology

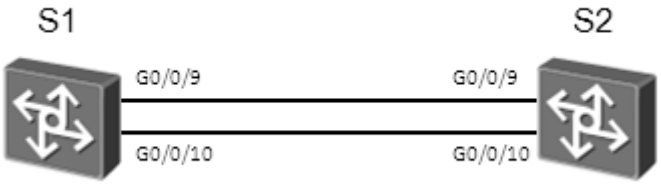


Figure 3.2 RSTP topology

Scenario

Assume that you are a network administrator of a company. The company network consists of two layers: core layer and access layer. The network uses a redundancy design. RSTP will be used to prevent loops. You can configure features to speed up RSTP route convergence at the edge network and configure RSTP protection function.

Tasks

Step 1 **Preparing the environment**

If you are starting this section with a non-configured device, begin here and then move to step 3. For those continuing from previous labs, begin at step 2.

Irrelevant interfaces must be disabled to ensure test result accuracy.

Shut down port interfaces Ethernet 0/0/1 on S3, Ethernet 0/0/13 and Ethernet 0/0/7 on S3, as well as Ethernet 0/0/14 and Ethernet 0/0/6 on S4 before starting STP configuration. Ensure that the devices start without any configuration files. If STP is disabled, run the stp enable command to enable STP.

```
<Quidway>system-view
Enter system view, return user view with Ctrl+Z.
[Quidway]sysname S1

<Quidway>system-view
Enter system view, return user view with Ctrl+Z.
[Quidway]sysname S2

<Quidway>system-view
[Quidway]sysname R3
[R3]interface Ethernet 0/0/1
[R3-Ethernet0/0/1]shutdown
[R3-Ethernet0/0/1]quit
[R3]interface Ethernet 0/0/13
[R3-Ethernet0/0/13]shutdown
[R3-Ethernet0/0/13]quit
[R3]interface Ethernet 0/0/7
[R3-Ethernet0/0/7]shutdown

<Quidway>system-view
[Quidway]sysname S4
[S4]inter Ethernet 0/0/14
[S4-Ethernet0/0/14]shutdown
[S4-Ethernet0/0/14]quit
[S4]interface Ethernet 0/0/6
[S4-Ethernet0/0/6]shutdown
```

Step 2 **Clean up the previous configuration**

Remove the configured STP priority from S1 and S2, and assigned cost on S1.

```
[S1]undo stp priority
[S1]inter GigabitEthernet 0/0/9
[S1-GigabitEthernet0/0/9]undo stp cost

[S2]undo stp priority
```

Step 3 **Configure RSTP and verify the RSTP configuration.**

Configure S1 and S2 to use RSTP as the spanning tree protocol.

```
[S1]stp mode rstp

[S2]stp mode rstp
```

Run the **display stp** command to view brief information about RSTP.

```
[S1]display  stp
-------[CIST Global Info][Mode RSTP]-------
CIST Bridge        :32768.4c1f-cc45-aace
Bridge Times       :Hello 2s MaxAge 20s FwDly 15s MaxHop 20
CIST Root/ERPC     :32768.4c1f-cc45-aacc / 20000
CIST RegRoot/IRPC   :32768.4c1f-cc45-aace / 0
CIST RootPortId    :128.9
BPDU-Protection    :Disabled
TC or TCN received  :28
TC count per hello  :0
STP Converge Mode   :Normal
Share region-configuration :Enabled
Time since last TC  :0 days 0h:11m:1s
……output omitted……

[S2]display  stp
-------[CIST Global Info][Mode RSTP]-------
CIST Bridge        :32768.4c1f-cc45-aacc
Bridge Times       :Hello 2s MaxAge 20s FwDly 15s MaxHop 20
CIST Root/ERPC     :32768.4c1f-cc45-aacc / 0
CIST RegRoot/IRPC   :32768.4c1f-cc45-aacc / 0
```

```
CIST RootPortId    :0.0
BPDU-Protection    :Disabled
TC or TCN received  :14
TC count per hello  :0
STP Converge Mode   :Normal
Share region-configuration :Enabled
Time since last TC  :0 days 0h:12m:23s
……output omitted……
```

Step 4 **Configure an edge port.**

Configure ports connected to the user terminals as edge ports. An edge port can transition to the forwarding state without participating in the RSTP calculation. In this example, interface Gigabit Ethernet 0/0/4 on S1 and S2 connect to a router and can be configured as edge ports.

```
[S1]interface GigabitEthernet 0/0/4
[S1-GigabitEthernet0/0/4]stp edged-port enable

[S2]interface GigabitEthernet 0/0/4
[S2-GigabitEthernet0/0/4]stp edged-port enable
```

Step 5 **Configure BPDU protection.**

Edge ports are directly connected to user terminal and will not receive BPDUs. Attackers may send pseudo BPDUs to attack the switching device. If the edge ports receive the BPDUs, the switching device configures the edge ports as non-edge ports and triggers a new spanning tree calculation. Network flapping then occurs. BPDU protection can be used to protect switching devices against malicious attacks.

Configure BPDU protection on both S1 and S2.

```
[S1]stp bpdu-protection

[S2]stp bpdu-protection
```

Run the **display stp brief** command to view the port protection.

```
<S1>display  stp brief
 MSTID  Port                    Role  STP State     Protection
   0    GigabitEthernet0/0/4      DESI  FORWARDING      BPDU
   0    GigabitEthernet0/0/9      ROOT  FORWARDING      NONE
```

```
  0    GigabitEthernet0/0/10      ALTE  DISCARDING     NONE

<S2>display  stp brief
 MSTID  Port                    Role  STP State     Protection
   0    GigabitEthernet0/0/4       DESI  FORWARDING     BPDU
   0    GigabitEthernet0/0/9       DESI  FORWARDING     NONE
   0    GigabitEthernet0/0/10      DESI  FORWARDING     NONE
```

After the configuration is complete, interface Gigabit Ethernet 0/0/4 on S1 and S2 shows as supporting BPDU protection.

Step 6 **Configure Loop protection**

On a network running RSTP, a switching device maintains the root port status and status of alternate ports by receiving BPDUs from an upstream switching device. If the switching device cannot receive BPDUs from the upstream device because of link congestion or unidirectional-link failure, the switching device re-selects a root port. The original root port becomes a designated port and the original discarding ports change to the Forwarding state. This switching may cause network loops, which can be mitigated by configuring loop protection.

Configure loop protection on both the root port and the alternate port.

```
[S1]display  stp brief
 MSTID  Port                    Role  STP State     Protection
   0    GigabitEthernet0/0/4       DESI  FORWARDING     BPDU
   0    GigabitEthernet0/0/9       ROOT  FORWARDING     NONE
   0    GigabitEthernet0/0/10      ALTE  DISCARDING     NONE
```

G0/0/9 and G0/0/10 on S1 are now the root port and alternate port. Configure loop protection on these two ports.

```
[S1]interface GigabitEthernet 0/0/9
[S1-GigabitEthernet0/0/9]stp loop-protection
[S1-GigabitEthernet0/0/9]quit
[S1]interface GigabitEthernet 0/0/10
[S1-GigabitEthernet0/0/10]stp loop-protection
```

Run the **display stp brief** command to view the port protection.

```
<S1>display  stp brief
```

```
 MSTID  Port                    Role  STP State     Protection
   0    GigabitEthernet0/0/4      DESI  FORWARDING      BPDU
   0    GigabitEthernet0/0/9      ROOT  FORWARDING      LOOP
   0    GigabitEthernet0/0/10     ALTE  DISCARDING      LOOP
```

Since S2 is root, all the ports are designated ports and therefore do not need to configure loop protection. After completing the configuration, you may wish to set S1 as the root, and configure loop protection on the root port and alternate port of S2 using the same process as with S1.

Final Configuration

```
<S1>display current-configuration
#
!Software Version V200R008C00SPC500
 sysname S1
#
 stp mode rstp
 stp bpdu-protection
#
interface GigabitEthernet0/0/4
 stp edged-port enable
#
interface GigabitEthernet0/0/9
 stp loop-protection
#
interface GigabitEthernet0/0/10
 stp loop-protection
#
user-interface con 0
user-interface vty 0 4
#
return
```

```
<S2>display current-configuration
#
!Software Version V200R008C00SPC500
 sysname S2
#
 stp mode rstp
```

```
 stp bpdu-protection
#
interface GigabitEthernet0/0/4
 stp edged-port enable
#
user-interface con 0
user-interface vty 0 4
#
return


<S3>display current-configuration
#
!Software Version V100R006C05
 sysname S3
#
interface Ethernet0/0/1
 shutdown
#
 interface Ethernet0/0/7
 shutdown
#
interface Ethernet0/0/13
 shutdown
#
user-interface con 0
user-interface vty 0 4
#
return


<S4>dis current-configuration
#
!Software Version V100R006C05
 sysname S4
#
interface Ethernet0/0/6
 shutdown
#
interface Ethernet0/0/14
 shutdown
#
```

```
user-interface con 0
user-interface vty 0 4
#
return
```

Module 4 Routing Configuration

Lab 4-1 Configuring Static Routes and Default Routes

Learning Objectives

As a result of this lab section, you should achieve the following tasks:

- Configuration of a static route using an interface and an IP address as the next hop.
- Verification of static route operation
- Implementation of the interconnection between a local and external network using a default route.
- Configuration of a backup static route on a router

Topology

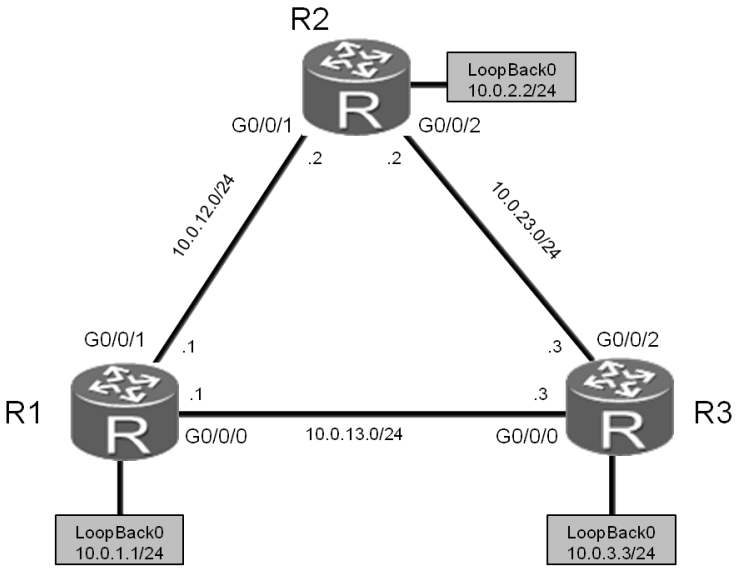


Figure 4.1 Lab topology for static and default routes

Scenario

Assume that you are a network administrator of a company that contains a single administrative domain and within the administrative domain, multiple networks have been defined, for which currently no method of routing exists.

Since the network scale is small, with only a few networks, static routes and default routes are to be used to implement interwork communication. The network addressing is to be applied as shown in Figure 4.1.

If a password is requested, and unless otherwise stated, please use the password: huawei

Tasks

Step 1 Perform basic system and IP address configuration.

Configure the device names and IP addresses for R1, R2, and R3.

```
<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname R1
[R1]interface GigabitEthernet 0/0/0
[R1-GigabitEthernet0/0/0]ip address 10.0.13.1 24
[R1-GigabitEthernet0/0/0]quit
[R1]interface GigabitEthernet 0/0/1
[R1-GigabitEthernet0/0/1]ip address 10.0.12.1 24
[R1-GigabitEthernet0/0/1]quit
[R1]interface LoopBack 0
[R1-LoopBack0]ip address 10.0.1.1 24
```

Run the **display current-configuration** command to check the configuration.

```
<R1>display ip interface brief
Interface                   IP Address/Mask     Physical   Protocol
......output omitted......
GigabitEthernet0/0/0          10.0.13.1/24        up         up
GigabitEthernet0/0/1          10.0.12.1/24        up         up
GigabitEthernet0/0/2          unassigned          up         down
LoopBack0                     10.0.1.1/24         up         up(s)
```

```
......output omitted......

<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname R2
[R2]interface GigabitEthernet 0/0/1
[R2-GigabitEthernet0/0/1]ip address 10.0.12.2 24
[R2-GigabitEthernet0/0/1]quit
[R2]interface GigabitEthernet0/0/2
[R2-GigabitEthernet0/0/2]ip add 10.0.23.2 24
[R2-GigabitEthernet0/0/2]quit
[R2]interface LoopBack0
[R2-LoopBack0]ip address 10.0.2.2 24


<R2>display ip interface brief
Interface                   IP Address/Mask     Physical   Protocol
......output omitted......
GigabitEthernet0/0/0         unassigned          up        down
GigabitEthernet0/0/1         10.0.12.2/24        up        up
GigabitEthernet0/0/2         10.0.23.2/24        up        up
LoopBack0                    10.0.2.2/24         up        up(s)
......output omitted......

<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname R3
[R3]interface GigabitEthernet 0/0/0
[R3-GigabitEthernet0/0/0]ip address 10.0.13.3 24
[R3-GigabitEthernet0/0/0]quit
[R3]interface GigabitEthernet0/0/2
[R3-GigabitEthernet0/0/2]ip address 10.0.23.3 24
[R3-GigabitEthernet0/0/2]quit
[R3]interface LoopBack 0
[R3-LoopBack0]ip address 10.0.3.3 24

<R3>display ip interface brief
Interface                   IP Address/Mask     Physical   Protocol
......output omitted......
GigabitEthernet0/0/0         10.0.13.3/24        up        up
GigabitEthernet0/0/1         unassigned          up        down
GigabitEthernet0/0/2         10.0.23.3/24        up        up
```

```
LoopBack0                       10.0.3.3/24         up         up(s)
......output omitted......
```

Use the **ping** command to test network connectivity from R1.

```
<R1>ping 10.0.12.2
  PING 10.0.12.2: 56  data bytes, press CTRL_C to break
    Reply from 10.0.12.2: bytes=56 Sequence=1 ttl=255 time=30 ms
    Reply from 10.0.12.2: bytes=56 Sequence=2 ttl=255 time=30 ms
    Reply from 10.0.12.2: bytes=56 Sequence=3 ttl=255 time=30 ms
    Reply from 10.0.12.2: bytes=56 Sequence=4 ttl=255 time=30 ms
    Reply from 10.0.12.2: bytes=56 Sequence=5 ttl=255 time=30 ms

  --- 10.0.12.2 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 30/30/30 ms

<R1>ping 10.0.13.3
  PING 10.0.13.2: 56  data bytes, press CTRL_C to break
    Reply from 10.0.13.3: bytes=56 Sequence=1 ttl=255 time=6 ms
    Reply from 10.0.13.3: bytes=56 Sequence=2 ttl=255 time=2 ms
    Reply from 10.0.13.3: bytes=56 Sequence=3 ttl=255 time=2 ms
    Reply from 10.0.13.3: bytes=56 Sequence=4 ttl=255 time=2 ms
    Reply from 10.0.13.3: bytes=56 Sequence=5 ttl=255 time=2 ms

  --- 10.0.13.3 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 2/2/6 ms
```

Use the ping command to test network connectivity from R2

```
<R2>ping 10.0.23.3
  PING 10.0.23.3: 56  data bytes, press CTRL_C to break
    Reply from 10.0.23.3: bytes=56 Sequence=1 ttl=255 time=31 ms
    Reply from 10.0.23.3: bytes=56 Sequence=2 ttl=255 time=31 ms
    Reply from 10.0.23.3: bytes=56 Sequence=3 ttl=255 time=41 ms
    Reply from 10.0.23.3: bytes=56 Sequence=4 ttl=255 time=31 ms
    Reply from 10.0.23.3: bytes=56 Sequence=5 ttl=255 time=41 ms
```

```
  --- 10.0.23.3 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 31/35/41 ms
```

Step 2 **Test connectivity**

Use the ping command to test network connectivity from R2 to neworks 10.0.13.0/24 and 10.0.3.0/24

```
<R2>ping 10.0.13.3
  PING 10.0.13.3: 56  data bytes, press CTRL_C to break
    Request time out
    Request time out
    Request time out
    Request time out
    Request time out

  --- 10.0.13.3 ping statistics ---
    5 packet(s) transmitted
    0 packet(s) received
    100.00% packet loss

<R2>ping 10.0.3.3
  PING 10.0.3.3: 56  data bytes, press CTRL_C to break
    Request time out
    Request time out
    Request time out
    Request time out
    Request time out

  --- 10.0.3.3 ping statistics ---
    5 packet(s) transmitted
    0 packet(s) received
100.00% packet loss
```

If R2 wishes to communicate with the network segment 10.0.3.0, a route destined for this network segment must be configured on R2, and routes destined for the R2 interface must be configured on R3.

The preceding test result shows that R2 cannot communicate with 10.0.3.3 and 10.0.13.3.

Run the **display ip routing-table** command to view the routing table of R2. The routing table does not contain the routes of the two networks.

```
<R2>display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
         Destinations : 13        Routes : 13
Destination/Mask    Proto   Pre  Cost      Flags NextHop         Interface
    10.0.2.0/24     Direct  0    0           D   10.0.2.2        LoopBack0
    10.0.2.2/32     Direct  0    0           D   127.0.0.1       LoopBack0
    10.0.2.255/32   Direct  0    0           D   127.0.0.1       LoopBack0
    10.0.12.0/24    Direct  0    0           D   10.0.12.2       GigabitEthernet0/0/1
    10.0.12.2/32    Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/1
    10.0.12.255/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/1
    10.0.23.0/24    Direct  0    0           D   10.0.23.2       GigabitEthernet0/0/2
    10.0.23.2/32    Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/2
    10.0.23.255/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/2
    127.0.0.0/8     Direct  0    0           D   127.0.0.1       InLoopBack0
    127.0.0.1/32    Direct  0    0           D   127.0.0.1       InLoopBack0
127.255.255.255/32  Direct  0    0           D   127.0.0.1       InLoopBack0
255.255.255.255/32  Direct  0    0           D   127.0.0.1       InLoopBack0
```

Step 3 **Configure static routes on R2.**

Configure a static route for destination networks 10.0.13.0/24 and 10.0.3.0/24, with the next hop set as the IP address 10.0.23.3 of R3, a preference value of 60 is the default and need not be set.

```
[R2]ip route-static 10.0.13.0 24 10.0.23.3
[R2]ip route-static 10.0.3.0 24 10.0.23.3
```

Note: In the **ip route-static** command, **24** indicates the subnet mask length, which can also be expressed using the decimal format 255.255.255.0.

```
<R2>display ip routing-table

Route Flags: R - relay, D - download to fib

Destination/Mask    Proto   Pre  Cost      Flags NextHop         Interface
```

```
10.0.3.0/24       Static  60   0      RD  10.0.23.3     GigabitEthernet0/0/2
10.0.12.0/24      Direct  0    0      D   10.0.12.2     GigabitEthernet0/0/1
10.0.12.2/32      Direct  0    0      D   127.0.0.1     GigabitEthernet0/0/1
10.0.12.255/32    Direct  0    0      D   127.0.0.1     GigabitEthernet0/0/1
10.0.13.0/24      Static  60   0      RD  10.0.23.3     GigabitEthernet0/0/2
10.0.23.0/24      Direct  0    0      D   10.0.23.2     GigabitEthernet0/0/2
10.0.23.2/32      Direct  0    0      D   127.0.0.1     GigabitEthernet0/0/2
```

Step 4 **Configure backup static routes.**

The data exchanged between R2 and 10.0.13.3 and 10.0.3.3 is transmitted through the link between R2 and R3. R2 fails to communicate with 10.0.13.3 and 10.0.3.3 if the link between R2 and R3 is faulty.

According to the topology, R2 can communicate with R3 through R1 if the link between R2 and R3 fails. A backup static route can be configured to enable this redundancy. Backup static routes do not take effect in normal cases. If the link between R2 and R3 fails, backup static routes are used to transfer data.

