《网络与通信》课程实验报告

实验四：网络路由实验

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实验目的：

1. 学会为 Cisco 路由器配置网络 IP 接口，并配置静态路由实验。
2. 加深理解目前较广泛使用的域内路由协议 RIP 和 OSPF。
3. 掌握在 Cisco 路由器上配置 RIP 和 OSPF 路由协议。

实验内容：

通过使用 Netsim 路由模拟软件进行 Cisco 路由器静态和动态路由实验。

具体的实验内容，请参阅实验指导书。

实验要求：（学生对预习要求的回答）（10 分）　　得分：

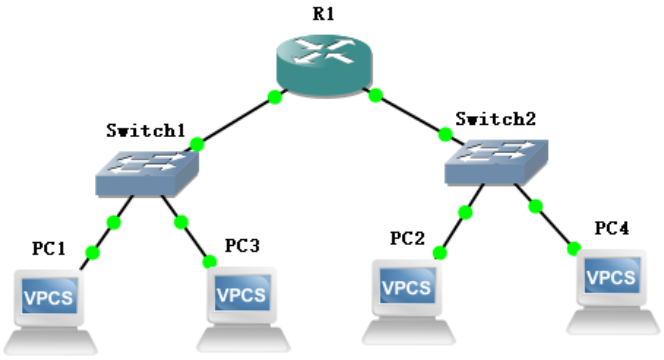
- 简述RIP和OSPF动态路由协议的要点

  RIP(路由信息协议)是一种距离向量路由协议，主要基于bellman-ford算法来计算到达目标网络的最佳路径。RIP使用跳数（hop count）作为距离度量，每个条数代表数据包经过一个路由器。跳数越少，路径越好。RIP支持的最大跳数为15，跳数超过15的网络被认为是不可达的，以此避免路由循环。RIP路由器定期（通常是30秒）向直接相邻的路由器发送整个路由表，确保网络拓扑变化能够及时被所有路由器知道。并且当路由表发生变化时，RIP路由器可以立即发送更新，不仅仅依赖于定期更新。

  OSPF(开放最短路径优先)是一种链路状态路由协议，用于在单一自治系统（AS）内部进行路由决策。与RIP不同，OSPF路由器通过交换链路状态信息来构建整个网络的拓扑图。每个路由器都会生成描述其直接连接的网络和邻居路由器的链路状态信息。OSPF使用dijkstra算法来计算到达每个网络的最短路径。为了支持大型网络，OSPF引入了区域的概念，一个自治系统可以划分为多个区域，每个区域维护自己的链路状态数据库，减少了路由更新和计算的开销。

实验过程中遇到的问题如何解决的？（10 分）　　得分：

问题 1：在初次安装 gns3 后，连接了如图的网络拓扑结构，PC1,3 可以 ping 通，PC2,4 可以 ping 通，PC1,2 之间无法 ping 通，怎么解决？



答：需要对路由器 R1 进行设置。将 PC1,3 的网关 192.168.1.254 添加到 R1 的路由表中。打开 R1 终端，先输入 show ip route 查看路由信息，发现什么都没有：

```
R1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, 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, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       a - application route
       + - replicated route, % - next hop override

Gateway of last resort is not set
```

输入如下命令：

Conf t

Ip routing

Interface e1/0

Ip address 192.168.1.254 255.255.255.0

No shutdown

End

输入 show ip route,查看更新后的路由表：

```
R1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, 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, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       a - application route
       + - replicated route, % - next hop override

Gateway of last resort is not set

      192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.1.0/24 is directly connected, Ethernet1/0
L        192.168.1.254/32 is directly connected, Ethernet1/0
```

