

华为路由交换由浅入深系列(四) : OSPF 单区域、多区域配置、 时间参数 DR/BDR 选举 重分布路由与认证演示

掌握目标

一基本配置：

二、OSPF 单区域配置

三、修改 OSPF Hello 和 Dead 时间

四、OSPF 重分布默认路由

五、OSPF DR/BDR 选举

六、配置 OSPF 多区域

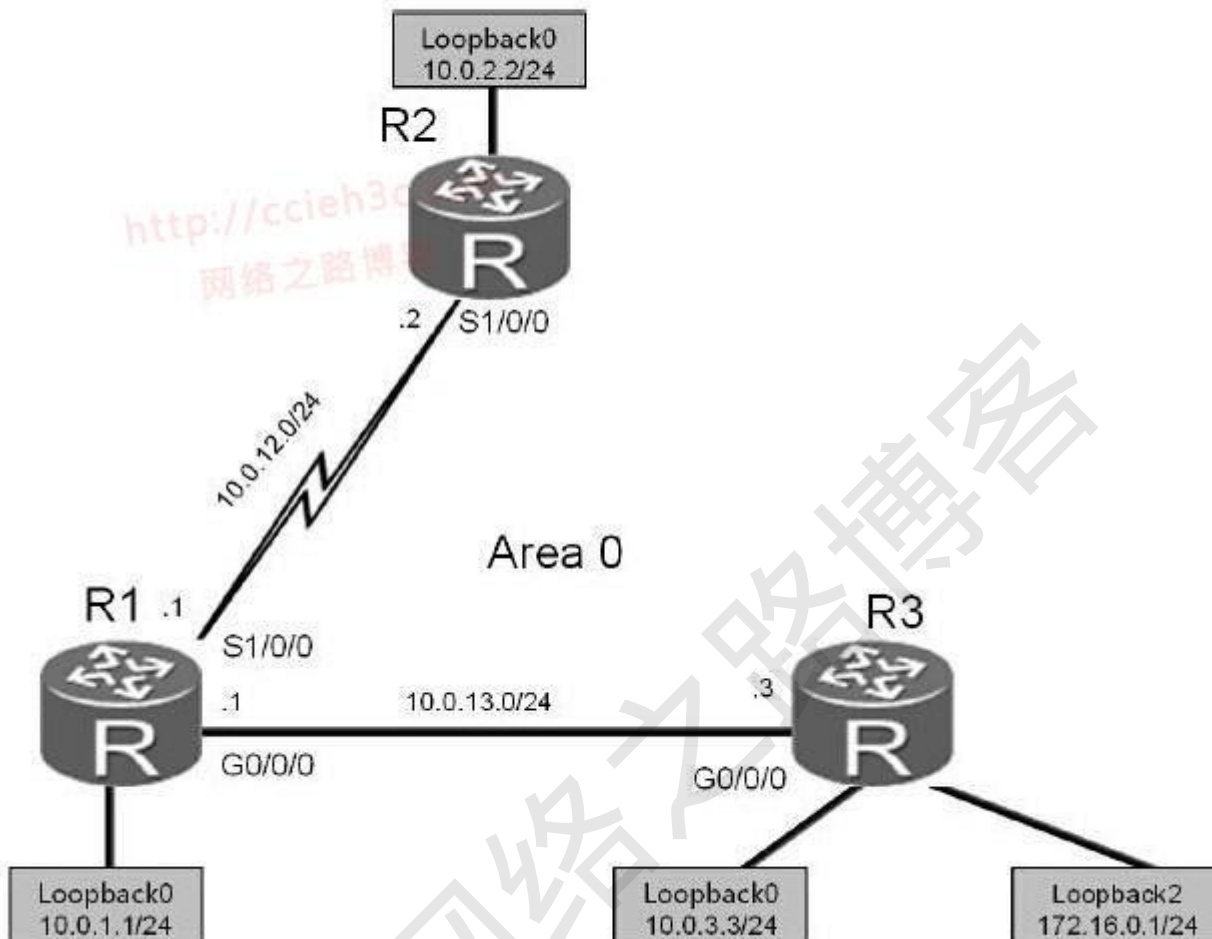
七、OSPF 直连路由重分布

八、配置 OSPF 认证

第四部分 OSPF配置

LAB1:

一、实验拓扑如下：



一、基本配置如下：

R1：

```
interface Serial1/0/0
ip address 10.0.12.1 255.255.255.0

interface GigabitEthernet0/0/0
ip address 10.0.13.1 255.255.255.0
```

```
interface LoopBack0

ip address 10.0.1.1 255.255.255.0
```

```
R2:

interface Serial1/0/0

ip address 10.0.12.2 255.255.255.0

interface LoopBack0

ip address 10.0.2.2 255.255.255.0
```

```
R3:

interface GigabitEthernet0/0/0

ip address 10.0.13.3 255.255.255.0
```

```
interface LoopBack0

ip address 10.0.3.3 255.255.255.0

interface LoopBack1

ip address 172.16.0.1 255.255.255.0
```

测试：

```
[R1]ping -c 2 10.0.12.2

PING 10.0.12.2: 56 data bytes, press CTRL_C to break

Reply from 10.0.12.2: bytes=56 Sequence=1 ttl=255 time=50 ms

Reply from 10.0.12.2: bytes=56 Sequence=2 ttl=255 time=10 ms

[R1]ping -c 2 10.0.13.3

PING 10.0.13.3: 56 data bytes, press CTRL_C to break

Reply from 10.0.13.3: bytes=56 Sequence=1 ttl=255 time=30 ms

Reply from 10.0.13.3: bytes=56 Sequence=2 ttl=255 time=10 ms
```

二、OSPF 配置如下：

[R1]ospf 1 router-id 10.0.1.1 =====启用 OPSF 进程，默认进程 ID 为 1.进程 ID 只具有本地意义，所以同一区域的不同路由器可以使用相同或者不同进程 ID。

```
[R1-ospf-1]are 0

[R1-ospf-1-area-0.0.0.0]network 10.0.1.0 0.0.0.255 =====network 后面配置反掩码

[R1-ospf-1-area-0.0.0.0]network 10.0.13.0 0.0.0.255

[R1-ospf-1-area-0.0.0.0]network 10.0.12.0 0.0.0.255
```

```
[R2]ospf 10 router-id 10.0.2.2

[R2-ospf-10]area 0

[R2-ospf-10-area-0.0.0.0]network 10.0.12.0 0.0.0.255

[R2-ospf-10-area-0.0.0.0]network 10.0.2.0 0.0.0.255
```

```
[R3]ospf 100 router-id 10.0.3.3

[R3-ospf-100]area 0

[R3-ospf-100-area-0.0.0.0]network 10.0.13.0 0.0.0.255

[R3-ospf-100-area-0.0.0.0]network 10.0.3.0 0.0.0.255
```

R1>display ip routing-table protocol ospf ===查看路由表中 OSPF 路由信息

Route Flags: R - relay, D - download to fib

Public routing table : OSPF

Destinations : 2 Routes : 2

OSPF routing table status : <Active>

Destinations : 2 Routes : 2

Destination/Mask	Proto	Pre	Cost	Flags	NextHop	Interface
10.0.2.2/32	OSPF	10	48	D	10.0.12.2	Serial1/0/0
10.0.3.3/32	OSPF	10	1	D	10.0.13.3	GigabitEthernet0/0/0

OSPF routing table status : <Inactive>

Destinations : 0 Routes : 0

```
测试：

<R1>ping -c 1 10.0.2.2

PING 10.0.2.2: 56 data bytes, press CTRL_C to break

Reply from 10.0.2.2: bytes=56 Sequence=1 ttl=255 time=10 ms
```

