2 Creating an Interconnected IP Network

2.1 Lab 1: IPv4 Addressing and Routing

2.1.1 Introduction

2.1.1.1 About This Lab

Internet Protocol version 4 (IPv4) is a core protocol of the TCP/IP protocol suite and works at the Internet layer in the TCP/IP model or the network layer in the Open System Interconnection (OSI) model. The network layer provides connectionless data transmission. Each IP datagram is transmitted independently, removing the need to establish a connection before IP datagrams are sent.

Routing is the basic element of data communication networks. It is the process of selecting paths on a network along which packets are sent from a source to a destination.

In this lab activity, you will configure IPv4 addresses and static IPv4 routes, and understand basic routing principles in the process.

2.1.1.2 Objectives

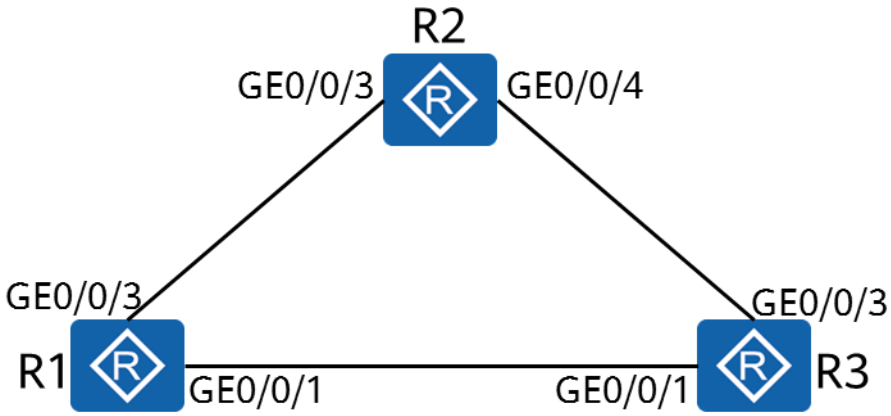
Upon completion of this task, you will be able to:

- Learn how to configure an IPv4 address on an interface
- Understand the functions and meanings of loopback interfaces
- Understand how direct routes are generated
- Learn how to configure static routes and understand the conditions for the static routes to take effect
- Learn how to test the connectivity of the network layer by using the ping tool
- Learn how to configure static routes and understand their application scenarios

2.1.1.3 Networking Topology

R1, R2, and R3 are gateways of their networks. You need to configure these gateways to connect these networks.

Figure 2-1 Lab topology for IPv4 addressing and routing



2.1.2 Lab Configuration

2.1.2.1 Configuration Roadmap

1. Configure IP addresses for the interfaces on the routers.
2. Configure static routes to interconnect the routers.

2.1.2.2 Configuration Procedure

Step 1 Complete basic device configuration.

Name the devices.

The details are not provided here.

Step 2 Display the IP address of the current interface and the routing table of the router.

Display the interface status on the router (R1 in this example).

```
[R1]display ip interface brief
*down: administratively down
^down: standby
(l): loopback
(s): spoofing
(E): E-Trunk down
The number of interface that is UP in Physical is 3
The number of interface that is DOWN in Physical is 5
The number of interface that is UP in Protocol is 1
The number of interface that is DOWN in Protocol is 10

Interface                   IP Address/Mask      Physical   Protocol
GigabitEthernet0/0/1        unassigned           up         down
GigabitEthernet0/0/2        unassigned           up         down
GigabitEthernet0/0/3        unassigned           up         down
```

The **display ip interface brief** command displays the brief information about interface IP addresses, including the IP addresses, subnet masks, physical status, link-layer protocol status, and number of interfaces in different states.

GigabitEthernet0/0/1 and GigabitEthernet0/0/3 on R1 are not configured with IP addresses. Therefore, the IP Address/Mask field is in the unassigned state, the Protocol field is in the down state, and the Physical field is in the up state.

Display the routing table on the router (R1 in this example).

```
[R1]display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
         Destinations : 4        Routes : 4

Destination/Mask    Proto   Pre  Cost      Flags NextHop         Interface

        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
```

InLoopBack0 is a default loopback interface.

