实验：OSPF 双栈

HCIE 综合实验 - OSPF 双栈

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OSPF 双栈 1： OSPF 基本配置
OSPF 双栈 2： OSPFv3 基础
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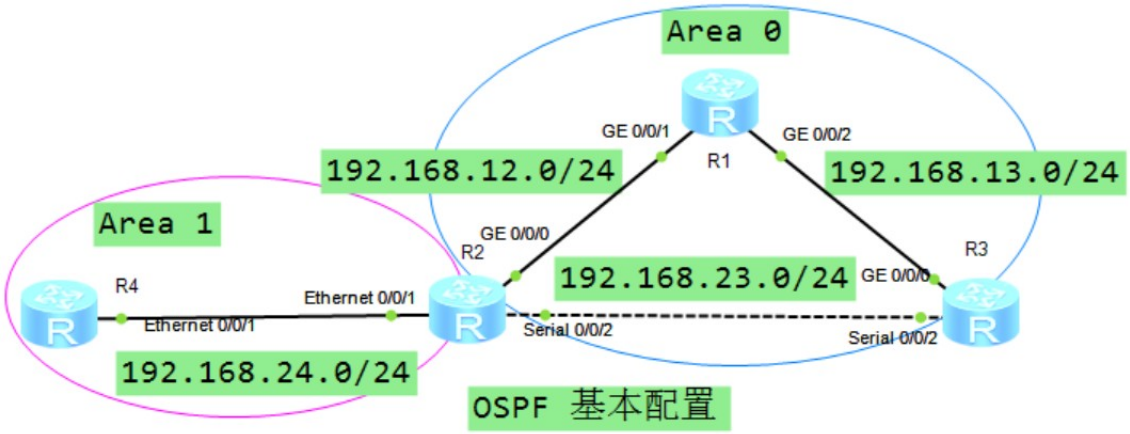
OSPF 双栈 1： OSPF 基本配置

OSPF 协议是为 IP 协议提供路由功能的路由协议。OSPFv2（OSPF 版本 2）是支持 IPv4 的路由协议



基本 IP 地址配置
R1:
```
undo terminal monitor
sys
sysname R1
int loop 0
ip add 1.1.1.1 24
int g0/0/1
ip add 192.168.12.1 24
int g0/0/2
ip add 192.168.13.1 24
q
```

R2:
```
undo terminal monitor
sys
sysname R2
int loop 0
ip add 2.2.2.2 24
int g0/0/0
ip add 192.168.12.2 24
int s0/0/2
ip add 192.168.23.2 24
int e0/0/1
ip add 192.168.24.2 24
quit
```

R3:
```
undo terminal monitor
sys
sysname R3
int loop 0
ip add 3.3.3.3 24
```

```
int g0/0/0
ip add 192.168.13.3 24
int s0/0/2
ip add 192.168.23.3 24
quit

R4:
undo terminal monitor
sys
sysname R4
int loop 0
ip add 4.4.4.4 24
int e0/0/1
ip add 192.168.24.4 24
quit
```

配置 OSPF 协议

使用 network 来指定运行 OSPF 协议的接口和接口所在的区域。配置中需要注意，尽量精确匹配。

```
R1:
ospf router-id 1.1.1.1
area 0
network 192.168.12.1 0.0.0.0
network 192.168.13.1 0.0.0.0
network 1.1.1.1 0.0.0.0
q

R2:
ospf router-id 2.2.2.2
area 0
network 2.2.2.2 0.0.0.0
network 192.168.12.2 0.0.0.0
network 192.168.23.2 0.0.0.0
```

area 1
network 192.168.24.2 0.0.0.0
q

R3:
ospf router-id 3.3.3.3
area 0
network 3.3.3.3 0.0.0.0
network 192.168.13.3 0.0.0.0
network 192.168.23.3 0.0.0.0
q

R4:
ospf router-id 4.4.4.4
area 1
network 4.4.4.4 0.0.0.0
network 192.168.24.4 0.0.0.0
q

查看 OSPF 的 3 张表
dis ospf peer brief
dis ospf lsdb
dis ip routing-table protocol ospf