Amend th preferences for on the backup static routes to ensure that the routes are used only when the primary link fails. In this example, the preference of the backup static route is set to 80.

```
[R1]ip route-static 10.0.3.0 24 10.0.13.3

[R2]ip route-static 10.0.13.0 255.255.255.0 10.0.12.1 preference 80
[R2]ip route-static 10.0.3.0 24 10.0.12.1 preference 80

[R3]ip route-static 10.0.12.0 24 10.0.13.1
```

Step 5 **Test the static routes.**

View the current static route configuration in the routing table of R2.

```
<R2>display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
         Destinations : 15        Routes : 15

  Destination/Mask  Proto   Pre  Cost      Flags NextHop         Interface

        10.0.2.0/24  Direct  0    0           D   10.0.2.2        LoopBack0
        10.0.2.2/32  Direct  0    0           D   127.0.0.1       LoopBack0
```

```
     10.0.2.255/32  Direct  0    0        D   127.0.0.1   LoopBack0
       10.0.3.0/24  Static  60   0        RD  10.0.23.3   GigabitEthernet0/0/2
      10.0.12.0/24  Direct  0    0        D   10.0.12.2   GigabitEthernet0/0/1
      10.0.12.2/32  Direct  0    0        D   127.0.0.1   GigabitEthernet0/0/1
    10.0.12.255/32  Direct  0    0        D   127.0.0.1   GigabitEthernet0/0/1
      10.0.13.0/24  Static  60   0        RD  10.0.23.3   GigabitEthernet0/0/2
      10.0.23.0/24  Direct  0    0        D   10.0.23.2   GigabitEthernet0/0/2
      10.0.23.2/32  Direct  0    0        D   127.0.0.1   GigabitEthernet0/0/2
    10.0.23.255/32  Direct  0    0        D   127.0.0.1   GigabitEthernet0/0/2
       127.0.0.0/8  Direct  0    0        D   127.0.0.1   InLoopBack0
      127.0.0.1/32  Direct  0    0        D   127.0.0.1   InLoopBack0
127.255.255.255/32  Direct  0    0        D   127.0.0.1   InLoopBack0
255.255.255.255/32  Direct  0    0        D   127.0.0.1   InLoopBack0
```

The routing table contains two static routes that were configured in step 3. The value of the **Protocol** field is **Static**, indicating a static route. The value of the **Preference** field is **60**, indicating the default preference is used for the route.

Test network connectivity to ensure the route between R2 and R3 exists.

```
<R2>ping 10.0.13.3
  PING 10.0.13.3: 56  data bytes, press CTRL_C to break
    Reply from 10.0.13.3: bytes=56 Sequence=1 ttl=255 time=34 ms
    Reply from 10.0.13.3: bytes=56 Sequence=2 ttl=255 time=34 ms
    Reply from 10.0.13.3: bytes=56 Sequence=3 ttl=255 time=34 ms
    Reply from 10.0.13.3: bytes=56 Sequence=4 ttl=255 time=34 ms
    Reply from 10.0.13.3: bytes=56 Sequence=5 ttl=255 time=34 ms

  --- 10.0.13.3 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 34/34/34 ms

<R2>ping 10.0.3.3
  PING 10.0.3.3: 56  data bytes, press CTRL_C to break
    Reply from 10.0.3.3: bytes=56 Sequence=1 ttl=255 time=41 ms
    Reply from 10.0.3.3: bytes=56 Sequence=2 ttl=255 time=41 ms
    Reply from 10.0.3.3: bytes=56 Sequence=3 ttl=255 time=41 ms
    Reply from 10.0.3.3: bytes=56 Sequence=4 ttl=255 time=41 ms
    Reply from 10.0.3.3: bytes=56 Sequence=5 ttl=255 time=41 ms

  --- 10.0.3.3 ping statistics ---
```

```
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
round-trip min/avg/max = 41/41/41 ms
```

The command output shows that the route is functioning normally. The **tracert** command can also be run to view the path over which the data is transferred.

```
<R2>tracert 10.0.13.3
 traceroute to  10.0.13.3(10.0.13.3), max hops: 30 ,packet length: 40,
 press CTRL_C to break
 1 10.0.23.3 40 ms  31 ms  30 ms

<R2>tracert 10.0.3.3
 traceroute to  10.0.3.3(10.0.3.3), max hops: 30 ,packet length: 40,
 press CTRL_C to break
 1 10.0.23.3 40 ms  30 ms  30 ms
```

The command output verifies that R2 directly sends data to R3.

Step 6 **Test the backup static routes.**

Disable the path to 10.0.23.3 via GigabitEthernet0/0/2 on R2 and observe the changes in the IP routing tables.

```
[R2]interface GigabitEthernet0/0/2
[R2-GigabitEthernet0/0/2]shutdown
[R2-GigabitEthernet0/0/2]quit
```

Compare the routing tables with the previous routing tables before Gigabit Ethernet 0/0/2 was disabled.

```
<R2>display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
        Destinations : 12      Routes : 12

Destination/Mask    Proto   Pre Cost  Flags NextHop     Interface

    10.0.2.0/24     Direct  0    0       D   10.0.2.2    LoopBack0
    10.0.2.2/32     Direct  0    0       D   127.0.0.1   LoopBack0
```

```
    10.0.2.255/32   Direct  0    0        D   127.0.0.1   LoopBack0
    10.0.3.0/24     Static  80   0        D   10.0.12.2   GigabitEthernet0/0/1
    10.0.12.0/24    Direct  0    0        D   10.0.12.2   GigabitEthernet0/0/1
    10.0.12.2/32    Direct  0    0        D   127.0.0.1   GigabitEthernet0/0/1
    10.0.12.255/32  Direct  0    0        D   127.0.0.1   GigabitEthernet0/0/1
    10.0.13.0/24    Static  80   0        D   10.0.12.2   GigabitEthernet0/0/1
    127.0.0.0/8     Direct  0    0        D   127.0.0.1   InLoopBack0
    127.0.0.1/32    Direct  0    0        D   127.0.0.1   InLoopBack0
127.255.255.255/32  Direct  0    0        D   127.0.0.1   InLoopBack0
255.255.255.255/32  Direct  0    0        D   127.0.0.1   InLoopBack0
```

The next hops and preferences of the two routes as shown in the preceding routing table for R2 have changed.

Test connectivity between R2 and the destination addresses 10.0.13.3 and 10.0.3.3 on R2.

```
<R2>ping 10.0.3.3
  PING 10.0.3.3: 56  data bytes, press CTRL_C to break
    Reply from 10.0.3.3: bytes=56 Sequence=1 ttl=255 time=3 ms
    Reply from 10.0.3.3: bytes=56 Sequence=2 ttl=255 time=2 ms
    Reply from 10.0.3.3: bytes=56 Sequence=3 ttl=255 time=2 ms
    Reply from 10.0.3.3: bytes=56 Sequence=4 ttl=255 time=2 ms
    Reply from 10.0.3.3: bytes=56 Sequence=5 ttl=255 time=2 ms

  --- 10.0.3.3 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 2/2/3 ms

<R2>ping 10.0.13.3
  PING 10.0.13.3: 56  data bytes, press CTRL_C to break
    Reply from 10.0.13.3: bytes=56 Sequence=1 ttl=255 time=3 ms
    Reply from 10.0.13.3: bytes=56 Sequence=2 ttl=255 time=2 ms
    Reply from 10.0.13.3: bytes=56 Sequence=3 ttl=255 time=2 ms
    Reply from 10.0.13.3: bytes=56 Sequence=4 ttl=255 time=2 ms
    Reply from 10.0.13.3: bytes=56 Sequence=5 ttl=255 time=2 ms

  --- 10.0.13.3 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
```

```
round-trip min/avg/max = 2/2/3 ms
```

The network is not disconnected when the link between R2 and R3 is shut down.

The **tracert** command can also be run to view through over which path the data is being forwarded.

```
<R2>tracert 10.0.13.3
 traceroute to  10.0.13.3(10.0.13.3), max hops: 30 ,packet length: 40,press CTRL_C to break
 1 10.0.12.1 40 ms  21 ms  21 ms
 2 10.0.13.3 30 ms  21 ms  21 ms

<R2>tracert 10.0.3.3
 traceroute to  10.0.3.3(10.0.3.3), max hops: 30 ,packet length: 40,press CTRL_C to break
 1 10.0.12.1 40 ms  21 ms  21 ms
 2 10.0.13.3 30 ms  21 ms  21 ms
```

The command output shows that the data sent by R2 reaches R3 via the 10.0.12.0 and 10.0.13.0 networks connected to R1.

Step 7 **Using default routes to implement network connectivity.**

Enable the interface that was disabled in step 6 on R2.

```
[R2]interface GigabitEthernet 0/0/2
[R2-GigabitEthernet0/0/2]undo shutdown
```

Verify connectivity to the network 10.0.23.0 from R1.

```
[R1]ping 10.0.23.3
  PING 10.0.23.3: 56  data bytes, press CTRL_C to break
    Request time out
    Request time out
    Request time out
    Request time out
    Request time out

  --- 10.0.23.3 ping statistics ---
    5 packet(s) transmitted
    0 packet(s) received
100.00% packet loss
```

R3 cannot be reached because the route destined for 10.0.23.3 is not configured on R1.

```
<R1>display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
         Destinations : 14        Routes : 14
Destination/Mask    Proto   Pre  Cost      Flags NextHop         Interface

    10.0.1.0/24     Direct  0    0           D   10.0.1.1        LoopBack0
    10.0.1.1/32     Direct  0    0           D   127.0.0.1       LoopBack0
    10.0.1.255/32   Direct  0    0           D   127.0.0.1       LoopBack0
    10.0.3.0/24     Static  60   0           RD  10.0.13.3       GigabitEthernet0/0/0
    10.0.12.0/24    Direct  0    0           D   10.0.12.1       GigabitEthernet0/0/1
    10.0.12.1/32    Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/1
    10.0.12.255/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/1
    10.0.13.0/24    Direct  0    0           D   10.0.13.1       GigabitEthernet0/0/0
    10.0.13.1/32    Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/0
    10.0.13.255/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/0
    127.0.0.0/8     Direct  0    0           D   127.0.0.1       InLoopBack0
    127.0.0.1/32    Direct  0    0           D   127.0.0.1       InLoopBack0
127.255.255.255/32  Direct  0    0           D   127.0.0.1       InLoopBack0
255.255.255.255/32  Direct  0    0           D   127.0.0.1       InLoopBack0
```

A default route can be configured on R1 to implement network connectivity via a next hop of 10.0.13.3.

```
[R1]ip route-static 0.0.0.0 0.0.0.0 10.0.13.3
```

After the configuration is complete, test connectivity between R1 and 10.0.23.3.

```
<R1>ping 10.0.23.3
  PING 10.0.23.3: 56  data bytes, press CTRL_C to break
    Reply from 10.0.23.3: bytes=56 Sequence=1 ttl=255 time=3 ms
    Reply from 10.0.23.3: bytes=56 Sequence=2 ttl=255 time=2 ms
    Reply from 10.0.23.3: bytes=56 Sequence=3 ttl=255 time=2 ms
    Reply from 10.0.23.3: bytes=56 Sequence=4 ttl=255 time=2 ms
    Reply from 10.0.23.3: bytes=56 Sequence=5 ttl=255 time=2 ms

  --- 10.0.23.3 ping statistics ---
    5 packet(s) transmitted
```

```
    5 packet(s) received
    0.00% packet loss
round-trip min/avg/max = 2/2/3 ms
```

The default route forwards traffic destined for 10.0.23.3 to the next hop of 10.0.13.3 on R3. R3 is directly connected to the 10.0.23.0 network.

Step 8 **Configure a backup default route.**

If the link between R1 and R3 fails, a backup default route can be used to communicate with 10.0.23.3 and 10.0.3.3 via the 10.0.12.0 network.

However, R1 is not directly connected to these networks and therefore a backup route (in both directions) must be configured to provide a forwarding path.

```
[R1]ip route-static 0.0.0.0 0.0.0.0 10.0.12.2 preference 80

[R3]ip route-static 10.0.12.0 24 10.0.23.2 preference 80
```

Step 9 **Test the backup default route.**

View the routes of R1 when the link between R1 and R3 is operational.

```
<R1>display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
         Destinations : 15        Routes : 15
Destination/Mask    Proto   Pre  Cost      Flags NextHop         Interface
     0.0.0.0/0      Static  60   0           RD  10.0.13.3       GigabitEthernet0/0/0
     10.0.1.0/24    Direct  0    0           D   10.0.1.1        LoopBack0
     10.0.1.1/32    Direct  0    0           D   127.0.0.1       LoopBack0
     10.0.1.255/32  Direct  0    0           D   127.0.0.1       LoopBack0
     10.0.3.0/24    Static  60   0           RD  10.0.13.3       GigabitEthernet0/0/0
     10.0.12.0/24   Direct  0    0           D   10.0.12.1       GigabitEthernet0/0/1
     10.0.12.1/32   Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/1
     10.0.12.255/32 Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/1
     10.0.13.0/24   Direct  0    0           D   10.0.13.1       GigabitEthernet0/0/0
     10.0.13.1/32   Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/0
     10.0.13.255/32 Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/0
     127.0.0.0/8    Direct  0    0           D   127.0.0.1       InLoopBack0
     127.0.0.1/32   Direct  0    0           D   127.0.0.1       InLoopBack0
127.255.255.255/32  Direct  0    0           D   127.0.0.1       InLoopBack0
```

```
255.255.255.255/32  Direct  0    0      D   127.0.0.1   InLoopBack0
```

Disable Gigabit Ethernet 0/0/0 on R1 and disable interface Gigabit Ethernet 0/0/0 on R3 to simulate a link failure, and then view the routes of R1. Compare the current routes with the routes before Gigabit Ethernet 0/0/0 was disabled.

```
[R1]interface GigabitEthernet0/0/0
[R1-GigabitEthernet0/0/0]shutdown
[R1-GigabitEthernet0/0/0]quit

[R3]interface GigabitEthernet0/0/0
[R3-GigabitEthernet0/0/0]shutdown
[R3-GigabitEthernet0/0/0]quit

<R1>display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
         Destinations : 11        Routes : 11

Destination/Mask    Proto   Pre  Cost      Flags NextHop         Interface

        0.0.0.0/0   Static  80   0           RD  10.0.12.2       GigabitEthernet0/0/1
        10.0.1.0/24 Direct  0    0           D   10.0.1.1        LoopBack0
        10.0.1.1/32 Direct  0    0           D   127.0.0.1       LoopBack0
        10.0.1.255/32 Direct  0    0         D   127.0.0.1       LoopBack0
        10.0.12.0/24 Direct  0    0          D   10.0.12.1       GigabitEthernet0/0/1
        10.0.12.1/32 Direct  0    0          D   127.0.0.1       GigabitEthernet0/0/1
        10.0.12.255/32 Direct  0    0        D   127.0.0.1       GigabitEthernet0/0/1
        127.0.0.0/8 Direct  0    0          D   127.0.0.1       InLoopBack0
        127.0.0.1/32 Direct  0    0         D   127.0.0.1       InLoopBack0
127.255.255.255/32 Direct  0    0          D   127.0.0.1       InLoopBack0
255.255.255.255/32 Direct  0    0          D   127.0.0.1       InLoopBack0
```

According to the preceding routing table, the value of **80** in the Preference column indicates that the backup default route 0.0.0.0 is actively forwarding traffic to the next hop of 10.0.23.3.

Test network connectivity on R1.

```
<R1>ping 10.0.23.3
  PING 10.0.23.3: 56  data bytes, press CTRL_C to break
    Reply from 10.0.23.3: bytes=56 Sequence=1 ttl=254 time=76 ms
    Reply from 10.0.23.3: bytes=56 Sequence=2 ttl=254 time=250 ms
    Reply from 10.0.23.3: bytes=56 Sequence=3 ttl=254 time=76 ms
```

```
  Reply from 10.0.23.3: bytes=56 Sequence=4 ttl=254 time=76 ms
  Reply from 10.0.23.3: bytes=56 Sequence=5 ttl=254 time=76 ms
 --- 10.0.23.3 ping statistics ---
  5 packet(s) transmitted
  5 packet(s) received
  0.00% packet loss
  round-trip min/avg/max = 76/110/250 ms
<R1>tracert 10.0.23.3
traceroute to  10.0.23.3(10.0.23.2), max hops: 30 ,packet length: 40,press CTRL_C to break
 1 10.0.12.2 30 ms  26 ms  26 ms
 2 10.0.23.3 60 ms  53 ms  56 ms
```

The IP packets are reaching R3 (10.0.23.3) via the next hop 10.0.12.2 of R2.

Final Configuration

```
<R1>dis current-configuration
[V200R007C00SPC600]
#
 sysname R1
#
interface GigabitEthernet0/0/0
 shutdown
 ip address 10.0.13.1 255.255.255.0
#
interface GigabitEthernet0/0/1
 ip address 10.0.12.1 255.255.255.0
#
interface LoopBack0
 ip address 10.0.1.1 255.255.255.0
#
ip route-static 0.0.0.0 0.0.0.0 10.0.13.3
ip route-static 0.0.0.0 0.0.0.0 10.0.12.2 preference 80
ip route-static 10.0.3.0 255.255.255.0 10.0.13.3
ip route-static 10.0.12.0 255.255.255.0 10.0.23.2 preference 80
#
user-interface con 0
 authentication-mode password
 set authentication password cipher %$%$+L'YR&IZt'4,)>-*#lH",}%K-oJ_M9+'lOU~bD (\WTqB}%N,%
$%$
user-interface vty 0 4
```

```
#
return
<R2>display current-configuration
[V200R007C00SPC600]
#
 sysname R2
interface GigabitEthernet0/0/1
 ip address 10.0.12.2 255.255.255.0
#
interface GigabitEthernet0/0/2
 ip address 10.0.23.2 255.255.255.0
#
interface LoopBack0
 ip address 10.0.2.2 255.255.255.0
#
ip route-static 10.0.3.0 255.255.255.0 10.0.23.3
ip route-static 10.0.3.0 255.255.255.0 10.0.12.1 preference 80
ip route-static 10.0.13.0 255.255.255.0 10.0.23.3
ip route-static 10.0.13.0 255.255.255.0 10.0.12.1 preference 80
#
user-interface con 0
 authentication-mode password
 set authentication password cipher %$%$1=cd%b%/O%Id-8X:by1N,+s}'4wD6TvO<I|/pd#
#44C@+s#,%$%$
user-interface vty 0 4
#
return

<R3>display current-configuration
[V200R007C00SPC600]
#
 sysname R3
#
interface GigabitEthernet0/0/0
 shutdown
 ip address 10.0.13.3 255.255.255.0
#
interface GigabitEthernet0/0/2
 ip address 10.0.23.3 255.255.255.0
#
interface LoopBack0
 ip address 10.0.3.3 255.255.255.0
```

```
#
ip route-static 10.0.12.0 255.255.255.0 10.0.13.1
ip route-static 10.0.12.0 255.255.255.0 10.0.23.2 preference 80
#
user-interface con 0
 authentication-mode password
 set authentication password cipher %$%$ksXDMg7Ry6yUU:63:DQ),#/sQg"@*S\U#.s.bHW
xQ,y%#/v,%$%$
user-interface vty 0 4
#
return
```

Lab 4-2 Configuring RIPv1 and RIPv2

Learning Objectives

As a result of this lab section, you should achieve the following tasks:

- Establish routing loop prevention mechanisms for RIP
- Configuration of RIPv1.
- Enable RIP for a specified network and interface.
- Use of the **display** and **debugging** commands to view RIP operation.
- Procedure for testing connectivity of the RIP network.
- Configuration of RIPv2.