InLoopBack0 uses the fixed loopback address 127.0.0.1/8 to receive data packets destined for the host where InLoopBack0 resides. The IP address of the InLoopBack0 interface cannot be changed or advertised using a routing protocol.

Step 3 Configure IP addresses for physical interfaces.

Configure IP addresses for physical interfaces based on the following table.

Table 2-1 IP addresses of physical interfaces

Router	Interface	IP Address/Mask
R1	GigabitEthernet0/0/1	10.0.13.1/24
	GigabitEthernet0/0/3	10.0.12.1/24
R2	GigabitEthernet0/0/3	10.0.12.2/24
	GigabitEthernet0/0/4	10.0.23.2/24
R3	GigabitEthernet0/0/1	10.0.13.3/24
	GigabitEthernet0/0/3	10.0.23.3/24

```
<R1>system-view
[R1]interface GigabitEthernet0/0/1
[R1-GigabitEthernet0/0/1]ip address 10.0.13.1 24
[R1-GigabitEthernet0/0/1]quit
[R1]interface GigabitEthernet0/0/3
[R1-GigabitEthernet0/0/3]ip address 10.0.12.1 24
[R1-GigabitEthernet0/0/3]quit
```

```
<R2>system-view
[R2]interface GigabitEthernet0/0/3
[R2-GigabitEthernet0/0/3]ip address 10.0.12.2 24
[R2-GigabitEthernet0/0/3]quit
[R2]interface GigabitEthernet0/0/4
[R2-GigabitEthernet0/0/4]ip address 10.0.23.2 24
[R2-GigabitEthernet0/0/4]quit
```

```
<R3>system-view
[R3]interface GigabitEthernet0/0/1
[R3-GigabitEthernet0/0/1]ip address 10.0.13.3 24
[R3-GigabitEthernet0/0/1]quit
[R3]interface GigabitEthernet0/0/3
[R3-GigabitEthernet0/0/3]ip address 10.0.23.3 24
[R3-GigabitEthernet0/0/3]quit
```

Use the ping tool to test the connectivity.

```
[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=70 ms
    Reply from 10.0.12.2: bytes=56 Sequence=2 ttl=255 time=50 ms
    Reply from 10.0.12.2: bytes=56 Sequence=3 ttl=255 time=40 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=50 ms

  --- 10.0.12.2 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 30/48/70 ms

[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=50 ms
    Reply from 10.0.13.3: bytes=56 Sequence=2 ttl=255 time=60 ms
    Reply from 10.0.13.3: bytes=56 Sequence=3 ttl=255 time=50 ms
    Reply from 10.0.13.3: bytes=56 Sequence=4 ttl=255 time=30 ms
    Reply from 10.0.13.3: bytes=56 Sequence=5 ttl=255 time=30 ms

  --- 10.0.13.3 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 30/44/60 ms
```

Display 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

        10.0.12.0/24  Direct  0    0           D   10.0.12.1       GigabitEthernet0/0/3
        10.0.12.1/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/3
      10.0.12.255/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/3
        10.0.13.0/24  Direct  0    0           D   10.0.13.1       GigabitEthernet0/0/1
        10.0.13.1/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/1
      10.0.13.255/32  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
```

The preceding command output shows that three direct routes are automatically generated for each interface after the IP addresses of the interfaces are configured, which are

1. A route to the network where the interface resides
2. The host route to the interface
3. The host route to the broadcast address of the network where the interface resides

NOTE

A host route is a route with a 32-bit mask.

Step 2 Create a loopback interface.

Configure the loopback interface according to the following table.

Table 1-1 IP addresses of loopback interfaces

Router	Interface	IP Address/Mask
R1	LoopBack0	10.0.1.1/32
R2	LoopBack0	10.0.1.2/32
R3	LoopBack0	10.0.1.3/32

Loopback interfaces are logical interfaces manually configured and do not exist physically. Logical interfaces can be used to exchange data. A loopback interface is always Up at the physical layer and link layer unless it is manually shut down. Generally, a loopback interface uses a 32-bit mask. Loopback interfaces are used for the following purposes:

1. Used as the address for identifying and managing the router
2. Used as the router ID in OSPF
3. Used for improving network reliability

In this lab activity, the loopback interfaces are used to simulate clients.

