

实验 RIPv2 配置

【实验名称】

RIPv2 配置。

【实验目的】

理解 RIP 两个版本之间的区别，掌握如何配置 RIPv2。

【背景描述】

假设在校园网在地理上分为 2 个区域，每个区域内分别有一台路由器连接了 2 个子网，需要将两台路由器通过以太网链路连接在一起并进行适当的配置，以实现这 4 个子网之间的互联互通。为了在未来每个校园区域扩充子网数量的时候，管理员不需要同时更改路由器的配置，计划使用 RIP 路由协议实现子网之间的互通。

【需求分析】

两台路由器通过快速以太网端口连接在一起，每个路由器上设置 2 个 Loopback 端口模拟子网，在所有端口运行 RIP 路由协议，实现所有子网间的互通。

【实验拓扑】

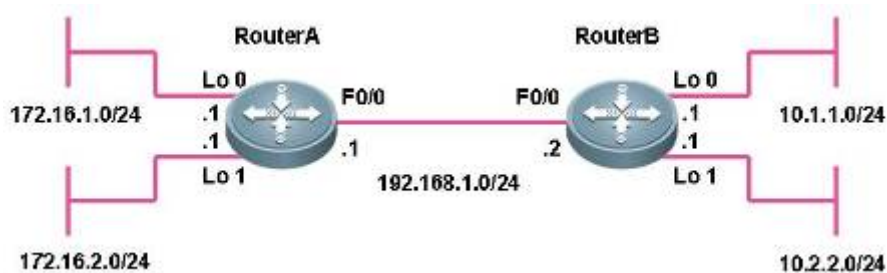


图 7-2 实验拓扑图

【实验设备】

路由器 2 台

【预备知识】

路由器的工作原理和基本配置方法，距离矢量路由协议，RIP 工作原理，RIPv1 和 RIPv2 的区别，RIPv2 的配置方法

【实验原理】

RIP 协议有两个版本 RIPv1 和 RIPv2。

RIPv1 属于有类路由协议，不支持 VLSM（变长子网掩码），RIPv1 是以广播的形式进行路由信息的更新的；更新周期为 30 秒。

RIPv2 属于无类路由协议，支持 VLSM（变长子网掩码），RIPv2 是以组播的形式进行路由信息的更新的，组播地址是 224.0.0.9。RIPv2 还支持基于端口的认证，提高网络的安全性。

【实验步骤】

第一步：配置两台路由器的主机名、接口 IP 地址

```
RSR20#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
RSR20(config)#hostname RouterA
RouterA(config)#
RouterA(config)#interface fastEthernet 0/0
RouterA(config-if)#ip address 192.168.1.1 255.255.255.0
RouterA(config-if)#no shutdown
RouterA(config-if)#exit
RouterA(config)#
RouterA(config)#interface loopback 0
RouterA(config-if)#Aug 15 23:46:32 RouterA %7:~LINE PROTOCOL CHANGE:
Interface Loopback 0, changed state to UP
RouterA(config-if)#ip address 172.16.1.1 255.255.255.0
RouterA(config-if)#exit
RouterA(config)#
RouterA(config)#interface loopback 1
RouterA(config-if)#Aug 15 23:47:00 RouterA %7:~LINE PROTOCOL CHANGE:
Interface Loopback 1, changed state to UP
RouterA(config-if)#ip address 172.16.2.1 255.255.255.0
RouterA(config-if)#exit
```

```
RSR20#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
RSR20(config)#hostname RouterB
RouterB(config)#
RouterB(config)#interface fastEthernet 0/0
RouterB(config-if)#ip address 192.168.1.2 255.255.255.0
RouterB(config-if)#no shutdown
RouterB(config-if)#exit
RouterB(config)#
RouterB(config)#interface loopback 0
RouterB(config-if)#Aug 8 21:00:00 RouterB %7:~LINE PROTOCOL CHANGE:
Interface Loopback 0, changed state to UP
RouterB(config-if)#ip address 10.1.1.1 255.255.255.0
RouterB(config-if)#exit
RouterB(config)#
RouterB(config)#interface loopback 1
RouterB(config-if)#Aug 8 21:00:28 RouterB %7:~LINE PROTOCOL CHANGE:
Interface Loopback 1, changed state to UP
RouterB(config-if)#ip address 10.2.2.1 255.255.255.0
```

```
RouterB(config-if)#exit
```