Topology

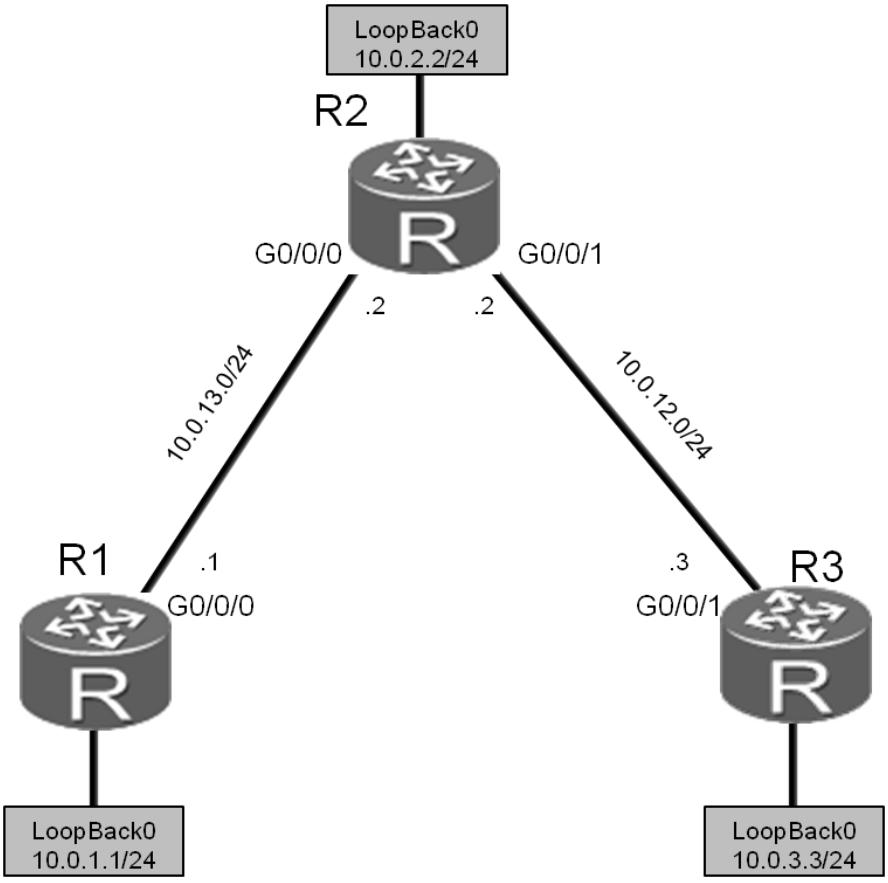


Figure 4.2 Lab topology for RIPv1 and RIPv2

Scenario

Assume that you are a network administrator in charge of managing a small administrative domain consisting of three routers and five networks. Due to the limited requirement, RIP is to be used to support routing. RIPv1 is initially configured, but you realize that RIPv2 has many advantages. After some consideration, you transition the domain to support RIPv2.

Tasks

Step 1 **Preparing the environment.**

If you are starting this section with a non-configured device begin here and then move to step 3. For those continuing from previous labs, begin at step 2.

```
<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname R1
[R1]interface GigabitEthernet 0/0/0
[R1-GigabitEthernet0/0/0]ip address 10.0.13.1 24
[R1-GigabitEthernet0/0/0]quit
[R1]interface LoopBack 0
[R1-LoopBack0]ip address 10.0.1.1 24
[R1-LoopBack0]quit

<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname R2
[R2]interface GigabitEthernet 0/0/1
[R2-GigabitEthernet0/0/1]ip address 10.0.12.2 24
[R2-GigabitEthernet0/0/1]quit
[R2]interface LoopBack 0
[R2-LoopBack0]ip address 10.0.2.2 24

<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname R3
[R3]interface LoopBack 0
[R3-LoopBack0]ip address 10.0.3.3 24
```

Step 2 **Clean up the previous configuration**

Clean up previous static route configuration and disable all unused interfaces

```
[R1]interface GigabitEthernet0/0/1
[R1-GigabitEthernet0/0/1]shutdown
```

```
[R1-GigabitEthernet0/0/1]quit
[R1]interface GigabitEthernet0/0/0
[R1-GigabitEthernet0/0/0]undo shutdown
[R1-GigabitEthernet0/0/0]quit
[R1]undo ip route-static 0.0.0.0 0.0.0.0
[R1]undo ip route-static 10.0.3.0 255.255.255.0
[R1]undo ip route-static 10.0.12.0 255.255.255.0


[R2]interface GigabitEthernet 0/0/2
[R2-GigabitEthernet0/0/2]shutdown
[R2-GigabitEthernet0/0/2]quit
[R2]undo ip route-static 10.0.3.0 255.255.255.0
[R2]undo ip route-static 10.0.13.0 255.255.255.0

[R3]interface GigabitEthernet 0/0/2
[R3-GigabitEthernet0/0/2]shutdown
[R3-GigabitEthernet0/0/2]quit
[R3]undo ip route-static 10.0.12.0 255.255.255.0
```

Step 3 **Additional address configuration**

Configure the following additional interfaces for R2 and R3.

```
[R2]interface GigabitEthernet 0/0/0
[R2-GigabitEthernet0/0/0]ip address 10.0.13.2 24

[R3]interface GigabitEthernet0/0/1
[R3-GigabitEthernet0/0/1]ip address 10.0.12.3 24
```

Verify that R1 and R2 can communicate with one another over the 10.0.13.0 network.

```
<R1>ping 10.0.13.2
  PING 10.0.13.2: 56  data bytes, press CTRL_C to break
    Reply from 10.0.13.2: bytes=56 Sequence=1 ttl=255 time=30 ms
    Reply from 10.0.13.2: bytes=56 Sequence=2 ttl=255 time=30 ms
    Reply from 10.0.13.2: bytes=56 Sequence=3 ttl=255 time=30 ms
    Reply from 10.0.13.2: bytes=56 Sequence=4 ttl=255 time=30 ms
    Reply from 10.0.13.2: bytes=56 Sequence=5 ttl=255 time=30 ms

  --- 10.0.13.2 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 30/30/30 ms
```

Verify that R2 can successfully reach R3 over the 10.0.12.0 network.

```
<R2>ping 10.0.12.3
  PING 10.0.12.2: 56  data bytes, press CTRL_C to break
    Reply from 10.0.12.3: bytes=56 Sequence=1 ttl=255 time=31 ms
    Reply from 10.0.12.3: bytes=56 Sequence=2 ttl=255 time=31 ms
    Reply from 10.0.12.3: bytes=56 Sequence=3 ttl=255 time=41 ms
    Reply from 10.0.12.3: bytes=56 Sequence=4 ttl=255 time=31 ms
    Reply from 10.0.12.3: bytes=56 Sequence=5 ttl=255 time=41 ms

  --- 10.0.12.3 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 31/35/41 ms
```

Step 4 **Configure RIPv1.**

Enable RIP on R1, and then advertise the 10.0.0.0 network segment.

```
[R1]rip 1
[R1-rip-1]network 10.0.0.0
```

Enable RIP on R2, and then advertise the 10.0.0.0 network segment.

```
[R2]rip 1
[R2-rip-1]network 10.0.0.0
```

Enable RIP on R3, and then advertise the 10.0.0.0 network segment.

```
[R3]rip 1
[R3-rip-1]network 10.0.0.0
```

Step 5 **Verify RIPv1 routes.**

View the routing tables of R1, R2, and R3. Make sure that these routers have learned the RIP routes that are highlighted in gray in the following command output.

```
<R1>display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
         Destinations : 13        Routes : 13

Destination/Mask    Proto   Pre  Cost      Flags NextHop         Interface

    10.0.1.0/24     Direct  0    0           D   10.0.1.1        LoopBack0
    10.0.1.1/32     Direct  0    0           D   127.0.0.1       LoopBack0
    10.0.1.255/32   Direct  0    0           D   127.0.0.1       LoopBack0
    10.0.2.0/24     RIP     100  1           D   10.0.13.2       GigabitEthernet0/0/0
    10.0.3.0/24     RIP     100  2           D   10.0.13.2       GigabitEthernet0/0/0
    10.0.12.0/24    RIP     100  1           D   10.0.13.2       GigabitEthernet0/0/0
    10.0.13.0/24    Direct  0    0           D   10.0.13.1       GigabitEthernet0/0/0
    10.0.13.1/32    Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/0
    10.0.13.255/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/0
    127.0.0.0/8     Direct  0    0           D   127.0.0.1       InLoopBack0
    127.0.0.1/32    Direct  0    0           D   127.0.0.1       InLoopBack0
127.255.255.255/32  Direct  0    0           D   127.0.0.1       InLoopBack0
255.255.255.255/32  Direct  0    0           D   127.0.0.1       InLoopBack0

<R2>display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
         Destinations : 15        Routes : 15

Destination/Mask    Proto   Pre  Cost      Flags NextHop         Interface

    10.0.1.0/24     RIP     100  1           D   10.0.13.1       GigabitEthernet0/0/0
```

```
    10.0.2.0/24     Direct  0    0       D   10.0.2.2    LoopBack0
    10.0.2.2/32     Direct  0    0       D   127.0.0.1   LoopBack0
    10.0.2.255/32   Direct  0    0       D   127.0.0.1   LoopBack0
    10.0.3.0/24     RIP     100  1       D   10.0.12.3   GigabitEthernet0/0/1
    10.0.12.0/24    Direct  0    0       D   10.0.12.2   GigabitEthernet0/0/1
    10.0.12.2/32    Direct  0    0       D   127.0.0.1   GigabitEthernet0/0/1
    10.0.12.255/32  Direct  0    0       D   127.0.0.1   GigabitEthernet0/0/1
    10.0.13.0/24    Direct  0    0       D   10.0.13.2   GigabitEthernet0/0/0
    10.0.13.2/32    Direct  0    0       D   127.0.0.1   GigabitEthernet0/0/0
    10.0.13.255/32  Direct  0    0       D   127.0.0.1   GigabitEthernet0/0/0
    127.0.0.0/8     Direct  0    0       D   127.0.0.1   InLoopBack0
    127.0.0.1/32    Direct  0    0       D   127.0.0.1   InLoopBack0
127.255.255.255/32  Direct  0    0       D   127.0.0.1   InLoopBack0
255.255.255.255/32  Direct  0    0       D   127.0.0.1   InLoopBack0

 <R3>display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
        Destinations : 13      Routes : 13

Destination/Mask    Proto   Pre  Cost      Flags NextHop         Interface

10.0.1.0/24         RIP     100  2           D   10.0.12.2       GigabitEthernet0/0/1
10.0.2.0/24         RIP     100  1           D   10.0.12.2       GigabitEthernet0/0/1
10.0.3.0/24         Direct  0    0           D   10.0.3.3        LoopBack0
10.0.3.3/32         Direct  0    0           D   127.0.0.1       LoopBack0
10.0.3.255/32       Direct  0    0           D   127.0.0.1       LoopBack0
10.0.12.0/24        Direct  0    0           D   10.0.12.3       GigabitEthernet0/0/1
10.0.12.3/32        Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/1
10.0.12.255/32      Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/1
10.0.13.0/24        RIP     100  1           D   10.0.12.2       GigabitEthernet0/0/1
127.0.0.0/8         Direct  0    0           D   127.0.0.1       InLoopBack0
127.0.0.1/32        Direct  0    0           D   127.0.0.1       InLoopBack0
127.255.255.255/32  Direct  0    0           D   127.0.0.1       InLoopBack0
255.255.255.255/32  Direct  0    0           D   127.0.0.1       InLoopBack0
```

Test connectivity from R1 to IP address 10.0.23.3. R1 and R3 can communicate with one another.

```
[R1]ping 10.0.12.3
  PING 10.0.12.3: 56  data bytes, press CTRL_C to break
    Reply from 10.0.12.3: bytes=56 Sequence=1 ttl=254 time=70 ms
    Reply from 10.0.12.3: bytes=56 Sequence=2 ttl=254 time=65 ms
    Reply from 10.0.12.3: bytes=56 Sequence=3 ttl=254 time=65 ms
    Reply from 10.0.12.3: bytes=56 Sequence=4 ttl=254 time=65 ms
    Reply from 10.0.12.3: bytes=56 Sequence=5 ttl=254 time=65 ms

  --- 10.0.12.3 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 65/66/70 ms
```

The **debugging** command can be used to view RIP periodic updates.

Run the **debugging** command to enable the RIP debugging function. The **debugging** command can be used only in the user view. To identify the currently enabled debugging information, use the **display debugging** command. Run the **terminal debugging** command to display the debugging information.

The information about RIP interactions between routers is displayed.

```
<R1>debugging rip 1
<R1>display debugging
RIP Process id: 1
    Debugs ON: SEND, RECEIVE, PACKET, TIMER, EVENT, BRIEF,
               JOB, ROUTE-PROCESSING, ERROR,
               REPLAY-PROTECT, GR
<R1>terminal debugging
Info: Current terminal debugging is on.
<R1>
Mar 29 2016 09:45:07.860.1+00:00 R1 RIP/7/DBG: 6: 12734: RIP 1: Receiving v1 response on
GigabitEthernet0/0/0 from 10.0.13.2 with 3 RTEs
<R1>
Mar 29 2016 09:45:07.860.2+00:00 R1 RIP/7/DBG: 6: 12785: RIP 1: Receive response from 10.0.13.2
on GigabitEthernet0/0/0
<R1>
Mar 29 2016 09:45:07.860.3+00:00 R1 RIP/7/DBG: 6: 12796: Packet: Version 1, Cmd response, Length
64
<R1>
Mar 29 2016 09:45:07.860.4+00:00 R1 RIP/7/DBG: 6: 12845: Dest 10.0.2.0, Cost 1
<R1>
```

```
Mar 29 2016 09:45:07.860.5+00:00 R1 RIP/7/DBG: 6: 12845: Dest 10.0.3.0, Cost 2
<R1>
Mar 29 2016 09:45:07.860.6+00:00 R1 RIP/7/DBG: 6: 12845: Dest 10.0.12.0, Cost 1
<R1>
Mar 29 2016 09:45:09.370.1+00:00 R1 RIP/7/DBG: 25: 5071: RIP 1: Periodic timer expired for
interface GigabitEthernet0/0/1
```

Run the **undo debugging rip <process-id>** or **undo debugging all** command to disable the debugging functions.

```
<R1>undo debugging rip 1
```

Individual parameters can be specified to control the debugging information viewed. For example, the **debugging rip 1 event** command allows for only periodical update events sent or received by routers to be viewed. The question mark (?) can be added to the command to query other parameters.

```
<R1>debugging rip 1 event
<R1>
Mar 29 2016 10:00:04.880.1+00:00 R1 RIP/7/DBG: 25: 5719: RIP 1: Periodic timer expired for
interface GigabitEthernet0/0/0 (10.0.13.1) and its added to periodic update queue
<R1>
Mar 29 2016 10:00:04.890.1+00:00 R1 RIP/7/DBG: 25: 6048: RIP 1: Interface GigabitEthernet0/0/0
(10.0.13.1) is deleted from the periodic update queue

<R1>undo debugging all
Info: All possible debugging has been turned off
```

Warning: If too many debugging functions are enabled, a large number of router resources will be utilized that may result in system service failure. Therefore, the use of commands (such as **debug all**) for enabling debugging functions in batches should be performed with caution.

Step 6 **Configure RIPv2.**

After the preceding configuration, you need to configure only **version 2** in the RIP sub view.

```
[R1]rip 1
[R1-rip-1]version 2


[R2]rip 1
```

```
[R2-rip-1]version 2

[R3]rip 1
[R3-rip-1]version 2
```

Step 7 **Verify RIPv2 routes.**

View the routing tables of R1, R2, and R3.

Run the **display ip routing-table** command to view the routing tables of R1, R2, and R3. Compare the routes that are highlighted with RIPv1 routes.

```
<R1>display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
         Destinations : 13        Routes : 13

Destination/Mask    Proto   Pre  Cost      Flags NextHop         Interface

      10.0.1.0/24   Direct  0    0           D   10.0.1.1        LoopBack0
      10.0.1.1/32   Direct  0    0           D   127.0.0.1       LoopBack0
      10.0.1.255/32 Direct  0    0           D   127.0.0.1       LoopBack0
      10.0.2.0/24   RIP     100  1           D   10.0.13.2       GigabitEthernet0/0/0
      10.0.3.0/24   RIP     100  2           D   10.0.13.2       GigabitEthernet0/0/0
      10.0.12.0/24  RIP     100  1           D   10.0.13.2       GigabitEthernet0/0/0
      10.0.13.0/24  Direct  0    0           D   10.0.13.1       GigabitEthernet0/0/0
      10.0.13.1/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/0
      10.0.13.255/32 Direct 0    0           D   127.0.0.1       GigabitEthernet0/0/0
      127.0.0.0/8   Direct  0    0           D   127.0.0.1       InLoopBack0
      127.0.0.1/32  Direct  0    0           D   127.0.0.1       InLoopBack0
127.255.255.255/32  Direct  0    0           D   127.0.0.1       InLoopBack0
255.255.255.255/32  Direct  0    0           D   127.0.0.1       InLoopBack0



<R2>display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
         Destinations : 15        Routes : 15
```

```
Destination/Mask    Proto   Pre  Cost Flags NextHop     Interface

    10.0.1.0/24     RIP     100  1       D   10.0.13.1   GigabitEthernet0/0/0
    10.0.2.0/24     Direct  0    0       D   10.0.2.2    LoopBack0
    10.0.2.2/32     Direct  0    0       D   127.0.0.1   LoopBack0
    10.0.2.255/32   Direct  0    0       D   127.0.0.1   LoopBack0
    10.0.3.0/24     RIP     100  1       D   10.0.12.3   GigabitEthernet0/0/1
    10.0.12.0/24    Direct  0    0       D   10.0.12.2   GigabitEthernet0/0/1
    10.0.12.2/32    Direct  0    0       D   127.0.0.1   GigabitEthernet0/0/1
    10.0.12.255/32  Direct  0    0       D   127.0.0.1   GigabitEthernet0/0/1
    10.0.13.0/24    Direct  0    0       D   10.0.13.2   GigabitEthernet0/0/0
    10.0.13.2/32    Direct  0    0       D   127.0.0.1   GigabitEthernet0/0/0
    10.0.13.255/32  Direct  0    0       D   127.0.0.1   GigabitEthernet0/0/0
    127.0.0.0/8     Direct  0    0       D   127.0.0.1   InLoopBack0
    127.0.0.1/32    Direct  0    0       D   127.0.0.1   InLoopBack0
127.255.255.255/32  Direct  0    0       D   127.0.0.1   InLoopBack0
255.255.255.255/32  Direct  0    0       D   127.0.0.1   InLoopBack0

[R3]display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
        Destinations : 13       Routes : 13

Destination/Mask    Proto   Pre  Cost Flags NextHop     Interface

    10.0.1.0/24     RIP     100  2       D   10.0.12.2   GigabitEthernet0/0/1
    10.0.2.0/24     RIP     100  1       D   10.0.12.2   GigabitEthernet0/0/1
    10.0.3.0/24     Direct  0    0       D   10.0.3.3    LoopBack0
    10.0.3.3/32     Direct  0    0       D   127.0.0.1   LoopBack0
    10.0.3.255/32   Direct  0    0       D   127.0.0.1   LoopBack0
    10.0.12.0/24    Direct  0    0       D   10.0.12.3   GigabitEthernet0/0/1
    10.0.12.3/32    Direct  0    0       D   127.0.0.1   GigabitEthernet0/0/1
    10.0.12.255/32  Direct  0    0       D   127.0.0.1   GigabitEthernet0/0/1
    10.0.13.0/24    RIP     100  1       D   10.0.12.2   GigabitEthernet0/0/1
    127.0.0.0/8     Direct  0    0       D   127.0.0.1   InLoopBack0
    127.0.0.1/32    Direct  0    0       D   127.0.0.1   InLoopBack0
127.255.255.255/32  Direct  0    0       D   127.0.0.1   InLoopBack0
255.255.255.255/32  Direct  0    0       D   127.0.0.1   InLoopBack0
```

Test connectivity from R1 to the IP destination 10.0.12.3 on interface Gigabit Ethernet 0/0/2 of R3.

```
<R1>ping 10.0.12.3
  PING 10.0.12.3: 56  data bytes, press CTRL_C to break
    Reply from 10.0.12.3: bytes=56 Sequence=1 ttl=254 time=74 ms
    Reply from 10.0.12.3: bytes=56 Sequence=2 ttl=254 time=75 ms
    Reply from 10.0.12.3: bytes=56 Sequence=3 ttl=254 time=75 ms
    Reply from 10.0.12.3: bytes=56 Sequence=4 ttl=254 time=75 ms
    Reply from 10.0.12.3: bytes=56 Sequence=5 ttl=254 time=75 ms

  --- 10.0.12.3 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 74/74/75 ms
```

The **debugging** command can be used to view the RIPv2 periodic updates.

```
<R1>terminal debugging
Info: Current terminal debugging is on.
<R1>debugging rip 1 event
<R1>
Mar 29 2016 10:41:04.490.1+00:00 R1 RIP/7/DBG: 25: 5719: RIP 1: Periodic timer expired for interface GigabitEthernet0/0/0 (10.0.13.1) and its added to periodic update queue
<R1>
Mar 29 2016 10:41:04.500.1+00:00 R1 RIP/7/DBG: 25: 6048: RIP 1: Interface GigabitEthernet0/0/0 (10.0.13.1) is deleted from the periodic update queue

<R1>undo debugging rip 1

<R1>debugging rip 1 packet
<R1>
Mar 29 2016 10:43:07.770.1+00:00 R1 RIP/7/DBG: 6: 12776: RIP 1: Sending response on interface GigabitEthernet0/0/0 from 10.0.13.1 to 224.0.0.9
<R1>
Mar 29 2016 10:43:07.770.2+00:00 R1 RIP/7/DBG: 6: 12796: Packet: Version 2, Cmd response, Length 24
<R1>
Mar 29 2016 10:43:07.770.3+00:00 R1 RIP/7/DBG: 6: 12864: Dest 10.0.1.0/24, Nexthop 0.0.0.0, Cost 1, Tag 0

<R1>undo debugging rip 1
```

Additional Exercises: Analyzing and Verifying

When using RIPv1, a router sends network IDs and other route update information to its neighbor routers without sending subnet masks. How do neighbor routers process the route update information and generate the corresponding subnet masks?