```
[R1]interface LoopBack0
[R1-LoopBack0]ip address 10.0.1.1 32
[R2]interface LoopBack0
[R2-LoopBack0]ip address 10.0.1.2 32
[R3]interface LoopBack0
[R3-LoopBack0]ip address 10.0.1.3 32
```

Display the routing table on the router (R1 in this example).

```
 [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

      10.0.1.1/32   Direct  0    0           D   127.0.0.1       LoopBack0
     10.0.12.0/24   Direct  0    0           D   10.0.12.1       GigabitEthernet0/0/3
     10.0.12.1/32   Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/3
   10.0.12.255/32   Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/3
     10.0.13.0/24   Direct  0    0           D   10.0.13.1       GigabitEthernet0/0/1
     10.0.13.1/32   Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/1
   10.0.13.255/32   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
```

Direct routes have been generated.

Test the connectivity between the loopback interfaces.

```
[R1]ping -a 10.0.1.1 10.0.1.2
  PING 10.0.1.2: 56  data bytes, press CTRL_C to break
    Request time out
    Request time out
    Request time out
    Request time out
    Request time out

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

Using the **ping –a** *source-ip-address destination-ip-address* command to specify the source and destination IP addresses of ping packets. At this point, the router does not have a route to the destination IP address. Therefore, the ping operation fails.

Step 2 Configure static routes.

On R1, configure a route to the loopback0 interfaces of R2 and R3.

```
[R1]ip route-static 10.0.1.2 32 10.0.12.2
[R1]ip route-static 10.0.1.3 32 10.0.13.3
```

Display the routing table of R1.

```
[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

        10.0.1.1/32  Direct  0    0           D   127.0.0.1       LoopBack0
        10.0.1.2/32  Static  60   0           RD  10.0.12.2       GigabitEthernet0/0/3
        10.0.1.3/32  Static  60   0           RD  10.0.13.3       GigabitEthernet0/0/1
       10.0.12.0/24  Direct  0    0           D   10.0.12.1       GigabitEthernet0/0/3
       10.0.12.1/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/3
  10.0.12.255/32             Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/3
       10.0.13.0/24  Direct  0    0           D   10.0.13.1       GigabitEthernet0/0/1
       10.0.13.1/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/1
  10.0.13.255/32             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
```

The configured static routes are added to the IP routing table.

Test connectivity.

```
[R1]ping -a 10.0.1.1 10.0.1.2
  PING 10.0.1.2: 56  data bytes, press CTRL_C to break
    Request time out
    Request time out
    Request time out
    Request time out
    Request time out

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

The loopback0 interface of R2 still cannot be pinged because R2 does not have a route to the loopback0 interface of R1.

On R2, add a route to LoopBack0 of R1.

```
[R2]ip route-static 10.0.1.1 32 10.0.12.1
```

Test connectivity.

```
<R1>ping -a 10.0.1.1 10.0.1.2
  PING 10.0.1.2: 56  data bytes, press CTRL_C to break
    Reply from 10.0.1.2: bytes=56 Sequence=1 ttl=255 time=60 ms
    Reply from 10.0.1.2: bytes=56 Sequence=2 ttl=255 time=30 ms
    Reply from 10.0.1.2: bytes=56 Sequence=3 ttl=255 time=10 ms
    Reply from 10.0.1.2: bytes=56 Sequence=4 ttl=255 time=50 ms
    Reply from 10.0.1.2: bytes=56 Sequence=5 ttl=255 time=30 ms

  --- 10.0.1.2 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
round-trip min/avg/max = 10/36/60 ms
```

Loopback0 on R1 can communicate with loopback0 on R2.

Configure other necessary routes.

