配置静态路由组建小型网络

难度（最高五星）：★★★　　　　建议学时：2学时

目录

实验说明

任务描述

静态路由是指由管理员手动配置和维护的路由。静态路由配置简单，被广泛应用于网络中。另外，静态路由还可以实现负载均衡和路由备份。因此，学习并掌握好静态路由的应用与配置是非常必要的。

完成本任务后，学生会对静态路由有一个清晰的了解，可以独立使用静态路由组建和配置一个小型网络。

学习目标

完成本任务的学习后，你应当能：

1. 掌握静态路由的配置方法
2. 掌握测试静态路由连通性的方法
3. 掌握通过配置缺省路由实现本地网络与外部网络间的访问
4. 掌握静态备份路由的配置方法

任务准备

网络拓扑

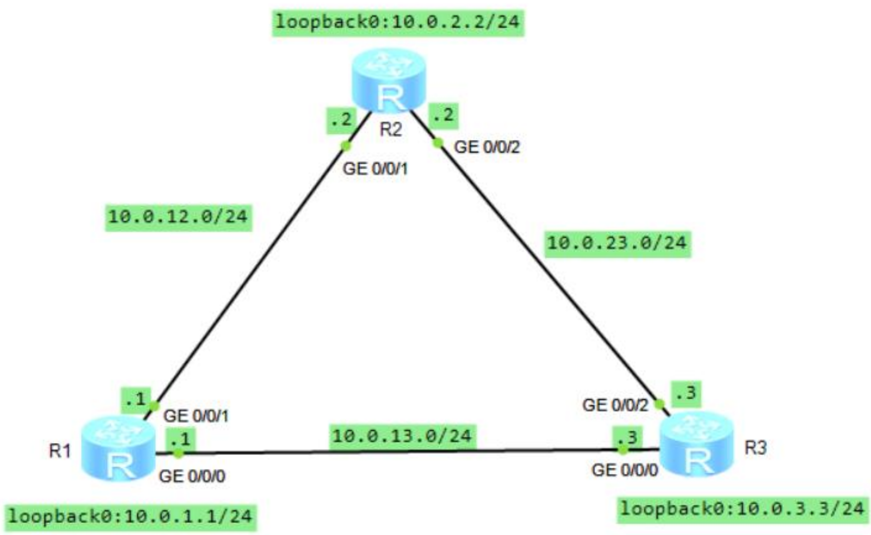

图1 使用静态路由组建小型网络实验拓扑

初始配置

- R1的初始配置

```
<Huawei>system-view
```

```
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname R1
[R1]int LoopBack 0
[R1-LoopBack0]ip address 10.0.1.1 24
[R1-LoopBack0]quit
[R1]int g0/0/0
[R1-GigabitEthernet0/0/0]ip address 10.0.13.1 24
[R1-GigabitEthernet0/0/0]quit
[R1]int g0/0/1
[R1-GigabitEthernet0/0/1]ip address 10.0.12.1 24
[R1-GigabitEthernet0/0/1]quit
[R1]
```

- R2的初始配置

```
<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname R2
[R2]int LoopBack 0
[R2-LoopBack0]ip address 10.0.2.2 24
[R2-LoopBack0]quit
[R2]int g0/0/1
[R2-GigabitEthernet0/0/1]ip address 10.0.12.2 24
[R2-GigabitEthernet0/0/1]quit
[R2]int g0/0/2
[R2-GigabitEthernet0/0/2]ip address 10.0.23.2 24
[R2-GigabitEthernet0/0/2]quit
[R2]
```

- R3的初始配置

```
<Huawei>system-view
Enter system view, return user view with Ctrl+Z.
[Huawei]sysname R3
[R3]int LoopBack 0
[R3-LoopBack0]ip address 10.0.3.3 24
[R3-LoopBack0]int g0/0/0
[R3-GigabitEthernet0/0/0]ip address 10.0.13.3 24
[R3-GigabitEthernet0/0/0]quit
[R3]int g0/0/2
```

```
[R3-GigabitEthernet0/0/2]ip address 10.0.23.3 24
[R3-GigabitEthernet0/0/2]
[R3-GigabitEthernet0/0/2]quit
[R3]
```

