CEC 中国电子 | MAIPU 迈普

动态路由协议-OSPF

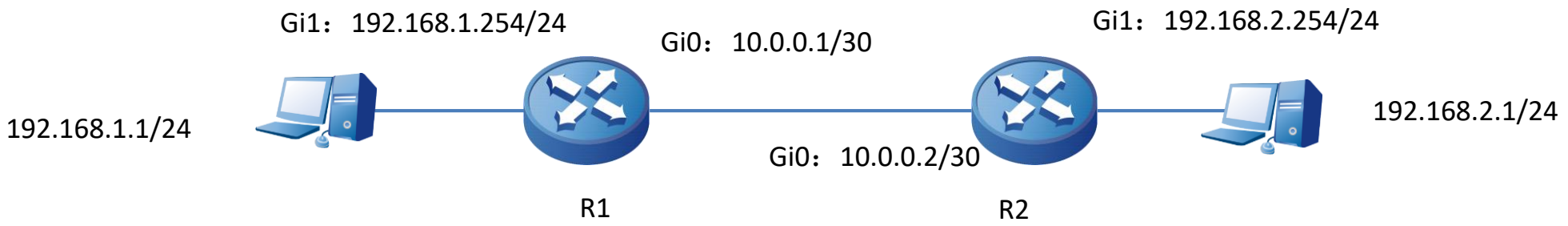
迈普通信技术股份有限公司

课程目标

- 了解OSPF协议应用场景
- 熟悉掌握OSPF协议原理
- 熟练掌握OSPF协议配置
- 了解OSPF协议故障排查思路及方法

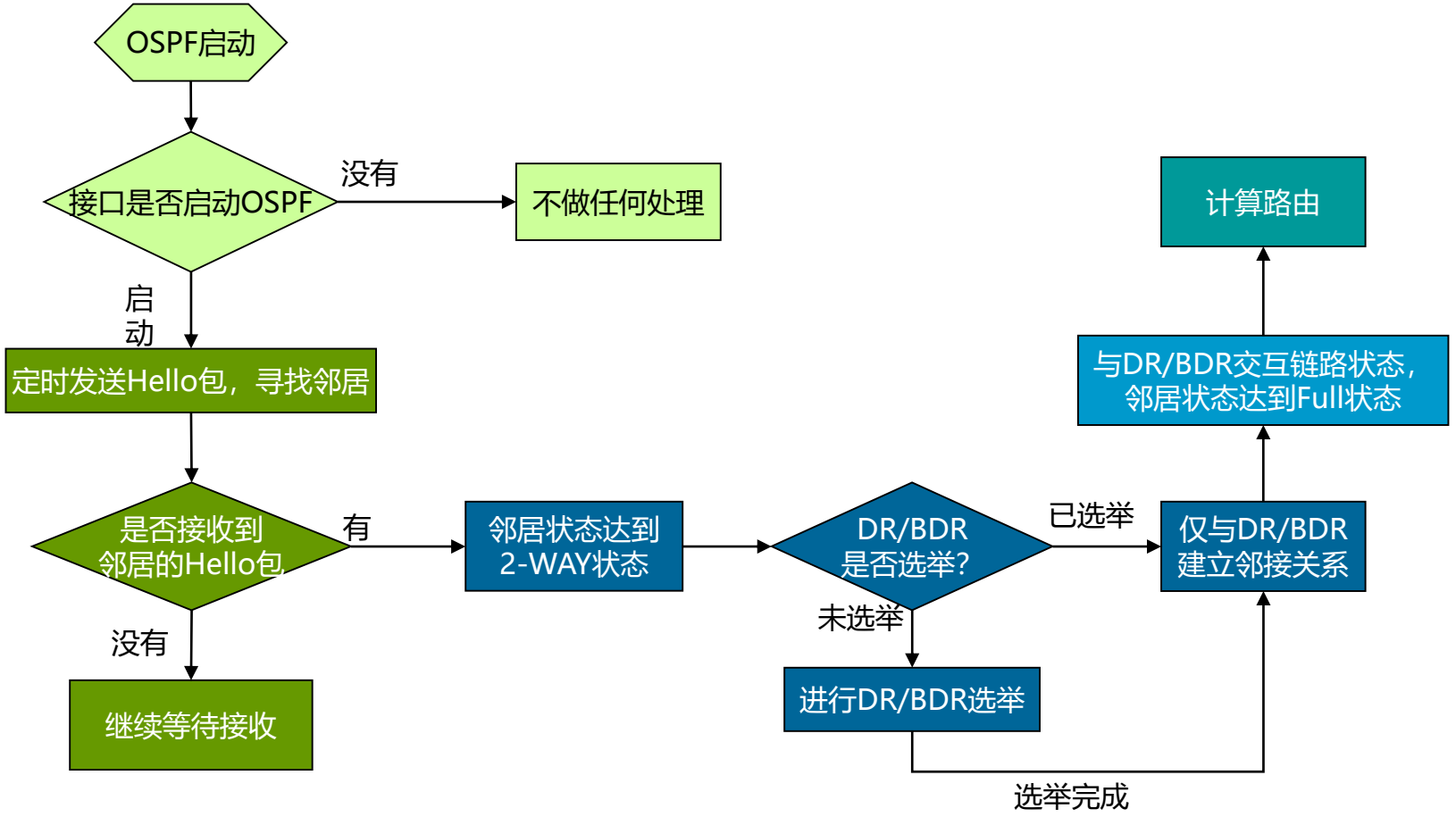
目录

什么是OSPF



- OSPF（Open Shortest Path First，开放最短路径优先）是IETF 开发的基于链路状态的自治系统内部路由协议
- OSPF仅传播对端设备不具备的路由信息，网络收敛迅速，并有效避免了网络资源浪费
- OSPF直接工作于IP层之上，IP协议号为89
- OSPF以组播地址发送协议包