```
[R2]ip route-static 10.0.1.3 32 10.0.23.3
```

```
[R3]ip route-static 10.0.1.1 32 10.0.13.1
[R3]ip route-static 10.0.1.2 32 10.0.23.2
```

Test the connectivity between the loopback0 interfaces of the routers by referring to the proceeding description.

Step 3 Configure a path from R1 to R2 via R3 as the backup path from LoopBack0 of R1 to LoopBack0 of R2.

Configure static routes on R1 and R2.

```
[R1]ip route-static 10.0.1.2 32 10.0.13.3 preference 100
[R2]ip route-static 10.0.1.1 32 10.0.23.3 preference 100
```

Display the routing tables of R1 and R2.

```
[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

        10.0.1.1/32  Direct  0    0           D   127.0.0.1       LoopBack0
        10.0.1.2/32  Static  60   0          RD   10.0.12.2       GigabitEthernet0/0/3
        10.0.1.3/32  Static  60   0          RD   10.0.13.3       GigabitEthernet0/0/1
       10.0.12.0/24  Direct  0    0           D   10.0.12.1       GigabitEthernet0/0/3
       10.0.12.1/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/3
     10.0.12.255/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/3
       10.0.13.0/24  Direct  0    0           D   10.0.13.1       GigabitEthernet0/0/1
       10.0.13.1/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/1
     10.0.13.255/32  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
```

```
[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  Static  60   0          RD   10.0.12.1       GigabitEthernet0/0/3
        10.0.1.2/32  Direct  0    0           D   127.0.0.1       LoopBack0
        10.0.1.3/32  Static  60   0          RD   10.0.23.3       GigabitEthernet0/0/4
       10.0.12.0/24  Direct  0    0           D   10.0.12.2       GigabitEthernet0/0/3
       10.0.12.2/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/3
     10.0.12.255/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/3
       10.0.23.0/24  Direct  0    0           D   10.0.23.2       GigabitEthernet0/0/4
       10.0.23.2/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/4
     10.0.23.255/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/4
        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 static route with a preference value of 100 is not added to the routing table.

Shut down GigabitEthernet0/0/3 interface on R1 and R2 to invalidate the route with the highest priority.

```
[R1]interface GigabitEthernet0/0/3
[R1-GigabitEthernet0/0/3]shutdown
```

Display the routing table on R1 and R2. The command output shows that the routes with a lower priority are activated when the routes with a higher priority are invalidated.

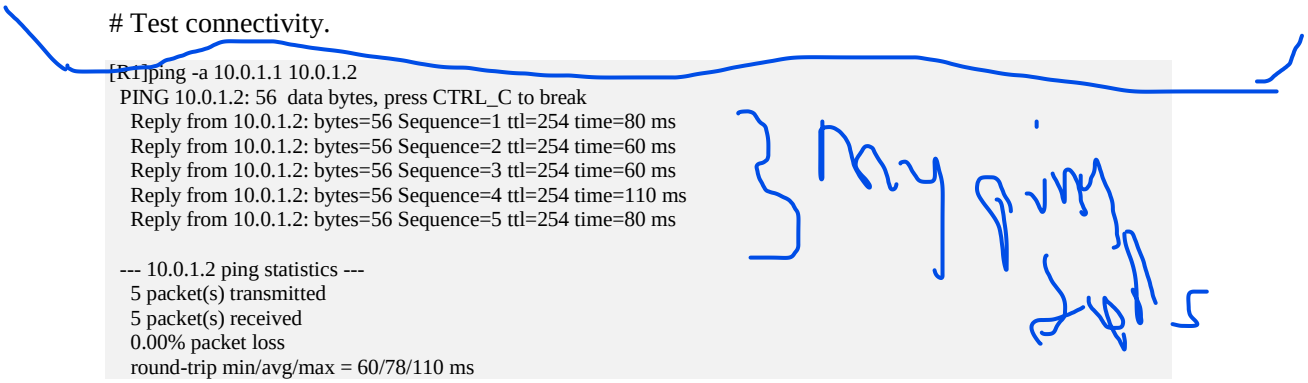
```
[R1]display IP routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
         Destinations : 10        Routes : 10

Destination/Mask    Proto   Pre  Cost      Flags NextHop         Interface

        10.0.1.1/32  Direct  0    0           D   127.0.0.1       LoopBack0
        10.0.1.2/32  Static  100  0           RD  10.0.13.3       GigabitEthernet0/0/1
        10.0.1.3/32  Static  60   0           RD  10.0.13.3       GigabitEthernet0/0/1
       10.0.13.0/24  Direct  0    0           D   10.0.13.1       GigabitEthernet0/0/1
       10.0.13.1/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/1
     10.0.13.255/32  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
```

```
[R2]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

        10.0.1.1/32  Static  100  0           RD  10.0.23.3       GigabitEthernet0/0/4
        10.0.1.2/32  Direct  0    0           D   127.0.0.1       LoopBack0
        10.0.1.3/32  Static  60   0           RD  10.0.23.3       GigabitEthernet0/0/4
       10.0.23.0/24  Direct  0    0           D   10.0.23.2       GigabitEthernet0/0/4
       10.0.23.2/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/4
     10.0.23.255/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/4
        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
```

