

《网络工程与组网技术》

课程实验报告

(2021 学年)

实验名称 网络路由技术

学 院 网络空间安全学院

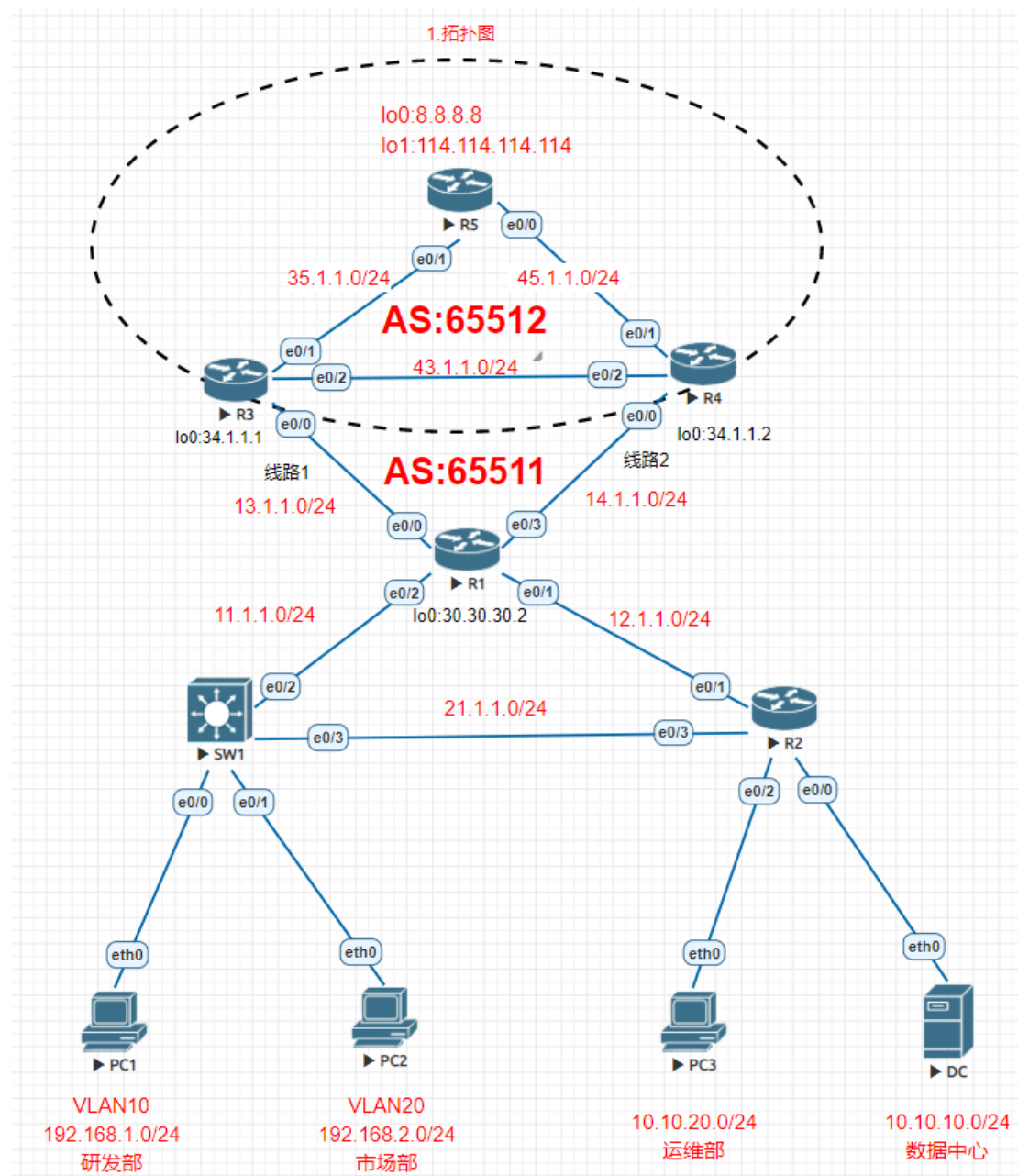
专业班级 571191

学号姓名 57119101 王晨阳

2021 年 7 月 14 日

一、实验说明

1. 网络拓扑



二、实验任务

1、IP 配置

按照拓扑中 IP 标记配置 IP，每个部门的网关均为该部门所属网段最后一个可用 IP 地址。

2、OSPF 路由配置

SW1、R1、R2 之间使用 OSPF 路由协议，ospf 进程号 100,具体要求如下:

- 所有路由器均运行在骨干区域(area 0)
- route-id 分别为 R1: 1.1.1.1,R2: 2.2.2.2,SW1: 3.3.3.3
- 要求 R1 为两个网络中的 DR，SW-1、R2 均不参与 DR 的选举

- 通告对应路由，使得各部门之间能够互通。
- 在路由器 R1 上为 SW1、R3 下发默认路由 3、BGP 路由配置
- R3、R4、R5 之间建立内部 BGP 的邻居关系,R1 与 R3、R4 之间建立外部 BGP 邻居关系。
R1 的 AS 为 65511, R3、R4、R5 的 AS 为 65512
- R5 中 BGP 重分发直连路由
- R1 上将 OSPF 的路由重分发到 BGP 中，并过滤掉运维部的路由信息。

4、路由策略控制

- 配置路由策略，要求在 AS 65511 中访问 AS 65512 中的业务实现数据分流，访问 8.8.8.8 时走线路 1，访问 114.114.114.114 时走线路 2。
- 在 AS 65512 中访问 AS 65511 的业务实现数据分流，访问研发和市场部走线路 1，访问数据中心走线路 2。

5、策略路由

策略路由配置，要求运维部访问市场部、研发走 R2-R1 线路，研发、市场部访问运维部走 SW1-R1 之间线路。

三、网络节点配置

1) IP配置

R1配置

```
R1(config)#interface Loopback0
R1(config-if)#no shutdown
R1(config-if)#ip address 30.30.30.2 255.255.255.255
R1(config)#interface Ethernet0/0
R1(config-if)#no shutdown
R1(config-if)#ip address 13.1.1.1 255.255.255.0
R1(config)#interface Ethernet0/1
R1(config-if)#no shutdown
R1(config-if)# ip address 12.1.1.2 255.255.255.0
R1(config)#interface Ethernet0/2
R1(config-if)#no shutdown
R1(config-if)#ip address 11.1.1.2 255.255.255.0
R1(config)#interface Ethernet0/3
R1(config-if)#no shutdown
R1(config-if)#ip address 14.1.1.1 255.255.255.0
```

R2配置

```
R2(config)#interface Ethernet0/0
R2(config-if)#no shutdown
R2(config-if)#ip address 10.10.10.254 255.255.255.0
R2(config)#interface Ethernet0/1
R2(config-if)#no shutdown
R2(config-if)#ip address 12.1.1.1 255.255.255.0
R2(config)#interface Ethernet0/2
R2(config-if)#no shutdown
R2(config-if)#ip address 10.10.20.254 255.255.255.0
```

```
R2(config)#interface Ethernet0/3
R2(config-if)#no shutdown
R2(config-if)#ip address 21.1.1.2 255.255.255.0
```

R3配置

```
R3(config)#interface Loopback0
R3(config-if)#no shutdown
R3(config-if)#ip address 34.1.1.1 255.255.255.255
R3(config)#interface Ethernet0/0
R3(config-if)#no shutdown
R3(config-if)#ip address 13.1.1.2 255.255.255.0
R3(config)#interface Ethernet0/1
R3(config-if)#no shutdown
R3(config-if)#ip address 35.1.1.2 255.255.255.0
R3(config)#interface Ethernet0/2
R3(config-if)#no shutdown
R3(config-if)#ip address 43.1.1.1 255.255.255.0
```

R4配置

```
R4(config)#interface Loopback0
R4(config-if)#no shutdown
R4(config-if)#ip address 34.1.1.2 255.255.255.255
R4(config)#interface Ethernet0/0
R4(config-if)#no shutdown
R4(config-if)#ip address 14.1.1.2 255.255.255.0
R4(config)#interface Ethernet0/1
R4(config-if)#no shutdown
R4(config-if)#ip address 45.1.1.2 255.255.255.0
R4(config)#interface Ethernet0/2
R4(config-if)#no shutdown
R4(config-if)#ip address 43.1.1.2 255.255.255.0
```

R5配置

```
R5(config)#hostname R5
R5(config)#interface Loopback0
R5(config-if)#no shutdown
R5(config-if)#ip address 8.8.8.8 255.255.255.255
R5(config)#interface Loopback1
R5(config-if)#no shutdown
R5(config-if)#ip address 114.114.114.114 255.255.255.255
R5(config)#interface Ethernet0/0
R5(config-if)#no shutdown
R5(config-if)#ip address 45.1.1.1 255.255.255.0
R5(config)#interface Ethernet0/1
R5(config-if)#no shutdown
R5(config-if)#ip address 35.1.1.1 255.255.255.0
```