第二步：在两台路由器上启用 RIPv2，但不关闭自动汇总

```
RouterA(config)#router rip
RouterA(config-router)#network 192.168.1.0
RouterA(config-router)#network 172.16.1.0
RouterA(config-router)#version 2
! 配置使用 RIPv2
RouterA(config-router)#exit
```

```
RouterB(config)#router rip
RouterB(config-router)#network 192.168.1.0
RouterB(config-router)#network 10.0.0.0
RouterB(config-router)#version 2
RouterB(config-router)#exit
```

第三步：查看路由表

从路由表中可以看到，仍然只有 B 类主网络 172.16.0.0/16 和 A 类主网络 10.0.0.0/8 出现在路由表之中。虽然 RIPv2 支持 VLSM，但 RouterA 和 RouterB 都是边界路由器，分别是 B 类主网络 172.16.0.0/16 和 C 类主网络 192.168.1.0/24 的边界、A 类主网络 10.0.0.0/8 和 C 类主网络 192.168.1.0/24 的边界，因此在执行自动的路由汇总。

RouterA#show ip route

```
Codes: C - connected, S - static, R - RIP B - BGP
O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
* - candidate default
```

Gateway of last resort is no set

```
R 10.0.0.0/8 [120/1] via 192.168.1.2, 00:00:10, FastEthernet 0/0
C 172.16.1.0/24 is directly connected, Loopback 0
C 172.16.1.1/32 is local host.
C 172.16.2.0/24 is directly connected, Loopback 1
C 172.16.2.1/32 is local host.
C 192.168.1.0/24 is directly connected, FastEthernet 0/0
C 192.168.1.1/32 is local host.
```

RouterB#show ip route

```
Codes: C - connected, S - static, R - RIP B - BGP
O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
```

i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
* - candidate default

Gateway of last resort is no set

C 10.1.1.0/24 is directly connected, Loopback 0
C 10.1.1.1/32 is local host.
C 10.2.2.0/24 is directly connected, Loopback 1
C 10.2.2.1/32 is local host.
R 172.16.0.0/16 [120/1] via 192.168.1.1, 00:00:02, FastEthernet 0/0
C 192.168.1.0/24 is directly connected, FastEthernet 0/0
C 192.168.1.2/32 is local host.

第四步：关闭自动路由汇总

RouterA(config)#router rip
RouterA(config-router)#no auto-summary
! 关闭 RIPv2 的自动路由汇总功能
RouterA(config-router)#end

RouterB(config)#router rip
RouterB(config-router)#no auto-summary
RouterB(config-router)#end

第五步：查看 RIP 配置信息，路由表

RouterA#show ip route
Codes: C - connected, S - static, R - RIP B - BGP
O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
* - candidate default

Gateway of last resort is no set

R 10.1.1.0/24 [120/1] via 192.168.1.2, 00:00:03, FastEthernet 0/0
R 10.2.2.0/24 [120/1] via 192.168.1.2, 00:00:03, FastEthernet 0/0
C 172.16.1.0/24 is directly connected, Loopback 0
C 172.16.1.1/32 is local host.
C 172.16.2.0/24 is directly connected, Loopback 1
C 172.16.2.1/32 is local host.
C 192.168.1.0/24 is directly connected, FastEthernet 0/0
C 192.168.1.1/32 is local host.

! 可以看到 RIP 路由表中已经学习到了子网的路由

RouterA#show ip rip
Routing Protocol is "rip"

Sending updates every 30 seconds, next due in 23 seconds

Invalid after 180 seconds, flushed after 120 seconds

Outgoing update filter list for all interface is: not set

Incoming update filter list for all interface is: not set

Default redistribution metric is 1

Redistributing:

Default version control: send version 2, receive version 2

Interface	Send	Recv	Key-chain
FastEthernet 0/0	2	2	
Loopback 0	2	2	
Loopback 1	2	2	

Routing for Networks:

172.16.0.0

192.168.1.0

Distance: (default is 120)

! 在配置 RIPv2 版本后，RIP 路由器将只接收和发送版本 2 的更新报文

RouterA#show ip rip database

10.0.0.0/8 auto-summary

10.1.1.0/24

[1] via 192.168.1.2 FastEthernet 0/0 00:28

10.2.2.0/24

[1] via 192.168.1.2 FastEthernet 0/0 00:28

172.16.0.0/16 auto-summary

172.16.1.0/24

[1] directly connected, Loopback 0

172.16.2.0/24

[1] directly connected, Loopback 1

192.168.1.0/24 auto-summary

192.168.1.0/24

[1] directly connected, FastEthernet 0/0

! RIP 的数据库中保存了子网条目的信息

RouterA#show ip rip interface

FastEthernet 0/0 is up, line protocol is up

Routing Protocol: RIP

Receive RIPv2 packets only

Send RIPv2 packets only

Passive interface: Disabled

Split horizon: Enabled

V2 Broadcast: Disabled

Multicast registe: Registered

Interface Summary Rip:

Not Configured

IP interface address:

192.168.1.1/24

FastEthernet 0/1 is down, line protocol is down

RIP is not enabled on this interface

Null 0 is up, line protocol is up

RIP is not enabled on this interface

Loopback 0 is up, line protocol is up

Routing Protocol: RIP

Receive RIPv2 packets only

Send RIPv2 packets only

Passive interface: Disabled

Split horizon: Enabled

V2 Broadcast: Disabled

Multicast registe: Registered

Interface Summary Rip:

Not Configured

IP interface address:

172.16.1.1/24

Loopback 1 is up, line protocol is up

Routing Protocol: RIP

Receive RIPv2 packets only

Send RIPv2 packets only

Passive interface: Disabled

Split horizon: Enabled

V2 Broadcast: Disabled

Multicast registe: Registered

Interface Summary Rip:

Not Configured

IP interface address:

172.16.2.1/24

RouterB#show ip route

Codes: C - connected, S - static, R - RIP B - BGP

O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2

i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area

* - candidate default

Gateway of last resort is no set

C 10.1.1.0/24 is directly connected, Loopback 0

C 10.1.1.1/32 is local host.

C 10.2.2.0/24 is directly connected, Loopback 1

C 10.2.2.1/32 is local host.

```

R    172.16.1.0/24 [120/1] via 192.168.1.1, 00:00:22, FastEthernet 0/0
R    172.16.2.0/24 [120/1] via 192.168.1.1, 00:00:22, FastEthernet 0/0
C    192.168.1.0/24 is directly connected, FastEthernet 0/0
C    192.168.1.2/32 is local host.

```

RouterB#show ip rip

Routing Protocol is "rip"

Sending updates every 30 seconds, next due in 22 seconds

Invalid after 180 seconds, flushed after 120 seconds

Outgoing update filter list for all interface is: not set

Incoming update filter list for all interface is: not set

Default redistribution metric is 1

Redistributing:

Default version control: send version 2, receive version 2

Interface	Send	Recv	Key-chain
FastEthernet 0/0	2	2	
Loopback 0	2	2	
Loopback 1	2	2	

Routing for Networks:

10.0.0.0

192.168.1.0

Distance: (default is 120)

RouterB#

RouterB#show ip rip dat

RouterB#show ip rip database

10.0.0.0/8 auto-summary

10.1.1.0/24

[1] directly connected, Loopback 0

10.2.2.0/24

[1] directly connected, Loopback 1

172.16.0.0/16 auto-summary

172.16.1.0/24

[1] via 192.168.1.1 FastEthernet 0/0 00:02

172.16.2.0/24

[1] via 192.168.1.1 FastEthernet 0/0 00:02

192.168.1.0/24 auto-summary

192.168.1.0/24

[1] directly connected, FastEthernet 0/0

RouterB#show ip rip interface

FastEthernet 0/0 is up, line protocol is up

Routing Protocol: RIP

Receive RIPv2 packets only

Send RIPv2 packets only

Passive interface: Disabled

Split horizon: Enabled

V2 Broadcast: Disabled

Multicast register: Registered

Interface Summary RIPv2:

Not Configured

IP interface address:

192.168.1.2/24

FastEthernet 0/1 is down, line protocol is down

RIP is not enabled on this interface

Null 0 is up, line protocol is up

RIP is not enabled on this interface

Loopback 0 is up, line protocol is up

Routing Protocol: RIPv2

Receive RIPv2 packets only

Send RIPv2 packets only

Passive interface: Disabled

Split horizon: Enabled

V2 Broadcast: Disabled

Multicast register: Registered

Interface Summary RIPv2:

Not Configured

IP interface address:

10.1.1.1/24

Loopback 1 is up, line protocol is up

Routing Protocol: RIPv2

Receive RIPv2 packets only

Send RIPv2 packets only

Passive interface: Disabled

Split horizon: Enabled

V2 Broadcast: Disabled

Multicast register: Registered

Interface Summary RIPv2:

Not Configured

IP interface address:

10.2.2.1/24

第六步：测试网络连通性

RouterA#ping 10.1.1.1

Sending 5, 100-byte ICMP Echoes to 10.1.1.1, timeout is 2 seconds:

< press Ctrl+C to break >

!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/10 ms

RouterA#ping 10.2.2.1

Sending 5, 100-byte ICMP Echoes to 10.2.2.1, timeout is 2 seconds:

< press Ctrl+C to break >

!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

RouterB#ping 172.16.1.1

Sending 5, 100-byte ICMP Echoes to 172.16.1.1, timeout is 2 seconds:

< press Ctrl+C to break >

!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

RouterB#ping 172.16.2.1

Sending 5, 100-byte ICMP Echoes to 172.16.2.1, timeout is 2 seconds:

< press Ctrl+C to break >

!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/10 ms

第七步：用 debug 命令观察路由器接收和发生路由更新的情况

下面是一个完整的 RIPv2 路由器接收更新和发送更新的过程，从中可以看到 RouterB 接收到了 RouterA 发送的更新，其中包含两条路由信息 172.16.1.0 和 172.16.2.0（可以看到水平分割原则的作用），然后刷新了路由表。

RouterB 本身发送的更新报文则在 Fa0/0、Lo0 和 Lo1 三个端口发出，使用组播方式，组播地址为 224.0.0.9，使用的是 UDP 520 端口。在水平分割的原则下，每个端口发送的路由信息均不相同。

注意 RIPv2 的更新报文格式和 RIPv1 的不同。

RouterB#debug ip rip

RouterB#Aug 8 21:58:08 RouterB %7: [RIP] RIP recveived packet, sock=2125
src=192.168.1.1 len=44

Aug 8 21:58:08 RouterB %7: [RIP] Cancel peer remove timer

Aug 8 21:58:08 RouterB %7:[RIP] Peer remove timer shedule...

Aug 8 21:58:08 RouterB %7: [RIP] Both do not need auth, Auth ok

**Aug 8 21:58:08 RouterB %7: route-entry: family 2 tag 0 ip 172.16.1.0
mask 255.255.255.0 nhop 0.0.0.0 metric 1**

**Aug 8 21:58:08 RouterB %7: route-entry: family 2 tag 0 ip 172.16.2.0
mask 255.255.255.0 nhop 0.0.0.0 metric 1**

Aug 8 21:58:08 RouterB %7: [RIP] Received version 2 response packet

Aug 8 21:58:08 RouterB %7: [RIP] Old path is: nhop=192.168.1.1
routesrc=192.168.1.1 intf=1

Aug 8 21:58:08 RouterB %7: [RIP] New path is: nhop=192.168.1.1
routesrc=192.168.1.1

Aug 8 21:58:08 RouterB %7: [RIP] [172.16.1.0/24] RIP route refresh!

Aug 8 21:58:08 RouterB %7: [RIP] [172.16.1.0/24] RIP distance apply from 192.168.1.1!

Aug 8 21:58:08 RouterB %7: [RIP] [172.16.1.0/24] ready to refresh kernel...

Aug 8 21:58:08 RouterB %7: [RIP] NSM refresh: IPv4 RIP Route 172.16.1.0/24 distance=120 metric=1 nexthop_num=1 distance=120 nexthop=192.168.1.1 ifindex=1

Aug 8 21:58:08 RouterB %7: [RIP] [172.16.1.0/24] cancel route timer

Aug 8 21:58:08 RouterB %7: [RIP] [172.16.1.0/24] route timer schedule...

Aug 8 21:58:08 RouterB %7: [RIP] Old path is: nhop=192.168.1.1 routesrc=192.168.1.1 intf=1

Aug 8 21:58:08 RouterB %7: [RIP] New path is: nhop=192.168.1.1 routesrc=192.168.1.1

Aug 8 21:58:08 RouterB %7: [RIP] [172.16.2.0/24] RIP route refresh!

Aug 8 21:58:08 RouterB %7: [RIP] [172.16.2.0/24] RIP distance apply from 192.168.1.1!

Aug 8 21:58:08 RouterB %7: [RIP] [172.16.2.0/24] ready to refresh kernel...

Aug 8 21:58:08 RouterB %7: [RIP] NSM refresh: IPv4 RIP Route 172.16.2.0/24 distance=120 metric=1 nexthop_num=1 distance=120 nexthop=192.168.1.1 ifindex=1

Aug 8 21:58:08 RouterB %7: [RIP] [172.16.2.0/24] cancel route timer

Aug 8 21:58:08 RouterB %7: [RIP] [172.16.2.0/24] route timer schedule...