How are RIPv1 and RIPv2 compatible with each other?

Final Configuration

```
<R1>display current-configuration
[V200R007C00SPC600]
#
 sysname R1
#
interface GigabitEthernet0/0/0
 ip address 10.0.13.1 255.255.255.0
#
interface GigabitEthernet0/0/1
 shutdown
 ip address 10.0.12.1 255.255.255.0
#
interface LoopBack0
 ip address 10.0.1.1 255.255.255.0
#
rip 1
 version 2
 network 10.0.0.0
#
user-interface con 0
 authentication-mode password
 set authentication password cipher %$%$+L'YR&IZt'4,)>-*#lH",}%K-oJ_M9+'lOU~bD (\WTqB}%N,%
$%$
user-interface vty 0 4
#
return
```

```
<R2>display current-configuration
[V200R007C00SPC600]
#
 sysname R2
#
interface GigabitEthernet0/0/0
 ip address 10.0.13.2 255.255.255.0
#
interface GigabitEthernet0/0/1
 ip address 10.0.12.2 255.255.255.0
#
interface GigabitEthernet0/0/2
 shutdown
 ip address 10.0.23.2 255.255.255.0
#
interface LoopBack0
 ip address 10.0.2.2 255.255.255.0
#
rip 1
 version 2
 network 10.0.0.0
#
user-interface con 0
 authentication-mode password
 set authentication password cipher %$%$1=cd%b%/O%Id-8X:by1N,+s}'4wD6TvO<I|/pd# #44C@+s#,%
$%$
user-interface vty 0 4
#
return


<R3>display current-configuration
[V200R007C00SPC600]
#
 sysname R3
#
interface GigabitEthernet0/0/0
 shutdown
 ip address 10.0.13.3 255.255.255.0
#
interface GigabitEthernet0/0/1
```

```
 ip address 10.0.12.3 255.255.255.0
#
interface GigabitEthernet0/0/2
 shutdown
 ip address 10.0.23.3 255.255.255.0
#
interface LoopBack0
 ip address 10.0.3.3 255.255.255.0
#
rip 1
 version 2
 network 10.0.0.0
#
user-interface con 0
 authentication-mode password
 set authentication password cipher %$%$ksXDMg7Ry6yUU:63:DQ),#/sQg"@*S\U#.s.bHW xQ,y%#/v,%
$%$
user-interface vty 0 4
#
return
```

Lab 4-3 RIPv2 Route Aggregation and Authentication

Learning Objectives

As a result of this lab section, you should achieve the following tasks:

- Aggregation of routes in RIPv2
- Implementation of authentication between RIP peers
- Troubleshoot RIP peer authentication failures.

Topology

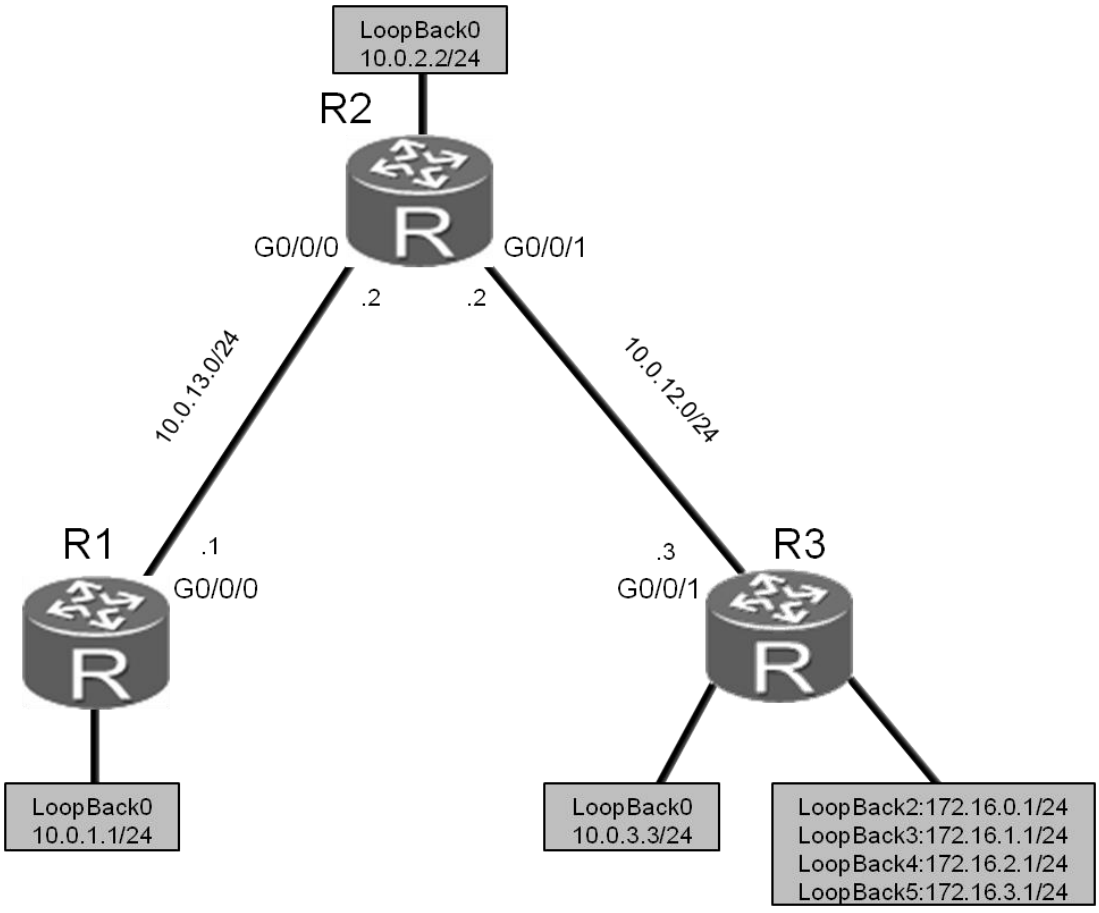


Figure 4.3 RIPv2 route aggregation and authentication topology

Scenario

As the network administrator of a small company you are responsible for the support of a RIPv2 based enterprise network. In order to better manage and optimize the routing table, route aggregation is required.

Additionally, concerns over the insertion of rogue devices into the network that may affect routing tables means that RIP authentication is required to protect the network.

Tasks

Step 1 **Preparing the environment**

If you are starting this section with a non-configured device begin here and then move to step 2. For those continuing from previous labs, begin at step 2.

Configure the base system information and addressing for R1, R2 and R3 on the

network.

```
<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname R1
[R1]interface GigabitEthernet 0/0/0
[R1-GigabitEthernet0/0/0]ip address 10.0.13.1 24
[R1-GigabitEthernet0/0/0]quit
[R1]interface LoopBack 0
[R1-LoopBack0]ip address 10.0.1.1 24

<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname R2
[R2]interface GigabitEthernet 0/0/0
[R2-GigabitEthernet0/0/0]ip address 10.0.13.2 24
[R2-GigabitEthernet0/0/0]quit
[R2]interface GigabitEthernet 0/0/1
[R2-GigabitEthernet0/0/1]ip address 10.0.12.2 24
[R2-GigabitEthernet0/0/1]quit
[R2]interface LoopBack 0
```

```
[R2-LoopBack0]ip address 10.0.2.2 24


<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname R3
[R3]interface GigabitEthernet 0/0/1
[R3-GigabitEthernet0/0/1]ip address 10.0.12.3 24
[R3-GigabitEthernet0/0/1]quit
[R3]interface LoopBack 0
[R3-LoopBack0]ip address 10.0.3.3 24
```

After the IP addresses have been configured for the interfaces, test the network connectivity.

```
<R1>ping 10.0.13.2
  PING 10.0.13.2: 56  data bytes, press CTRL_C to break
    Reply from 10.0.13.2: bytes=56 Sequence=1 ttl=255 time=30 ms
    Reply from 10.0.13.2: bytes=56 Sequence=2 ttl=255 time=30 ms
    Reply from 10.0.13.2: bytes=56 Sequence=3 ttl=255 time=30 ms
    Reply from 10.0.13.2: bytes=56 Sequence=4 ttl=255 time=30 ms
    Reply from 10.0.13.2: bytes=56 Sequence=5 ttl=255 time=30 ms

  --- 10.0.13.2 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 30/30/30 ms

<R2>ping 10.0.12.3
  PING 10.0.12.3: 56  data bytes, press CTRL_C to break
    Reply from 10.0.12.3: bytes=56 Sequence=1 ttl=255 time=31 ms
    Reply from 10.0.12.3: bytes=56 Sequence=2 ttl=255 time=31 ms
    Reply from 10.0.12.3: bytes=56 Sequence=3 ttl=255 time=41 ms
    Reply from 10.0.12.3: bytes=56 Sequence=4 ttl=255 time=31 ms
    Reply from 10.0.12.3: bytes=56 Sequence=5 ttl=255 time=41 ms

  --- 10.0.12.3 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 31/35/41 ms
```

Configure RIPv2 on R1, R2, and R3.

```
[R1]rip 1
[R1-rip-1]version 2
[R1-rip-1]network 10.0.0.0

[R2]rip 1
[R2-rip-1]version 2
[R2-rip-1]network 10.0.0.0

[R3]rip 1
[R3-rip-1]version 2
[R3-rip-1]network 10.0.0.0
```

Step 2 **Configuration of additional loopback addresses**

Establish additional loopback interfaces to represent multiple networks on R3.

```
[R3-LoopBack0]interface LoopBack 2
[R3-LoopBack2]ip address 172.16.0.1 24
[R3-LoopBack2]interface LoopBack 3
[R3-LoopBack3]ip address 172.16.1.1 24
[R3-LoopBack3]interface LoopBack 4
[R3-LoopBack4]ip address 172.16.2.1 24
[R3-LoopBack4]interface LoopBack 5
[R3-LoopBack5]ip address 172.16.3.1 24
```

Step 3 **Advertize the loopback addresses in RIP.**

The networks for the configured loopback interfaces need to be advertized.

Advertise the 172.16.0.0 network range on R3.

```
[R3]rip
[R3-rip-1]network 172.16.0.0
```

View the routing table of R1 to verify the new networks are being advertized.

```
<R1>display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
```

```
Routing Tables: Public
        Destinations : 17       Routes : 17

Destination/Mask    Proto   Pre  Cost      Flags NextHop         Interface

    10.0.1.0/24     Direct  0    0           D   10.0.1.1        LoopBack0
    10.0.1.1/32     Direct  0    0           D   127.0.0.1       LoopBack0
    10.0.1.255/32   Direct  0    0           D   127.0.0.1       LoopBack0
    10.0.2.0/24     RIP     100  1           D   10.0.13.2       GigabitEthernet0/0/0
    10.0.3.0/24     RIP     100  2           D   10.0.13.2       GigabitEthernet0/0/0
    10.0.12.0/24    RIP     100  1           D   10.0.13.2       GigabitEthernet0/0/0
    10.0.13.0/24    Direct  0    0           D   10.0.13.1       GigabitEthernet0/0/0
    10.0.13.1/32    Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/0
    10.0.13.255/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/0
    127.0.0.0/8     Direct  0    0           D   127.0.0.1       InLoopBack0
    127.0.0.1/32    Direct  0    0           D   127.0.0.1       InLoopBack0
127.255.255.255/32  Direct  0    0           D   127.0.0.1       InLoopBack0
    172.16.0.0/24   RIP     100  2           D   10.0.13.2       GigabitEthernet0/0/0
    172.16.1.0/24   RIP     100  2           D   10.0.13.2       GigabitEthernet0/0/0
    172.16.2.0/24   RIP     100  2           D   10.0.13.2       GigabitEthernet0/0/0
    172.16.3.0/24   RIP     100  2           D   10.0.13.2       GigabitEthernet0/0/0
255.255.255.255/32  Direct  0    0           D   127.0.0.1       InLoopBack0
```

The information in grey shows that R1 has learned specific routes but not aggregated routes.

Test network connectivity from R1 to the 172.16.0.0 network range.

```
<R1>ping 172.16.0.1
  PING 172.16.0.1: 56  data bytes, press CTRL_C to break
    Reply from 172.16.0.1: bytes=56 Sequence=1 ttl=254 time=80 ms
    Reply from 172.16.0.1: bytes=56 Sequence=2 ttl=254 time=79 ms
    Reply from 172.16.0.1: bytes=56 Sequence=3 ttl=254 time=79 ms
    Reply from 172.16.0.1: bytes=56 Sequence=4 ttl=254 time=79 ms
    Reply from 172.16.0.1: bytes=56 Sequence=5 ttl=254 time=79 ms

  --- 172.16.0.1 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 79/79/80 ms
```

Step 4 **Configure RIP manual route aggregation on R2.**

Run the **rip summary-address** command on S1/0/0 of R2 to configure RIP route aggregation. The four routes (172.16.0.0/24, 172.16.1.0/24, 172.16.2.0/24, and 172.16.3.0/24) are to be aggregated into one route, 172.16.0.0/16.

```
[R2]interface GigabitEthernet0/0/0
[R2-GigabitEthernet0/0/0]rip summary-address 172.16.0.0 255.255.0.0
```

View the routing table of R1 that should now include an aggregated route.

```
<R1>display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
         Destinations : 14        Routes : 14

Destination/Mask    Proto   Pre  Cost      Flags NextHop         Interface

      10.0.1.0/24   Direct  0    0           D   10.0.1.1        LoopBack0
      10.0.1.1/32   Direct  0    0           D   127.0.0.1       LoopBack0
      10.0.1.255/32 Direct  0    0           D   127.0.0.1       LoopBack0
      10.0.2.0/24   RIP     100  1           D   10.0.13.2       GigabitEthernet0/0/0
      10.0.3.0/24   RIP     100  2           D   10.0.13.2       GigabitEthernet0/0/0
      10.0.12.0/24  RIP     100  1           D   10.0.13.2       GigabitEthernet0/0/0
      10.0.13.0/24  Direct  0    0           D   10.0.13.1       GigabitEthernet0/0/0
      10.0.13.1/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/0
      10.0.13.255/32 Direct 0    0           D   127.0.0.1       GigabitEthernet0/0/0
      127.0.0.0/8   Direct  0    0           D   127.0.0.1       InLoopBack0
      127.0.0.1/32  Direct  0    0           D   127.0.0.1       InLoopBack0
127.255.255.255/32  Direct  0    0           D   127.0.0.1       InLoopBack0
      172.16.0.0/16 RIP     100  2           D   10.0.13.2       GigabitEthernet0/0/0
255.255.255.255/32  Direct  0    0           D   127.0.0.1       InLoopBack0
```

The highlighted information shows the aggregated route. There is now no specific route is listed in the routing table.

Verify that the routes are still supported for the 172.16.0.0 network range.

```
<R1>ping 172.16.0.1
  PING 172.16.0.1: 56  data bytes, press CTRL_C to break
    Reply from 172.16.0.1: bytes=56 Sequence=1 ttl=254 time=60 ms
    Reply from 172.16.0.1: bytes=56 Sequence=2 ttl=254 time=59 ms
    Reply from 172.16.0.1: bytes=56 Sequence=3 ttl=254 time=80 ms
    Reply from 172.16.0.1: bytes=56 Sequence=4 ttl=254 time=60 ms
    Reply from 172.16.0.1: bytes=56 Sequence=5 ttl=254 time=60 ms

  --- 172.16.0.1 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
round-trip min/avg/max = 59/63/80 ms
```

The preceding information shows that route aggregation reduces the size of the routing table without affecting communication to aggregated networks.

Step 5 **Configure RIP authentication.**

Configure plain text authentication between R1 and R2 and MD5 based authentication between R2 and R3. The authentication password in all cases should be **huawei**.

```
[R1]interface GigabitEthernet0/0/0
[R1-GigabitEthernet0/0/0]rip authentication-mode simple huawei

[R2]interface GigabitEthernet0/0/0
[R2-GigabitEthernet0/0/0]rip authentication-mode simple huawei
[R2-GigabitEthernet0/0/0]quit
[R2]interface GigabitEthernet0/0/1
[R2-GigabitEthernet0/0/1]rip authentication-mode md5 usual huawei

[R3]interface GigabitEthernet0/0/1
[R3-GigabitEthernet0/0/1]rip authentication-mode md5 usual huawei
```