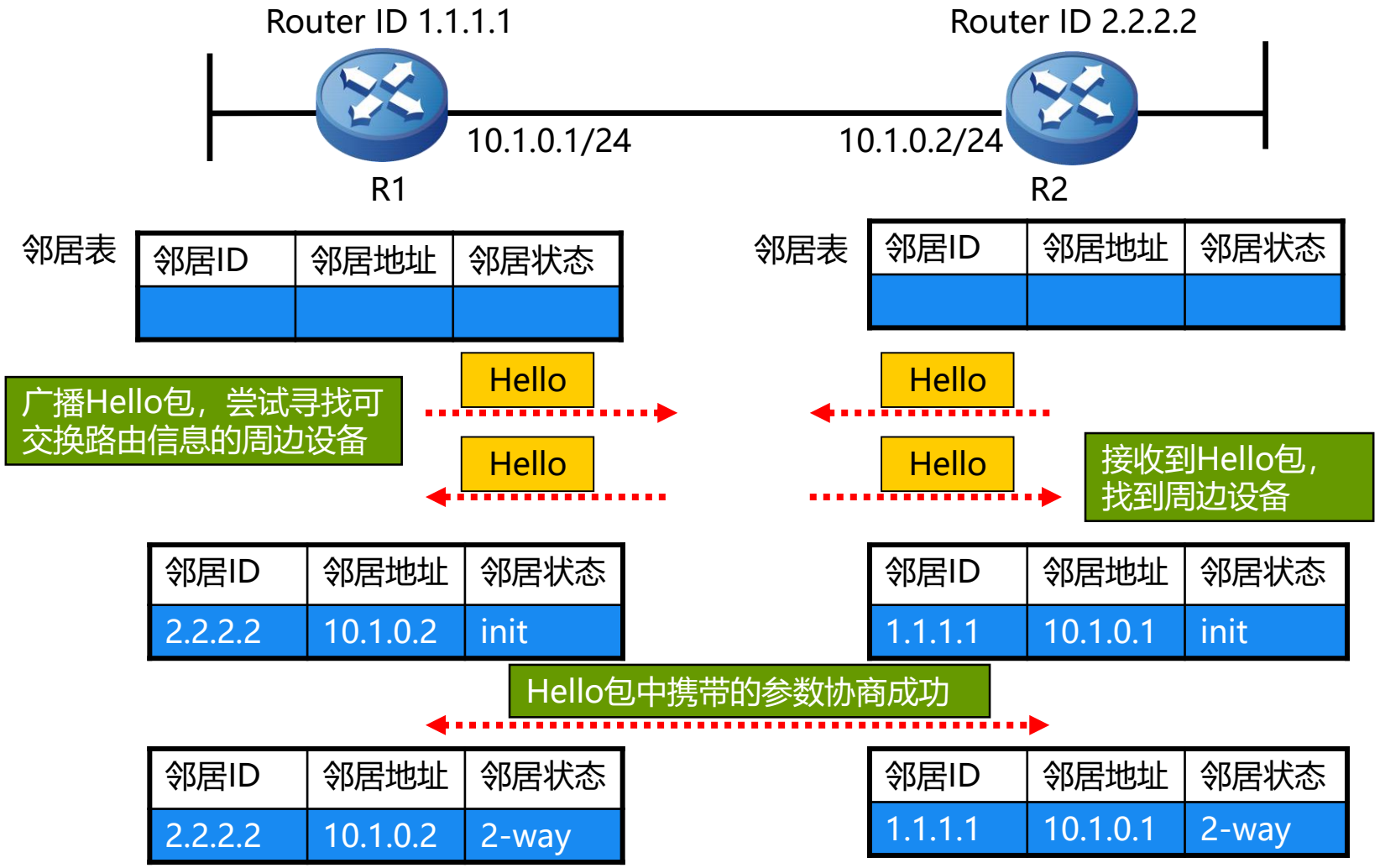
OSPF协议工作过程概述



OSPF协议工作过程的四个阶段：

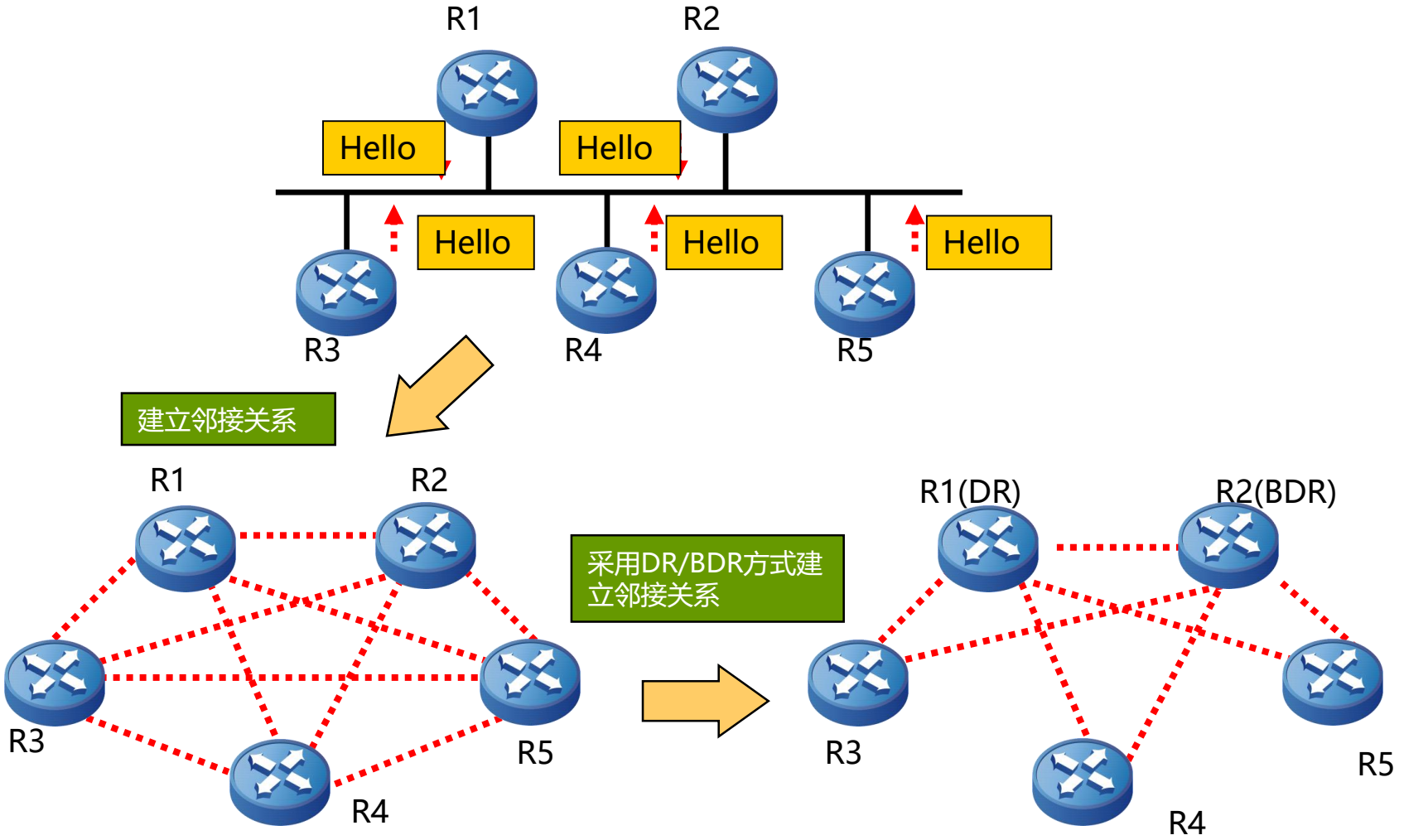
- 寻找邻居
- 建立邻接关系
- 链路状态信息传递
- 计算路由

寻找邻居



- 邻居状态达到2-way状态后，R1与R2之间开始建立邻接关系

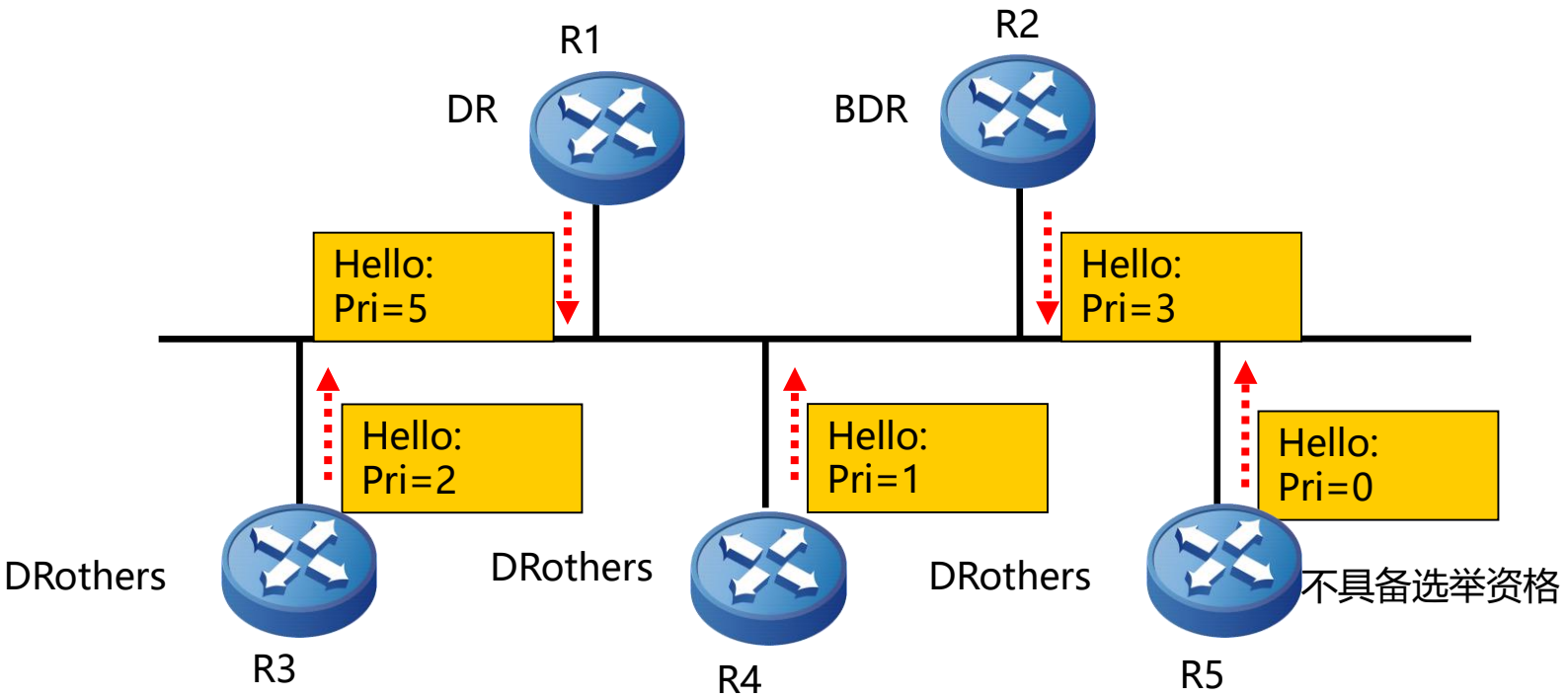
建立邻接关系