[R1]dis ospf peer brief

OSPF Process 1 with Router ID 1.1.1.1
Peer Statistic Information

Area Id Interface

```
Neighbor id             State
 0.0.0.0
GigabitEthernet0/0/1
2.2.2.2                       Full
 0.0.0.0
GigabitEthernet0/0/2
3.3.3.3                       Full

------------------------------------------
-----------------------------
[R1]

[R1]dis ospf lsdb

     OSPF Process 1 with Router ID 1.1.1.1
         Link State Database

                          Area: 0.0.0.0
 Type              LinkState ID
AdvRouter                     Age    Len
Sequence      Metric
 Router         2.2.2.2
2.2.2.2                        53    72
80000007              0
 Router         1.1.1.1
1.1.1.1                        46    60
80000008              0
 Router         3.3.3.3
3.3.3.3                        45    72
80000006              0
```

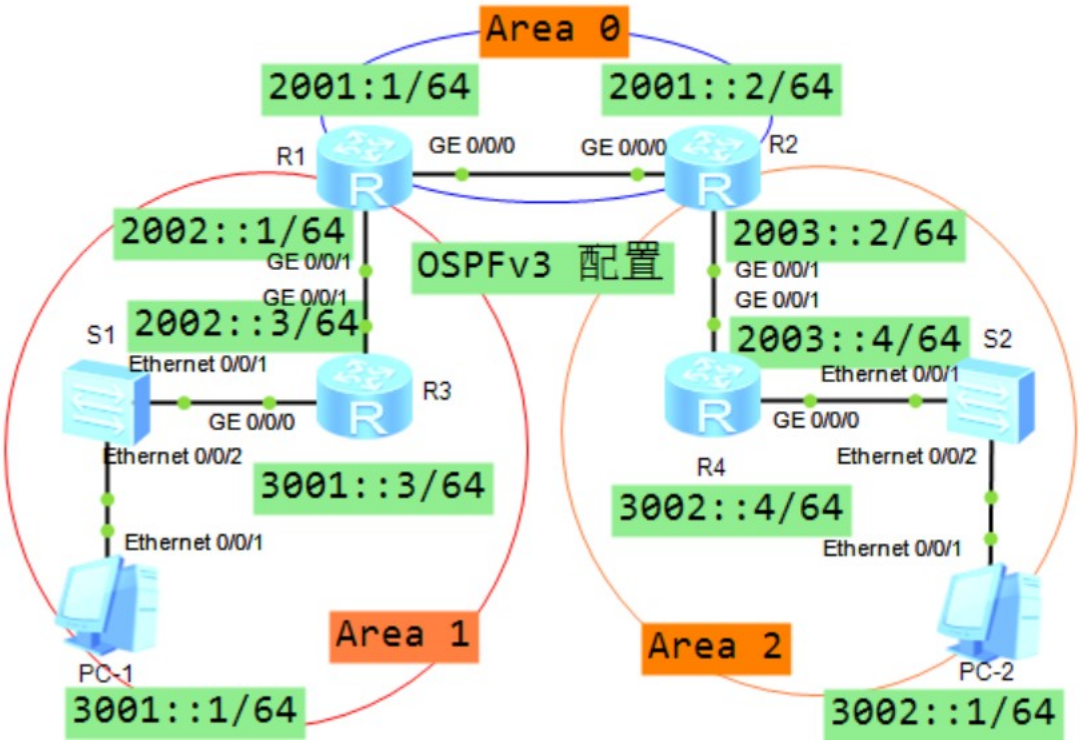
```
 Network      192.168.13.3         3.3.3.3
45    32        80000002              0
 Network      192.168.12.2         2.2.2.2
53    32        80000002              0
 Sum-Net      192.168.24.0         2.2.2.2
93    28        80000001              1
 Sum-Net      4.4.4.4
2.2.2.2                           37    28
80000001

[R1]dis ip routing-table protocol ospf


Destination/Mask        Proto      Pre
Cost        Flags NextHop
Interface

2.2.2.2/32    OSPF        10      1
D      192.168.12.2
GigabitEthernet0/0/1
3.3.3.3/32    OSPF        10      1
D      192.168.13.3
GigabitEthernet0/0/2
4.4.4.4/32    OSPF        10      2
D      192.168.12.2
GigabitEthernet0/0/1
192.168.23.0/24    OSPF        10      1563
D    192.168.12.2      GigabitEthernet0/0/1
                                    OSPF
10      1563    D    192.168.13.3
```

```
GigabitEthernet0/0/2
192.168.24.0/24    OSPF         10       2
D       192.168.12.2
GigabitEthernet0/0/1
```