After the configuration is complete, verify that the routes are not affected.

```
<R1>display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
         Destinations : 14        Routes : 14

Destination/Mask    Proto   Pre  Cost      Flags NextHop         Interface

    10.0.1.0/24     Direct  0    0           D   10.0.1.1        LoopBack0
    10.0.1.1/32     Direct  0    0           D   127.0.0.1       LoopBack0
    10.0.1.255/32   Direct  0    0           D   127.0.0.1       LoopBack0
    10.0.2.0/24     RIP     100  1           D   10.0.13.2       GigabitEthernet0/0/0
    10.0.3.0/24     RIP     100  2           D   10.0.13.2       GigabitEthernet0/0/0
    10.0.12.0/24    RIP     100  1           D   10.0.13.2       GigabitEthernet0/0/0
    10.0.13.0/24    Direct  0    0           D   10.0.13.1       GigabitEthernet0/0/0
    10.0.13.1/32    Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/0
    10.0.13.255/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/0
    127.0.0.0/8     Direct  0    0           D   127.0.0.1       InLoopBack0
    127.0.0.1/32    Direct  0    0           D   127.0.0.1       InLoopBack0
127.255.255.255/32  Direct  0    0           D   127.0.0.1       InLoopBack0
    172.16.0.0/16   RIP     100  2           D   10.0.13.2       GigabitEthernet0/0/0
255.255.255.255/32  Direct  0    0           D   127.0.0.1       InLoopBack0

<R2>display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
         Destinations : 19        Routes : 19

Destination/Mask    Proto   Pre  Cost      Flags NextHop         Interface

    10.0.1.0/24     RIP     100  1           D   10.0.13.1       GigabitEthernet0/0/0
    10.0.2.0/24     Direct  0    0           D   10.0.2.2        LoopBack0
    10.0.2.2/32     Direct  0    0           D   127.0.0.1       LoopBack0
    10.0.2.255/32   Direct  0    0           D   127.0.0.1       LoopBack0
    10.0.3.0/24     RIP     100  1           D   10.0.12.3       GigabitEthernet0/0/1
    10.0.12.0/24    Direct  0    0           D   10.0.12.2       GigabitEthernet0/0/1
    10.0.12.2/32    Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/1
    10.0.12.255/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/1
    10.0.13.0/24    Direct  0    0           D   10.0.13.2       GigabitEthernet0/0/0
    10.0.13.2/32    Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/0
```

```
    10.0.13.255/32  Direct  0    0       D   127.0.0.1   GigabitEthernet0/0/0
    127.0.0.0/8     Direct  0    0       D   127.0.0.1   InLoopBack0
    127.0.0.1/32    Direct  0    0       D   127.0.0.1   InLoopBack0
127.255.255.255/32  Direct  0    0       D   127.0.0.1   InLoopBack0
    172.16.0.0/24   RIP     100  1       D   10.0.12.3   GigabitEthernet0/0/1
    172.16.1.0/24   RIP     100  1       D   10.0.12.3   GigabitEthernet0/0/1
    172.16.2.0/24   RIP     100  1       D   10.0.12.3   GigabitEthernet0/0/1
    172.16.3.0/24   RIP     100  1       D   10.0.12.3   GigabitEthernet0/0/1
255.255.255.255/32  Direct  0    0       D   127.0.0.1   InLoopBack0

<R3>display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
    Routing Tables: Public
            Destinations : 25      Routes : 25
Destination/Mask    Proto   Pre  Cost Flags NextHop     Interface

    10.0.1.0/24     RIP     100  2       D   10.0.12.2   GigabitEthernet0/0/1
    10.0.2.0/24     RIP     100  1       D   10.0.12.2   GigabitEthernet0/0/1
    10.0.3.0/24     Direct  0    0       D   10.0.3.3    LoopBack0
    10.0.3.3/32     Direct  0    0       D   127.0.0.1   LoopBack0
    10.0.3.255/32   Direct  0    0       D   127.0.0.1   LoopBack0
    10.0.12.0/24    Direct  0    0       D   10.0.12.3   GigabitEthernet0/0/1
    10.0.12.3/32    Direct  0    0       D   127.0.0.1   GigabitEthernet0/0/1
    10.0.12.255/32  Direct  0    0       D   127.0.0.1   GigabitEthernet0/0/1
    10.0.13.0/24    RIP     100  1       D   10.0.12.2   GigabitEthernet0/0/1
    127.0.0.0/8     Direct  0    0       D   127.0.0.1   InLoopBack0
    127.0.0.1/32    Direct  0    0       D   127.0.0.1   InLoopBack0
127.255.255.255/32  Direct  0    0       D   127.0.0.1   InLoopBack0
    172.16.0.0/24   Direct  0    0       D   172.16.0.1  LoopBack2
    172.16.0.1/32   Direct  0    0       D   127.0.0.1   LoopBack2
    172.16.0.255/32 Direct  0    0       D   127.0.0.1   LoopBack2
    172.16.1.0/24   Direct  0    0       D   172.16.1.1  LoopBack3
    172.16.1.1/32   Direct  0    0       D   127.0.0.1   LoopBack3
    172.16.1.255/32 Direct  0    0       D   127.0.0.1   LoopBack3
    172.16.2.0/24   Direct  0    0       D   172.16.2.1  LoopBack4
    172.16.2.1/32   Direct  0    0       D   127.0.0.1   LoopBack4
    172.16.2.255/32 Direct  0    0       D   127.0.0.1   LoopBack4
    172.16.3.0/24   Direct  0    0       D   172.16.3.1  LoopBack5
    172.16.3.1/32   Direct  0    0       D   127.0.0.1   LoopBack5
    172.16.3.255/32 Direct  0    0       D   127.0.0.1   LoopBack5
255.255.255.255/32  Direct  0    0       D   127.0.0.1   InLoopBack0
```

Step 6 **Generate and rectify RIPv2 authentication faults.**

Change the authentication password on G0/0/0 of R2 to **huawei2**.

```
[R2]interface GigabitEthernet0/0/0
[R2-GigabitEthernet0/0/0]rip authentication-mode simple huawei2
```

View the routing table of R1.

```
<R1>display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
        Destinations : 10      Routes : 10

Destination/Mask    Proto   Pre  Cost      Flags NextHop         Interface

    10.0.1.0/24     Direct  0    0           D   10.0.1.1        LoopBack0
    10.0.1.1/32     Direct  0    0           D   127.0.0.1       LoopBack0
    10.0.1.255/32   Direct  0    0           D   127.0.0.1       LoopBack0
    10.0.13.0/24    Direct  0    0           D   10.0.13.1       GigabitEthernet0/0/0
    10.0.13.1/32    Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/0
    10.0.13.255/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/0
    127.0.0.0/8     Direct  0    0           D   127.0.0.1       InLoopBack0
    127.0.0.1/32    Direct  0    0           D   127.0.0.1       InLoopBack0
127.255.255.255/32  Direct  0    0           D   127.0.0.1       InLoopBack0
255.255.255.255/32  Direct  0    0           D   127.0.0.1       InLoopBack0
```

Since R1 and R2 use different RIP authentication passwords, R1 will not receive any advertised RIP routes from R2.

Restore the authentication password on G0/0/0 of R2 to **huawei**.

```
[R2]interface GigabitEthernet0/0/0
[R2- GigabitEthernet0/0/0]rip authentication-mode simple huawei
```

Change the authentication mode on G0/0/1 of R2 to plain text authentication.

```
[R2]interface GigabitEthernet0/0/1
[R2-GigabitEthernet0/0/1]rip authentication-mode simple huawei
```

Run the following command to delete the routes learned by R3 from R2 before you change the authentication password.

View the routing table of R3.

```
<R3>display ip routing-table

Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
        Destinations : 22      Routes : 22

Destination/Mask    Proto   Pre  Cost Flags  NextHop     Interface

    10.0.3.0/24     Direct  0    0       D   10.0.3.3    LoopBack0
    10.0.3.3/32     Direct  0    0       D   127.0.0.1   LoopBack0
    10.0.3.255/32   Direct  0    0       D   127.0.0.1   LoopBack0
    10.0.12.0/24    Direct  0    0       D   10.0.12.3   GigabitEthernet0/0/1
    10.0.12.3/32    Direct  0    0       D   127.0.0.1   GigabitEthernet0/0/1
    10.0.12.255/32  Direct  0    0       D   127.0.0.1   GigabitEthernet0/0/1
    127.0.0.0/8     Direct  0    0       D   127.0.0.1   InLoopBack0
    127.0.0.1/32    Direct  0    0       D   127.0.0.1   InLoopBack0
127.255.255.255/32  Direct  0    0       D   127.0.0.1   InLoopBack0
    172.16.0.0/24   Direct  0    0       D   172.16.0.1  LoopBack2
    172.16.0.1/32   Direct  0    0       D   127.0.0.1   LoopBack2
    172.16.0.255/32 Direct  0    0       D   127.0.0.1   LoopBack2
    172.16.1.0/24   Direct  0    0       D   172.16.1.1  LoopBack3
    172.16.1.1/32   Direct  0    0       D   127.0.0.1   LoopBack3
    172.16.1.255/32 Direct  0    0       D   127.0.0.1   LoopBack3
    172.16.2.0/24   Direct  0    0       D   172.16.2.1  LoopBack4
    172.16.2.1/32   Direct  0    0       D   127.0.0.1   LoopBack4
    172.16.2.255/32 Direct  0    0       D   127.0.0.1   LoopBack4
    172.16.3.0/24   Direct  0    0       D   172.16.3.1  LoopBack5
    172.16.3.1/32   Direct  0    0       D   127.0.0.1   LoopBack5
    172.16.3.255/32 Direct  0    0       D   127.0.0.1   LoopBack5
255.255.255.255/32  Direct  0    0       D   127.0.0.1   InLoopBack0
```

Since R2 and R3 use different RIP authentication modes, R3 cannot receive any advertised RIP routes from R2.

Restore the authentication mode on G0/0/1 of R2 to MD5.

```
[R2]interface GigabitEthernet0/0/1
[R2-GigabitEthernet0/0/1]rip authentication-mode md5 usual huawei
```

Verify that routes in routing tables of R1, R2, and R3 have been restored. Note that

RIP updates routes periodically, so may take a moment to be restored.

```
<R1>display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
         Destinations : 14        Routes : 14

Destination/Mask    Proto   Pre  Cost      Flags NextHop         Interface

    10.0.1.0/24     Direct  0    0           D   10.0.1.1        LoopBack0
    10.0.1.1/32     Direct  0    0           D   127.0.0.1       LoopBack0
    10.0.1.255/32   Direct  0    0           D   127.0.0.1       LoopBack0
    10.0.2.0/24     RIP     100  1           D   10.0.13.2       GigabitEthernet0/0/0
    10.0.3.0/24     RIP     100  2           D   10.0.13.2       GigabitEthernet0/0/0
    10.0.12.0/24    RIP     100  1           D   10.0.13.2       GigabitEthernet0/0/0
    10.0.13.0/24    Direct  0    0           D   10.0.13.1       GigabitEthernet0/0/0
    10.0.13.1/32    Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/0
    10.0.13.255/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/0
    127.0.0.0/8     Direct  0    0           D   127.0.0.1       InLoopBack0
    127.0.0.1/32    Direct  0    0           D   127.0.0.1       InLoopBack0
127.255.255.255/32  Direct  0    0           D   127.0.0.1       InLoopBack0
    172.16.0.0/16   RIP     100  2           D   10.0.13.2       GigabitEthernet0/0/0
255.255.255.255/32  Direct  0    0           D   127.0.0.1       InLoopBack0

[R2]display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
         Destinations : 19        Routes : 19

Destination/Mask    Proto   Pre  Cost      Flags NextHop         Interface

    10.0.1.0/24     RIP     100  1           D   10.0.13.1       GigabitEthernet0/0/0
    10.0.2.0/24     Direct  0    0           D   10.0.2.2        LoopBack0
    10.0.2.2/32     Direct  0    0           D   127.0.0.1       LoopBack0
    10.0.2.255/32   Direct  0    0           D   127.0.0.1       LoopBack0
    10.0.3.0/24     RIP     100  1           D   10.0.12.3       GigabitEthernet0/0/1
    10.0.12.0/24    Direct  0    0           D   10.0.12.2       GigabitEthernet0/0/1
    10.0.12.2/32    Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/1
    10.0.12.255/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/1
    10.0.13.0/24    Direct  0    0           D   10.0.13.2       GigabitEthernet0/0/0
    10.0.13.2/32    Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/0
```

```
    10.0.13.255/32  Direct  0    0       D   127.0.0.1   GigabitEthernet0/0/0
    127.0.0.0/8     Direct  0    0       D   127.0.0.1   InLoopBack0
    127.0.0.1/32    Direct  0    0       D   127.0.0.1   InLoopBack0
127.255.255.255/32  Direct  0    0       D   127.0.0.1   InLoopBack0
    172.16.0.0/24   RIP     100  1       D   10.0.12.3   GigabitEthernet0/0/1
    172.16.1.0/24   RIP     100  1       D   10.0.12.3   GigabitEthernet0/0/1
    172.16.2.0/24   RIP     100  1       D   10.0.12.3   GigabitEthernet0/0/1
    172.16.3.0/24   RIP     100  1       D   10.0.12.3   GigabitEthernet0/0/1
255.255.255.255/32  Direct  0    0       D   127.0.0.1   InLoopBack0

<R3>display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
    Routing Tables: Public
            Destinations : 25      Routes : 25
Destination/Mask    Proto   Pre  Cost Flags NextHop     Interface

    10.0.1.0/24     RIP     100  2       D   10.0.12.2   GigabitEthernet0/0/1
    10.0.2.0/24     RIP     100  1       D   10.0.12.2   GigabitEthernet0/0/1
    10.0.3.0/24     Direct  0    0       D   10.0.3.3    LoopBack0
    10.0.3.3/32     Direct  0    0       D   127.0.0.1   LoopBack0
    10.0.3.255/32   Direct  0    0       D   127.0.0.1   LoopBack0
    10.0.12.0/24    Direct  0    0       D   10.0.12.3   GigabitEthernet0/0/1
    10.0.12.3/32    Direct  0    0       D   127.0.0.1   GigabitEthernet0/0/1
    10.0.12.255/32  Direct  0    0       D   127.0.0.1   GigabitEthernet0/0/1
    10.0.13.0/24    RIP     100  1       D   10.0.12.2   GigabitEthernet0/0/1
    127.0.0.0/8     Direct  0    0       D   127.0.0.1   InLoopBack0
    127.0.0.1/32    Direct  0    0       D   127.0.0.1   InLoopBack0
127.255.255.255/32  Direct  0    0       D   127.0.0.1   InLoopBack0
    172.16.0.0/24   Direct  0    0       D   172.16.0.1  LoopBack2
    172.16.0.1/32   Direct  0    0       D   127.0.0.1   LoopBack2
    172.16.0.255/32 Direct  0    0       D   127.0.0.1   LoopBack2
    172.16.1.0/24   Direct  0    0       D   172.16.1.1  LoopBack3
    172.16.1.1/32   Direct  0    0       D   127.0.0.1   LoopBack3
    172.16.1.255/32 Direct  0    0       D   127.0.0.1   LoopBack3
    172.16.2.0/24   Direct  0    0       D   172.16.2.1  LoopBack4
    172.16.2.1/32   Direct  0    0       D   127.0.0.1   LoopBack4
    172.16.2.255/32 Direct  0    0       D   127.0.0.1   LoopBack4
    172.16.3.0/24   Direct  0    0       D   172.16.3.1  LoopBack5
    172.16.3.1/32   Direct  0    0       D   127.0.0.1   LoopBack5
    172.16.3.255/32 Direct  0    0       D   127.0.0.1   LoopBack5
255.255.255.255/32  Direct  0    0       D   127.0.0.1   InLoopBack0
```

Final Configuration

```
<R1>display current-configuration
[V200R007C00SPC600]
#
 sysname R1
#
interface GigabitEthernet0/0/0
 ip address 10.0.13.1 255.255.255.0
 rip authentication-mode simple cipher %$%$S2AJ2_mJ)Hf++RSng6^NN|Xl%$%$
#
interface LoopBack0
 ip address 10.0.1.1 255.255.255.0
#
rip 1
 version 2
 network 10.0.0.0
#
user-interface con 0
 authentication-mode password
 set authentication password cipher %$%$+L'YR&IZt'4,)>-*#lH",}%K-oJ_M9+'lOU~bD (\WTqB}%N,%
$%$
user-interface vty 0 4
#
return

<R2>display current-configuration
[V200R007C00SPC600]
#
 sysname R2
#
interface GigabitEthernet0/0/0
 ip address 10.0.13.2 255.255.255.0
 rip authentication-mode simple cipher %$%$+Ob&JcQxU6mUJ(ZXLZY#OEXz%$%$
 rip summary-address 172.16.0.0 255.255.0.0
#
interface GigabitEthernet0/0/1
 ip address 10.0.12.2 255.255.255.0
 rip authentication-mode md5 usual cipher %$%$C]'$.`NWGZ}|gLV%:XF>OG}|%$%$
#
interface LoopBack0
 ip address 10.0.2.2 255.255.255.0
```

```
#
rip 1
 version 2
 network 10.0.0.0
#
user-interface con 0
 authentication-mode password
 set authentication password cipher %$%$1=cd%b%/O%Id-8X:by1N,+s}'4wD6TvO<I|/pd# #44C@+s#,%
$%$
user-interface vty 0 4
#
return


<R3>display current-configuration
[V200R007C00SPC600]
#
 sysname R3
#
interface GigabitEthernet0/0/1
 ip address 10.0.12.3 255.255.255.0
 rip authentication-mode md5 usual cipher %$%$_5VL+wN6FNe]rVKbh[E(O=E>%$%$
#
interface LoopBack0
 ip address 10.0.3.3 255.255.255.0
#
interface LoopBack2
 ip address 172.16.0.1 255.255.255.0
#
interface LoopBack3
 ip address 172.16.1.1 255.255.255.0
#
interface LoopBack4
 ip address 172.16.2.1 255.255.255.0
#
interface LoopBack5
 ip address 172.16.3.1 255.255.255.0
#
rip 1
 version 2
 network 10.0.0.0
 network 172.16.0.0
```

```
#
user-interface con 0
 authentication-mode password
 set authentication password cipher %$%$ksXDMg7Ry6yUU:63:DQ),#/sQg"@*S\U#.s.bHW xQ,y%#/v,%
$%$
user-interface vty 0 4
#
return
```

Lab 4-4 OSPF Single-Area Configuration

Learning Objectives

As a result of this lab section, you should achieve the following tasks:

- Configuration of the Router-ID for OSPF.
- Establish OSPF on a specified interface or network.
- View OSPF operations using display commands.
- Advertisement of default routes in OSPF.
- Change of the OSPF hello interval and dead interval.
- Familiarization with DR or BDR election on multi-access networks.
- Change of the OSPF route priority to manipulate DR election.

Topology

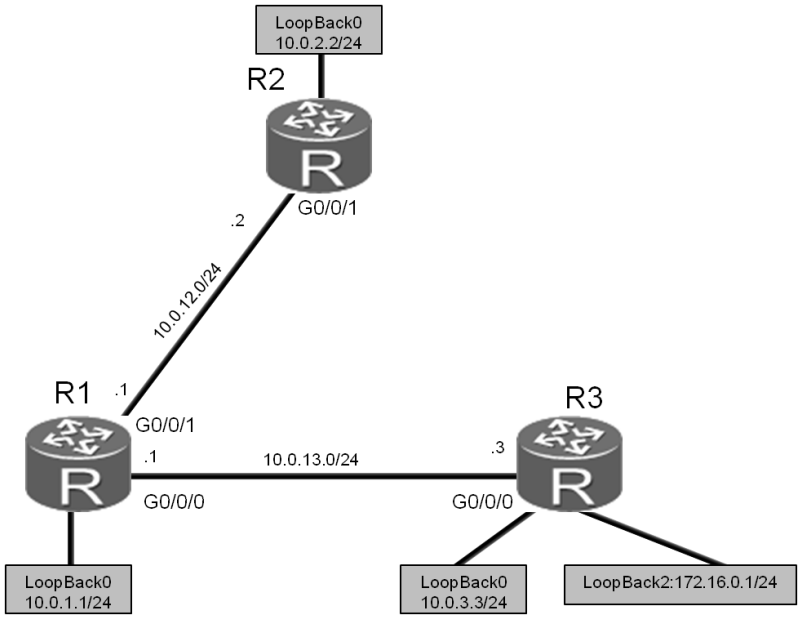


Figure 4.4 OSPF single area topology

Scenario

As the network administrator of an establishing small enterprise, it is required that a network be implemented using OSPF. Then network is to support a single area and with consideration for future expansion it is requested that this area be set as area 0. OSPF is required to advertise default routes and also elect both a DR and BDR for network resiliency.

Tasks

Step 1 **Prepare the environment**

If you are starting this section with a non-configured device, begin here and then move to step 3. For those continuing from previous labs, begin at step 2.