邻接关系数 $R = \frac{n(n-1)}{2}$

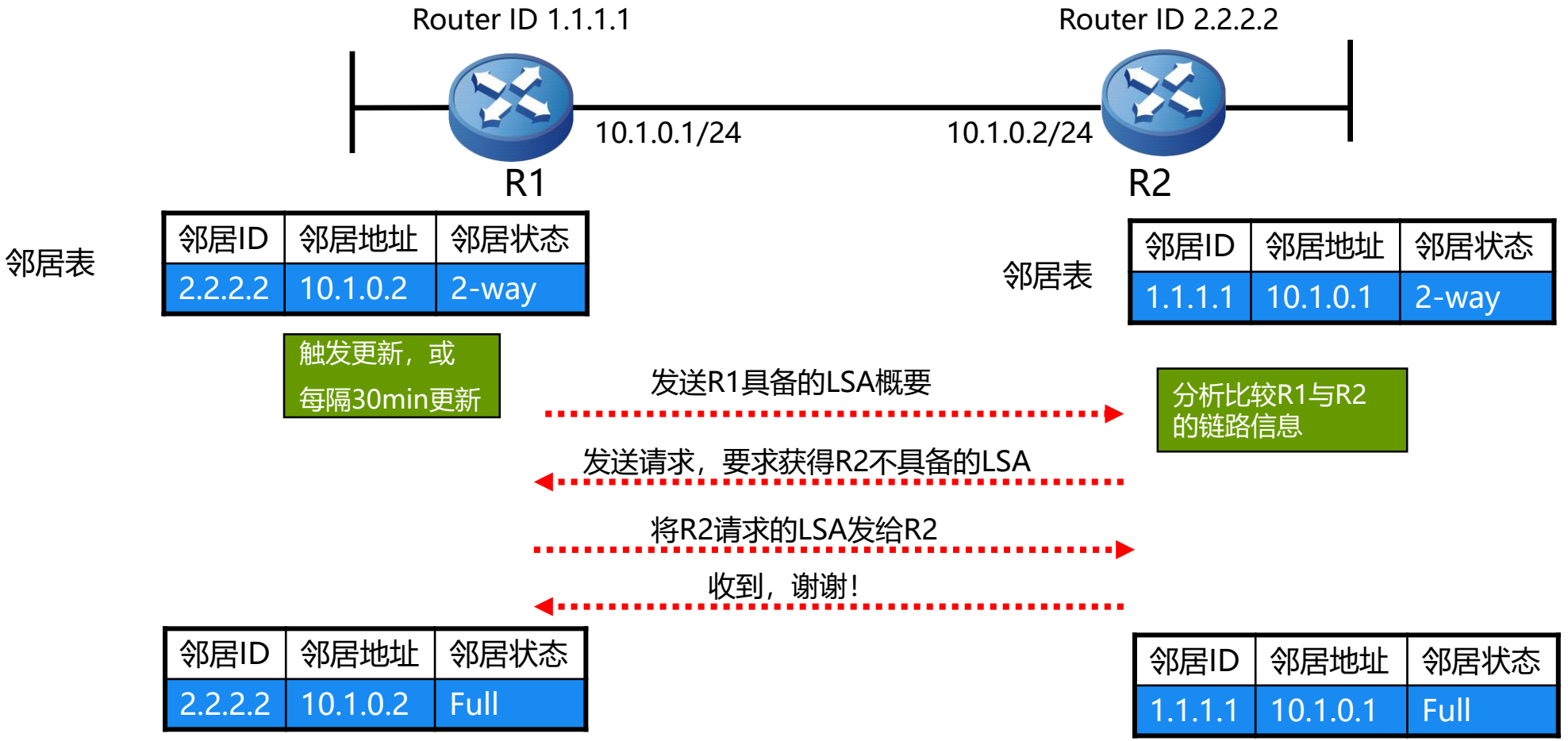
邻接关系数 $R = 2(n-2) + 1$

DR和BDR选举



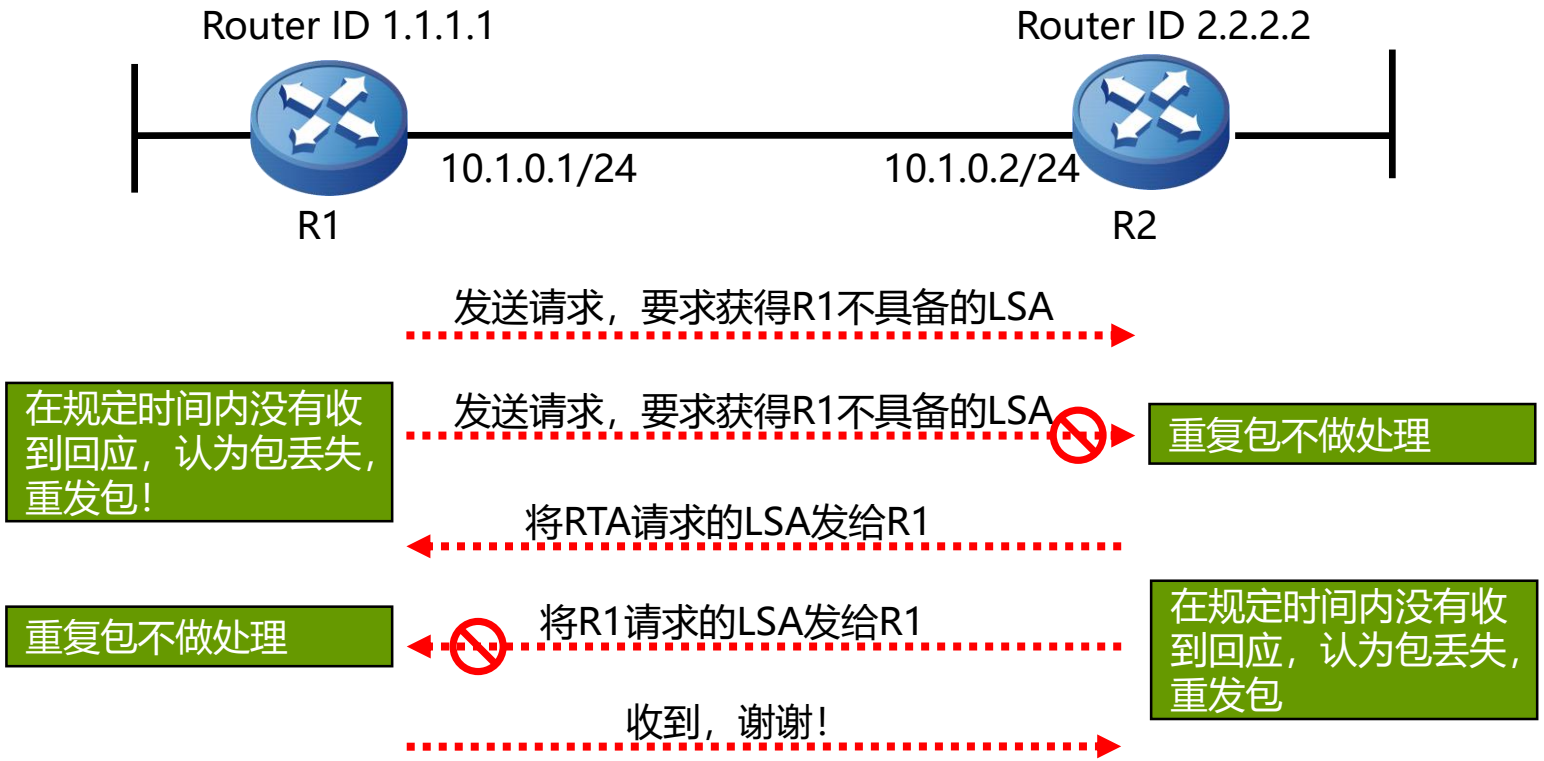
- Hello包携带路由器优先级，优先级为0的路由器不具备选举资格
- 先选举BDR，再选举DR
- DR和BDR一旦选定，即使OSPF区域内新增优先级更高的路由器，DR和BDR也不重新选举，只有当DR和BDR都失效后，才参与选举