--- 10.0.2.2 ping statistics ---

1 packet(s) transmitted

1 packet(s) received

0.00% packet loss

round-trip min/avg/max = 10/10/10 ms

<R1>ping -c 1 10.0.3.3

PING 10.0.3.3: 56 data bytes, press CTRL_C to break

Reply from 10.0.3.3: bytes=56 Sequence=1 ttl=255 time=10 ms

--- 10.0.3.3 ping statistics ---

1 packet(s) transmitted

1 packet(s) received

0.00% packet loss

round-trip min/avg/max = 10/10/10 ms

<R1>display ospf peer ===显示 OSPF 邻居详细信息

OSPF Process 1 with Router ID 10.0.12.1

Neighbors

Area 0.0.0.0 interface 10.0.12.1(Serial1/0/0)'s neighbors

Router ID: 10.0.2.2 Address: 10.0.12.2

State: Full Mode:Nbr is Slave Priority: 1

DR: None BDR: None MTU: 0

Dead timer due in 32 sec

Retrans timer interval: 5

Neighbor is up for 00:09:52

Authentication Sequence: [0]

Neighbors

Area 0.0.0.0 interface 10.0.13.1(GigabitEthernet0/0/0)'s neighbors

Router ID: 10.0.3.3 Address: 10.0.13.3

State: Full Mode:Nbr is Slave Priority: 1

DR: 10.0.13.1 BDR: 10.0.13.3 MTU: 0

Dead timer due in 34 sec

Retrans timer interval: 5

Neighbor is up for 00:06:50

Authentication Sequence: [0]

<R1>display ospf peer brief ===显示 OSPF 简洁信息

OSPF Process 1 with Router ID 10.0.12.1

Peer Statistic Information

Area Id	Interface	Neighbor id	State
---------	-----------	-------------	-------

0.0.0.0	Serial1/0/0	10.0.2.2	Full
0.0.0.0	GigabitEthernet0/0/0	10.0.3.3	Full

三、修改 OSPF Hello 和 Dead 时间

<R1>display ospf interface g0/0/0 ===查看 OSPF Hello 与 Dead 默认时间

OSPF Process 1 with Router ID 10.0.12.1

Interfaces

Interface: 10.0.13.1 (GigabitEthernet0/0/0)

Cost: 1 State: DR Type: Broadcast MTU: 1500

Priority: 1

Designated Router: 10.0.13.1

Backup Designated Router: 10.0.13.3

Timers: Hello 10 , Dead 40 , Poll 120 , Retransmit 5 , Transmit Delay 1

[R3]int g0/0/0

[R3-GigabitEthernet0/0/0]ospf timer hello 15

[R3-GigabitEthernet0/0/0]ospf timer dead 60

<R1>display ip routing-table protocol ospf

Route Flags: R - relay, D - download to fib

Public routing table : OSPF

Destinations : 1 Routes : 1

OSPF routing table status : <Active>

Destinations : 1 Routes : 1

Destination/Mask	Proto	Pre	Cost	Flags	NextHop	Interface
10.0.2.2/32	OSPF	10	48	D	10.0.12.2	Serial1/0/0

OSPF routing table status : <Inactive>

Destinations : 0 Routes : 0

注：由于 R1 和 R3 之间 hello 与 dead 时间不一致，所以邻居无法建立。

[R1]int g0/0/0

[R1-GigabitEthernet0/0/0]ospf timer hello 15

[R1-GigabitEthernet0/0/0]ospf timer dead 60

[R1]display ip routing-table protocol ospf

Route Flags: R - relay, D - download to fib

Public routing table : OSPF

Destinations : 2 Routes : 2

OSPF routing table status : <Active>

Destinations : 2 Routes : 2

Destination/Mask	Proto	Pre	Cost	Flags	NextHop	Interface
10.0.2.2/32	OSPF	10	48	D	10.0.12.2	Serial1/0/0
10.0.3.3/32	OSPF	10	1	D	10.0.13.3	GigabitEthernet0/0/0

OSPF routing table status : <Inactive>

Destinations : 0 Routes : 0

=====OSPF 邻居建立必要条件=====

- 1.router-id 不能相同
- 2.hello and dead 必须相同
- 3.区域 ID 必须相同
- 4.认证 key-id 及密码必须相同
- 5.特殊区域标记相同
- 6.三层 MTU 必须相同
- 7.子网掩码必须相同（ 在一个需要 DR/BDR 环境中 ）
- 8.最小范围内的双向互通