Establish the basic system configuration and addressing for the lab.

```
<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname R1
[R1]interface GigabitEthernet 0/0/1
[R1-GigabitEthernet 0/0/1]ip address 10.0.12.1 24
[R1-GigabitEthernet 0/0/1]quit
[R1]interface GigabitEthernet 0/0/0
[R1-GigabitEthernet0/0/0]ip address 10.0.13.1 24
[R1-GigabitEthernet0/0/0]quit
[R1]interface LoopBack 0
[R1-LoopBack0]ip address 10.0.1.1 24

<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname R2
[R2]interface GigabitEthernet 0/0/1
[R2-GigabitEthernet 0/0/1]ip address 10.0.12.2 24
[R2-GigabitEthernet 0/0/1]quit
[R2]interface LoopBack 0
[R2-LoopBack0]ip address 10.0.2.2 24
```

```
<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname R3
[R3]interface GigabitEthernet 0/0/0
[R3-GigabitEthernet0/0/0]ip address 10.0.13.3 24
[R3-GigabitEthernet0/0/0]quit
[R3]interface LoopBack 0
[R3-LoopBack0]ip address 10.0.3.3 24
[R3-LoopBack0]quit
[R3]interface LoopBack 2
[R3-LoopBack2]ip address 172.16.0.1 24
```

Step 2 **Clean up the previous configuration.**

Enable the interfaces necessary for this lab and disable those not needed.

```
[R1]interface GigabitEthernet 0/0/1
[R1-GigabitEthernet0/0/1]undo shutdown
[R1-GigabitEthernet0/0/1]quit

[R2]interface GigabitEthernet 0/0/0
[R2-GigabitEthernet0/0/0]undo rip summary-address 172.16.0.0 255.255.0.0
[R2-GigabitEthernet0/0/0]shutdown

[R3]interface GigabitEthernet 0/0/0
[R3-GigabitEthernet0/0/0]undo shutdown
[R3-GigabitEthernet0/0/0]quit
[R3]interface GigabitEthernet 0/0/1
[R3-GigabitEthernet0/0/1]shutdown
[R3-GigabitEthernet0/0/1]quit
[R3]undo interface LoopBack 3
Info: This operation may take a few seconds. Please wait for a moment...succeeded.
[R3]undo interface LoopBack 4
Info: This operation may take a few seconds. Please wait for a moment...succeeded.
[R3]undo interface LoopBack 5
Info: This operation may take a few seconds. Please wait for a moment...succeeded.
```

Remove the configured RIP authentication and RIP 1 process.

```
[R1]interface GigabitEthernet 0/0/0
[R1-GigabitEthernet0/0/0]undo rip authentication-mode
[R1-GigabitEthernet0/0/0]quit
[R1]undo rip 1
Warning: The RIP process will be deleted. Continue?[Y/N]y

[R2]interface GigabitEthernet 0/0/0
[R2-GigabitEthernet0/0/0]undo rip authentication-mode
[R2-GigabitEthernet0/0/0]quit
[R2]interface GigabitEthernet 0/0/1
[R2-GigabitEthernet0/0/1]undo rip authentication-mode
[R2-GigabitEthernet0/0/1]quit
[R2]undo rip 1
Warning: The RIP process will be deleted. Continue?[Y/N]y

[R3]interface GigabitEthernet 0/0/1
[R3-GigabitEthernet0/0/1]undo rip authentication-mode
[R3-GigabitEthernet0/0/1]quit
[R3]undo rip 1
Warning: The RIP process will be deleted. Continue?[Y/N]y
```

Step 3 **Configure OSPF.**

Assign the value 10.0.1.1 (as used on logical interface loopback 0 for simplicity) as the router ID. Use OSPF process 1 (the default process), and specify network segments 10.0.1.0/24, 10.0.12.0/24, and 10.0.13.0/24 as part of OSPF area 0.

```
[R1]ospf 1 router-id 10.0.1.1
[R1-ospf-1]area 0
[R1-ospf-1-area-0.0.0.0]network 10.0.1.0 0.0.0.255
[R1-ospf-1-area-0.0.0.0]network 10.0.13.0 0.0.0.255
[R1-ospf-1-area-0.0.0.0]network 10.0.12.0 0.0.0.255
```

Different process ID's will generate multiple link state databases, therefore ensure that all routers use the same OSPF process ID. The wildcard mask must be specified as part of the **network** command.

Manually assign the value 10.0.2.2 as the router ID. Use OSPF process 1, and advertise network segments 10.0.12.0/24 and 10.0.2.0/24 into OSPF area 0.

```
[R2]ospf 1 router-id 10.0.2.2
[R2-ospf-1]area 0
```

```
[R2-ospf-1-area-0.0.0.0]network 10.0.2.0 0.0.0.255
[R2-ospf-1-area-0.0.0.0]network 10.0.12.0 0.0.0.255
```

```
…output omitted…
Mar 30 2016 09:41:39+00:00 R2 %%01OSPF/4/NBR_CHANGE_E(l)[5]:Neighbor changes event: neighbor status
changed. (ProcessId=1, NeighborAddress=10.0.12.1, NeighborEvent=LoadingDone,
NeighborPreviousState=Loading, NeighborCurrentState=Full)
```

Adjacency is attained when "NeighborCurrentState=Full". For R3, Manually assign the value 10.0.3.3 as the router ID. Use OSPF process 1, and advertise network segments 10.0.3.0/24 and 10.0.13.0/24 into OSPF area 0.

```
[R3]ospf 1 router-id 10.0.3.3
[R3-ospf-1]area 0
[R3-ospf-1-area-0.0.0.0]network 10.0.3.0 0.0.0.255
[R3-ospf-1-area-0.0.0.0]network 10.0.13.0 0.0.0.255
…output omitted…
Mar 30 2016 16:05:34+00:00 R3 %%01OSPF/4/NBR_CHANGE_E(l)[5]:Neighbor changes event: neighbor status
changed. (ProcessId=1, NeighborAddress=10.0.13.1, NeighborEvent=LoadingDone,
NeighborPreviousState=Loading, NeighborCurrentState=Full)
```

Step 4 **Verify the OSPF configuration.**

After OSPF route convergence is complete, view routing tables of R1, R2, and R3.

```
<R1>display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
        Destinations : 15       Routes : 15

Destination/Mask    Proto   Pre  Cost      Flags NextHop         Interface

    10.0.1.0/24     Direct  0    0           D   10.0.1.1        LoopBack0
    10.0.1.1/32     Direct  0    0           D   127.0.0.1       LoopBack0
    10.0.1.255/32   Direct  0    0           D   127.0.0.1       LoopBack0
    10.0.2.2/32     OSPF    10   1           D   10.0.12.2       GigabitEthernet0/0/1
    10.0.3.3/32     OSPF    10   1           D   10.0.13.3       GigabitEthernet0/0/0
    10.0.12.0/24    Direct  0    0           D   10.0.12.1       GigabitEthernet0/0/1
    10.0.12.1/32    Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/1
```

```
    10.0.12.255/32  Direct  0    0      D   127.0.0.1   GigabitEthernet0/0/1
    10.0.13.0/24    Direct  0    0      D   10.0.13.1   GigabitEthernet0/0/0
    10.0.13.1/32    Direct  0    0      D   127.0.0.1   GigabitEthernet0/0/0
    10.0.13.255/32  Direct  0    0      D   127.0.0.1   GigabitEthernet0/0/0
    127.0.0.0/8     Direct  0    0      D   127.0.0.1   InLoopBack0
    127.0.0.1/32    Direct  0    0      D   127.0.0.1   InLoopBack0
127.255.255.255/32  Direct  0    0      D   127.0.0.1   InLoopBack0
255.255.255.255/32  Direct  0    0      D   127.0.0.1   InLoopBack0

<R2>display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
        Destinations : 13      Routes : 13

Destination/Mask    Proto   Pre  Cost      Flags NextHop         Interface

    10.0.1.1/32     OSPF    10   1         D   10.0.12.1   GigabitEthernet0/0/1
    10.0.2.0/24     Direct  0    0         D   10.0.2.2    LoopBack0
    10.0.2.2/32     Direct  0    0         D   127.0.0.1   LoopBack0
    10.0.2.255/32   Direct  0    0         D   127.0.0.1   LoopBack0
    10.0.3.3/32     OSPF    10   2         D   10.0.12.1   GigabitEthernet0/0/1
    10.0.12.0/24    Direct  0    0         D   10.0.12.2   GigabitEthernet0/0/1
    10.0.12.2/32    Direct  0    0         D   127.0.0.1   GigabitEthernet0/0/1
    10.0.12.255/32  Direct  0    0         D   127.0.0.1   GigabitEthernet0/0/1
    10.0.13.0/24    OSPF    10   2         D   10.0.12.1   GigabitEthernet0/0/1
    127.0.0.0/8     Direct  0    0         D   127.0.0.1   InLoopBack0
    127.0.0.1/32    Direct  0    0         D   127.0.0.1   InLoopBack0
127.255.255.255/32  Direct  0    0         D   127.0.0.1   InLoopBack0
255.255.255.255/32  Direct  0    0         D   127.0.0.1   InLoopBack0

<R3>display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
        Destinations : 16      Routes : 16

Destination/Mask    Proto   Pre  Cost      Flags NextHop         Interface

    10.0.1.1/32     OSPF    10   1         D   10.0.13.1   GigabitEthernet0/0/0
    10.0.2.2/32     OSPF    10   2         D   10.0.13.1   GigabitEthernet0/0/0
    10.0.3.0/24     Direct  0    0         D   10.0.3.3    LoopBack0
```

```
    10.0.3.3/32     Direct  0    0       D   127.0.0.1   LoopBack0
    10.0.3.255/32   Direct  0    0       D   127.0.0.1   LoopBack0
    10.0.12.0/24    OSPF    10   2       D   10.0.13.1   GigabitEthernet0/0/0
    10.0.13.0/24    Direct  0    0       D   10.0.13.3   GigabitEthernet0/0/0
    10.0.13.3/32    Direct  0    0       D   127.0.0.1   GigabitEthernet0/0/0
    10.0.13.255/32  Direct  0    0       D   127.0.0.1   GigabitEthernet0/0/0
    127.0.0.0/8     Direct  0    0       D   127.0.0.1   InLoopBack0
    127.0.0.1/32    Direct  0    0       D   127.0.0.1   InLoopBack0
127.255.255.255/32  Direct  0    0       D   127.0.0.1   InLoopBack0
    172.16.0.0/24   Direct  0    0       D   172.16.0.1  LoopBack2
    172.16.0.1/32   Direct  0    0       D   127.0.0.1   LoopBack2
    172.16.0.255/32 Direct  0    0       D   127.0.0.1   LoopBack2
255.255.255.255/32  Direct  0    0       D   127.0.0.1   InLoopBack0
```

Test network connectivity between R2 and R1 at 10.0.1.1 and between R2 and R3 at 10.0.3.3.

```
<R2>ping 10.0.1.1
  PING 10.0.1.1: 56  data bytes, press CTRL_C to break
    Reply from 10.0.1.1: bytes=56 Sequence=1 ttl=255 time=37 ms
    Reply from 10.0.1.1: bytes=56 Sequence=2 ttl=255 time=42 ms
    Reply from 10.0.1.1: bytes=56 Sequence=3 ttl=255 time=42 ms
    Reply from 10.0.1.1: bytes=56 Sequence=4 ttl=255 time=45 ms
    Reply from 10.0.1.1: bytes=56 Sequence=5 ttl=255 time=42 ms

--- 10.0.1.1 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 37/41/45 ms

<R2>ping 10.0.3.3
  PING 10.0.3.3: 56  data bytes, press CTRL_C to break
    Reply from 10.0.3.3: bytes=56 Sequence=1 ttl=254 time=37 ms
    Reply from 10.0.3.3: bytes=56 Sequence=2 ttl=254 time=42 ms
    Reply from 10.0.3.3: bytes=56 Sequence=3 ttl=254 time=42 ms
    Reply from 10.0.3.3: bytes=56 Sequence=4 ttl=254 time=42 ms
    Reply from 10.0.3.3: bytes=56 Sequence=5 ttl=254 time=42 ms

 --- 10.0.3.3 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
```

```
  0.00% packet loss
  round-trip min/avg/max = 37/41/42 ms
```

Run the **display ospf peer** command to view the OSPF neighbor status.

```
<R1>display ospf peer

       OSPF Process 1 with Router ID 10.0.1.1
              Neighbors

 Area 0.0.0.0 interface 10.0.12.1(GigabitEthernet0/0/1)'s neighbors
 Router ID: 10.0.2.2        Address: 10.0.12.2
   State: Full  Mode:Nbr is  Master  Priority: 1
   DR: 10.0.12.1  BDR: 10.0.12.2  MTU: 0
   Dead timer due in 32  sec
   Retrans timer interval: 5
   Neighbor is up for 00:47:59
   Authentication Sequence: [ 0 ]

              Neighbors

 Area 0.0.0.0 interface 10.0.13.1(GigabitEthernet0/0/0)'s neighbors
 Router ID: 10.0.3.3        Address: 10.0.13.3
   State: Full  Mode:Nbr is  Master  Priority: 1
   DR: 10.0.13.1  BDR: 10.0.13.3  MTU: 0
   Dead timer due in 34  sec
   Retrans timer interval: 5
   Neighbor is up for 00:41:44
   Authentication Sequence: [ 0 ]
```

The **display ospf peer** command displays detailed information about any peering neighbors. In the example given, the link 10.0.13.1 of R1 shows to be the DR. The DR election is non pre-emptive, meaning that the link of R3 will not take over the role of DR from R1 unless the OSPF process is reset.

The **display ospf peer brief** command can also be used to display a condensed version of the OSPF peer information.

```
<R1>display ospf peer brief

       OSPF Process 1 with Router ID 10.0.1.1
              Peer Statistic Information
```

```
 ---------------------------------------------------------------------------
 Area Id         Interface                     Neighbor id     State
 0.0.0.0         GigabitEthernet0/0/0            10.0.3.3        Full
 0.0.0.0         GigabitEthernet0/0/1            10.0.2.2        Full
---------------------------------------------------------------------------
<R2>display ospf peer brief

       OSPF Process 1 with Router ID 10.0.2.2
               Peer Statistic Information
 ---------------------------------------------------------------------------
 Area Id         Interface                     Neighbor id     State
 0.0.0.0        GigabitEthernet0/0/1             10.0.1.1        Full
 ---------------------------------------------------------------------------

<R3>display ospf peer brief
       OSPF Process 1 with Router ID 10.0.3.3
               Peer Statistic Information
 ---------------------------------------------------------------------------
 Area Id         Interface                     Neighbor id     State
 0.0.0.0         GigabitEthernet0/0/0            10.0.1.1        Full
 ---------------------------------------------------------------------------
```

Step 5 **Change the OSPF hello interval and dead interval.**

Run the **display ospf interface GigabitEthernet 0/0/0** command on R1 to view the default OSPF hello interval and dead interval.

```
<R1>display ospf interface GigabitEthernet 0/0/0

       OSPF Process 1 with Router ID 10.0.1.1
              Interfaces


 Interface: 10.0.13.1 (GigabitEthernet0/0/0)
 Cost: 1      State: DR       Type: Broadcast    MTU: 1500
 Priority: 1
 Designated Router: 10.0.13.1
 Backup Designated Router: 10.0.13.3
 Timers: Hello 10 , Dead 40 , Poll  120 , Retransmit 5 , Transmit Delay 1
```

Run the **ospf timer** command to change the OSPF hello interval and dead interval on GE0/0/0 of R1 to 15s and 60s respectively.

```
[R1]interface GigabitEthernet 0/0/0
[R1-GigabitEthernet0/0/0]ospf timer hello 15
[R1-GigabitEthernet0/0/0]ospf timer dead 60
Mar 30 2016 16:58:39+00:00 R1 %%01OSPF/3/NBR_DOWN_REASON(l)[1]:Neighbor state leaves full or
changed to Down. (ProcessId=1, NeighborRouterId=10.0.3.3, NeighborAreaId=0,
NeighborInterface=GigabitEthernet0/0/0,NeighborDownImmediate reason=Neighbor Down Due to
Inactivity, NeighborDownPrimeReason=Interface Parameter Mismatch,
NeighborChangeTime=2016-03-30 16:58:39)

<R1>display ospf interface GigabitEthernet 0/0/0

        OSPF Process 1 with Router ID 10.0.1.1
               Interfaces


 Interface: 10.0.13.1 (GigabitEthernet0/0/0)
 Cost: 1      State: DR       Type: Broadcast    MTU: 1500
 Priority: 1
 Designated Router: 10.0.13.1
 Backup Designated Router: 10.0.13.3
 Timers: Hello 15 , Dead 60 , Poll  120 , Retransmit 5 , Transmit Delay 1
```

Check the OSPF neighbor status on R1.

```
<R1>display ospf peer brief

        OSPF Process 1 with Router ID 10.0.1.1
                Peer Statistic Information
 ----------------------------------------------------------------------------
 Area Id         Interface                     Neighbor id     State
 0.0.0.0         GigabitEthernet0/0/1            10.0.2.2        Full
 ----------------------------------------------------------------------------
```

The preceding information shows that R1 has only one neighbor, R2. Since the OSPF hello intervals and dead intervals on R1 and R3 are different, R1 and R3 will fail to establish an OSPF neighbor relationship.

Run the **ospf timer** command to change the OSPF hello interval and dead interval on GE0/0/0 of R3 to 15s and 60s respectively.

```
[R3]interface GigabitEthernet 0/0/0
[R3-GigabitEthernet0/0/0]ospf timer hello 15
[R3-GigabitEthernet0/0/0]ospf timer dead 60
…output omitted…
```

```
Mar 30 2016 17:03:33+00:00 R3 %%01OSPF/4/NBR_CHANGE_E(l)[4]:Neighbor changes event: neighbor
status changed. (ProcessId=1, NeighborAddress=10.0.13.1, NeighborEvent=LoadingDone,
NeighborPreviousState=Loading, NeighborCurrentState=Full)

<R3>display ospf interface GigabitEthernet 0/0/0

        OSPF Process 1 with Router ID 10.0.3.3
               Interfaces

 Interface: 10.0.13.3 (GigabitEthernet0/0/0)
 Cost: 1      State: DR       Type: Broadcast    MTU: 1500
 Priority: 1
 Designated Router: 10.0.13.3
 Backup Designated Router: 10.0.13.1
 Timers: Hello 15 , Dead 60 , Poll  120 , Retransmit 5 , Transmit Delay 1
```

Check the OSPF neighbor status on R1 again.

```
<R1>display ospf peer brief
        OSPF Process 1 with Router ID 10.0.1.1
                Peer Statistic Information
 ----------------------------------------------------------------------------
 Area Id         Interface                     Neighbor id     State
 0.0.0.0         GigabitEthernet0/0/0            10.0.3.3        Full
 0.0.0.0         GigabitEthernet0/0/1            10.0.2.2        Full
----------------------------------------------------------------------------
```

Step 6 **Advertise default routes in OSPF.**

Configure OSPF to advertise default routes on R3.

```
[R3]ip route-static 0.0.0.0 0.0.0.0 LoopBack 2
[R3]ospf 1
[R3-ospf-1]default-route-advertise
```

View routing tables of R1 and R2. You can see that R1 and R2 have learned the default routes advertised by R3.

```
<R1>display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
```

```
        Destinations : 16      Routes : 16

Destination/Mask    Proto   Pre  Cost Flags NextHop     Interface

    0.0.0.0/0       O_ASE   150  1      D   10.0.13.3   GigabitEthernet0/0/0
    10.0.1.0/24     Direct  0    0      D   10.0.1.1    LoopBack0
    10.0.1.1/32     Direct  0    0      D   127.0.0.1   LoopBack0
    10.0.1.255/32   Direct  0    0      D   127.0.0.1   LoopBack0
    10.0.2.2/32     OSPF    10   1      D   10.0.12.2   GigabitEthernet0/0/1
    10.0.3.3/32     OSPF    10   1      D   10.0.13.3   GigabitEthernet0/0/0
    10.0.12.0/24    Direct  0    0      D   10.0.12.1   GigabitEthernet0/0/1
    10.0.12.1/32    Direct  0    0      D   127.0.0.1   GigabitEthernet0/0/1
    10.0.12.255/32  Direct  0    0      D   127.0.0.1   GigabitEthernet0/0/1
    10.0.13.0/24    Direct  0    0      D   10.0.13.1   GigabitEthernet0/0/0
    10.0.13.1/32    Direct  0    0      D   127.0.0.1   GigabitEthernet0/0/0
    10.0.13.255/32  Direct  0    0      D   127.0.0.1   GigabitEthernet0/0/0
    127.0.0.0/8     Direct  0    0      D   127.0.0.1   InLoopBack0
    127.0.0.1/32    Direct  0    0      D   127.0.0.1   InLoopBack0
127.255.255.255/32  Direct  0    0      D   127.0.0.1   InLoopBack0
255.255.255.255/32  Direct  0    0      D   127.0.0.1   InLoopBack0


<R2>display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
        Destinations : 14      Routes : 14

Destination/Mask    Proto   Pre  Cost Flags NextHop     Interface

    0.0.0.0/0       O_ASE   150  1      D   10.0.12.1   GigabitEthernet0/0/1
    10.0.1.1/32     OSPF1   0    1      D   10.0.12.1   GigabitEthernet0/0/1
    10.0.2.0/24     Direct  0    0      D   10.0.2.2    LoopBack0
    10.0.2.2/32     Direct  0    0      D   127.0.0.1   LoopBack0
    10.0.2.255/32   Direct  0    0      D   127.0.0.1   LoopBack0
    10.0.3.3/32     OSPF    10   2      D   10.0.12.1   GigabitEthernet0/0/1
    10.0.12.0/24    Direct  0    0      D   10.0.12.2   GigabitEthernet0/0/1
    10.0.12.2/32    Direct  0    0      D   127.0.0.1   GigabitEthernet0/0/1
    10.0.12.255/32  Direct  0    0      D   127.0.0.1   GigabitEthernet0/0/1
    10.0.13.0/24    OSPF    10   2      D   10.0.12.1   GigabitEthernet0/0/1
    127.0.0.0/8     Direct  0    0      D   127.0.0.1   InLoopBack0
    127.0.0.1/32    Direct  0    0      D   127.0.0.1   InLoopBack0
```

```
127.255.255.255/32  Direct  0    0       D   127.0.0.1   InLoopBack0
255.255.255.255/32  Direct  0    0       D   127.0.0.1   InLoopBack0
```

```
<R3>display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
        Destinations : 17       Routes : 17

Destination/Mask    Proto   Pre  Cost      Flags NextHop         Interface

    0.0.0.0/0       Static  60   0           D   172.16.0.1      LoopBack2
    10.0.1.1/32     OSPF    10   1           D   10.0.13.1       GigabitEthernet0/0/0
    10.0.2.2/32     OSPF    10   2           D   10.0.13.1       GigabitEthernet0/0/0
    10.0.3.0/24     Direct  0    0           D   10.0.3.3        LoopBack0
    10.0.3.3/32     Direct  0    0           D   127.0.0.1       LoopBack0
    10.0.3.255/32   Direct  0    0           D   127.0.0.1       LoopBack0
    10.0.12.0/24    OSPF    10   2           D   10.0.13.1       GigabitEthernet0/0/0
    10.0.13.0/24    Direct  0    0           D   10.0.13.3       GigabitEthernet0/0/0
    10.0.13.3/32    Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/0
    10.0.13.255/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/0
    127.0.0.0/8     Direct  0    0           D   127.0.0.1       InLoopBack0
    127.0.0.1/32    Direct  0    0           D   127.0.0.1       InLoopBack0
127.255.255.255/32  Direct  0    0           D   127.0.0.1       InLoopBack0
    172.16.0.0/24   Direct  0    0           D   172.16.0.1      LoopBack2
    172.16.0.1/32   Direct  0    0           D   127.0.0.1       LoopBack2
    172.16.0.255/32 Direct  0    0           D   127.0.0.1       LoopBack2
255.255.255.255/32  Direct  0    0           D   127.0.0.1       InLoopBack0
```