传递信息



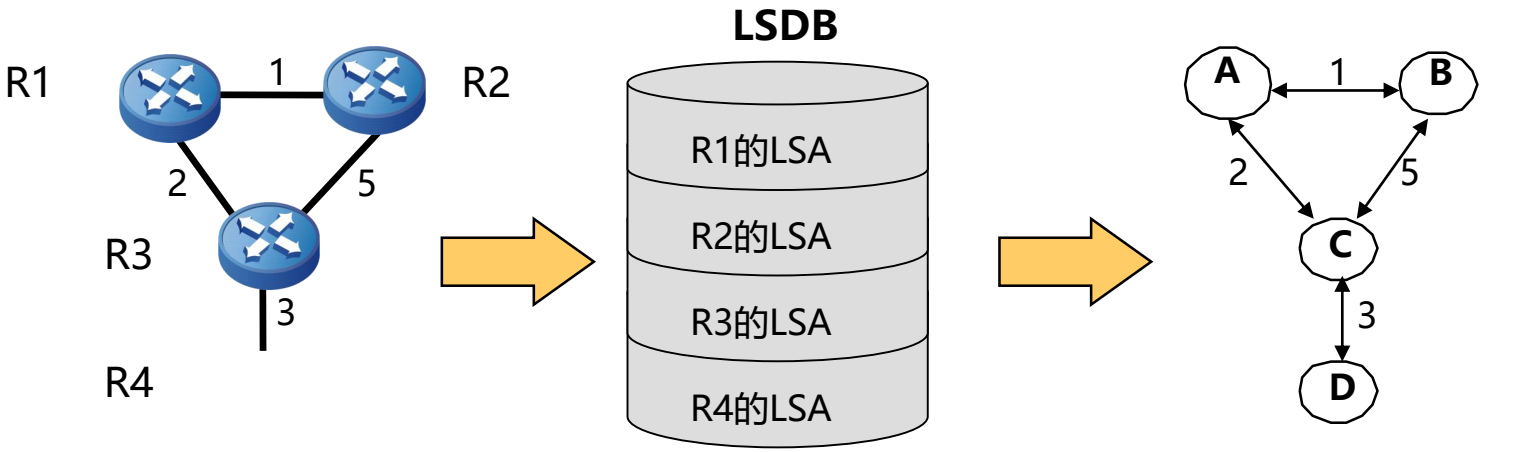
- 以上是R2获得R1 LSA的过程，R1也通过相同的过程获得R2的LSA
- 在R2与R1的LSA信息同步后，R1在R2邻居表内的状态变迁为Full状态