= = = = = = = = = =

OSPF 双栈 2： OSPFv3 基础

OSPFv3 设计时基于 OSPFv2 ，但又区别于 OSPFv2 ， 其改进了 OSPFv2 协议的缺点，增强了协议的扩展性及灵活性。



基本 IP 地址配置

R1:

```
undo ter mo
sy
```

```
sys R1
ipv6
int g0/0/0
ipv6 enable
ipv6 add 2001::1/64
int g0/0/1
ipv6 enable
ipv6 add 2002::1/64
q

R2:
undo ter mo
sy
sys R2
ipv6
int g0/0/0
ipv6 enable
ipv6 add 2001::2/64
int g0/0/1
ipv6 enable
ipv6 add 2003::2/64
q

R3:
undo ter mo
sy
sys R3
ipv6
int g0/0/0
ipv6 enable
ipv6 add 3001::3/64
int g0/0/1
ipv6 enable
ipv6 add 2002::3/64
```

q

R4:
undo ter mo
sy
sys R4
ipv6
int g0/0/0
ipv6 enable
ipv6 add 3002::4/64
int g0/0/1
ipv6 enable
ipv6 add 2003::4/64
q

配置 OSPFv3 协议 ，先全局起 OSPFv3 协议的 router id ，之后在接口下配置
R1 :
ospfv3 1
router-id 1.1.1.1
int g0/0/0
ospfv3 1 area 0
int g0/0/1
ospfv3 1 area 1
q

R2 :
ospfv3 1
router-id 2.2.2.2
int g0/0/0
ospfv3 1 area 0
int g0/0/1
ospfv3 1 area 2
q

R3：
ospfv3 1
router-id 3.3.3.3
int g0/0/0
ospfv3 1 area 1
int g0/0/1
ospfv3 1 area 1
q

R4：
ospfv3 1
router-id 4.4.4.4
int g0/0/0
ospfv3 1 area 2
int g0/0/1
ospfv3 1 area 2
q

配置完成后，查看　DR ,是邻居为 DR
dis ospfv3 peer
dis ospfv3 lsdb
dis ospfv3 routing
dis ospfv3 topology
dis ospfv3 int g0/0/0

R1:
dis ospfv3 peer
dis ospfv3 peer verbose

[R1]dis ospfv3 peer
OSPFv3 Process (1)
OSPFv3 Area (0.0.0.0)

```
Neighbor ID          Pri    State       Dead
Time Interface             Instance ID
2.2.2.2                  1    Full/DR
00:00:37    GE0/0/0                      0
OSPFv3 Area (0.0.0.1)
Neighbor ID          Pri    State       Dead
Time Interface             Instance ID
3.3.3.3                  1    Full/DR
00:00:39  GE0/0/1                      0
```

dis ospfv3 lsdb

```
                        OSPFv3 Router with ID
(1.1.1.1) (Process 1)
                                  Link-LSA
(Interface GigabitEthernet0/0/0)

Link State ID      Origin Router        Age
Seq#               CkSum    Prefix
0.0.0.3                  1.1.1.1
0248    0x80000001 0xd301            1
0.0.0.3                  2.2.2.2
0220    0x80000001 0xddc8            1

                                  Intra-Area-
Prefix-LSA (Area 0.0.0.1)

Link State ID      Origin Router        Age
Seq#               CkSum    Prefix
Reference
0.0.0.1                  3.3.3.3
```

```
0166    0x80000004 0xc7b0      1    Router-
LSA
0.0.0.2                   3.3.3.3
0170    0x80000001 0xc2c2      1
Network-LSA
```