Run the **ping** command to test connectivity between R2 and Loopback2 at 172.16.0.1.

```
<R2>ping 172.16.0.1
  PING 172.16.0.1: 56  data bytes, press CTRL_C to break
    Reply from 172.16.0.1: bytes=56 Sequence=1 ttl=254 time=47 ms
    Reply from 172.16.0.1: bytes=56 Sequence=2 ttl=254 time=37 ms
    Reply from 172.16.0.1: bytes=56 Sequence=3 ttl=254 time=37 ms
    Reply from 172.16.0.1: bytes=56 Sequence=4 ttl=254 time=37 ms
    Reply from 172.16.0.1: bytes=56 Sequence=5 ttl=254 time=37 ms
```

```
--- 172.16.0.1 ping statistics ---
   5 packet(s) transmitted
   5 packet(s) received
   0.00% packet loss
   round-trip min/avg/max = 37/39/47 ms
```

Step 7 **Control OSPF DR or BDR election.**

Run the **display ospf peer** command to view the DR and BDR of R1 and R3.

```
<R1>display ospf peer 10.0.3.3

        OSPF Process 1 with Router ID 10.0.1.1
               Neighbors

 Area 0.0.0.0 interface 10.0.13.1(GigabitEthernet0/0/0)'s neighbors
 Router ID: 10.0.3.3        Address: 10.0.13.3
   State: Full  Mode:Nbr is  Master  Priority: 1
   DR: 10.0.13.3  BDR: 10.0.13.1  MTU: 0
   Dead timer due in 49  sec
   Retrans timer interval: 5
   Neighbor is up for 00:17:40
   Authentication Sequence: [ 0 ]
```

The preceding information shows that R3 is the DR and R1 is the BDR. This is because R3's router ID 10.0.3.3 is greater than R1's router ID 10.0.1.1. R1 and R3 use the default priority of 1, so their router IDs are used for DR or BDR election.

Run the **ospf dr-priority** command to change DR priorities of R1 and R3.

```
[R1]interface GigabitEthernet 0/0/0
[R1-GigabitEthernet0/0/0]ospf dr-priority 200

[R3]interface GigabitEthernet 0/0/0
[R3-GigabitEthernet0/0/0]ospf dr-priority 100
```

A DR or BDR is elected in non-preemption mode, by default. After router priorities are changed, a DR is not re-elected, so you must reset the OSPF neighbor relationship between R1 and R3.

Shut down and re-enable Gigabit Ethernet 0/0/0 interfaces on R1 and R3 to reset the OSPF neighbor relationship between R1 and R3.

```
[R3]interface GigabitEthernet0/0/0
[R3-GigabitEthernet0/0/0]shutdown

[R1]interface GigabitEthernet0/0/0
[R1-GigabitEthernet0/0/0]shutdown

[R1-GigabitEthernet0/0/0]undo shutdown

[R3-GigabitEthernet0/0/0]undo shutdown
```

Run the **display ospf peer** command to view the DR and BDR of R1 and R3.

```
[R1]display ospf peer 10.0.3.3

        OSPF Process 1 with Router ID 10.0.1.1
               Neighbors

 Area 0.0.0.0 interface 10.0.13.1(GigabitEthernet0/0/0)'s neighbors
 Router ID: 10.0.3.3        Address: 10.0.13.3
   State: Full  Mode:Nbr is  Master  Priority: 100
   DR: 10.0.13.1  BDR: 10.0.13.3  MTU: 0
   Dead timer due in 52  sec
   Retrans timer interval: 5
   Neighbor is up for 00:00:25
   Authentication Sequence: [ 0 ]
```

According to the preceding information, R1's priority is higher than R3's priority, so R1 becomes DR and R3 becomes the BDR.

Final Configuration

```
<R1>display current-configuration
[V200R007C00SPC600]
#
 sysname R1
#
interface GigabitEthernet0/0/0
 ip address 10.0.13.1 255.255.255.0
 ospf dr-priority 200
 ospf timer hello 15
#
interface GigabitEthernet0/0/1
```

```
 ip address 10.0.12.1 255.255.255.0
#
interface LoopBack0
 ip address 10.0.1.1 255.255.255.0
#
ospf 1 router-id 10.0.1.1
 area 0.0.0.0
  network 10.0.1.0 0.0.0.255
  network 10.0.12.0 0.0.0.255
  network 10.0.13.0 0.0.0.255
#
user-interface con 0
 authentication-mode password
 set authentication password cipher %$%$+L'YR&IZt'4,)>-*#lH",}%K-oJ_M9+'lOU~bD (\WTqB}%N,%
$%$
user-interface vty 0 4
#
return


<R2>display current-configuration
[V200R007C00SPC600]
#
 sysname R2
#
interface GigabitEthernet0/0/1
 ip address 10.0.12.2 255.255.255.0
#
interface LoopBack0
 ip address 10.0.2.2 255.255.255.0
#
ospf 1 router-id 10.0.2.2
 area 0.0.0.0
  network 10.0.2.0 0.0.0.255
  network 10.0.12.0 0.0.0.255
#
user-interface con 0
 authentication-mode password
 set authentication password cipher %$%$1=cd%b%/O%Id-8X:by1N,+s}'4wD6TvO<I|/pd#
#44C@+s#,%$%$
user-interface vty 0 4
#
```

```
return
```

```
<R3>display current-configuration
[V200R007C00SPC600]
#
 sysname R3
#
interface GigabitEthernet0/0/0
 ip address 10.0.13.3 255.255.255.0
 ospf dr-priority 100
 ospf timer hello 15
#
interface LoopBack0
 ip address 10.0.3.3 255.255.255.0
#
interface LoopBack2
 ip address 172.16.0.1 255.255.255.0
#
ospf 1 router-id 10.0.3.3
 default-route-advertise
 area 0.0.0.0
  network 10.0.3.0 0.0.0.255
  network 10.0.13.0 0.0.0.255
#
ip route-static 0.0.0.0 0.0.0.0 LoopBack2
#
user-interface con 0
 authentication-mode password
 set authentication password cipher %$%$ksXDMg7Ry6yUU:63:DQ),#/sQg"@*S\U#.s.bHW xQ,y%#/v,%
$%$
user-interface vty 0 4
#
return
```

Module 5 FTP and DHCP

Lab 5-1 Configuring FTP Services

Learning Objectives

As a result of this lab section, you should achieve the following tasks:

- Establishment of the FTP service.
- Configuration of FTP server parameters.
- Successful file transfer from an FTP server.

Topology

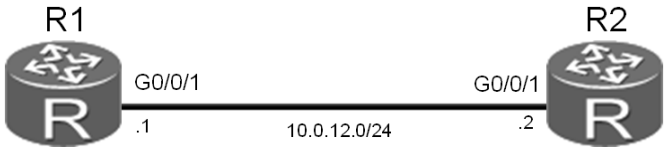


Figure 5.1 FTP topology

Scenario

As a network administrator of a company, you have been tasked with implementing FTP services on the network. You need to implement the FTP service on a router assigned to be an FTP server. The router should allow clients to successfully establish a TCP session to the FTP application and transfer files.

Tasks

Step 1 **Preparing the environment.**

If you are starting this section with a non-configured device, begin here and then move to step 2. For those continuing from previous labs, begin at step 2.

```
<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname R1
[R1]interface  GigabitEthernet 0/0/1
[R1-GigabitEthernet0/0/1]ip address 10.0.12.1 24

<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname R2
[R2]interface  GigabitEthernet 0/0/1
[R2-GigabitEthernet0/0/1]ip address 10.0.12.2 24
```

Verify that R1 can reach R2, and vice versa..

```
 [R1]ping 10.0.12.2
  PING 10.0.12.2: 56  data bytes, press CTRL_C to break
    Reply from 10.0.12.2: bytes=56 Sequence=1 ttl=255 time=10 ms
    Reply from 10.0.12.2: bytes=56 Sequence=2 ttl=255 time=1 ms
    Reply from 10.0.12.2: bytes=56 Sequence=3 ttl=255 time=1 ms
    Reply from 10.0.12.2: bytes=56 Sequence=4 ttl=255 time=10 ms
    Reply from 10.0.12.2: bytes=56 Sequence=5 ttl=255 time=1 ms

  --- 10.0.12.2 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 1/4/10 ms
```

Step 2 **Enable the FTP service on the router.**

The FTP service is disabled by default on the router. It must be enabled before FTP can be used. Configure an FTP server using R1 with R2 as the client. The same steps

can be reversed to enable R2 to also act as an FTP server.

```
[R1]ftp server enable
Info: Succeeded in starting the FTP server
[R1]set default ftp-directory flash:
```

Configure user authorization for FTP users to access the server. Unauthorized users will not be able to access the FTP server, reducing security risks.

```
[R1]aaa
[R1-aaa]local-user huawei password  cipher  huawei123
Info: Add a new user.

[R1-aaa]local-user huawei service-type ftp
Info: The cipher password has been changed to an irreversible-cipher password.
Warning: The user access modes include Telnet, FTP or HTTP, and so security risks exist.
Info: After you change the rights (including the password, access type, FTP directory, and
level) of a local user, the rights of users already online do not change. The change takes
effect to users who go online after the change.
[R1-aaa]local-user huawei privilege level 15
Info: After you change the rights (including the password, access type, FTP directory, and
level) of a local user, the rights of users already online do not change. The change takes
effect to users who go online after the change.
[R1-aaa]local-user huawei ftp-directory flash:
Info: After you change the rights (including the password, access type, FTP directory, and
level) of a local user, the rights of users already online do not change. The change takes
effect to users who go online after the change.


[R1]display ftp-server
  FTP server is running
  Max user number              5
  User count                   0
  Timeout value(in minute)       30
  Listening port               21
  Acl number                   0
  FTP server's source address    0.0.0.0
```

The FTP server is running on R1 and listens on TCP port 21 by default.

Step 3 **Establish an FTP client connection**

Establish a connection to the FTP Server from R2.

```
<R2>ftp 10.0.12.1
Trying 10.0.12.1 ...
Press CTRL+K to abort
Connected to 10.0.12.1.
220 FTP service ready.
User(10.0.12.1:(none)):huawei
331 Password required for huawei.
Enter password:
230 User logged in.

[R2-ftp]
```

Following entry of the correct user name and password, the FTP server can be successfully logged into.

Run the **dir** command before downloading a file or after uploading a file to view the detailed information of the file.

```
[R2-ftp]dir
200 Port command okay.
150 Opening ASCII mode data connection for *.
drwxrwxrwx   1 noone    nogroup        0 May 03 18:03 .
-rwxrwxrwx   1 noone    nogroup 114552448 Jan 19  2012 AR2220E-V200R006C10SPC300.cc
-rwxrwxrwx   1 noone    nogroup    159858 May 03 17:59 mon_file.txt
-rwxrwxrwx   1 noone    nogroup    304700 Mar 03 11:11 sacrule.dat
-rwxrwxrwx   1 noone    nogroup       783 Mar 03 11:12 default_local.cer
-rwxrwxrwx   1 noone    nogroup         0 Dec 20  2015 brdxpon_snmp_cfg.efs
-rwxrwxrwx   1 noone    nogroup       777 May 03 18:03 vrpcfg.zip
drwxrwxrwx   1 noone    nogroup         0 Mar 10 11:14 update
drwxrwxrwx   1 noone    nogroup         0 May 03 18:03 localuser
drwxrwxrwx   1 noone    nogroup         0 Mar 17 10:45 dhcp
-rwxrwxrwx   1 noone    nogroup       460 May 03 18:03 private-data.txt
-rwxrwxrwx   1 noone    nogroup 126352896 Mar 10 11:09 AR2220E-V200R007C00SPC600.cc
drwxrwxrwx   1 noone    nogroup         0 Mar 10 11:15 shelldir
-rwxrwxrwx   1 noone    nogroup     11606 May 03 18:00 mon_lpu_file.txt
drwxrwxrwx   1 noone    nogroup         0 Mar 18 14:45 huawei
-rwxrwxrwx   1 noone    nogroup       120 Mar 18 15:02 text.txt226 Transfer complete.
FTP: 836 byte(s) received in 0.976 second(s) 856.55byte(s)/sec.
```

Set the transfer mode for the files to be transferred.

```
[R2-ftp]binary
```

```
200 Type set to I.
```

Retrieve a file from the FTP server. Note: If the vrpcfg.zip file is not present in the sd1: directory of R1, use the **save** command on R1 to create it.

```
[R2-ftp]get vrpcfg.zip vrpnew.zip
200 Port command okay.
150 Opening BINARY mode data connection for vrpcfg.zip.
226 Transfer complete.
FTP: 120 byte(s) received in 0.678 second(s) 176.99byte(s)/sec.
```

After downloading the file from FTP server, use the **bye** command to close the connection

```
[R2-ftp]bye
221 Server closing.

<R2>dir
Directory of flash:/

  Idx  Attr     Size(Byte)  Date       Time(LMT)  FileName
    0  -rw-   114,552,448  Jan 19 2012 15:32:52   AR2220E-V200R006C10SPC300.cc
    1  -rw-       270,176  Apr 30 2016 03:17:08   mon_file.txt
    2  -rw-       304,700  Mar 03 2016 11:11:44   sacrule.dat
    3  -rw-           783  Mar 03 2016 11:12:22   default_local.cer
    4  -rw-             0  Dec 20 2015 00:06:14   brdxpon_snmp_cfg.efs
    5  -rw-           775  Apr 29 2016 17:51:48   vrpcfg.zip
    6  drw-             -  Mar 10 2016 11:28:46   update
    7  drw-             -  Apr 23 2016 17:33:38   localuser
    8  drw-             -  Mar 21 2016 20:59:46   dhcp
    9  -rw-           394  Apr 29 2016 17:51:50   private-data.txt
   10  -rw-   126,352,896  Mar 10 2016 11:14:40   AR2220E-V200R007C00SPC600.cc
   11  drw-             -  Mar 10 2016 11:29:20   shelldir
   12  -rw-        23,950  Apr 27 2016 16:06:06   mon_lpu_file.txt
   13  -rw-           120  Mar 24 2016 11:45:44   huawei.zip
   14  -rw-           777  May 10 2016 14:23:43   vrpnew.zip
```

A file can be uploaded to the FTP server by using the command **put**, for which a new file name can also be assigned.

```
[R2-ftp]put vrpnew.zip vrpnew2.zip
200 Port command okay.
150 Opening BINARY mode data connection for vrpnew2.zip.
226 Transfer complete.
FTP: 120 byte(s) sent in 0.443 second(s) 270.88byte(s)/sec.
```

After uploading the file, check for the presence of the file on FTP server.

```
<R1>dir
Directory of flash:/

  Idx  Attr     Size(Byte)  Date       Time(LMT)  FileName
    0  -rw-       286,620  Mar 14 2016 09:22:20   sacrule.dat
    1  -rw-       512,000  Mar 28 2016 14:39:16   mon_file.txt
    2  -rw-     1,738,816  Mar 17 2016 12:05:36   web.zip
    3  -rw-        48,128  Mar 10 2016 14:16:56   ar2220E_v200r001sph001.pat
    4  -rw-           120  Mar 28 2016 10:09:50   iascfg.zip
    5  -rw-           699  Mar 28 2016 17:52:38   vrpcfg.zip
    6  -rw-    93,871,872  Mar 14 2016 09:13:26   ar2220-V200R007C00SPC600.cc
    7  -rw-       512,000  Mar 28 2016 14:40:20   mon_lpu_file.txt
    8  -rw-           699  Mar 02 2016 15:44:16   vrpnew2.zip
```

Remove the created vrpnew.zip and vrpnew2.zip files on R1 and R2.

```
<R1>delete flash:/vrpnew2.zip
Delete flash:/vrpnew2.zip? (y/n)[n]:y
Info: Deleting file flash:/vrpnew2.zip...succeed.

<R2>delete flash:/vrpnew.zip
Delete flash:/vrpnew.zip? (y/n)[n]:y
Info: Deleting file flash:/vrpnew.zip...succeed.
```

Note: Please take extreme care when deleting the configuration files so to ensure that the entire flash:/ directory of R1 and R2 is not erased.

Final Configuration

```
<R1>display current-configuration
[V200R007C00SPC600]
#
 sysname R1
 ftp server enable
```

```
 set default ftp-directory flash:
#
aaa
 authentication-scheme default
 authorization-scheme default
 accounting-scheme default
 domain default
 domain default_admin
 local-user admin password cipher %$%$=i~>Xp&aY+*2cEVcS-A23Uwe%$%$
 local-user admin service-type http
 local-user huawei password cipher %$%$f+~&ZkCn]NUX7m.t;tF9R48s%$%$
 local-user huawei privilege level 15
 local-user huawei ftp-directory flash:/
 local-user huawei service-type ftp
#
interface GigabitEthernet0/0/1
 ip address 10.0.12.1 255.255.255.0
#
user-interface con 0
 authentication-mode password
 set authentication password cipher %$%$+L'YR&IZt'4,)>-*#lH",}%K-oJ_M9+'lOU~bD (\WTqB}%N,%
$%$
user-interface vty 0 4
#
return

<R2>display current-configuration
[V200R007C00SPC600]
#
 sysname R2
 ftp server enable
 set default ftp-directory flash:
#
aaa
 authentication-scheme default
 authorization-scheme default
 accounting-scheme default
 domain default
 domain default_admin
 local-user admin password cipher %$%$=i~>Xp&aY+*2cEVcS-A23Uwe%$%$
 local-user admin service-type http
 local-user huawei password cipher %$%$<;qM3D/O;ZLqy/"&6wEESdg$%$%$
```

```
 local-user huawei privilege level 15
 local-user huawei ftp-directory flash:/
 local-user huawei service-type ftp
#
interface GigabitEthernet0/0/1
 ip address 10.0.12.2 255.255.255.0
#
user-interface con 0
 authentication-mode password
 set authentication password cipher %$%$1=cd%b%/O%Id-8X:by1N,+s}'4wD6TvO<I|/pd# #44C@+s#,%
$%$
user-interface vty 0 4
#
return
```

Lab 5-2 Implementing DHCP

Learning Objectives

As a result of this lab section, you should achieve the following tasks:

- Configuration of a global DHCP pool.
- Configuration of an interface based DHCP pool.
- Enable DHCP discovery and IP allocation for switch interfaces.
- Method of global address pool configuration.
- Method of interface address pool configuration.