可以看到，网络 192.168.1.0 成功添加到了路由表中。接下来将交换机 2 连接的网络也添加

到 R1 中，执行以下命令：

Conf t

Ip routing

Interface e1/1

Ip address 192.168.2.254 255.255.255.0

No shutdown

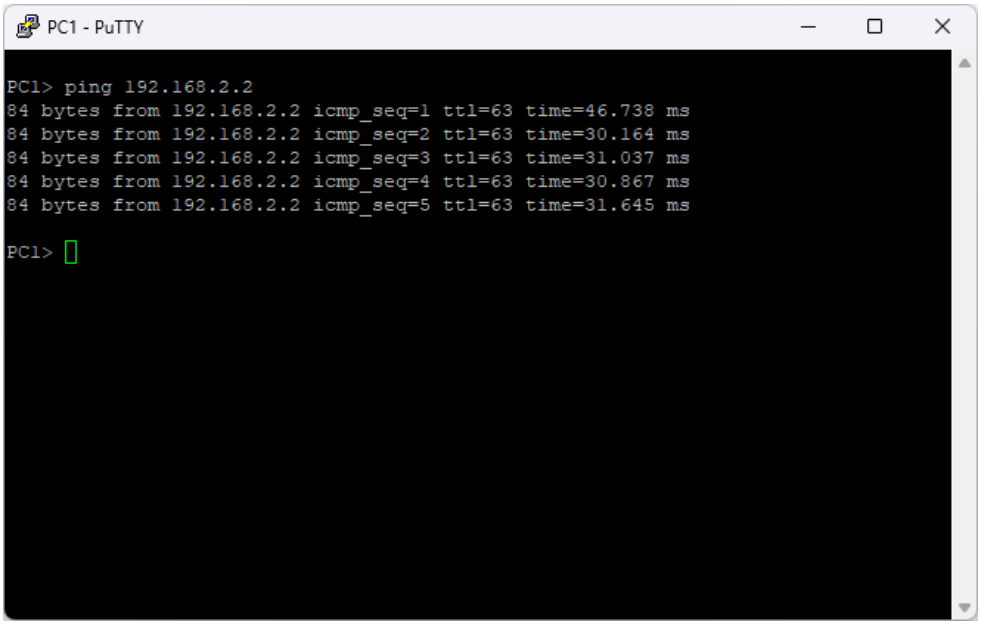
End

Show ip route

可以看到，网络 192.168.2.254 也被成功添加到了 R1 路由表中。

```
R1(config)#ip routing
R1(config)#interface e1/1
R1(config-if)#ip address 192.168.2.254 255.255.255.0
R1(config-if)#no shutdown
R1(config-if)#end
R1#sho
*Oct 19 15:03:32.435: %SYS-5-CONFIG_I: Configured from console by console
R1#sho
*Oct 19 15:03:33.691: %LINK-3-UPDOWN: Interface Ethernet1/1, changed state to up
*Oct 19 15:03:34.691: %LINEPROTO-5-UPDOWN: Line protocol on Interface Ethernet1/1, changed state to up
R1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, 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, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       a - application route
       + - replicated route, % - next hop override

Gateway of last resort is not set

      192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.1.0/24 is directly connected, Ethernet1/0
L        192.168.1.254/32 is directly connected, Ethernet1/0
      192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.2.0/24 is directly connected, Ethernet1/1
L        192.168.2.254/32 is directly connected, Ethernet1/1
```

接下来测试 PC1pingPC2,打开 PC1 终端，输入 ping 192.168.2.2,显示延迟信息，表明网络已接通。



问题 2：打开 GNS3 后，在打开工程时，总是出现如下报错：

Dynamips error when running command 'nio create_udp udp-dd8efe53-c15d-4ab3-89b0-3f16d7998ce3 10010 127.0.0.1 10011 ': unable to create UDP NIO 怎么解决？

答：报错信息显示的是 UDP 端口 10010 被占用了，打开 cmd，输入

netstat -ano | findstr "10010"

查看哪个进程占用了端口 10010，发现 PID 为 6648 的进程占用了端口 10010，打开任务管理器，搜索 PID 为 6648 的进程，发现 NVIDIA 网页服务相关的一个进程在运行，点击结束该任务后，就能重新打开工程了。

问题 3：路由器配置好后，如何查看路由表？

答：点击任意一个路由器后，输入 show ip route 即可看到路由表信息，如果没有如期显示结果，可能当前在其他操作级目录，输入 end 返回到初始菜单级，输入 show ip route 即可。也可以逐步输入 exit 返回上一级。此外，输入 sh ip protocol 可以查看使用的路由协议。

本次实验的体会（结论）（10 分）　　得分：

本次实验，我学习了 GNS3 软件的实验，模拟了静态和动态路由的配置实验。我深刻体会到了网络路由配置过程中的复杂性。

静态路由通过手动输入地址，进行路由表的配置，而动态路由配置中，通过选择不同的动态路由协议，如 RIP，OSPF 等，可以大大提高路由配置效率。

同时，我也惊讶于路由器内居然也能和操作系统一样运行进程，如 OSPF 进程。此外，我还感受到了算法的强大性，如 bellman-ford 算法和 dijkstra 算法，能够在如此如法的网络拓扑结构中高效地找到最佳路径进行数据包的传输。