dis ospfv3 routing

```
[R1]dis ospfv3 routing

Codes : E2 - Type 2 External, E1 - Type 1
External, IA - Inter-Area,
                N - NSSA, U - Uninstalled

OSPFv3 Process (1)
          Destination
Metric
              Next-hop
          2001::/64
1
              directly connected,
GigabitEthernet0/0/0
          2002::/64
1
              directly connected,
GigabitEthernet0/0/1
    IA 2003::/64
2
              via FE80::2E0:FCFF:FE81:47EE,
GigabitEthernet0/0/0
          3001::/64
```

```
2
                via FE80::2E0:FCFF:FEE2:3D24,
GigabitEthernet0/0/1
    IA 3002::/64
3
                via FE80::2E0:FCFF:FE81:47EE,
GigabitEthernet0/0/0
```

dis ospfv3 topology

```
[R1]dis ospfv3 topology
OSPFv3 Process (1)
OSPFv3 Area (0.0.0.0) topology
Type    ID(If-Index)
Bits         Metric    Next-Hop
Interface
Rtr      1.1.1.1
B        --
Rtr      2.2.2.2
B        1               2.2.2.2
GE0/0/0
Net      2.2.2.2(3)
1              0.0.0.0
GE0/0/0

OSPFv3 Area (0.0.0.1) topology
Type    ID(If-Index)
Bits         Metric    Next-Hop
Interface
Rtr      1.1.1.1
```

```
B          --
Rtr        3.3.3.3
1                  3.3.3.3
GE0/0/1
Net        3.3.3.3(4)
1                  0.0.0.0
GE0/0/1
```

```
dis ospfv3 int g0/0/0
```

```
[R1]dis ospfv3 int g0/0/0
GigabitEthernet0/0/0 is up, line protocol
is up
  Interface ID 0x3
    Interface MTU 1500
    IPv6 Prefixes
        FE80::2E0:FCFF:FEB5:6770 (Link-
Local Address)
        2001::1/64
    OSPFv3 Process (1), Area 0.0.0.0,
Instance ID 0
        Router ID 1.1.1.1, Network Type
BROADCAST, Cost: 1
        Transmit Delay is 1 sec, State
Backup, Priority 1
```

两台 PC 可以相互通信

```
PC>ping 3002::1
Ping 3002::1: 32 data bytes, Press Ctrl_C to break
Request timeout!
```

From 3002::1: bytes=32 seq=2 hop limit=251 time=125 ms
From 3002::1: bytes=32 seq=3 hop limit=251 time=94 ms
From 3002::1: bytes=32 seq=4 hop limit=251 time=78 ms

OSPFv3 多进程

OSPF 支持多进程，在同一台路由器上可以运行多个不同的 OSPF 进程，它们之间互不影响，彼此独立。不同 OSPF 进程之间的路由交互相当于不同路由协议之间的路由交互。
路由器的一个接口只能属于某一个 OSPF 进程。
R2 上运行两个进程 ， 1 和 2 ，把 g0/0/1 放在进程 2 中，进程 1 与进程 2 进行相互引入

```
int g0/0/1
und ospfv3 1 area 2

ospfv3 2
router-id 21.21.21.21
int g0/0/1
ospfv3 2 area 2
```

在 R2 的把 OSPFv3 的 2 个进程相互引入
R2：

```
ospfv3 1
import-route ospfv3 2

ospfv3 2
import-route ospfv3 1
```

查看 R1 上学习到的路由 ，宣告的路由为 IA ，引入的路由

默认为 E2 类型的

```
<R1>dis ospfv3 routing

Codes : E2 - Type 2 External, E1 - Type 1
External, IA - Inter-Area,
                N - NSSA, U - Uninstalled

OSPFv3 Process (1)
          Destination
Metric
              Next-hop
          2001::/64
1
              directly connected,
GigabitEthernet0/0/0
          2002::/64
1
              directly connected,
GigabitEthernet0/0/1
    E2 2003::/64
1
              via FE80::2E0:FCFF:FE81:47EE,
GigabitEthernet0/0/0
          3001::/64
2
              via FE80::2E0:FCFF:FEE2:3D24,
GigabitEthernet0/0/1
    E2 3002::/64
1
              via FE80::2E0:FCFF:FE81:47EE,
```