Topology

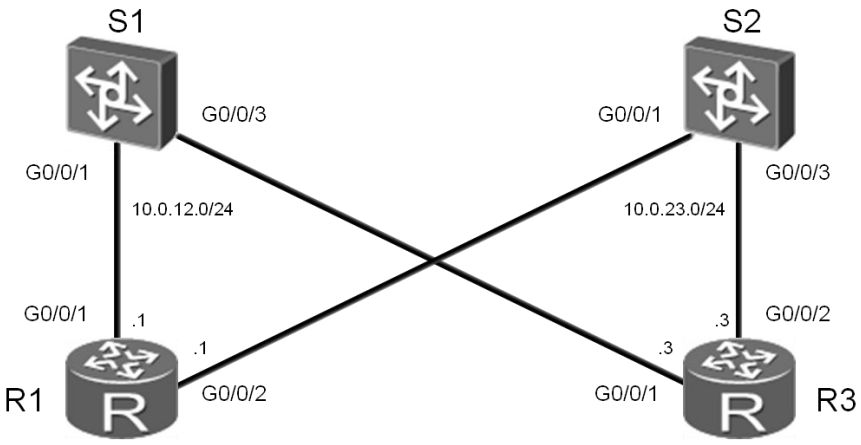


Figure 5.2 DHCP topology

Scenario

As the administrator of an enterprise you have been tasked with implementing DHCP application services within the network. The gateway router in the company network is to be configured as a DHCP server. IP addressing from an address pool are to be offered by the gateway(s) (R1 and R3) to respective access layer devices.

Tasks

Step 1 **Preparing the environment**

If you are starting this section with a non-configured device, begin here and then move to step 3. For those continuing from previous labs, begin at step 2.

Establish the addressing for the lab and temporarily shut down the interfaces Gigabit Ethernet 0/0/2 of R1 and Gigabit Ethernet 0/0/1 of R3.

```
<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname R1
[R1]interface GigabitEthernet 0/0/1
[R1-GigabitEthernet0/0/1]ip address 10.0.12.1 24
[R1-GigabitEthernet0/0/1]quit

<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname R3
[R3]interface GigabitEthernet 0/0/1
[R3-GigabitEthernet0/0/1]ip address 10.0.12.3 24
[R3-GigabitEthernet0/0/1]shutdown
[R3-GigabitEthernet0/0/1]quit
[R3]interface GigabitEthernet 0/0/2
[R3-GigabitEthernet0/0/2]ip address 10.0.23.3 24


<Quidway>system-view
Enter system view, return user view with Ctrl+Z.
[Quidway]sysname S1


<Quidway>system-view
Enter system view, return user view with Ctrl+Z.
[Quidway]sysname S2
```

Step 2 **Cleaning up the previous configuration**

Re-enable to Gigabit Ethernet 0/0/2 interface on R3.

```
[R3]interface GigabitEthernet 0/0/2
[R3-GigabitEthernet0/0/2]undo shutdown
```

Step 3 **Additional configuration**

Disable the port interfaces between S1 and S2 as well as other interfaces to prevent interference from other devices.

```
[S1]interface GigabitEthernet 0/0/9
[S1-GigabitEthernet0/0/9]shutdown
[S1-GigabitEthernet0/0/9]quit
[S1]interface GigabitEthernet 0/0/10
[S1-GigabitEthernet0/0/10]shutdown
[S1-GigabitEthernet0/0/10]quit
[S1]interface GigabitEthernet 0/0/13
[S1-GigabitEthernet0/0/13]shutdown
[S1-GigabitEthernet0/0/13]quit
[S1]interface GigabitEthernet 0/0/14
[S1-GigabitEthernet0/0/14]shutdown

[S2]interface GigabitEthernet 0/0/9
[S2-GigabitEthernet0/0/9]shutdown
[S2-GigabitEthernet0/0/9]quit
[S2]interface GigabitEthernet 0/0/10
[S2-GigabitEthernet0/0/10]shutdown
[S2-GigabitEthernet0/0/10]quit
[S2]interface GigabitEthernet 0/0/7
[S2-GigabitEthernet0/0/7]shutdown
[S2-GigabitEthernet0/0/23]quit
[S2]interface GigabitEthernet 0/0/6
[S2-GigabitEthernet0/0/6]shutdown

[R1]interface GigabitEthernet 0/0/2
[R1-GigabitEthernet0/0/2]ip address 10.0.23.1 24
```

```
[R1-GigabitEthernet0/0/2]shutdown
```

Verify that Gigabit Ethernet interfaces 0/0/9, 0/0/10, 0/0/13 and 0/0/14, have been shut down on S1 and that Gigabit Ethernet interfaces 0/09, 0/0/10, 0/0/23 and 0/0/24 have been shut down on S2.

```
<S1>display interface brief
…output omitted…
Interface               PHY   Protocol InUti OutUti   inErrors  outErrors
GigabitEthernet0/0/1    up      up      0.01%   0.01%       0         0
GigabitEthernet0/0/2    up      up      0.01%   0.01%       0         0
GigabitEthernet0/0/3    down    down       0%      0%       0         0
GigabitEthernet0/0/4    up      up         0%   0.01%       0         0
GigabitEthernet0/0/5    up      up         0%   0.01%       0         0
GigabitEthernet0/0/6    down    down       0%      0%       0         0
GigabitEthernet0/0/7    down    down       0%      0%       0         0
GigabitEthernet0/0/8    down    down       0%      0%       0         0
GigabitEthernet0/0/9    *down   down       0%      0%       0         0
GigabitEthernet0/0/10   *down   down       0%      0%       0         0
GigabitEthernet0/0/11   down    down       0%      0%       0         0
GigabitEthernet0/0/12   down    down       0%      0%       0         0
GigabitEthernet0/0/13   *down   down       0%      0%       0         0
GigabitEthernet0/0/14   *down   down       0%      0%       0         0
…output omitted…

<S2>display interface brief
…output omitted…
GigabitEthernet0/0/9    *down   down       0%      0%       0         0
GigabitEthernet0/0/10   *down   down       0%      0%       0         0
GigabitEthernet0/0/11   up      up      0.01%   0.01%       0         0
GigabitEthernet0/0/12   up      up      0.01%   0.01%       0         0
GigabitEthernet0/0/13   up      up         0%   0.01%       0         0
GigabitEthernet0/0/14   down    down       0%      0%       0         0
GigabitEthernet0/0/15   down    down       0%      0%       0         0
GigabitEthernet0/0/16   down    down       0%      0%       0         0
```

```
GigabitEthernet0/0/17   down    down        0%      0%        0         0
GigabitEthernet0/0/18   down    down        0%      0%        0         0
GigabitEthernet0/0/19   down    down        0%      0%        0         0
GigabitEthernet0/0/20   down    down        0%      0%        0         0
GigabitEthernet0/0/21   down    down        0%      0%        0         0
GigabitEthernet0/0/22   down    down        0%      0%        0         0
GigabitEthernet0/0/23   *down   down        0%      0%        0         0
GigabitEthernet0/0/24   *down   down        0%      0%        0         0
…output omitted…
```

Verify that only interface Gigabit Ethernet 0/0/2 is disabled on R1 and that only interface Gigabit Ethernet 0/0/1 is disabled on R3.

```
<R1>display ip interface brief
…output omitted…
GigabitEthernet0/0/1            10.0.12.1/24        up          up
GigabitEthernet0/0/2            10.0.23.1/24        *down       down
…output omitted…

<R3>display ip interface brief
…output omitted…
GigabitEthernet0/0/1            10.0.12.3/24        *down       down
GigabitEthernet0/0/2            10.0.23.3/24        up          up
…output omitted…
```

Step 4 **Enable the DHCP function.**

The DHCP service is not enabled by default, enable the DHCP service on the router(s).

```
[R1]dhcp enable

[R3]dhcp enable
```

Step 5 **Create a global IP address pool**

Create an address pool named **pool1** for R1 and **pool2** for R3. Configure attributes for **pool1** and **pool2**, including address range, egress gateway, and IP address lease period.

```
[R1]ip pool pool1
Info: It's successful to create an IP address pool.
[R1-ip-pool-pool1]network 10.0.12.0 mask 24
[R1-ip-pool-pool1]gateway-list 10.0.12.1
[R1-ip-pool-pool1]lease day 1 hour 12
[R1]interface GigabitEthernet 0/0/1
[R1-GigabitEthernet0/0/1]dhcp select global

[R3]ip pool pool2
Info: It's successful to create an IP address pool.
[R3-ip-pool-pool2]network 10.0.23.0 mask 24
[R3-ip-pool-pool2]gateway-list 10.0.23.3
[R3-ip-pool-pool2]lease day 1 hour 12
[R3]interface GigabitEthernet 0/0/2
[R3-GigabitEthernet0/0/2]dhcp select global
```

Run the **display ip pool name <name>** command on the router to view the assigned IP address pool configuration parameters.

```
<R1>display ip pool name pool1
  Pool-name      : pool1
  Pool-No        : 0
  Lease          : 1 Days 12 Hours 0 Minutes
  Domain-name    : -
  DNS-server0    : -
  NBNS-server0   : -
  Netbios-type   : -
  Position       : Local         Status         : Unlocked
  Gateway-0      : 10.0.12.1
  Mask           : 255.255.255.0
  VPN instance   : --

--------------------------------------------------------------------------      Start
            End      Total  Used  Idle(Expired)  Conflict  Disable
------------------------------------------------------------------------------
   10.0.12.1    10.0.12.254   253     0       253(0)         0         0
------------------------------------------------------------------------------
```

Configure the default management interface for S1 to request an IP address from the DHCP server (R1). Perform the same steps on S2 for R3.

```
[S1]dhcp enable
[S1]interface Vlanif 1
[S1-Vlanif1]ip address dhcp-alloc

<S1>display ip interface brief
…output omitted…
Interface                IP Address/Mask     Physical   Protocol
MEth0/0/1                  unassigned          down       down
NULL0                      unassigned          up         up(s)
Vlanif1                    10.0.12.254/24      up         up
```

Verify that this address was taken from the DHCP pool named pool1 on R1, and for S2, from the DHCP pool named pool2 on R3.

```
<R1>display ip pool name pool1
  Pool-name      : pool1
  Pool-No        : 0
  Lease          : 1 Days 12 Hours 0 Minutes
  Domain-name    : -
  DNS-server0    : -
  NBNS-server0   : -
  Netbios-type   : -
  Position       : Local          Status          : Unlocked
  Gateway-0      : 10.0.12.1
  Mask           : 255.255.255.0
  VPN instance   : --

--------------------------------------------------------------------------------
    Start           End     Total  Used  Idle(Expired)  Conflict  Disable
--------------------------------------------------------------------------------
   10.0.12.1    10.0.12.254   253    1       252(0)        0       0
--------------------------------------------------------------------------------


 <R3>display ip pool name pool2
  Pool-name      : pool2
  Pool-No        : 0
```

```
  Lease          : 1 Days 12 Hours 0 Minutes
  Domain-name    : -
  DNS-server0    : -
  NBNS-server0   : -
  Netbios-type   : -
  Position       : Local          Status          : Unlocked
  Gateway-0      : 10.0.23.3
  Mask           : 255.255.255.0
  VPN instance   : --
 --------------------------------------------------------------------------------
       Start         End      Total  Used  Idle(Expired)  Conflict  Disable
 --------------------------------------------------------------------------------
     10.0.23.1   10.0.23.254   253    1       252(0)          0        0
 --------------------------------------------------------------------------------
```

Ensure that global pool configuration has been completed for both R1 and R3 before continuing!

Step 6 **Create an interface based IP address pool**

Disable the interface Gigabit Ethernet 0/0/1 R1. For R3 disable interface Gigabit Ethernet 0/0/2.

```
[R1]interface GigabitEthernet 0/0/1
[R1-GigabitEthernet0/0/1]shutdown

[R3]interface GigabitEthernet 0/0/2
[R3-GigabitEthernet0/0/2]shutdown
```

Configure an interface address pool to allow the clients connected via Gigabit Ethernet 0/0/2 of R1 to obtain IP addresses. Perform the same operation for Gigabit Ethernet 0/0/1 of R3. Do not enable these interfaces, as we do not yet wish to activate the DHCP service on the network.

```
[R1]interface GigabitEthernet 0/0/2
[R1-GigabitEthernet0/0/2]dhcp select interface


[R3]interface GigabitEthernet 0/0/1
[R3-GigabitEthernet0/0/1]dhcp select interface
```

Isolate addresses from the pool GigabitEthernet0/0/2 for R1, and the pool GigabitEthernet0/0/1 for R3, for DNS services. Additionally, set the IP address lease

period for the interface address pool.

```
[R1-GigabitEthernet0/0/2]dhcp server dns-list 10.0.23.254
[R1-GigabitEthernet0/0/2]dhcp server excluded-ip-address 10.0.23.254
[R1-GigabitEthernet0/0/2]dhcp server lease day  1 hour 12

[R3-GigabitEthernet0/0/1]dhcp server dns-list 10.0.12.254
[R3-GigabitEthernet0/0/1]dhcp server excluded-ip-address 10.0.12.254
[R3-GigabitEthernet0/0/1]dhcp server lease day 1 hour 12
```

Run the **display ip pool interface** command on the router to view the configured parameters of the interface address pool. For R3 the interface is Gigabit Ethernet 0/0/1.

```
<R1>display ip pool interface GigabitEthernet0/0/2
  Pool-name      : GigabitEthernet0/0/2
  Pool-No        : 1
  Lease          : 1 Days 12 Hours 0 Minutes
  Domain-name    : -
  DNS-server0    : 10.0.23.254
  NBNS-server0   : -
  Netbios-type   : -
  Position       : Interface      Status          : Unlocked
  Gateway-0      : 10.0.23.1
  Mask           : 255.255.255.0
  VPN instance   : --
 --------------------------------------------------------------------------------
        Start         End      Total  Used  Idle(Expired)  Conflict  Disable
 --------------------------------------------------------------------------------
      10.0.23.1   10.0.23.254   253    0       252(0)        0         1
 --------------------------------------------------------------------------------
```

Flush the existing Vlanif1 address from S2 to allow for dynamic allocation of a new IP address from the interface GigabitEthernet0/0/2 pool.

```
[S2]interface Vlanif 1
[S2-Vlanif1]shutdown
[S2-Vlanif1]undo shutdown
```

Enable interface Gigabit Ethernet 0/0/2 to allow the DHCP server to become active

on the network and to begin sending DHCP discover messages.

```
[R1]interface GigabitEthernet0/0/2
[R1-GigabitEthernet0/0/2]undo shutdown

<R1>display ip pool interface GigabitEthernet0/0/2
  Pool-name      : GigabitEthernet0/0/2
  Pool-No        : 1
  Lease          : 1 Days 12 Hours 0 Minutes
  Domain-name    : -
  DNS-server0    : 10.0.23.254
  NBNS-server0   : -
  Netbios-type   : -
  Position       : Interface      Status          : Unlocked
  Gateway-0      : 10.0.23.1
  Mask           : 255.255.255.0
  VPN instance   : --
 ------------------------------------------------------------------------------
       Start          End     Total  Used  Idle(Expired)  Conflict  Disable
 ------------------------------------------------------------------------------
     10.0.23.1   10.0.23.254   253    1       251(0)         0         1
 ------------------------------------------------------------------------------
<S2>display ip interface brief
…output omitted…
Interface                   IP Address/Mask     Physical   Protocol
MEth0/0/1                    unassigned          down       down
NULL0                        unassigned          up         up(s)
Vlanif1                      10.0.23.253/24      up         up
```

The interface Vlanif1 shows to have been allocated an address from the GigabitEthernet0/0/2 address pool of R1.

Flush the existing Vlanif1 address from S1 to allow for dynamic allocation of a new IP address from the interface GigabitEther0/0/1 pool.

```
[S1]interface Vlanif 1
```

```
[S1-Vlanif1]shutdown
[S1-Vlanif1]undo shutdown
```

Enable interface Gigabit Ethernet 0/0/1 to allow the DHCP server to become active on the network and to begin sending DHCP discover messages.

```
[R3]interface GigabitEthernet 0/0/1
[R3-GigabitEthernet0/0/1]undo shutdown
```

Verify that the new IP address as been allocated from the interface pool.

```
<R3>display ip pool interface GigabitEthernet0/0/1
  Pool-name      : GigabitEthernet0/0/1
  Pool-No        : 1
  Lease          : 1 Days 12 Hours 0 Minutes
  Domain-name    : -
  DNS-server0    : 10.0.12.254
  NBNS-server0   : -
  Netbios-type   : -
  Position       : Interface      Status          : Unlocked
  Gateway-0      : 10.0.12.3
  Mask           : 255.255.255.0
  VPN instance   : --
 ------------------------------------------------------------------------------
       Start        End       Total  Used  Idle(Expired)  Conflict  Disable
 ------------------------------------------------------------------------------
     10.0.12.1   10.0.12.254   253    1       251(0)         0         1
 ------------------------------------------------------------------------------
<S1>display ip interface brief
…output omitted…
Interface                   IP Address/Mask     Physical   Protocol
MEth0/0/1                    unassigned          down       down
NULL0                        unassigned          up         up(s)
Vlanif1                      10.0.12.253/24      up         up
```

It should also be noted that a default static route pointing to the DHCP server is automatically generated by the switch, as seen in the final configuration below.

Final Configuration

```
[R1]display current-configuration
[V200R007C00SPC600]
#
 sysname R1
#
dhcp enable
#
ip pool pool1
 gateway-list 10.0.12.1
 network 10.0.12.0 mask 255.255.255.0
 lease day 1 hour 12 minute 0
#
interface GigabitEthernet0/0/1
 shutdown
 ip address 10.0.12.1 255.255.255.0
 dhcp select global
#
interface GigabitEthernet0/0/2
 ip address 10.0.23.1 255.255.255.0
 dhcp select interface
 dhcp server excluded-ip-address 10.0.23.254
 dhcp server lease day 1 hour 12 minute 0
 dhcp server dns-list 10.0.23.254
#
user-interface con 0
 authentication-mode password
 set authentication password cipher %$%$+L'YR&IZt'4,)>-*#lH",}%K-oJ_M9+'lOU~bD(\WTqB}%N,%$%
$user-interface vty 0 4
#
return

[R3]dis current-configuration
[V200R007C00SPC600]
#
 sysname R3
#
dhcp enable
#
ip pool pool2
```

```
 gateway-list 10.0.23.3
 network 10.0.23.0 mask 255.255.255.0
 lease day 1 hour 12 minute 0
#
interface GigabitEthernet0/0/1
 ip address 10.0.12.3 255.255.255.0
 dhcp select interface
 dhcp server excluded-ip-address 10.0.12.254
 dhcp server lease day 1 hour 12 minute 0
 dhcp server dns-list 10.0.12.254
#
interface GigabitEthernet0/0/2
 shutdown
 ip address 10.0.23.3 255.255.255.0
 dhcp select global
#
user-interface con 0
 authentication-mode password
 set authentication password cipher %$%$ksXDMg7Ry6yUU:63:DQ),#/sQg"@*S\U#.s.bHWxQ,y%#/v,%$%
$
user-interface vty 0 4
#
return

<S1>dis current-configuration
#
!Software Version V200R008C00SPC500
 sysname S1
#
 dhcp enable
#
interface Vlanif1
 ip address dhcp-alloc
#
 ip route-static 0.0.0.0 0.0.0.0 10.0.12.3
#
user-interface con 0
user-interface vty 0 4
#
return

<S2>display current-configuration
```

```
#
!Software Version V200R008C00SPC500
 sysname S2
#
 dhcp enable
#
interface Vlanif1
 ip address dhcp-alloc
#
 ip route-static 0.0.0.0 0.0.0.0 10.0.23.1
#
user-interface con 0
user-interface vty 0 4
#
return
```