=====

四、OSPF 重分布默认路由

```
[R3]ip route-static 0.0.0.0 0 lo 1
```

[R3]ospf 100

[R3-ospf-100]default-route-advertise ===重分布默认路由

<R1>display ip routing-table protocol os | in 0.0.0.0

Route Flags: R - relay, D - download to fib

Public routing table : OSPF

Destinations : 3 Routes : 3

OSPF routing table status : <Active>

Destinations : 3 Routes : 3

Destination/Mask	Proto	Pre	Cost	Flags	NextHop	Interface
0.0.0.0/0	O_ASE	150	1	D	10.0.13.3	GigabitEthernet0/0/0

OSPF routing table status : <Inactive>

Destinations : 0 Routes : 0

<R1>ping 172.16.0.1

PING 172.16.0.1: 56 data bytes, press CTRL_C to break

Reply from 172.16.0.1: bytes=56 Sequence=1 ttl=255 time=10 ms

Reply from 172.16.0.1: bytes=56 Sequence=2 ttl=255 time=20 ms

Reply from 172.16.0.1: bytes=56 Sequence=3 ttl=255 time=10 ms

五、OSPF DR/BDR 选举

<R1>display ospf peer

OSPF Process 1 with Router ID 10.0.12.1

Neighbors

Area 0.0.0.0 interface 10.0.12.1(Serial1/0/0)'s neighbors

Router ID: 10.0.2.2 Address: 10.0.12.2

State: Full Mode:Nbr is Slave Priority: 1

DR: None BDR: None MTU: 0

Dead timer due in 31 sec

Retrans timer interval: 5

Neighbor is up for 01:17:49

Authentication Sequence: [0]

Neighbors

Area 0.0.0.0 interface 10.0.13.1(GigabitEthernet0/0/0)'s neighbors

Router ID: 10.0.3.3 Address: 10.0.13.3

State: Full Mode:Nbr is Slave Priority: 1

DR: 10.0.13.1 BDR: 10.0.13.3 MTU: 0

Dead timer due in 59 sec

Retrans timer interval: 5

Neighbor is up for 00:30:15

Authentication Sequence: [0]