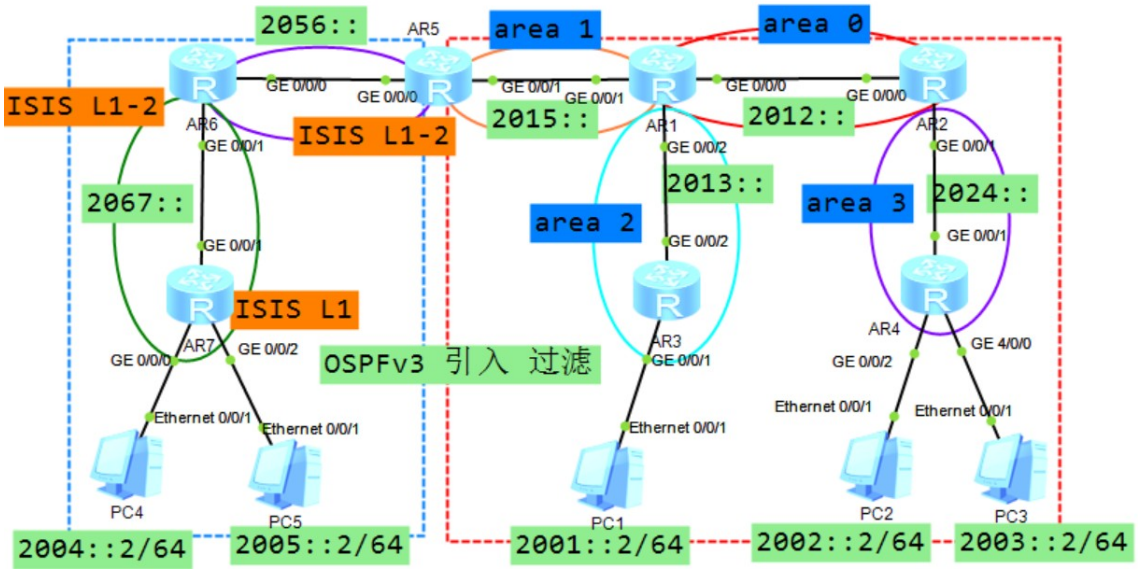
GigabitEthernet0/0/0

两个进程相互引入后，两台 PC 还是可以相互通信的
PC>ping 3002::1
Ping 3002::1: 32 data bytes, Press Ctrl_C to break
From 3002::1: bytes=32 seq=2 hop limit=251
time=125 ms

= = = = = = = = = =

OSPF 双栈 3： OSPFv3 引入 过滤

在大型园区网络中，往往使用不同的路由协议进行组网，实现全网的网络互通。不同的协议间通信，除了路由协议本身，还需要引入外部路由及路由信息过滤等技术。



基本 IP 地址配置

R1:
undo ter mo
sy
sys R1

```
ipv6
int g0/0/0
ipv6 enable
ipv6 add 2012::1/64
int g0/0/1
ipv6 enable
ipv6 add 2015::1/64
int g0/0/2
ipv6 enable
ipv6 add 2013::1/64
q
```

R2:

```
undo ter mo
sy
sys R2
ipv6
int g0/0/0
ipv6 enable
ipv6 add 2012::2/64
int g0/0/1
ipv6 enable
ipv6 add 2024::2/64
q
```

R3:

```
undo ter mo
sy
sys R3
ipv6
int g0/0/1
ipv6 enable
ipv6 add 2001::3/64
int g0/0/2
```

ipv6 enable
ipv6 add 2013::3/64
q

R4:
undo ter mo
sy
sys R4
ipv6
int g0/0/1
ipv6 enable
ipv6 add 2024::4/64
int g0/0/2
ipv6 enable
ipv6 add 2002::4/64
int g4/0/0
ipv6 enable
ipv6 add 2003::4/64
q