SW1配置

```

SW1(config)#vlan 10
SW1(config)#vlan 20
SW1(config)#vlan 30
SW1(config)#vlan 40
SW1(config)#interface Ethernet0/0
SW1(config-if)#no shutdown
SW1(config-if)#switchport access vlan 10
SW1(config)#interface Ethernet0/1
SW1(config-if)#no shutdown
SW1(config-if)#switchport access vlan 20
SW1(config)#interface Ethernet0/2
SW1(config-if)#no shutdown
SW1(config-if)#switchport access vlan 30
SW1(config)#interface Ethernet0/3
SW1(config-if)#no shutdown
SW1(config-if)#switchport access vlan 40
SW1(config)#interface Vlan10
SW1(config-if)#no shutdown
SW1(config-if)#ip address 192.168.1.254 255.255.255.0
SW1(config)#interface Vlan20
SW1(config-if)#no shutdown
SW1(config-if)#ip address 192.168.2.254 255.255.255.0
SW1(config)#interface Vlan30
SW1(config-if)#no shutdown
SW1(config-if)#ip address 11.1.1.1 255.255.255.0
SW1(config)#interface Vlan40
SW1(config-if)#no shutdown
SW1(config-if)#ip address 21.1.1.1 255.255.255.0

```

2) OSPF路由配置

R1配置

```

R1(config)#router ospf 100 #新建ospf进程100
R1(config-router)#router-id 1.1.1.1 #设置router-id为1.1.1.1
R1(config-router)#redistribute bgp 65511 subnets
#将本路由器学习到的BGP路由条目重分发进OSPF
R1(config-router)#network 11.1.1.0 0.0.0.255 area 0 #将网络11.1.1.0/24宣告进area 0
R1(config-router)#network 12.1.1.0 0.0.0.255 area 0 #将网络12.1.1.0/24宣告进area 0
R1(config-router)#default-information originate always
#将去往AS65512的默认路由重分发进OSPF

```

R2配置

```

R2(config)#router ospf 100
R1(config-router)#router-id 2.2.2.2 #设置router-id为2.2.2.2
R2(config-router)#network 10.10.10.0 0.0.0.255 area 0
#将网络10.10.10.0/24宣告进area0
R2(config-router)#network 10.10.20.0 0.0.0.255 area 0

```

```
R2(config-router)#network 12.1.1.0 0.0.0.255 area 0
R2(config-router)#network 21.1.1.0 0.0.0.255 area 0
R2(config)#interface Ethernet0/1
R2(config-if)#ip ospf priority 0 #设置ospf 优先级为0
R2(config)#interface Ethernet0/3
R2(config-if)#ip ospf priority 0 #设置ospf优先级为0
```

SW1配置

```
SW1(config)#router ospf 100
SW1(config-router)#router-id 3.3.3.3
SW1(config-router)#network 11.1.1.0 0.0.0.255 area 0
SW1(config-router)#network 21.1.1.0 0.0.0.255 area 0
SW1(config-router)#network 192.168.1.0 0.0.0.255 area 0
SW1(config-router)#network 192.168.2.0 0.0.0.255 area 0
SW1(config)#interface vlan 30
SW1(config-if)#ip ospf priority 0
SW1(config)#interface vlan 40
SW1(config-if)#ip ospf priority 0
```

3) BGP路由配置

3.1

R1配置

```
R1(config)#router bgp 65511 #将本路由器划入AS65511中
R1(config)#no bgp log-neighbor-changes #取消BGP邻居状态变更日志记录
R1(config)#neighbor 13.1.1.2 remote-as 65512
#设置邻居连接该设备接口的ip地址并设置邻居的AS号
R1(config)#neighbor 14.1.1.2 remote-as 65512
#设置邻居连接该设备接口的ip地址并设置邻居的AS号
```

R3 配置

```
R3(config)#router bgp 65512
R3(config-router)#no bgp log-neighbor-changes #取消BGP邻居状态变更日志记录
R3(config-router)#neighbor 13.1.1.1 remote-as 65511
R3(config-router)#neighbor 35.1.1.1 remote-as 65512
R3(config-router)#neighbor 35.1.1.1 next-hop-self #修改下一跳为本as内的设备
R3(config-router)#neighbor 43.1.1.2 remote-as 65512
R3(config-router)#neighbor 43.1.1.2 next-hop-self
```