任务实施

1 查看基础配置

在R1、R2和R3上执行display ip interface brief命令，检查配置情况。

```
<R1>display ip interface brief
*down: administratively down
^down: standby
(l): loopback
(s): spoofing
The number of interface that is UP in Physical is 4
The number of interface that is DOWN in Physical is 1
The number of interface that is UP in Protocol is 4
The number of interface that is DOWN in Protocol is 1

Interface                         IP Address/Mask      Physical   Protocol
GigabitEthernet0/0/0              10.0.13.1/24         up         up
GigabitEthernet0/0/1              10.0.12.1/24         up         up
GigabitEthernet0/0/2              unassigned           down       down
LoopBack0                         10.0.1.1/24          up         up(s)
NULL0                             unassigned           up         up(s)
<R1>

<R2>display ip int brief
*down: administratively down
^down: standby
(l): loopback
(s): spoofing
The number of interface that is UP in Physical is 4
The number of interface that is DOWN in Physical is 1
The number of interface that is UP in Protocol is 4
The number of interface that is DOWN in Protocol is 1

Interface                         IP Address/Mask      Physical   Protocol
```

```
GigabitEthernet0/0/0              unassigned          down         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)
NULL0                             unassigned          up           up(s)
<R2>

<R3>display ip int brief
*down: administratively down
^down: standby
(l): loopback
(s): spoofing
The number of interface that is UP in Physical is 4
The number of interface that is DOWN in Physical is 1
The number of interface that is UP in Protocol is 4
The number of interface that is DOWN in Protocol is 1

Interface                         IP Address/Mask     Physical     Protocol
GigabitEthernet0/0/0              10.0.13.3/24        up           up
GigabitEthernet0/0/1              unassigned          down         down
GigabitEthernet0/0/2              10.0.23.3/24        up           up
LoopBack0                         10.0.3.3/24         up           up(s)
NULL0                             unassigned          up           up(s)
<R3>
```

执行ping命令，检测R1与其它设备间的连通性。

```
<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=40 ms
    Reply from 10.0.12.2: bytes=56 Sequence=2 ttl=255 time=20 ms
    Reply from 10.0.12.2: bytes=56 Sequence=3 ttl=255 time=10 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=20 ms

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

```
    round-trip min/avg/max = 10/20/40 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=40 ms
    Reply from 10.0.13.3: bytes=56 Sequence=2 ttl=255 time=30 ms
    Reply from 10.0.13.3: bytes=56 Sequence=3 ttl=255 time=30 ms
    Reply from 10.0.13.3: bytes=56 Sequence=4 ttl=255 time=20 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 = 20/30/40 ms
<R1>
```

执行ping命令，检测R2与其它设备间的连通性。

```
<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=20 ms
    Reply from 10.0.23.3: bytes=56 Sequence=2 ttl=255 time=30 ms
    Reply from 10.0.23.3: bytes=56 Sequence=3 ttl=255 time=20 ms
    Reply from 10.0.23.3: bytes=56 Sequence=4 ttl=255 time=30 ms
    Reply from 10.0.23.3: bytes=56 Sequence=5 ttl=255 time=10 ms

  --- 10.0.23.3 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 10/22/30 ms

<R2>
```

2 测试 R2 到目的网络 10.0.13.0/24、10.0.3.0/24 的连通性

```
<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

<R2>
```

R2如果要与10.0.3.0/24网络通信，需要R2上有去往该网段的路由信息，并且R3上也需要有到R2相应接口所在IP网段的路由信息。上述检测结果表明，R2不能与10.0.3.3和10.0.13.3网络通信。

执行display ip routing-table命令，查看R2上的路由表。可以发现路由表中没有到这两个网段的路由信息。