In this case, the original static route becomes invalid and the static route with a lower priority is activated.

Test connectivity.

```
[R1]ping -a 10.0.1.1 10.0.1.2
  PING 10.0.1.2: 56  data bytes, press CTRL_C to break
    Reply from 10.0.1.2: bytes=56 Sequence=1 ttl=254 time=80 ms
    Reply from 10.0.1.2: bytes=56 Sequence=2 ttl=254 time=60 ms
    Reply from 10.0.1.2: bytes=56 Sequence=3 ttl=254 time=60 ms
    Reply from 10.0.1.2: bytes=56 Sequence=4 ttl=254 time=110 ms
    Reply from 10.0.1.2: bytes=56 Sequence=5 ttl=254 time=80 ms

  --- 10.0.1.2 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 60/78/110 ms
```



Trace the path of the data packets.

```
[R1]tracert -a 10.0.1.1 10.0.1.2
```

```
traceroute to  10.0.1.2(10.0.1.2), max hops: 30 ,packet length: 40,press CTRL_C to break

1 10.0.13.3 40 ms  30 ms  50 ms

2 10.0.23.2 80 ms  80 ms  60 ms
```

The **tracert** command displays the path of packets from the source to the destination.

The command output shows that the data packets pass through GigabitEthernet0/0/1 and GigabitEthernet0/0/3 of R3 and are then forwarded to GigabitEthernet0/0/4 of R2.

NOTE

In some lab environments, the devices may not respond to ICMP packets for security reasons. Therefore, the results may vary. You can press Ctrl+C to end the tracert operation.

Step 4 Configure default routes to connect the LoopBack0 interface of R1 and the LoopBack0 interface of R2.

Restore the interfaces and delete the configured routes.

```
[R1]interface GigabitEthernet0/0/3
[R1-GigabitEthernet0/0/3]undo shutdown
[R1-GigabitEthernet0/0/3]quit
[R1]undo ip route-static 10.0.1.2 255.255.255.255 10.0.12.2
[R1]undo ip route-static 10.0.1.2 255.255.255.255 10.0.13.3 preference 100
```

Display the routing table of R1.

```
[R1]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

        10.0.1.1/32  Direct  0    0           D   127.0.0.1       LoopBack0
        10.0.1.3/32  Static  60   0           RD  10.0.13.3       GigabitEthernet0/0/1
       10.0.12.0/24  Direct  0    0           D   10.0.12.1       GigabitEthernet0/0/3
       10.0.12.1/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/3
     10.0.12.255/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/3
       10.0.13.0/24  Direct  0    0           D   10.0.13.1       GigabitEthernet0/0/1
       10.0.13.1/32  Direct  0    0           D   127.0.0.1       GigabitEthernet0/0/1
     10.0.13.255/32  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
```

R1 does not have a route to LoopBack0 (10.1.1.2/32) of R2.