传递信息（续）

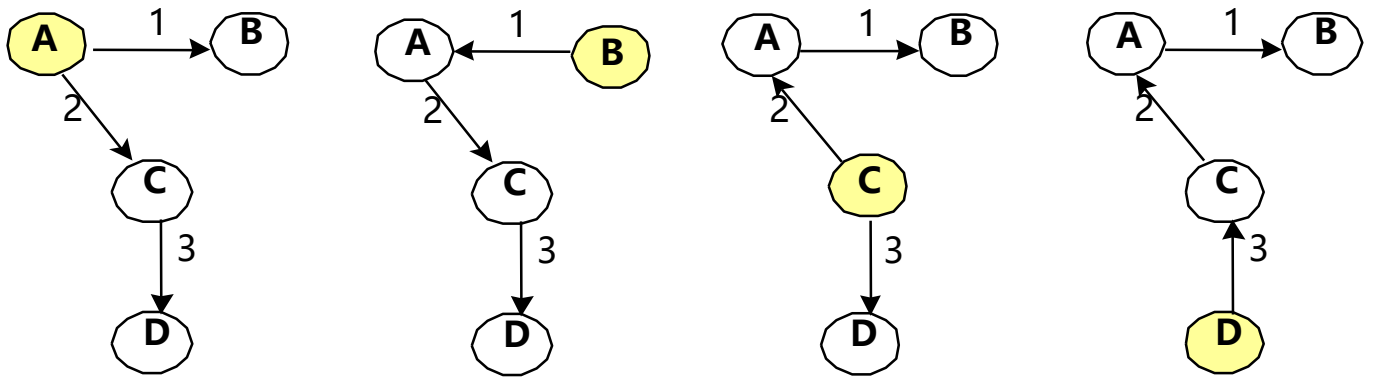


- OSPF协议包具备超时重传机制
- OSPF协议包具备序列号，对重复包不做处理
- LSA更新携带掩码，支持VLSM

路由计算



(一)网络的拓扑结构　(二)每台路由器的LSDB　(三)由LSDB得到的带权有向图



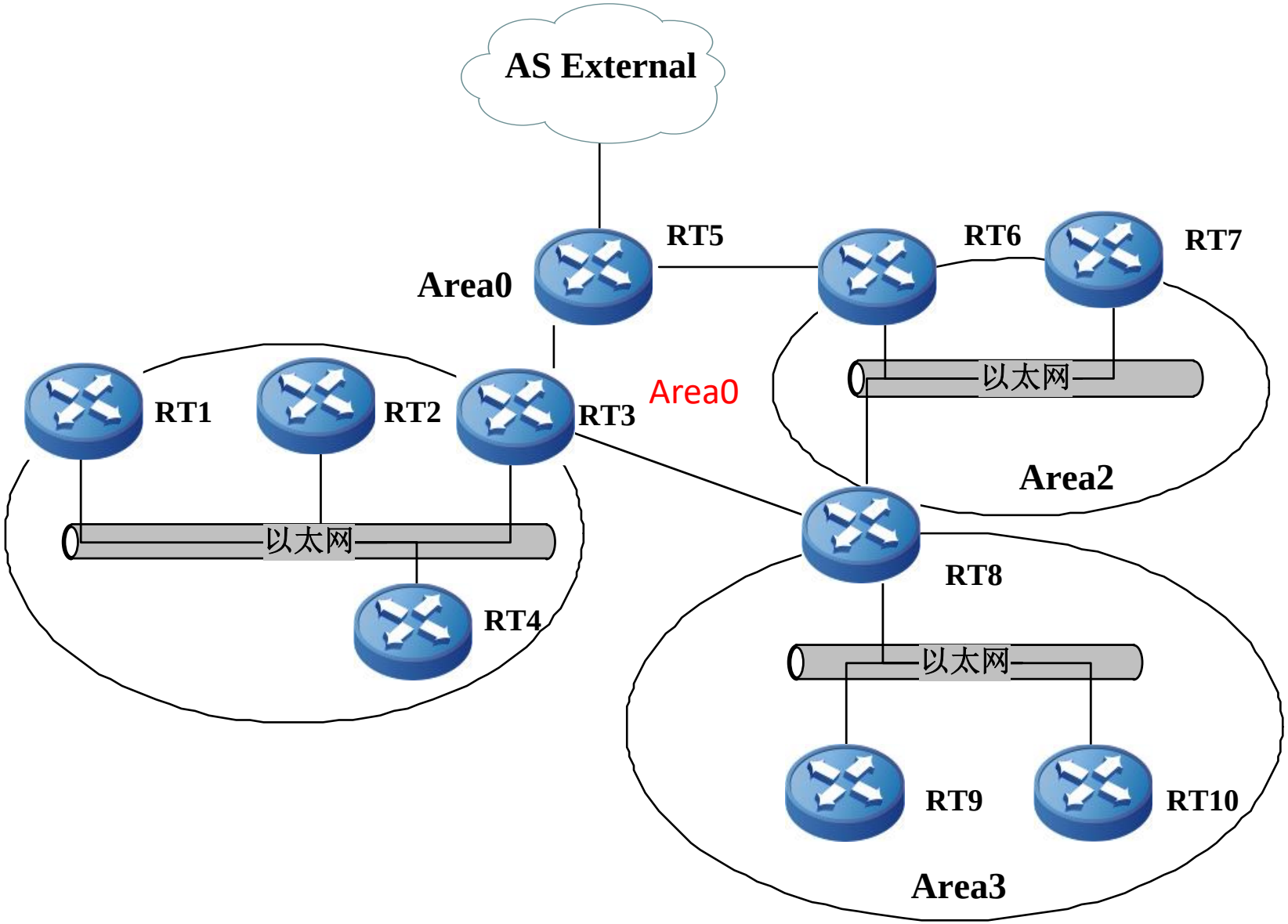
(四)每台路由器分别以自己为根节点计算最小生成树

OSPF在大型网络中应用可能遇到的问题

当网络规模变大时，有些问题会从量变到质变：即理论讲是可行，但实际上可能已不能正常工作了

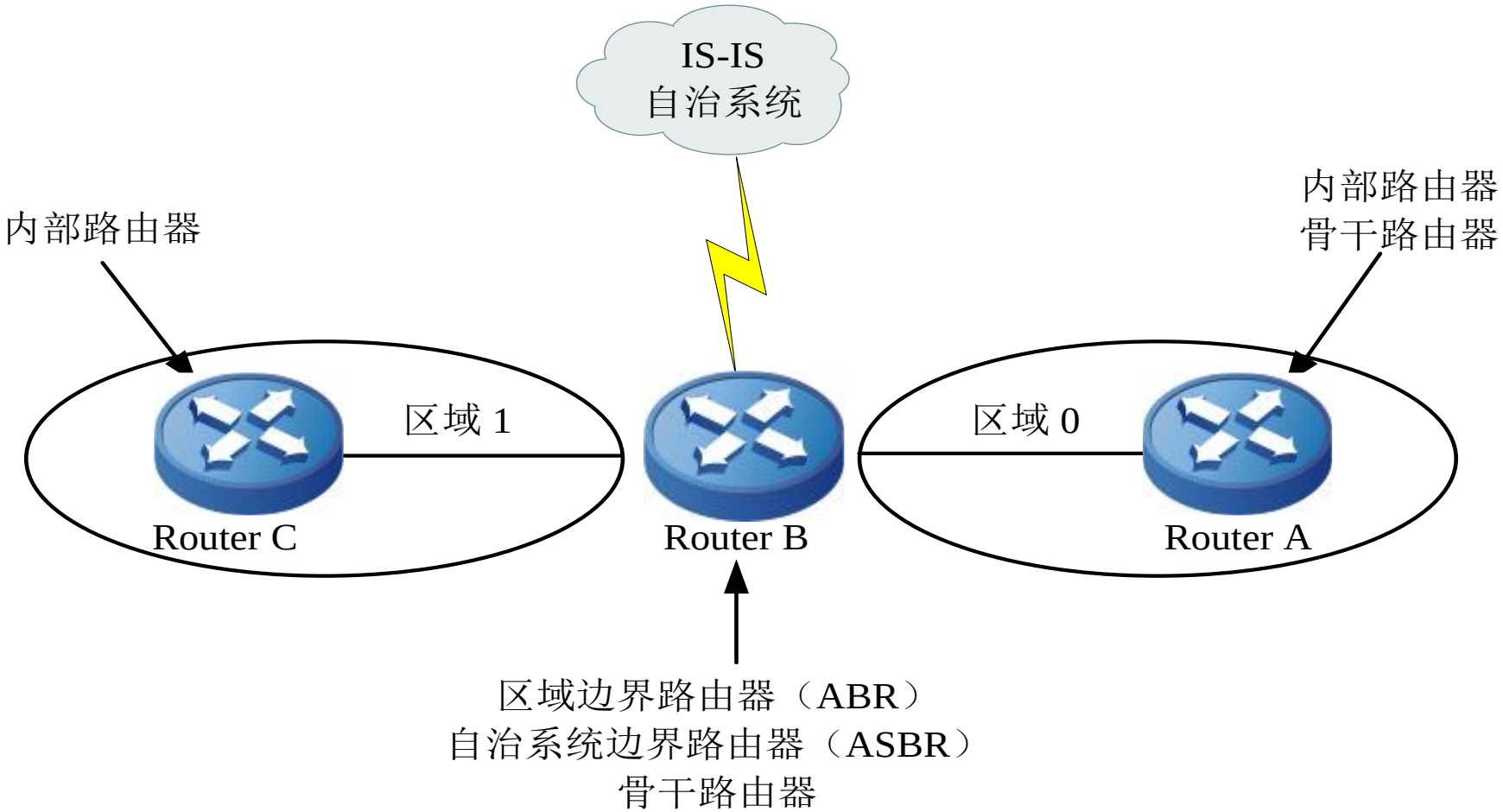
- 缺点1：LSDB非常庞大，占用大量存储空间
  - 相对与DV来说，不仅存储路由信息，还存储链路状态
  - 而DV只存储路由信息，当然DV的每个路由器也不知道全网拓扑结构
- 缺点2：计算最小生成树耗时增加，CPU负担很重
  - 相对与DV，计算复杂，要算出一个树来，而DV算法只是简单的路由表的加减
  - 有1台路由器链路状态发生变化，全网的所有路由都要重新计算（一有风吹草动，都要重新计算）
- 缺点3：网络拓扑结构经常发生变化，网络经常处于“动荡”之中
  - 就象往湖里投个石子，会波及整个网络
  - 而网络中链路变化是经常的，up或down，所以，整个网络不停的动荡