R4配置

```
R4(config)#router bgp 65512
R4(config-router)#no bgp log-neighbor-changes #取消BGP邻居状态变更日志记录
R4(config-router)#neighbor 14.1.1.1 remote-as 65511
R4(config-router)#neighbor 43.1.1.1 remote-as 65512
R4(config-router)#neighbor 45.1.1.1 remote-as 65512
R4(config-router)#neighbor 45.1.1.1 next-hop-self #修改下一跳为本as内的设备
```

R5配置

```
R5(config)#router bgp 65512
R5(config-router)#no bgp log-neighbor-changes #取消BGP邻居状态变更日志记录
```

```
R5(config-router)#redistribute connected #重分发直连路由到BGP
```

```
R5(config-router)#neighbor 35.1.1.2 remote-as 65512
```

```
R5(config-router)#neighbor 35.1.1.2 next-hop-self
```

```
R5(config-router)#neighbor 45.1.1.2 remote-as 65512
```

```
R5(config-router)#neighbor 45.1.1.2 next-hop-self
```

3.2

R5 配置

```
R5(config)#router bgp 65512
R5(config-router)#redistribute connected #重分发直连路由进BGP
```

3.3

R1 配置

```
R1(config)#access-list 1 permit 192.168.1.0 0.0.0.255
#新建acl过滤掉运维部的路由条目，该路由条目不需要重分发进BGP
R1(config)#access-list 1 permit 192.168.2.0 0.0.0.255
R1(config)#access-list 1 permit 10.10.10.0 0.0.0.255
R1(config)#route-map osimport permit 10 #新建route-map过滤运维部的OSPF路由条目
R1(config-route-map)#match ip address 1 #匹配研发部、市场部和数据中心的路由条目
R1(config)#router bgp 65511
R1(config-router)#redistribute ospf 100 route-map osimport
#向AS65512重分发OSPF路由条目但过滤运维部的路由条目
```

4) 路由策略控制

4.1

R3 配置

```
R3(config)#access-list 1 permit 8.8.8.0 0.0.0.255
R3(config)#access-list 2 permit 114.114.114.0 0.0.0.255
R3(config)#access-list 99 permit any
R3(config)#route-map bgp2 permit 10
R3(config-route-map)#match ip address 1
R3(config-route-map)#set metric 1000 #设置med值
R3(config)#route-map bgp2 permit 20
R3(config-route-map)#match ip address 2
R3(config-route-map)#set metric 2000 #设置med值
R3(config)#route-map bgp2 permit 30
R3(config-route-map)#match ip address 99 #放行其他路由条目
R3(config)#router bgp 65512
R3(config-router)#neighbor 13.1.1.1 route-map bgp2 out #应用路由图到邻居13.1.1.1
```

R4配置

```
R4(config)#access-list 1 permit 8.8.8.0 0.0.0.255
R4(config)#access-list 2 permit 114.114.114.0 0.0.0.255
R4(config)#access-list 99 permit any
R4(config)#route-map bgp2 permit 10
R4(config-route-map)#match ip address 1
R4(config-route-map)#set metric 2000
R4(config)#route-map bgp2 permit 20
R4(config-route-map)#match ip address 2
R4(config-route-map)#set metric 1000
R4(config)#route-map bgp2 permit 30
R4(config-route-map)#match ip address 99 #放行其他路由条目
R4(config)#router bgp 65512
R4(config-router)#neighbor 14.1.1.1 route-map bgp2 out #应用路由图到邻居14.1.1.1
```


4.2

R3配置

```
R3(config)#access-list 3 permit 192.168.1.0 0.0.0.255
R3(config)#access-list 3 permit 192.168.2.0 0.0.0.255
R3(config)#access-list 4 permit 10.10.10.0 0.0.0.255
R3(config)#route-map bgp1 permit 10
R3(config-route-map)# match ip address 3
R3(config-route-map)#set local-preference 200 #设置local-preference值
R3(config)#route-map bgp1 permit 20
R3(config-route-map)#match ip address 4
R3(config-route-map)#set local-preference 50 #设置local-preference值
R3(config)#route-map bgp1 permit 30
R3(config-route-map)#match ip address 99
R3(config)#router bgp 65512
R3(config-router)#neighbor 35.1.1.1 route-map bgp1 out
```

R4配置

```
R4(config)#access-list 3 permit 10.10.10.0 0.0.0.255
R4(config)#access-list 4 permit 192.168.1.0 0.0.0.255
R4(config)#access-list 4 permit 192.168.2.0 0.0.0.255
R4(config)#route-map bgp1 permit 10
R4(config-route-map)#match ip address 3
R4(config-route-map)#set local-preference 200
R4(config)#route-map bgp2 permit 20
R4(config-route-map)# match ip address 4
R4(config-route-map)# set local-preference 50
R4(config)#route-map bgp2 permit 30
R4(config-route-map)#match ip address 99
R4(config)#router bgp 65512
R4(config-router)#neighbor 35.1.1.1 route-map bgp1 out
```