Configure a default route on R1.

```
[R1]ip route-static 0.0.0.0 0 10.0.12.2
```

Display the routing table of R1.

```
[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

      0.0.0.0/0     Static  60   0           RD  10.0.12.2       GigabitEthernet0/0/3
        10.0.1.1/32 Direct  0    0           D   127.0.0.1       LoopBack0
        10.0.1.3/32 Static  60   0           RD  10.0.13.3       GigabitEthernet0/0/1
       10.0.12.0/24 Direct  0    0           D   10.0.12.1       GigabitEthernet0/0/3
```

```
     10.0.12.1/32   Direct  0    0          D   127.0.0.1       GigabitEthernet0/0/3
    10.0.12.255/32             Direct  0    0          D   127.0.0.1       GigabitEthernet0/0/3
     10.0.13.0/24   Direct  0    0          D   10.0.13.1       GigabitEthernet0/0/1
     10.0.13.1/32   Direct  0    0          D   127.0.0.1       GigabitEthernet0/0/1
    10.0.13.255/32             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
```

The default route has been activated.

Test the connectivity between LoopBack0 of R1 and LoopBack0 of R2.

```
[R1]ping -a 10.0.1.1 10.0.1.2
  PING 10.0.1.2: 56  data bytes, press CTRL_C to break
    Reply from 10.0.1.2: bytes=56 Sequence=1 ttl=255 time=50 ms
    Reply from 10.0.1.2: bytes=56 Sequence=2 ttl=255 time=30 ms
    Reply from 10.0.1.2: bytes=56 Sequence=3 ttl=255 time=20 ms
    Reply from 10.0.1.2: bytes=56 Sequence=4 ttl=255 time=40 ms
    Reply from 10.0.1.2: bytes=56 Sequence=5 ttl=255 time=20 ms

  --- 10.0.1.2 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 20/32/50 ms
```

LoopBack0 of R1 can communicate with LoopBack0 of R2.

----End

1.1.2 Verification

You can run the ping and tracert commands to test the connectivity between loopback0 interfaces on different devices.

1.1.3 Configuration Reference

Configuration on R1

```
#
 sysname R1
#
interface GigabitEthernet0/0/1
 ip address 10.0.13.1 255.255.255.0
#
interface GigabitEthernet0/0/3
 ip address 10.0.12.1 255.255.255.0
#
interface LoopBack0
 ip address 10.0.1.1 255.255.255.255
#
ip route-static 0.0.0.0 0.0.0.0 10.0.12.2
ip route-static 10.0.1.3 255.255.255.255 10.0.13.3
#
return
```

Configuration on R2

```
#
 sysname R2
#
interface GigabitEthernet0/0/3
 ip address 10.0.12.2 255.255.255.0
#
interface GigabitEthernet0/0/4
 ip address 10.0.23.2 255.255.255.0
#
interface LoopBack0
```

```
 ip address 10.0.1.2 255.255.255.255
#
ip route-static 10.0.1.1 255.255.255.255 10.0.12.1
ip route-static 10.0.1.1 255.255.255.255 10.0.23.3 preference 100
ip route-static 10.0.1.3 255.255.255.255 10.0.23.3
#
return
```

Configuration on R3

```
#
 sysname R3
#
interface GigabitEthernet0/0/1
 ip address 10.0.13.3 255.255.255.0
#
interface GigabitEthernet00/3
 ip address 10.0.23.3 255.255.255.0
#
interface LoopBack0
 ip address 10.0.1.3 255.255.255.255
#
ip route-static 10.0.1.1 255.255.255.255 10.0.13.1
ip route-static 10.0.1.2 255.255.255.255 10.0.23.2
#
return
```

1.1.4 Quiz

1. In what situations will the configured static route be added to the IP routing table? Can a route be added to the IP routing table if the configured next hop is unreachable?
2. In step 3, if the **-a** argument is not specified during the connectivity test between loopback interfaces, what is the source IP address of ICMP packets? Why?