注：默认优先级是 1，由于 R3 router-id 大于 R1 router-id 所以 R3 为 DR,R1 为 BDR。

[R1]int g0/0/0

[R1-GigabitEthernet0/0/0]ospf dr-priority 200 ===配置 OSPF 优先级为 200

注：由于 DR/BDR 选举默认为不抢占模式，因此修改了优先级后，不会重新进行选举，所以要重置 R1 与 R3 之间邻居关系。

[R1]int g0/0/0

[R1-GigabitEthernet0/0/0]shut

[R1-GigabitEthernet0/0/0]undo shut

<R3>display ospf peer

OSPF Process 100 with Router ID 10.0.3.3

Neighbors

Area 0.0.0.0 interface 10.0.13.3(GigabitEthernet0/0/0)'s neighbors

Router ID: 10.0.12.1 Address: 10.0.13.1

State: Full Mode:Nbr is Master Priority: 200

DR: 10.0.13.1 BDR: 10.0.13.3 MTU: 0

Dead timer due in 52 sec

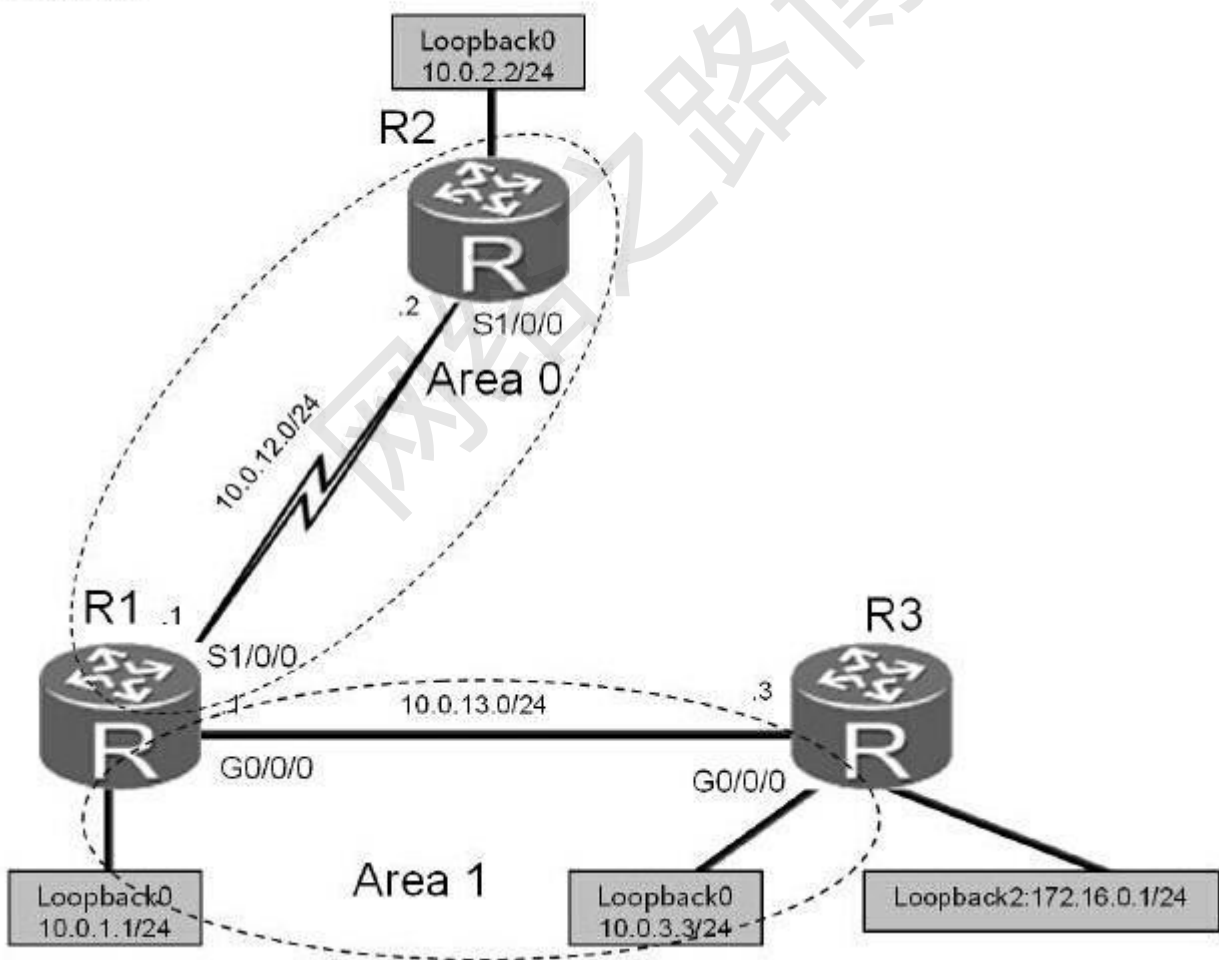
Retrans timer interval: 5

Neighbor is up for 00:02:10

Authentication Sequence: [0]

LAB2

一、实验拓扑如下：



六、配置 OSPF 多区域

R1 :

```
[R1]ospf 1 router-id 10.0.1.1
[R1-ospf-1]area 0
[R1-ospf-1-area-0.0.0.0]network 10.0.12.0 0.0.0.255
[R1-ospf-1-area-0.0.0.0]quit
[R1-ospf-1]area 1
[R1-ospf-1-area-0.0.0.1]network 10.0.13.0 0.0.0.255
[R1-ospf-1-area-0.0.0.1]network 10.0.1.0 0.0.0.255
```

R2 :

```
[R2]ospf 1 router-id 10.0.2.2
[R2-ospf-1]area 0
[R2-ospf-1-area-0.0.0.0]network 10.0.12.0 0.0.0.255
[R2-ospf-1-area-0.0.0.0]network 10.0.2.0 0.0.0.255
```