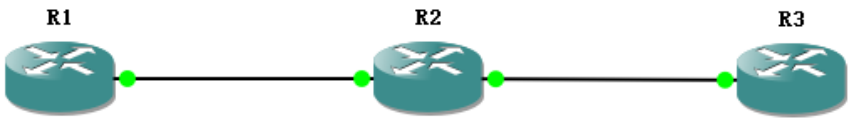
本次试验后，我对 GNS3 软件更加感兴趣了，后续会使用它做更多的网络模拟实验。

思考题：（10 分）

思考题 1：（4 分）　　得分：

按照实验指导书的要求，按照实验指导书上的网络拓扑图，分别写出每台路由器上的静态路由表项。并使用 ping 进行连通性测试的结果。

答：根据实验要求与实验指南，添加三个路由器，并添加连接，拓扑结构如图所示：



先为每个路由器设置接口 IP 地址：

	Router1	Router2	Router3
Interface ethernet 1/0	10.1.1.2	10.1.1.1	12.5.10.2
Interface ethernet1/1		12.5.10.1	

命令如下：

Enable

Conf t

Ip routing

Interface e1/0

Ip address 10.1.1.2 255.255.255.0

No shutdown

```
R3#ping 10.1.1.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.1.2, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
```

尝试从 R3 到 R1 的接口 ip 地址 10.1.1.2ping 测试，发现 ping 不通。我们需要进行静态路由配置命令，首先输入 conf t（等价于 config terminal）进入全局配置。将 R1 路由的网段添加到 R3 的路由表中。命令如下：

ip route 10.1.1.0 255.255.255.0 12.5.10.1

从左到右分别是：静态路由配置命令，对方路由 IP，子网掩码，下一跳 IP。输入 end 返回上一级，输入 show ip route 查看路由表，发现已经有了 R1 路由 IP 信息，下一跳 IP 也已经指明。同理，将 R1 终端打开，相同操作，输入命令：

Ip route 12.5.10.0 255.255.255.0 10.1.1.1

这样，就将 R3 的网络添加到了 R1 的路由表中了，这样 R1,R3 可以相互 ping 通了。

```
R3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R3(config)#ip route 10.1.1.0 255.255.255.0 12.5.10.1
R3(config)#end
R3#sho
*Oct 19 14:26:26.343: %SYS-5-CONFIG_I: Configured from console by console
R3#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, 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, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       a - application route
       + - replicated route, % - next hop override

Gateway of last resort is not set

      10.0.0.0/24 is subnetted, 1 subnets
S        10.1.1.0 [1/0] via 12.5.10.1
      12.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C        12.5.10.0/24 is directly connected, Ethernet1/0
L        12.5.10.2/32 is directly connected, Ethernet1/0
```

测试 R3 对 R1ping 测试：对 ip 地址 10.1.1.2(R1)进行 ping 连通测试，显示成功。

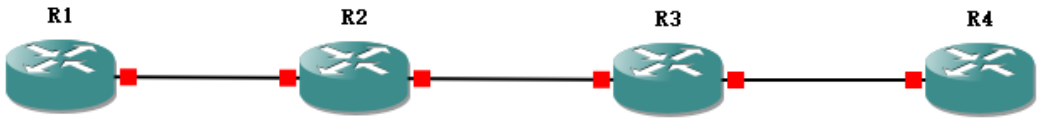
```
R3#ping 10.1.1.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.1.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/60/64 ms
```

思考题2：（6分）	得分：

按照实验指导书，动态路由实验的要求，写出每台路由器上的 RIP 和 OSPF 路由表项。并写出 Ping 的连通性测试结果。

答：一、配置RIP路由：

根据实验指导书要求，构建如图所示的网络拓扑图：



配置每个路由器对应接口的ip地址：

路由器	接口	Ip地址
R1	Ethernet1/0	10.1.1.2
R2	Ethernet1/0	10.1.1.1
	Ethernet1/1	12.5.10.1
R3	Ethernet1/0	12.5.10.2
	Ethernet1/1	23.1.1.2
R4	Ethernet1/0	23.1.1.1

R1状态：

```
R1#show ip int brief
Interface                  IP-Address      OK? Method Status                Protocol
Ethernet0/0                unassigned      YES unset  administratively down down
GigabitEthernet0/0         unassigned      YES unset  administratively down down
Ethernet1/0                10.1.1.2        YES manual up                    up
Ethernet1/1                unassigned      YES unset  administratively down down
Ethernet1/2                unassigned      YES unset  administratively down down
Ethernet1/3                unassigned      YES unset  administratively down down
R1#
```