OSPF区域划分



- 骨干区域（主干区域）
- 非骨干区域（标准区域）

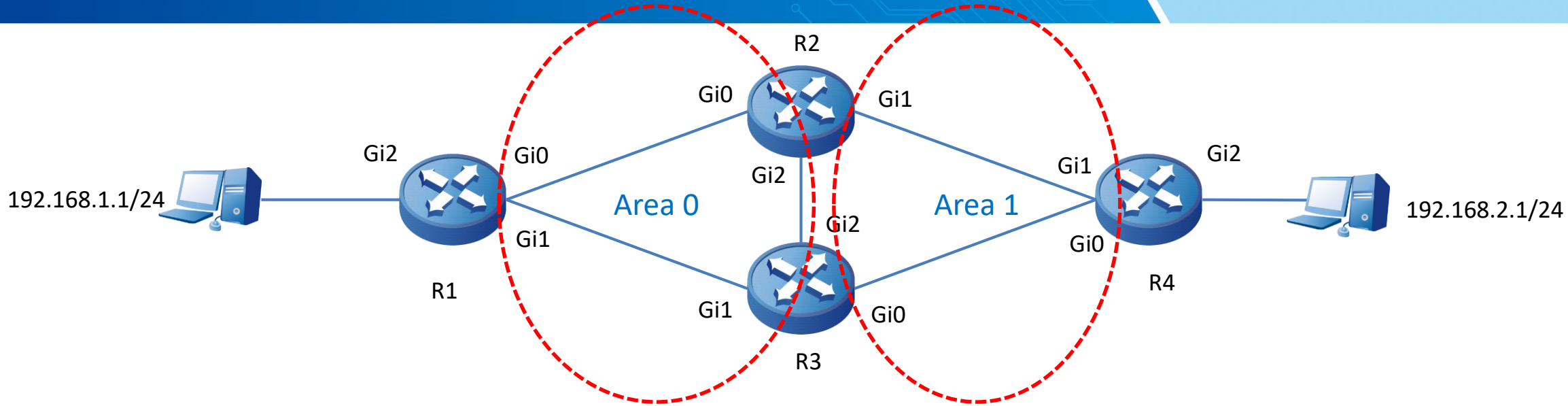
OSPF网络中路由器的角色



OSPF配置步骤

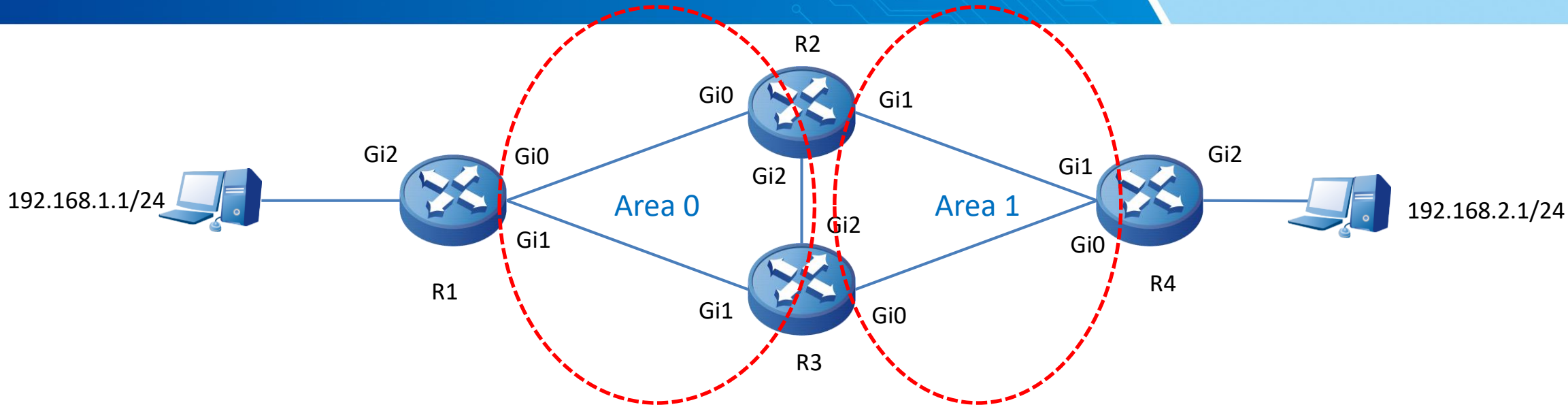
- 根据需求划分区域
- 启动ospf进程
- 将路由器接口和所属的区域通告出去

OSPF配置



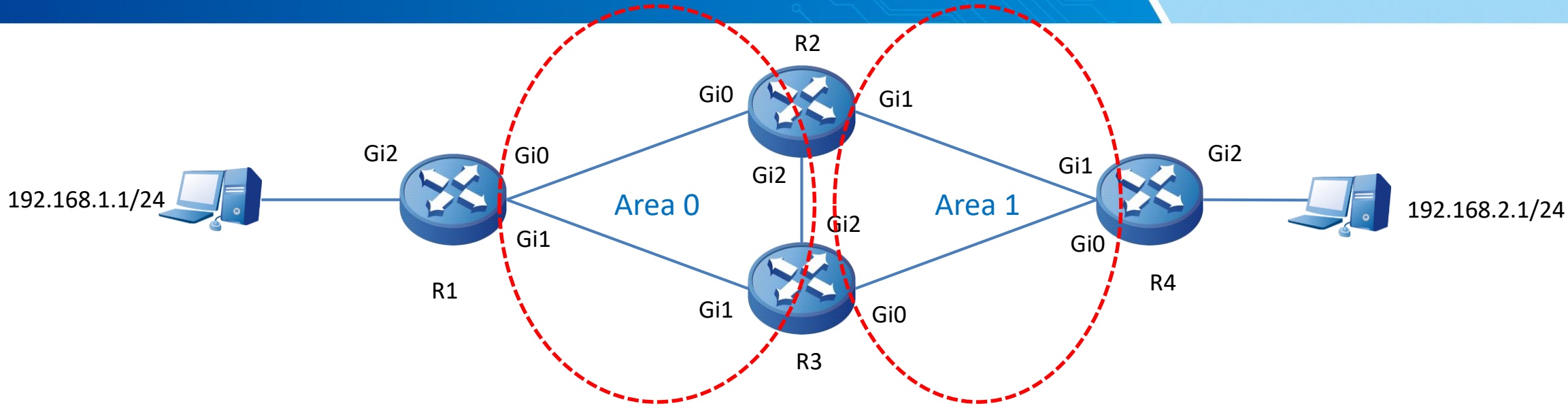
设备	接口	IP	设备	接口	IP
R1	Gi0	10.0.0.1/30	R3	Gi0	10.0.0.17/30
	Gi1	10.0.0.5/30		Gi1	10.0.0.6/30
	Gi2	192.168.1.254/24		Gi2	10.0.0.10/30
R2	Gi0	10.0.0.2/30	R4	Gi0	10.0.0.18/30
	Gi1	10.0.0.13/30		Gi1	10.0.0.14/30
	Gi2	10.0.0.9/30		Gi2	192.168.2.254/24

R1配置



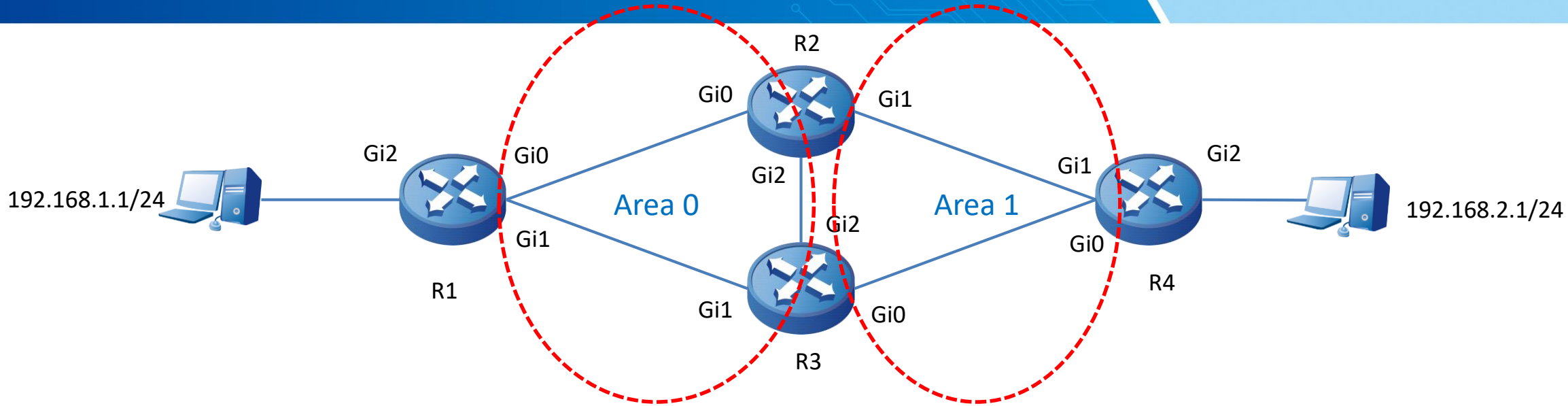
R1接口配置	R1OSPF配置	描述
interface gigabitethernet0 ip address 10.0.0.1 255.255.255.252 exit	router ospf 1 network 10.0.0.0 0.0.0.3 area 0 network 10.0.0.4 0.0.0.3 area 0 network 192.168.1.0 0.0.0.255 area 0 exit	启用OSPF进程，进程号1 指定相应OSPF接口和所属区域（注意使用反掩码）
interface gigabitethernet1 ip address 10.0.0.5 255.255.255.252 exit		
interface gigabitethernet2 ip address 192.168.1.254 255.255.255.0 exit		