R3 :

```
[R3]ospf 1 router-id 10.0.3.3
[R3-ospf-1]area 1
```

[R3-ospf-1-area-0.0.0.1]network 10.0.3.0 0.0.0.255

[R3-ospf-1-area-0.0.0.1]network 10.0.13.0 0.0.0.255

测试：

<R1>display ip rou pr os

Route Flags: R - relay, D - download to fib

Public routing table : OSPF

Destinations : 2 Routes : 2

OSPF routing table status : <Active>

Destinations : 2 Routes : 2

Destination/Mask	Proto	Pre	Cost	Flags	NextHop	Interface
------------------	-------	-----	------	-------	---------	-----------

10.0.2.2/32	OSPF	10	48	D	10.0.12.2	Serial1/0/0
-------------	------	----	----	---	-----------	-------------

10.0.3.3/32	OSPF	10	1	D	10.0.13.3	GigabitEthernet0/0/0
-------------	------	----	---	---	-----------	----------------------

OSPF routing table status : <Inactive>

Destinations : 0 Routes : 0

<R2>display ip routing-table protocol ospf

Route Flags: R - relay, D - download to fib

Public routing table : OSPF

Destinations : 3 Routes : 3

OSPF routing table status : <Active>

Destinations : 3 Routes : 3

Destination/Mask	Proto	Pre	Cost	Flags	NextHop	Interface
10.0.1.1/32	OSPF	10	48	D	10.0.12.1	Serial1/0/0
10.0.3.3/32	OSPF	10	49	D	10.0.12.1	Serial1/0/0
10.0.13.0/24	OSPF	10	49	D	10.0.12.1	Serial1/0/0

OSPF routing table status : <Inactive>

Destinations : 0 Routes : 0

<R1>ping -c 2 10.0.3.3

PING 10.0.3.3: 56 data bytes, press CTRL_C to break

Reply from 10.0.3.3: bytes=56 Sequence=1 ttl=255 time=20 ms

Reply from 10.0.3.3: bytes=56 Sequence=2 ttl=255 time=20 ms

<R1>ping -c 2 10.0.2.2

PING 10.0.2.2: 56 data bytes, press CTRL_C to break

Reply from 10.0.2.2: bytes=56 Sequence=1 ttl=255 time=10 ms

Reply from 10.0.2.2: bytes=56 Sequence=2 ttl=255 time=10 ms

<R1>display ospf peer brief

OSPF Process 1 with Router ID 10.0.1.1

Peer Statistic Information

Area Id	Interface	Neighbor id	State
0.0.0.0	Serial1/0/0	10.0.2.2	Full
0.0.0.1	GigabitEthernet0/0/0	10.0.3.3	Full

七、OSPF 直连路由重分布

[R3]ospf 1

[R3-ospf-1]import-route direct ===重分布直连

测试：

<R1>dis ip rout protocol os

Route Flags: R - relay, D - download to fib

Public routing table : OSPF

Destinations : 4 Routes : 4

OSPF routing table status : <Active>

Destinations : 4 Routes : 4

Destination/Mask	Proto	Pre	Cost	Flags	NextHop	Interface
10.0.2.2/32	OSPF	10	48	D	10.0.12.2	Serial1/0/0
10.0.3.0/24	O_ASE	150	1	D	10.0.13.3	GigabitEthernet0/0/0
10.0.3.3/32	OSPF	10	1	D	10.0.13.3	GigabitEthernet0/0/0
172.16.0.0/24	O_ASE	150	1	D	10.0.13.3	GigabitEthernet0/0/0