R2状态：

```
R2#
R2#show ip interface brief
Interface                  IP-Address      OK? Method Status                Protocol
Ethernet0/0                unassigned      YES unset  administratively down down
GigabitEthernet0/0         unassigned      YES unset  administratively down down
Ethernet1/0                10.1.1.1        YES manual up                    up
Ethernet1/1                12.5.10.1       YES manual up                    up
Ethernet1/2                unassigned      YES unset  administratively down down
Ethernet1/3                unassigned      YES unset  administratively down down
R2#
```

R3状态：

```
R3#show ip int brief
Interface                  IP-Address      OK? Method Status                Protocol
Ethernet0/0                unassigned      YES unset  administratively down down
GigabitEthernet0/0         unassigned      YES unset  administratively down down
Ethernet1/0                12.5.10.2       YES manual up                    up
Ethernet1/1                23.1.1.2        YES manual up                    up
Ethernet1/2                unassigned      YES unset  administratively down down
Ethernet1/3                unassigned      YES unset  administratively down down
R3#
```

R4状态：

```
R4#show ip int brief
Interface                  IP-Address      OK? Method Status                Protocol
Ethernet0/0                unassigned      YES unset  administratively down down
GigabitEthernet0/0         unassigned      YES unset  administratively down down
Ethernet1/0                23.1.1.1        YES manual up                    up
Ethernet1/1                unassigned      YES unset  administratively down down
Ethernet1/2                unassigned      YES unset  administratively down down
Ethernet1/3                unassigned      YES unset  administratively down down
R4#
```

配置R1-R4路由器的RIP动态路由协议，依次点开每个路由器的终端，输入以下命令：

Conf t

Router rip

Network 10.1.1.0[需要添加rip协议的网段]

使用ping命令测试连通性：

R4直接pingR1：

```
R4#ping 10.1.1.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.1.2, timeout is 2 seconds:
..!!!
Success rate is 60 percent (3/5), round-trip min/avg/max = 88/94/100 ms
```

显示成功率60%

R4 ping R3:

```
R4#ping 23.1.1.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 23.1.1.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/31/36 ms
```

测试成功！

R4 ping R2:

```
R4#ping 12.5.10.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 12.5.10.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 52/60/64 ms
```

测试成功！

R4 ping R1:

```
R4#ping 10.1.1.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.1.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 84/88/96 ms
```

测试成功！

可见，R1,R2,R3,R4之间连通成功！

查看R1路由表：

```
R1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, 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, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       a - application route
       + - replicated route, % - next hop override

Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C        10.1.1.0/24 is directly connected, Ethernet1/0
L        10.1.1.2/32 is directly connected, Ethernet1/0
R     12.0.0.0/8 [120/1] via 10.1.1.1, 00:00:18, Ethernet1/0
R     23.0.0.0/8 [120/2] via 10.1.1.1, 00:00:18, Ethernet1/0
```

可以看到，C表示直连，R1直连的网络为10.1.1.0,L表示本地，本地接口ip为10.1.1.2，通过路由学习得到网络12.0.0.0,管理距离（路由来源可信度）120，度量值（到达目的地的成本）1，via 10.1.1.1表示下一跳地址为10.1.1.1.通过路由学习得到网络23.0.0.0，到达成本为2.

查看R2路由表：

```
R2#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, 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, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       a - application route
       + - replicated route, % - next hop override

Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C        10.1.1.0/24 is directly connected, Ethernet1/0
L        10.1.1.1/32 is directly connected, Ethernet1/0
      12.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C        12.5.10.0/24 is directly connected, Ethernet1/1
L        12.5.10.1/32 is directly connected, Ethernet1/1
R     23.0.0.0/8 [120/1] via 12.5.10.2, 00:00:11, Ethernet1/1
```

可以看到，直连网络变成两个10.1.1.0和12.5.10.0，本地接口也有两个，为10.1.1.1和12.5.10.1，与实验预期一致。

查看R3路由表：

```
R3#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, 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, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       a - application route
       + - replicated route, % - next hop override

Gateway of last resort is not set

R     10.0.0.0/8 [120/1] via 12.5.10.1, 00:00:06, Ethernet1/0
      12.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C        12.5.10.0/24 is directly connected, Ethernet1/0
L        12.5.10.2/32 is directly connected, Ethernet1/0
      23.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C        23.1.1.0/24 is directly connected, Ethernet1/1
L        23.1.1.2/32 is directly connected, Ethernet1/1
```