R1和R3配置



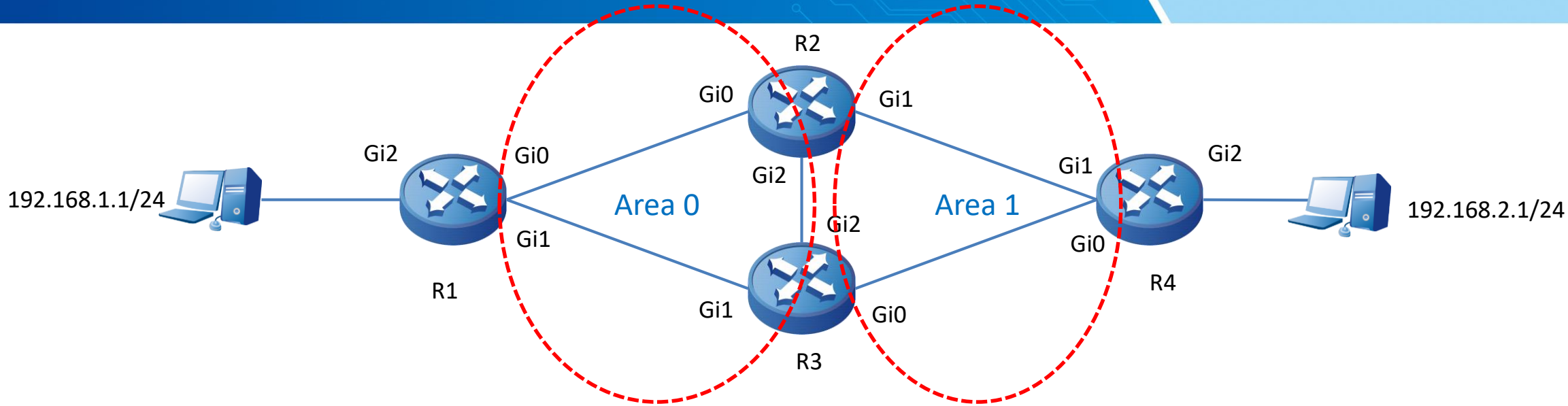
R2	R3
router ospf 1 network 10.0.0.0 0.0.0.3 area 0 network 10.0.0.8 0.0.0.3 area 0 network 10.0.0.12 0.0.0.3 area 1 exit	router ospf 1 network 10.0.0.4 0.0.0.3 area 0 network 10.0.0.8 0.0.0.3 area 0 network 10.0.0.16 0.0.0.3 area 1

R4配置



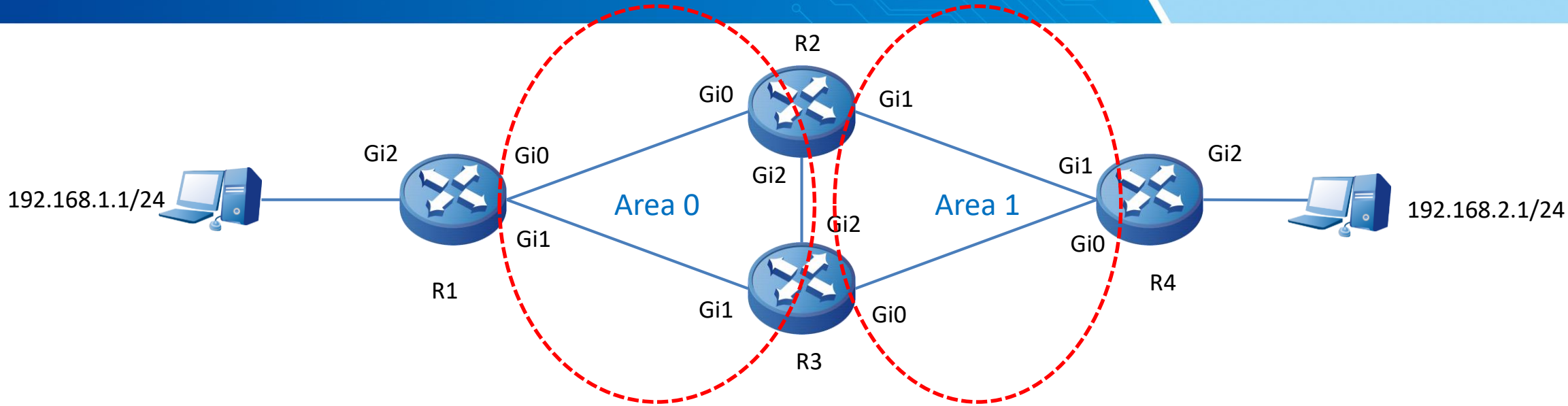
R1OSPF配置	R4OSPF配置	描述
router ospf 1 network 10.0.0.0 0.0.0.3 area 0 network 10.0.0.4 0.0.0.3 area 0 network 192.168.1.0 0.0.0.255 area 0 exit	router ospf 1 network 10.0.0.12 0.0.0.3 area 1 network 10.0.0.16 0.0.0.3 area 1 network 192.168.2.0 0.0.0.255 area 1 exit	启用OSPF进程，进程号1 指定相应OSPF接口和所属区域（注意使用反掩码）

OSPF邻居表



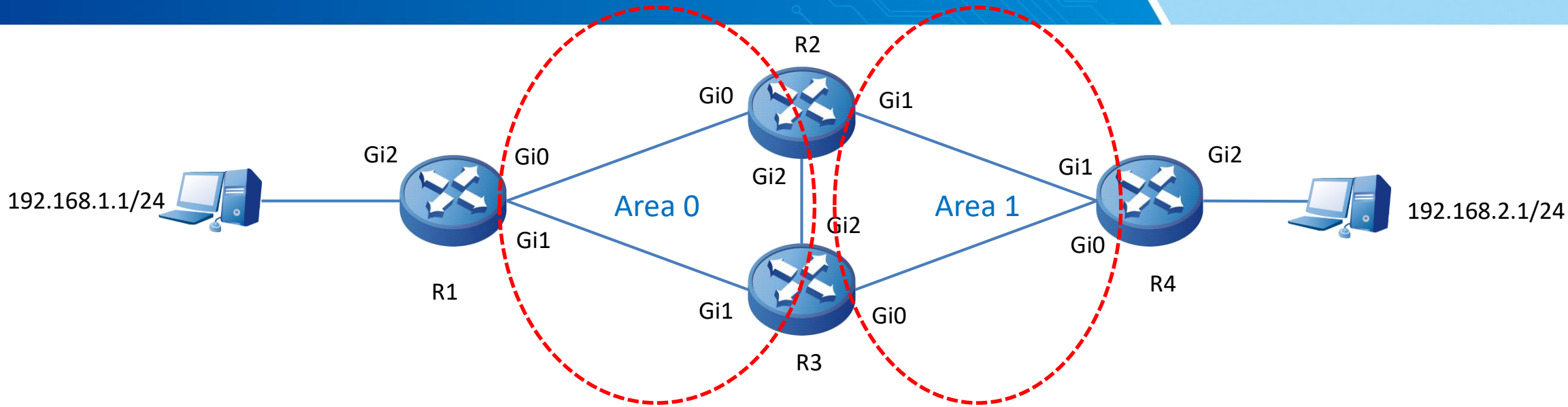
设备	邻居表
R1	R1#show ip ospf neighbor OSPF process 1: Neighbor ID Pri State Dead Time Address Interface 10.0.0.13 1 Full/Backup 00:00:34 10.0.0.2 gigabitethernet0 10.0.0.17 1 Full/Backup 00:00:32 10.0.0.6 gigabitethernet1
R4	R4#sh ip ospf neighbor OSPF process 1: Neighbor ID Pri State Dead Time Address Interface 10.0.0.13 1 Full/Backup 00:00:31 10.0.0.13 gigabitethernet1 10.0.0.17 1 Full/DR 00:00:32 10.0.0.17 gigabitethernet0