5) 策略路由

R2配置

```
R2(config)#access-list 100 permit ip 10.10.20.0 0.0.0.255 192.168.0.0 0.0.3.255
R2(config)#route-map out permit 10
R2(config-route-map)#match ip address 100
R2(config-route-map)#set ip next-hop 12.1.1.2 #设置目标下一跳地址
R2(config)#ip local policy route-map out #应用路由策略到出方向
```

SW1配置

```
SW1(config)#access-list 100 permit ip 192.168.1.0 0.0.0.255 10.10.20.0 0.0.0.255
SW1(config)#access-list 100 permit ip 192.168.2.0 0.0.0.255 10.10.20.0 0.0.0.255
SW1(config)#route-map out permit 10
SW1(config-route-map)#match ip address 100
SW1(config-route-map)#set ip next-hop 11.1.1.2 #设置目标下一跳地址
SW1(config)#ip local policy route-map out #应用路由策略到出方向
```

四、实验数据

1. 功能 1&3 测试

SW1

```
Gateway of last resort is 11.1.1.2 to network 0.0.0.0

0*E2  0.0.0.0/0 [110/1] via 11.1.1.2, 00:24:30, Vlan30
      8.0.0.0/32 is subnetted, 1 subnets
0 E2   8.8.8.8 [110/1] via 11.1.1.2, 00:17:16, Vlan30
      10.0.0.0/24 is subnetted, 2 subnets
0      10.10.10.0 [110/21] via 11.1.1.2, 00:20:28, Vlan30
0      10.10.20.0 [110/21] via 11.1.1.2, 00:20:28, Vlan30
      12.0.0.0/24 is subnetted, 1 subnets
0      12.1.1.0 [110/11] via 11.1.1.2, 00:24:30, Vlan30
      35.0.0.0/24 is subnetted, 1 subnets
0 E2   35.1.1.0 [110/1] via 11.1.1.2, 00:17:16, Vlan30
      45.0.0.0/24 is subnetted, 1 subnets
0 E2   45.1.1.0 [110/1] via 11.1.1.2, 00:17:16, Vlan30
      114.0.0.0/32 is subnetted, 1 subnets
0 E2   114.114.114.114 [110/1] via 11.1.1.2, 00:17:16, Vlan30
```

R1

```
Gateway of last resort is not set

      10.0.0.0/24 is subnetted, 2 subnets
0      10.10.10.0 [110/20] via 12.1.1.1, 00:27:40, Ethernet0/1
0      10.10.20.0 [110/20] via 12.1.1.1, 00:27:40, Ethernet0/1
      21.0.0.0/24 is subnetted, 1 subnets
0      21.1.1.0 [110/11] via 11.1.1.1, 00:26:23, Ethernet0/2
0      192.168.1.0/24 [110/11] via 11.1.1.1, 00:25:46, Ethernet0/2
0      192.168.2.0/24 [110/11] via 11.1.1.1, 00:25:36, Ethernet0/2
```

R2

```
Gateway of last resort is 12.1.1.2 to network 0.0.0.0

0*E2  0.0.0.0/0 [110/1] via 12.1.1.2, 00:28:11, Ethernet0/1
      8.0.0.0/32 is subnetted, 1 subnets
0 E2   8.8.8.8 [110/1] via 12.1.1.2, 00:19:37, Ethernet0/1
      11.0.0.0/24 is subnetted, 1 subnets
0      11.1.1.0 [110/20] via 12.1.1.2, 00:22:49, Ethernet0/1
      35.0.0.0/24 is subnetted, 1 subnets
0 E2   35.1.1.0 [110/1] via 12.1.1.2, 00:19:37, Ethernet0/1
      45.0.0.0/24 is subnetted, 1 subnets
0 E2   45.1.1.0 [110/1] via 12.1.1.2, 00:19:37, Ethernet0/1
      114.0.0.0/32 is subnetted, 1 subnets
0 E2   114.114.114.114 [110/1] via 12.1.1.2, 00:19:37, Ethernet0/1
0      192.168.1.0/24 [110/21] via 12.1.1.2, 00:22:49, Ethernet0/1
0      192.168.2.0/24 [110/21] via 12.1.1.2, 00:22:49, Ethernet0/1
```

