实验 11 配置 RIPv1 和 RIPv2

一、实验目标

- 理解 RIP 的路由协议的防环机制
- 掌握 RIPv1 的配置方法
- 掌握在特定网络和接口上启用 RIP 的方法
- 掌握 display 和 debugging 命令测试 RIP 的方法
- 掌握测试 RIP 路由网络连通性的方法
- 掌握 RIPv2 的配置方法

二、实验场景

您是公司的网络管理员。您所管理的小型网络中包含三台路由器，并贬划了五个网络。您需要在网络中配置 RIP 路由协议来实现路由信息的相互传输。最初使用的是 RIPv1，后来发现 RIPv2 更有优势，于是决定优化网络，使用 RIPv2。

三、实验拓扑图

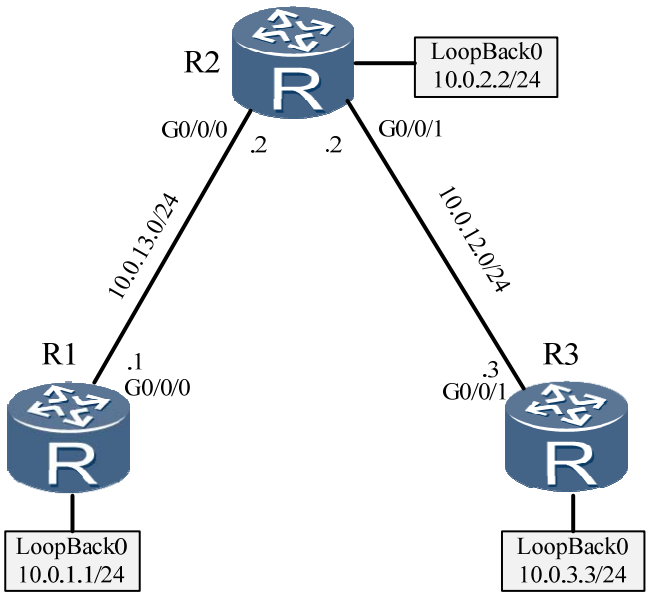

图11.1 配置RIPv1和RIPv2实验拓扑图

四、实验步骤

任务一 实验环境准备

如果本任务中您使用的是空配置设备，需要从任务一开始配置，然后跳过任务二。如果使用的设备包含上一个实验的配置，请直接从任务二开始配置。

步骤 1 配置 R1 端口及 IP 地址

```
<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
```

步骤 2 配置 R2 端口及 IP 地址

```
<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
```

步骤 3 配置 R3 端口及 IP 地址

```
<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
```

任务二 清除设备上原有的配置

清除上一个实验中的静态路由配置并关闭无关的接口。

步骤 1 清除 R1 原有配置

```
[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
```

步骤 2 清除 R2 原有配置

```
[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
```

步骤 3 清除 R3 原有配置

```
[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
```

任务三 配置 IP 地址

步骤 1 为 R2 和 R3 配置如下 IP 地址。

```
[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
```

步骤 2 测试 R1 与 R2 间的连通性。

```
<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
```

步骤 3 测试 R2 与 R3 间的连通性。

```
<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
```

任务四 配置 RIPv1 协议

步骤 1 在 R1 上启动 RIP 协议，并将 10.0.0.0 网段发布到 RIP 协议中。

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

步骤 2 在 R2 上启动 RIP 协议，并将 10.0.0.0 网段发布到 RIP 协议中。

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

步骤 3 在 R3 上启动 RIP 协议，并将 10.0.0.0 网段发布到 RIP 协议中。

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

任务五 验证 RIPv1 路由

步骤 1 查看 R1、R2 和 R3 的路由表。确保路由器已经学习到了如下显示信息中灰色阴影标注的 RIP 路由。

```
<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
```

步骤 2 检测 R1 到 IP 地址 10.0.12.3 的连通性。R1 和 R3 能够互通。

```
[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

步骤 3 执行 debugging 命令，查看 RIPv1 协议的定期更新情况。

执行 debugging 命令开启 RIP 调测功能。注意只能在用户视图下执行 debugging 命令。执行 display debugging 命令，查看当前的调测信息。执行 terminal debugging 命令，开启 debug 信息在终端屏幕上显示的功能。

路由器间的 RIP 交互信息显示如下：

```
<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> Nov 29 2013 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> Nov 29 2013 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> Nov 29 2013 09:45:07.860.3+00:00 R1 RIP/7/DBG: 6: 12796: Packet: Version 1, Cmd response, Length 64
<R1> Nov 29 2013 09:45:07.860.4+00:00 R1 RIP/7/DBG: 6: 12845: Dest 10.0.2.0, Cost 1
<R1> Nov 29 2013 09:45:07.860.5+00:00 R1 RIP/7/DBG: 6: 12845: Dest 10.0.3.0, Cost 2
<R1> Nov 29 2013 09:45:07.860.6+00:00 R1 RIP/7/DBG: 6: 12845: Dest 10.0.12.0, Cost 1
<R1>
Nov 29 2013 09:45:09.370.1+00:00 R1 RIP/7/DBG: 25: 5071: RIP 1: Periodic timer expired for interface GigabitEthernet0/0/1
```

步骤 4 执行 undo debugging rip <process-id> or undo debugging all 命令，关闭调测功能。

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

也可以使用带更多参数的命令查看某类型的调试信息，如 **debug rip 1 event** 查看路由器发出和收到的定期更新事件。其它参数可以使用“？”获取帮助。

```
<R1>debugging rip 1 event
<R1>
Nov 29 2013 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>
Nov 29 2013 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
```

警告：开启过多的调测功能将消耗路由器的大量资源，甚至可能导致宕机。因而，请慎重使用开启批量 debug 功能的命令，如 debug all。

任务六 配置 RIPv2 协议

基于前面的配置，只需在 RIP 子视图模式下配置 version 2 即可。

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

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

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

任务七 验证 RIPv2 路由

步骤 1 查看 R1、R2 和 R3 上的路由表。

执行 display ip routing-table 命令，查看 R1、R2 和 R3 上的路由表。注意比较灰色标注部分路由条目与之前 RIPv1 路由条目的不同之处。

```
<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
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
```

步骤 2 检测 R1 到 R3 的 G0/0/2 接口（IP 地址为 10.0.12.3）的连通性。

```
<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
```