OSPF邻居表



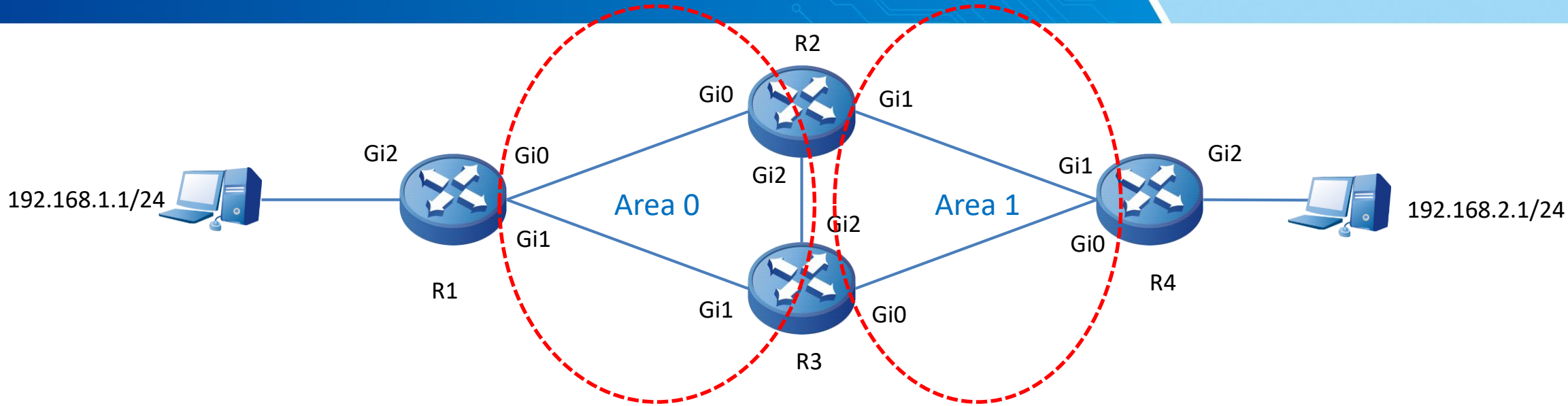
设备	邻居表
R2	R2#sh ip ospf neighbor OSPF process 1: Neighbor ID Pri State Dead Time Address Interface 192.168.1.254 1 Full/DR 00:00:35 10.0.0.1 gigabitethernet0 10.0.0.17 1 Full/DR 00:00:36 10.0.0.10 gigabitethernet2 192.168.2.254 1 Full/DR 00:00:37 10.0.0.14 gigabitethernet1
R3	Neighbor ID Pri State Dead Time Address Interface 192.168.1.254 1 Full/DR 00:00:36 10.0.0.5 gigabitethernet1 10.0.0.13 1 Full/Backup 00:00:32 10.0.0.9 gigabitethernet2 192.168.2.254 1 Full/Backup 00:00:31 10.0.0.18 gigabitethernet0

OSPF路由表



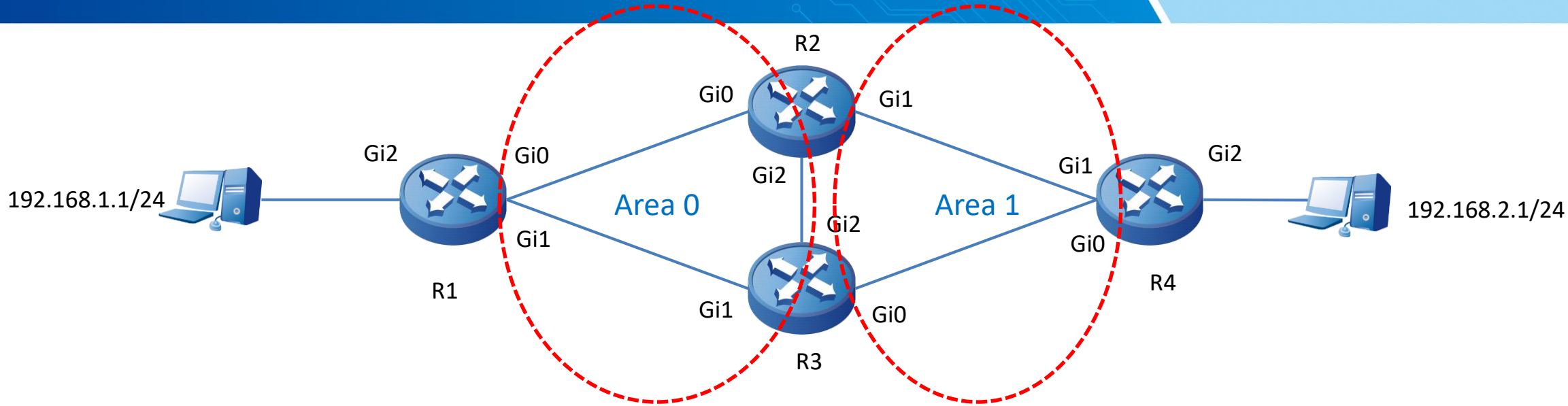
设备	邻居表
R1	R1#sh ip route C 10.0.0.0/30 is directly connected, 00:27:25, gigabitethernet0 C 10.0.0.4/30 is directly connected, 00:27:21, gigabitethernet1 O 10.0.0.8/30 [110/2] via 10.0.0.2, 00:09:30, gigabitethernet0 [110/2] via 10.0.0.6, 00:04:46, gigabitethernet1 O 10.0.0.12/30 [110/2] via 10.0.0.2, 00:09:21, gigabitethernet0 O 10.0.0.16/30 [110/2] via 10.0.0.6, 00:04:46, gigabitethernet1 C 127.0.0.0/8 is directly connected, 00:31:17, lo0 C 192.168.1.0/24 is directly connected, 00:26:50, gigabitethernet2 O 192.168.2.0/24 [110/3] via 10.0.0.2, 00:09:21, gigabitethernet0 [110/3] via 10.0.0.6, 00:04:46, gigabitethernet1

OSPF路由表



设备	邻居表
R2	O 10.0.0.4/30 [110/2] via 10.0.0.1, 00:18:11, gigabitethernet0 [110/2] via 10.0.0.10, 00:06:51, gigabitethernet2 O 10.0.0.16/30 [110/2] via 10.0.0.14, 00:11:04, gigabitethernet1 O 192.168.1.0/24 [110/2] via 10.0.0.1, 00:18:11, gigabitethernet0 O 192.168.2.0/24 [110/2] via 10.0.0.14, 00:11:04, gigabitethernet1
R3	O 10.0.0.0/30 [110/2] via 10.0.0.9, 00:11:56, gigabitethernet2 [110/2] via 10.0.0.5, 00:07:30, gigabitethernet1 O 10.0.0.12/30 [110/2] via 10.0.0.18, 00:07:43, gigabitethernet0 O 192.168.1.0/24 [110/2] via 10.0.0.5, 00:07:30, gigabitethernet1 O 192.168.2.0/24 [110/2] via 10.0.0.18, 00:13:46, gigabitethernet0

OSPF路由表



设备	邻居表
R4	O 10.0.0.0/30 [110/2] via 10.0.0.13, 00:12:36, gigabitethernet1 O 10.0.0.4/30 [110/2] via 10.0.0.17, 00:08:17, gigabitethernet0 O 10.0.0.8/30 [110/2] via 10.0.0.17, 00:14:24, gigabitethernet0 [110/2] via 10.0.0.13, 00:12:36, gigabitethernet1 C 10.0.0.12/30 is directly connected, 00:28:45, gigabitethernet1 C 10.0.0.16/30 is directly connected, 00:28:52, gigabitethernet0 C 127.0.0.0/8 is directly connected, 00:34:40, lo0 O 192.168.1.0/24 [110/3] via 10.0.0.13, 00:12:36, gigabitethernet1 [110/3] via 10.0.0.17, 00:08:10, gigabitethernet0 C 192.168.2.0/24 is directly connected, 00:28:37, gigabitethernet2

OSPF故障排除基本思路

- 分析步骤一：**了解详细的故障现象。**动态路由协议运行在路由器与路由器之间，出现故障后，首先要定位故障所在，比如路由表中缺少哪些路由、哪些邻居等等。
- 分析步骤二：**确认交互路由的路由器之间链路是否相通。**动态路由协议运行在ip层之上，各个路由器之间要交互路由协议报文，首先链路层要保证相通。
- 分析步骤三：**确认OSPF的配置没有问题。**检查相关邻居的配置，以及OSPF相关的功能配置是否正确。
- 分析步骤四：**确认所有邻居的状态是否为FULL或2way。**在此路由器上使用系统提供的show工具查看相关信息，比如OSPF的接口表，邻居表等等。
- 基本上OSPF问题都是**OSPF协商双方参数配置问题** 。

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