```
<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             D   10.0.12.2       GigabitEthernet 0/0/1
      10.0.12.2/32  Direct  0    0        D   127.0.0.1       GigabitEthernet 0/0/1
    10.0.12.255/32  Direct  0    0        D   127.0.0.1       GigabitEthernet 0/0/1
      10.0.23.0/24  Direct  0    0        D   10.0.23.2       GigabitEthernet 0/0/2
      10.0.23.2/32  Direct  0    0        D   127.0.0.1       GigabitEthernet 0/0/2
    10.0.23.255/32  Direct  0    0        D   127.0.0.1       GigabitEthernet 0/0/2
      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
<R2>
```

3 在 R2 上配置静态路由

配置目的地址为10.0.13.0/24和10.0.3.0/24的静态路由，路由的下一跳配置为R3的G0/0/0接口IP地址10.0.23.3。默认静态路由优先级为60，无需额外配置路由优先级信息。

```
[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
```

注意：在ip route-static命令中，24代表子网掩码长度，也可以写成完整的掩码形式如255.255.255.0。

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

```
      10.0.23.2/32  Direct  0    0          D   127.0.0.1      GigabitEthernet 0/0/2
     10.0.23.255/32 Direct  0    0          D   127.0.0.1      GigabitEthernet 0/0/2
      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

[R2]
```

4 配置备份静态路由

R2与网络10.0.13.3和10.0.3.3之间交互的数据通过R2与R3间的链路传输。如果R2和R3间的链路发生故障，R2将不能与网络10.0.13.3和10.0.3.3通信。

但是根据拓扑图可以看出，当R2和R3间的链路发生故障时，R2还可以通过R1与R3通信。所以可以通过配置一条备份静态路由实现路由的冗余备份。正常情况下，备份静态路由不生效。当R2和R3间的链路发生故障时，才使用备份静态路由传输数据。

配置备份静态路由时，需要修改备份静态路由的优先级，确保只有主链路故障时才使用备份路由。本任务中，需要将备份静态路由的优先级修改为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
```

5 验证静态路由

在R2的路由表中，查看当前的静态路由配置。

```
[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      GigabitEthernet 0/0/2
```

```
      10.0.12.0/24  Direct  0    0           D   10.0.12.2     GigabitEthernet 0/0/1
      10.0.12.2/32  Direct  0    0           D   127.0.0.1     GigabitEthernet 0/0/1
    10.0.12.255/32  Direct  0    0           D   127.0.0.1     GigabitEthernet 0/0/1
      10.0.13.0/24  Static  60   0          RD   10.0.23.3     GigabitEthernet 0/0/2
      10.0.23.0/24  Direct  0    0           D   10.0.23.2     GigabitEthernet 0/0/2
      10.0.23.2/32  Direct  0    0           D   127.0.0.1     GigabitEthernet 0/0/2
    10.0.23.255/32  Direct  0    0           D   127.0.0.1     GigabitEthernet 0/0/2
       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

[R2]
```

路由表中包含两条静态路由。其中，Protocol字段的值是Static，表明该路由是静态路由。Preference字段的值是60，表明该路由使用的是默认优先级。

当R2和R3之间链路正常时，R2与网络10.0.13.3和10.0.3.3之间交互的数据通过R2与R3间的链路传输。执行tracert命令，可以查看数据的传输路径。

```
<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
<R2>
```

命令的回显信息证实R2将数据直接发送给R3，未经过其他设备。

6 验证备份静态路由

关闭R2上的G0/0/2接口，模拟R2与R3间的链路发生故障，然后查看IP路由表的变化。

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

注意与关闭接口之前的路由表情况作对比。

```
[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          RD   10.0.12.1   GigabitEthernet 0/0/1
      10.0.12.0/24  Direct  0    0           D   10.0.12.2       GigabitEthernet 0/0/1
      10.0.12.2/32  Direct  0    0           D   127.0.0.1       GigabitEthernet 0/0/1
    10.0.12.255/32  Direct  0    0           D   127.0.0.1       GigabitEthernet 0/0/1
      10.0.13.0/24  Static  80   0          RD   10.0.12.1   GigabitEthernet 0/0/1
      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]
```