Aug 8 21:58:23 RouterB %7: [RIP] Output timer expired to send reponse

Aug 8 21:58:23 RouterB %7: [RIP] Prepare to send MULTICAST response...

Aug 8 21:58:23 RouterB %7: [RIP] Building update entries on FastEthernet 0/0

Aug 8 21:58:23 RouterB %7: 10.1.1.0/24 via 0.0.0.0 metric 1 tag 0

Aug 8 21:58:23 RouterB %7: 10.2.2.0/24 via 0.0.0.0 metric 1 tag 0

Aug 8 21:58:23 RouterB %7: [RIP] Send packet to 224.0.0.9 Port 520 on FastEthernet 0/0

Aug 8 21:58:23 RouterB %7: [RIP] Prepare to send MULTICAST response...

Aug 8 21:58:23 RouterB %7: [RIP] Building update entries on Loopback 0

Aug 8 21:58:23 RouterB %7: 10.2.2.0/24 via 0.0.0.0 metric 1 tag 0

Aug 8 21:58:23 RouterB %7: 172.16.1.0/24 via 0.0.0.0 metric 2 tag 0

Aug 8 21:58:23 RouterB %7: 172.16.2.0/24 via 0.0.0.0 metric 2 tag 0

Aug 8 21:58:23 RouterB %7: 192.168.1.0/24 via 0.0.0.0 metric 1 tag 0

Aug 8 21:58:23 RouterB %7: [RIP] Send packet to 224.0.0.9 Port 520 on Loopback 0

Aug 8 21:58:23 RouterB %7: [RIP] Prepare to send MULTICAST response...

Aug 8 21:58:23 RouterB %7: [RIP] Building update entries on Loopback 1

Aug 8 21:58:23 RouterB %7: 10.1.1.0/24 via 0.0.0.0 metric 1 tag 0

Aug 8 21:58:23 RouterB %7: 172.16.1.0/24 via 0.0.0.0 metric 2 tag 0

Aug 8 21:58:23 RouterB %7: 172.16.2.0/24 via 0.0.0.0 metric 2 tag 0

Aug 8 21:58:23 RouterB %7: 192.168.1.0/24 via 0.0.0.0 metric 1 tag 0

Aug 8 21:58:23 RouterB %7: [RIP] Send packet to 224.0.0.9 Port 520 on Loopback 1

Aug 8 21:58:23 RouterB %7: [RIP] Schedule response send timer

【注意事项】

- 1、配置 RIP 的 Network 命令时只支持 A、B、C 的主网络号，如果写入子网则自动转为主网络号。
- 2、No auto-summary 功能只有在 RIPv2 支持。
- 3、如果刚配置了 no auto-summary 命令后立刻查看路由表，除了能看到子网的路由条目外，还可以看到原本主网络的路由条目，该主网络的路由条目将在无效计时器、刷新计时器超时后才会被清除。

【参考配置】

RouterA#show running-config

Building configuration...

Current configuration : 642 bytes

!

version RGNOS 10.1.00(4), Release(18443)(Tue Jul 17 20:50:30 CST 2007 -ubulserver)

hostname RouterA

!

!

interface FastEthernet 0/0

ip address 192.168.1.1 255.255.255.0

duplex auto

speed auto

!

interface FastEthernet 0/1

duplex auto

speed auto

!

interface Loopback 0

ip address 172.16.1.1 255.255.255.0

!

interface Loopback 1

ip address 172.16.2.1 255.255.255.0

!

router rip

version 2

network 172.16.0.0

network 192.168.1.0

no auto-summary

!

line con 0

line aux 0

```
line vty 0 4
  login
!
end
```

RouterB#show running-config

```
Building configuration...
Current configuration : 636 bytes
!
version RGNOS 10.1.00(4), Release(18443)(Tue Jul 17 20:50:30 CST 2007 -ubulserver)
hostname RouterB
!
!
interface FastEthernet 0/0
  ip address 192.168.1.2 255.255.255.0
  duplex auto
  speed auto
!
interface FastEthernet 0/1
  duplex auto
  speed auto
!
interface Loopback 0
  ip address 10.1.1.1 255.255.255.0
!
interface Loopback 1
  ip address 10.2.2.1 255.255.255.0
!
router rip
  version 2
  network 10.0.0.0
  network 192.168.1.0
  no auto-summary
!
line con 0
line aux 0
line vty 0 4
  login
!
```