2. 功能 2 测试

SW1

```

SW1#show ip ospf int vl 10
Vlan10 is up, line protocol is up
  Internet Address 192.168.1.254/24, Area 0, Attached via Network Statement
  Process ID 100, Router ID 3.3.3.3, Network Type BROADCAST, Cost: 1
  Topology-MTID      Cost      Disabled      Shutdown      Topology Name
           0           1          no           no           Base
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 3.3.3.3, Interface address 192.168.1.254
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:02
  Supports Link-local Signaling (LLS)
  Cisco NSF helper support enabled
  IETF NSF helper support enabled
  Index 1/3/3, flood queue length 0
  Next 0x0(0)/0x0(0)/0x0(0)
  Last flood scan length is 0, maximum is 0
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 0, Adjacent neighbor count is 0
  Suppress hello for 0 neighbor(s)

```

```

SW1#show ip ospf int vl 20
Vlan20 is up, line protocol is up
  Internet Address 192.168.2.254/24, Area 0, Attached via Network Statement
  Process ID 100, Router ID 3.3.3.3, Network Type BROADCAST, Cost: 1
  Topology-MTID      Cost      Disabled      Shutdown      Topology Name
           0           1          no           no           Base
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 3.3.3.3, Interface address 192.168.2.254
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:03
  Supports Link-local Signaling (LLS)
  Cisco NSF helper support enabled
  IETF NSF helper support enabled
  Index 1/4/4, flood queue length 0
  Next 0x0(0)/0x0(0)/0x0(0)
  Last flood scan length is 0, maximum is 0
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 0, Adjacent neighbor count is 0
  Suppress hello for 0 neighbor(s)

```

```

SW1#show ip ospf int vl 30
Vlan30 is up, line protocol is up
 Internet Address 11.1.1.1/24, Area 0, Attached via Network Statement
 Process ID 100, Router ID 3.3.3.3, Network Type BROADCAST, Cost: 1
Topology-MTID      Cost      Disabled      Shutdown      Topology Name
    0              1         no           no           Base
Transmit Delay is 1 sec, State DROTHER, Priority 0
Designated Router (ID) 1.1.1.1, Interface address 11.1.1.2
No backup designated router on this network
Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
  oob-resync timeout 40
  Hello due in 00:00:08
Supports Link-local Signaling (LLS)
Cisco NSF helper support enabled
IETF NSF helper support enabled
Index 1/1/1, flood queue length 0
Next 0x0(0)/0x0(0)/0x0(0)
Last flood scan length is 1, maximum is 1
Last flood scan time is 0 msec, maximum is 0 msec
Neighbor Count is 1, Adjacent neighbor count is 1
  Adjacent with neighbor 1.1.1.1 (Designated Router)
Suppress hello for 0 neighbor(s)

```

```

SW1#show ip ospf int vl 40
Vlan40 is up, line protocol is up
 Internet Address 21.1.1.1/24, Area 0, Attached via Network Statement
 Process ID 100, Router ID 3.3.3.3, Network Type BROADCAST, Cost: 1
Topology-MTID      Cost      Disabled      Shutdown      Topology Name
    0              1         no           no           Base
Transmit Delay is 1 sec, State DROTHER, Priority 0
No designated router on this network
No backup designated router on this network
Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
  oob-resync timeout 40
  Hello due in 00:00:08
Supports Link-local Signaling (LLS)
Cisco NSF helper support enabled
IETF NSF helper support enabled
Index 1/2/2, flood queue length 0
Next 0x0(0)/0x0(0)/0x0(0)
Last flood scan length is 1, maximum is 1
Last flood scan time is 0 msec, maximum is 0 msec
Neighbor Count is 1, Adjacent neighbor count is 0
Suppress hello for 0 neighbor(s)

```

R1

```

R1#show ip ospf int e0/1
Ethernet0/1 is up, line protocol is up
  Internet Address 12.1.1.2/24, Area 0, Attached via Network Statement
  Process ID 100, Router ID 1.1.1.1, Network Type BROADCAST, Cost: 10
  Topology-MTID      Cost      Disabled      Shutdown      Topology Name
           0           10         no           no           Base
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 1.1.1.1, Interface address 12.1.1.2
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:01
  Supports Link-local Signaling (LLS)
  Cisco NSF helper support enabled
  IETF NSF helper support enabled
  Index 1/2/2, flood queue length 0
  Next 0x0(0)/0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 4
  Last flood scan time is 0 msec, maximum is 1 msec
  Neighbor Count is 1, Adjacent neighbor count is 1
    Adjacent with neighbor 2.2.2.2
  Suppress hello for 0 neighbor(s)