R5:
undo ter mo
sy
sys R5
ipv6
int g0/0/0
ipv6 enable
ipv6 add 2056::5/64
int g0/0/1
ipv6 enable
ipv6 add 2015::5/64
q

R6:

undo ter mo
sy
sys R6
ipv6
int g0/0/0
ipv6 enable
ipv6 add 2056::6/64
int g0/0/1
ipv6 enable
ipv6 add 2067::6/64
q

R7:
undo ter mo
sy
sys R7
ipv6
int g0/0/0
ipv6 enable
ipv6 add 2004::7/64
int g0/0/1
ipv6 enable
ipv6 add 2067::7/64
int g0/0/2
ipv6 enable
ipv6 add 2005::7/64
q

配置 OSPFv3 和 ISISv6

PC 接口引入直连的方式，进入 OSPFv3

R1:
ospfv3 1
router-id 1.1.1.1

```
int g0/0/0
ospfv3 1 area 0
int g0/0/1
ospfv3 1 area 1
int g0/0/2
ospfv3 1 area 2
q
```

R2:

```
ospfv3 1
router-id 2.2.2.2
int g0/0/0
ospfv3 1 area 0
int g0/0/1
ospfv3 1 area 3
q
```

R3:

```
ospfv3 1
router-id 3.3.3.3
int g0/0/2
ospfv3 1 area 2
q
```

R4:

```
ospfv3 1
router-id 4.4.4.4
int g0/0/1
ospfv3 1 area 3
q
```

R5:

```
ospfv3 1
router-id 5.5.5.5
```

```
int g0/0/1
ospfv3 1 area 1
q
```

R3 R4 引入直连接口

R3 :

```
ospfv3 1
import-route direct
q
```

R4 :

```
ospfv3 1
import-route direct
q
```

配置 ISISv6 协议

R5:

```
isis 1
ipv6 enable
is-level level-1-2
network-entity 10.0000.0000.0005.00
is-name R5
int g0/0/0
isis ipv6 enable
q
```

R6:

```
isis 1
ipv6 enable
is-level level-1-2
network-entity 10.0000.0000.0006.00
is-name R6
int g0/0/0
isis ipv6 enable
```

int g0/0/1
isis ipv6 enable
q

R7:
isis 1
ipv6 enable
is-level level-1
network-entity 10.0000.0000.0007.00
is-name R7
int g0/0/1
isis ipv6 enable
q
引入 ISIS 直连接口
R7 :
isis
ipv6 import-route direct level-1
q

R6 查看 ISIS 邻居关系的建立
R6: dis isis peer

```
Peer information for ISIS(1)

System Id          Interface
Circuit Id          State HoldTime Type
PRI
-------------------------------------------
-------------------------------
R5                                GE0/0/0
R5.01                        Up      8s
```

```
L1(L1L2) 64
R5                                  GE0/0/0
R5.01                           Up       8s
L2(L1L2) 64
R7                                  GE0/0/1
R7.02                           Up       7s
L1              64
```

路由重分发

在 R5 上配置 ISISv6 路由与 OSPFv3 路由的相互引入

R5:

```
ospfv3
import-route isis 1
q
isis 1
ipv6 import-route ospfv3 1
q
```

在 R6 上配置默认路由下发，使 R7 能正常访问外部网络。

R6:

```
isis
ipv6 default-route-advertise level-1
q
```

现在 5 台 PC 是可以相互 ping 通的

```
PC>ping 2001::2

Ping 2001::2: 32 data bytes, Press Ctrl_C to break
From 2001::2: bytes=32 seq=1 hop limit=250
time=31 ms
```

配置 OSPFv3 路由过滤

让 PC1　无法访问　PC2
R3:
acl ipv6 2000
rule deny source 2002:: 64
rule permit
q

ospfv3
filter-policy 2000 import
q
验证效果两台 PC 无法通信

配置让 PC2　PC3 无法访问　PC4 通信
R4:
acl ipv6 2000
rule deny source 2004:: 64
rule permit
q

ospfv3
filter-policy 2000 import
q
验证效果