注 : O_ASE 表示 OSPF 外部路由

<R2>ping -a 10.0.2.2 10.0.3.3 ===以 IP 10.0.2.2 为源

PING 10.0.3.3: 56 data bytes, press CTRL_C to break

Reply from 10.0.3.3: bytes=56 Sequence=1 ttl=254 time=20 ms

Reply from 10.0.3.3: bytes=56 Sequence=2 ttl=254 time=10 ms

Reply from 10.0.3.3: bytes=56 Sequence=3 ttl=254 time=20 ms

Reply from 10.0.3.3: bytes=56 Sequence=4 ttl=254 time=20 ms

R1>display ospf lsdb === 查看 LSA 数据库

OSPF Process 1 with Router ID 10.0.1.1

Link State Database

Area: 0.0.0.0

Type	LinkState ID	AdvRouter	Age	Len	Sequence	Metric
Router	10.0.2.2	10.0.2.2	1536	60	80000003	48
Router	10.0.1.1	10.0.1.1	1558	48	80000003	48
Sum-Net	10.0.13.0	10.0.1.1	1773	28	80000001	1
Sum-Net	10.0.3.3	10.0.1.1	1407	28	80000001	1
Sum-Net	10.0.1.1	10.0.1.1	1766	28	80000001	0
Sum-Asbr	10.0.3.3	10.0.1.1	522	28	80000001	1

Area: 0.0.0.1

Type	LinkState ID	AdvRouter	Age	Len	Sequence	Metric
Router	10.0.3.3	10.0.3.3	523	48	80000005	1
Router	10.0.1.1	10.0.1.1	1399	48	80000006	1
Network	10.0.13.1	10.0.1.1	1399	32	80000002	0
Sum-Net	10.0.12.0	10.0.1.1	1773	28	80000001	48
Sum-Net	10.0.2.2	10.0.1.1	1535	28	80000001	48

AS External Database

Type	LinkState ID	AdvRouter	Age	Len	Sequence	Metric
External	10.0.3.0	10.0.3.3	523	36	80000001	1

External	10.0.13.0	10.0.3.3	523	36	80000001	1
External	172.16.0.0	10.0.3.3	523	36	80000001	1

<R1>display ospf lsdb summary 10.0.3.3 =====查看 TYPE 3 LSA

OSPF Process 1 with Router ID 10.0.1.1

Area: 0.0.0.0

Link State Database

Type : Sum-Net

Ls id : 10.0.3.3

Adv rtr : 10.0.1.1

Ls age : 1693

Len : 28

Options : E

seq# : 80000001

chksum : 0x4cf3

Net mask : 255.255.255.255

Tos 0 metric: 1

Priority : Low

Area: 0.0.0.1

Link State Database

<R1>display ospf lsdb asbr ===查看 TYPE 4 LSA

OSPF Process 1 with Router ID 10.0.1.1

Area: 0.0.0.0

Link State Database

Type : Sum-Asbr

Ls id : 10.0.3.3

Adv rtr : 10.0.1.1

Ls age : 1031

Len : 28

Options : E

seq# : 80000001

chksum : 0x3e01

Tos 0 metric: 1

Area: 0.0.0.1

Link State Database

<R1>display ospf lsdb ase 172.16.0.0 ===查看 TYPE 5 LSA

OSPF Process 1 with Router ID 10.0.1.1

Link State Database

Type : External

Ls id : 172.16.0.0

Adv rtr : 10.0.3.3

Ls age : 1109

Len : 36

Options : E

seq# : 80000001

checksum : 0xf70c

Net mask : 255.255.255.0

TOS 0 Metric: 1

E type : 2

Forwarding Address : 0.0.0.0

Tag : 1

Priority : Low

八、配置 OSPF 认证

```
[R1]int s1/0/0
```

```
[R1-Serial1/0/0]ospf authentication-mode simple plain ccieh3c.taoobao.com
```

```
[R2]int s1/0/0
```

```
[R2-Serial1/0/0]ospf authentication-mode simple plain ccieh3c.taoobao.com
```

```
[R1-ospf-1]area 1
```

```
[R1-ospf-1-area-0.0.0.1]authentication-mode md5 1 cipher ccieh3c.taoobao.com
```

[R2-ospf-1]area 1

[R2-ospf-1-area-0.0.0.1]authentication-mode md5 1 cipher ccieh3c.taoobao.com

博主也只是业余时间写写技术文档，请大家见谅，大家觉得不错的话，可以推荐给朋友哦，博主会努力推出更好的系列文档的。如果大家有任何疑问或者文中有错误跟疏忽的地方，欢迎大家留言指出，博主看到后会第一时间修改，谢谢大家的支持，更多技术文章尽在网络之路博客，<http://ccieh3c.com>。

网络之路博客