在R2的路由表中，灰色所标记出的两条路由的下一跳和优先级均已发生变化。检测R2到目的地址10.0.13.3以及R3上的10.0.3.3的连通性。

```
<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
<R2>
```

网络并未因为R2与R3之间的链路被关闭而中断。执行tracert命令，查看数据包的转发路径。

```
<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>
<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
<R2>
```

命令的回显信息表明，R2发送的数据经过R1抵达R3设备。

7 配置缺省路由实现网络的互通

打开R2上在步骤6中关闭的接口。

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

验证从R1到10.0.23.3网络的连通性。

```
[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
```

因为R1上没有去往10.0.23.0网段的路由信息，所以报文无法到达R3。

```
<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    GigabitEthernet 0/0/0
      10.0.12.0/24  Direct  0    0           D   10.0.12.1    GigabitEthernet 0/0/1
      10.0.12.1/32  Direct  0    0           D   127.0.0.1    GigabitEthernet 0/0/1
    10.0.12.255/32  Direct  0    0           D   127.0.0.1    GigabitEthernet 0/0/1
      10.0.13.0/24  Direct  0    0           D   10.0.13.1    GigabitEthernet 0/0/0
      10.0.13.1/32  Direct  0    0           D   127.0.0.1    GigabitEthernet 0/0/0
    10.0.13.255/32  Direct  0    0           D   127.0.0.1    GigabitEthernet 0/0/0
      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

<R1>
```

可以在R1上配置一条下一跳为10.0.13.3的缺省路由来实现网络的连通。

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

配置完成后，检测R1和10.0.23.3网络间的连通性。

```
<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
```

R1通过缺省路由实现了与网段10.0.23.0间的通信。

8 配置备份缺省路由

当R1与R3间的链路发生故障时，R1可以使用备份缺省路由通过R2实现与10.0.23.3和10.0.3.3网络间通信。 配置两条备份路由，确保数据来回的双向都有路由。

```
[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
```

9 验证备份缺省路由

查看链路正常时R1上的路由条目。

```
[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     GigabitEthernet 0/0/0
      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      GigabitEthernet 0/0/0
     10.0.12.0/24   Direct  0    0           D   10.0.12.1      GigabitEthernet 0/0/1
     10.0.12.1/32   Direct  0    0           D   127.0.0.1      GigabitEthernet 0/0/1
   10.0.12.255/32   Direct  0    0           D   127.0.0.1      GigabitEthernet 0/0/1
```

```
      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     GigabitEthernet 0/0/0
    10.0.13.255/32  Direct  0    0           D   127.0.0.1     GigabitEthernet 0/0/0
       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

[R1]
```

关闭R1与R3上的G0/0/0接口模拟链路故障，然后查看R1的路由表。比较关闭接口前后的路由表变化情况。

```
[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     GigabitEthernet 0/0/1
      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     GigabitEthernet 0/0/1
     10.0.12.1/32   Direct  0    0           D   127.0.0.1     GigabitEthernet 0/0/1
   10.0.12.255/32   Direct  0    0           D   127.0.0.1     GigabitEthernet 0/0/1
      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]
```

上述路由表中，缺省路由0.0.0.0的Preference值为80，表明备用的缺省路由已生效。

```
<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>
```

网络并未因为R1与R3之间的链路被关闭而中断。执行tracert命令，查看数据包的转发路径。

```
<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
```

结果显示报文通过R2（10.0.12.2）到达R3（10.0.23.3）。

结果验证

实验过程中已验证。