```

```

R1#show ip ospf int e0/2
Ethernet0/2 is up, line protocol is up
  Internet Address 11.1.1.2/24, Area 0, Attached via Network Statement
  Process ID 100, Router ID 1.1.1.1, Network Type BROADCAST, Cost: 10
  Topology-MTID      Cost      Disabled      Shutdown      Topology Name
           0           10         no           no           Base
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 1.1.1.1, Interface address 11.1.1.2
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:03
  Supports Link-local Signaling (LLS)
  Cisco NSF helper support enabled
  IETF NSF helper support enabled
  Index 1/1/1, flood queue length 0
  Next 0x0(0)/0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 4
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1, Adjacent neighbor count is 1
    Adjacent with neighbor 3.3.3.3
  Suppress hello for 0 neighbor(s)

```

R2

```

R2#show ip ospf int e0/0
Ethernet0/0 is up, line protocol is up
  Internet Address 10.10.10.254/24, Area 0, Attached via Network Statement
  Process ID 100, Router ID 2.2.2.2, Network Type BROADCAST, Cost: 10
  Topology-MTID      Cost      Disabled      Shutdown      Topology Name
    0                10         no           no           Base
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 2.2.2.2, Interface address 10.10.10.254
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:06
  Supports Link-local Signaling (LLS)
  Cisco NSF helper support enabled
  IETF NSF helper support enabled
  Index 1/1/1, flood queue length 0
  Next 0x0(0)/0x0(0)/0x0(0)
  Last flood scan length is 0, maximum is 0
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 0, Adjacent neighbor count is 0
  Suppress hello for 0 neighbor(s)

```

```

R2#show ip ospf int e0/1
Ethernet0/1 is up, line protocol is up
  Internet Address 12.1.1.1/24, Area 0, Attached via Network Statement
  Process ID 100, Router ID 2.2.2.2, Network Type BROADCAST, Cost: 10
  Topology-MTID      Cost      Disabled      Shutdown      Topology Name
    0                10         no           no           Base
  Transmit Delay is 1 sec, State DROTHER, Priority 0
  Designated Router (ID) 1.1.1.1, Interface address 12.1.1.2
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:07
  Supports Link-local Signaling (LLS)
  Cisco NSF helper support enabled
  IETF NSF helper support enabled
  Index 1/3/3, flood queue length 0
  Next 0x0(0)/0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1, Adjacent neighbor count is 1
    Adjacent with neighbor 1.1.1.1 (Designated Router)
  Suppress hello for 0 neighbor(s)

```

```

R2#show ip ospf int e0/2
Ethernet0/2 is up, line protocol is up
  Internet Address 10.10.20.254/24, Area 0, Attached via Network Statement
  Process ID 100, Router ID 2.2.2.2, Network Type BROADCAST, Cost: 10
  Topology-MTID      Cost      Disabled      Shutdown      Topology Name
      0              10         no           no           Base
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 2.2.2.2, Interface address 10.10.20.254
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:03
  Supports Link-local Signaling (LLS)
  Cisco NSF helper support enabled
  IETF NSF helper support enabled
  Index 1/2/2, flood queue length 0
  Next 0x0(0)/0x0(0)/0x0(0)
  Last flood scan length is 0, maximum is 0
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 0, Adjacent neighbor count is 0
  Suppress hello for 0 neighbor(s)

```

```

R2#show ip ospf int e0/3
Ethernet0/3 is up, line protocol is up
  Internet Address 21.1.1.2/24, Area 0, Attached via Network Statement
  Process ID 100, Router ID 2.2.2.2, Network Type BROADCAST, Cost: 10
  Topology-MTID      Cost      Disabled      Shutdown      Topology Name
      0              10         no           no           Base
  Transmit Delay is 1 sec, State DROTHER, Priority 0
  No designated router on this network
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:02
  Supports Link-local Signaling (LLS)
  Cisco NSF helper support enabled
  IETF NSF helper support enabled
  Index 1/4/4, flood queue length 0
  Next 0x0(0)/0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1, Adjacent neighbor count is 0
  Suppress hello for 0 neighbor(s)