查看R4路由表：

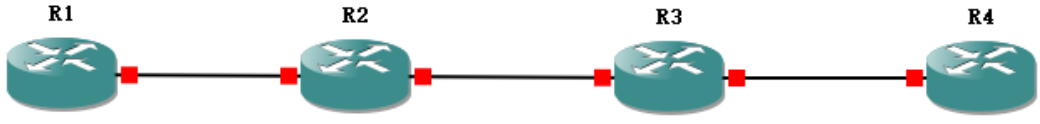
```
R4#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       a - application route
       + - replicated route, % - next hop override

Gateway of last resort is not set

R     10.0.0.0/8 [120/2] via 23.1.1.2, 00:00:26, Ethernet1/0
R     12.0.0.0/8 [120/1] via 23.1.1.2, 00:00:26, Ethernet1/0
      23.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C        23.1.1.0/24 is directly connected, Ethernet1/0
L        23.1.1.1/32 is directly connected, Ethernet1/0
R4#
```

R3,R4路由表同理。

由此可见，通过RIP协议动态配置了各个路由器的路由表，而不需要手动配置路由表，路由协议大大提高了网络配置效率。

二、配置OSPF：

沿用刚才的网络拓扑结构：



首先执行命令：

No router rip

关闭各个路由器的RIP协议.

```
R1(config)#no router rip
R1(config)#end
R1#show
*Oct 19 17:30:44.167: %SYS-5-CONFIG_I: Configured from console by console
R1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, 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, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       a - application route
       + - replicated route, % - next hop override

Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C        10.1.1.0/24 is directly connected, Ethernet1/0
L        10.1.1.2/32 is directly connected, Ethernet1/0
```

可以看到，R项的路由信息消失了。再对各个路由器启用ospf动态路由协议，命令如下：

Conf t

Router ospf 1

Network 10.1.1.0 0.0.0.255 area 0

以此类推，设置R1,R2,R3,R4路由器。

查看R1路由器的配置情况：

```
R1#sh ip protocol
*** IP Routing is NSF aware ***

Routing Protocol is "application"
  Sending updates every 0 seconds
  Invalid after 0 seconds, hold down 0, flushed after 0
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Maximum path: 32
  Routing for Networks:
  Routing Information Sources:
    Gateway         Distance      Last Update
  Distance: (default is 4)

Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 10.1.1.2
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    10.1.1.0 0.0.0.255 area 0
  Routing Information Sources:
    Gateway         Distance      Last Update
    23.1.1.2             110      00:04:44
    23.1.1.1             110      00:04:34
  Distance: (default is 110)
```

可以看到，R1有两个路由协议，application可能特定程序或服务定义的路由协议。Ospf 1是ospf进程，路由器唯一标识为10.1.1.2，路由器从ip地址为23.1.1.1和23.1.1.2的网关接收OSPF路由更新，距离为110（为OSPF的默认管理距离），显示了最后更新时间已经过去了4：44和4：34。已经成功启用了OSPF协议。

连通性测试：

R1 ping R2:

```
R1#ping 10.1.1.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.1.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 24/33/44 ms
```

R1 ping R3:

```
R1#ping 12.5.10.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 12.5.10.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 60/64/76 ms
```

R1 ping R4:

```
R1#ping 23.1.1.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 23.1.1.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 84/91/100 ms
```

均测试成功，证明R1,R2,R3,R4已连通。

查看R1路由表为例：

```
R1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, 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, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       a - application route
       + - replicated route, % - next hop override

Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C        10.1.1.0/24 is directly connected, Ethernet1/0
L        10.1.1.2/32 is directly connected, Ethernet1/0
      12.0.0.0/24 is subnetted, 1 subnets
O        12.5.10.0 [110/20] via 10.1.1.1, 00:16:00, Ethernet1/0
      23.0.0.0/24 is subnetted, 1 subnets
O        23.1.1.0 [110/30] via 10.1.1.1, 00:15:50, Ethernet1/0
```

路由表更新完毕，网络12.5.10.0和23.1.1.0都是通过OSPF学习得到。

至此，基于RIP协议和OSPF协议的动态路由实验均已完成。

指导教师评语：

日期：