```

3. 功能 4 测试

R3

```

R3#show ip route bgp
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, p - overrides from PfR

Gateway of last resort is not set

      8.0.0.0/32 is subnetted, 1 subnets
B       8.8.8.8 [200/0] via 35.1.1.1, 01:11:25
      10.0.0.0/24 is subnetted, 1 subnets
B       10.10.10.0 [20/20] via 13.1.1.1, 01:09:08
      45.0.0.0/24 is subnetted, 1 subnets
B       45.1.1.0 [200/0] via 35.1.1.1, 01:11:25
      114.0.0.0/32 is subnetted, 1 subnets
B       114.114.114.114 [200/0] via 35.1.1.1, 01:11:25
B       192.168.1.0/24 [20/11] via 13.1.1.1, 01:09:08
B       192.168.2.0/24 [20/11] via 13.1.1.1, 01:09:08

```

R4

```

R4#show ip route bgp
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, p - overrides from PfR

Gateway of last resort is not set

      8.0.0.0/32 is subnetted, 1 subnets
B       8.8.8.8 [200/0] via 45.1.1.1, 01:12:16
      10.0.0.0/24 is subnetted, 1 subnets
B       10.10.10.0 [20/20] via 14.1.1.1, 01:09:58
      35.0.0.0/24 is subnetted, 1 subnets
B       35.1.1.0 [200/0] via 45.1.1.1, 01:12:16
      114.0.0.0/32 is subnetted, 1 subnets
B       114.114.114.114 [200/0] via 45.1.1.1, 01:12:16
B       192.168.1.0/24 [20/11] via 14.1.1.1, 01:09:58
B       192.168.2.0/24 [20/11] via 14.1.1.1, 01:09:58

```

R5


```

R5#show ip route bgp
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, p - overrides from PfR

Gateway of last resort is not set

    10.0.0.0/24 is subnetted, 1 subnets
B       10.10.10.0 [200/20] via 45.1.1.2, 01:03:27
B       192.168.1.0/24 [200/11] via 35.1.1.2, 01:03:27
B       192.168.2.0/24 [200/11] via 35.1.1.2, 01:03:27

```

4. 功能 5 验证

PC1&R5

```

PC1> trace 114.114.114.114
trace to 114.114.114.114, 8 hops max, press Ctrl+C to stop
 1  192.168.1.254    0.211 ms  0.209 ms  0.222 ms
 2  11.1.1.2        0.493 ms  0.351 ms  0.274 ms
 3  14.1.1.2        0.492 ms  0.444 ms  0.361 ms
 4  *45.1.1.1       0.619 ms (ICMP type:3, code:3, Destination port unreachable) *

PC1> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1  192.168.1.254    0.236 ms  0.128 ms  0.120 ms
 2  11.1.1.2        0.307 ms  0.266 ms  0.228 ms
 3  13.1.1.2        0.480 ms  0.334 ms  0.312 ms
 4  *35.1.1.1       0.582 ms (ICMP type:3, code:3, Destination port unreachable) *

```

R5&PC1

```

R5>trace 192.168.1.1
Type escape sequence to abort.
Tracing the route to 192.168.1.1
VRF info: (vrf in name/id, vrf out name/id)
 1 35.1.1.2 0 msec 1 msec 0 msec
 2 13.1.1.1 0 msec 0 msec 1 msec
 3 11.1.1.1 0 msec 1 msec 1 msec
 4 192.168.1.1 [AS 65511] 1 msec 1 msec 1 msec

```

R5&DC

```

R5>trace 10.10.10.1
Type escape sequence to abort.
Tracing the route to 10.10.10.1
VRF info: (vrf in name/id, vrf out name/id)
 1 45.1.1.2 1 msec 0 msec 0 msec
 2 14.1.1.1 1 msec 1 msec 0 msec
 3 12.1.1.1 1 msec 0 msec 1 msec
 4 10.10.10.1 [AS 65511] 1 msec 0 msec 0 msec

```

5. 功能 6 验证

PC1&PC3

```

PC1> trace 10.10.20.1
trace to 10.10.20.1, 8 hops max, press Ctrl+C to stop
 1  192.168.1.254    0.209 ms  0.159 ms  0.163 ms
 2  11.1.1.2        0.337 ms  0.310 ms  0.253 ms
 3  12.1.1.1        0.593 ms  0.355 ms  0.447 ms
 4  *10.10.20.1     1.551 ms (ICMP type:3, code:3, Destination port unreachable)

```

```
PC3> trace 192.168.1.1
trace to 192.168.1.1, 8 hops max, press Ctrl+C to stop
 1  10.10.20.254    0.230 ms  0.113 ms  0.105 ms
 2  12.1.1.2       0.279 ms  0.212 ms  0.215 ms
 3  11.1.1.1       0.411 ms  0.474 ms  0.355 ms
 4  *192.168.1.1   0.500 ms (ICMP type:3, code:3, Destination port unreachable)
```