Lab5 实验报告

一、 实验目的

1、 理解网络协议 RIP，OSPF，BGP 的运作过程

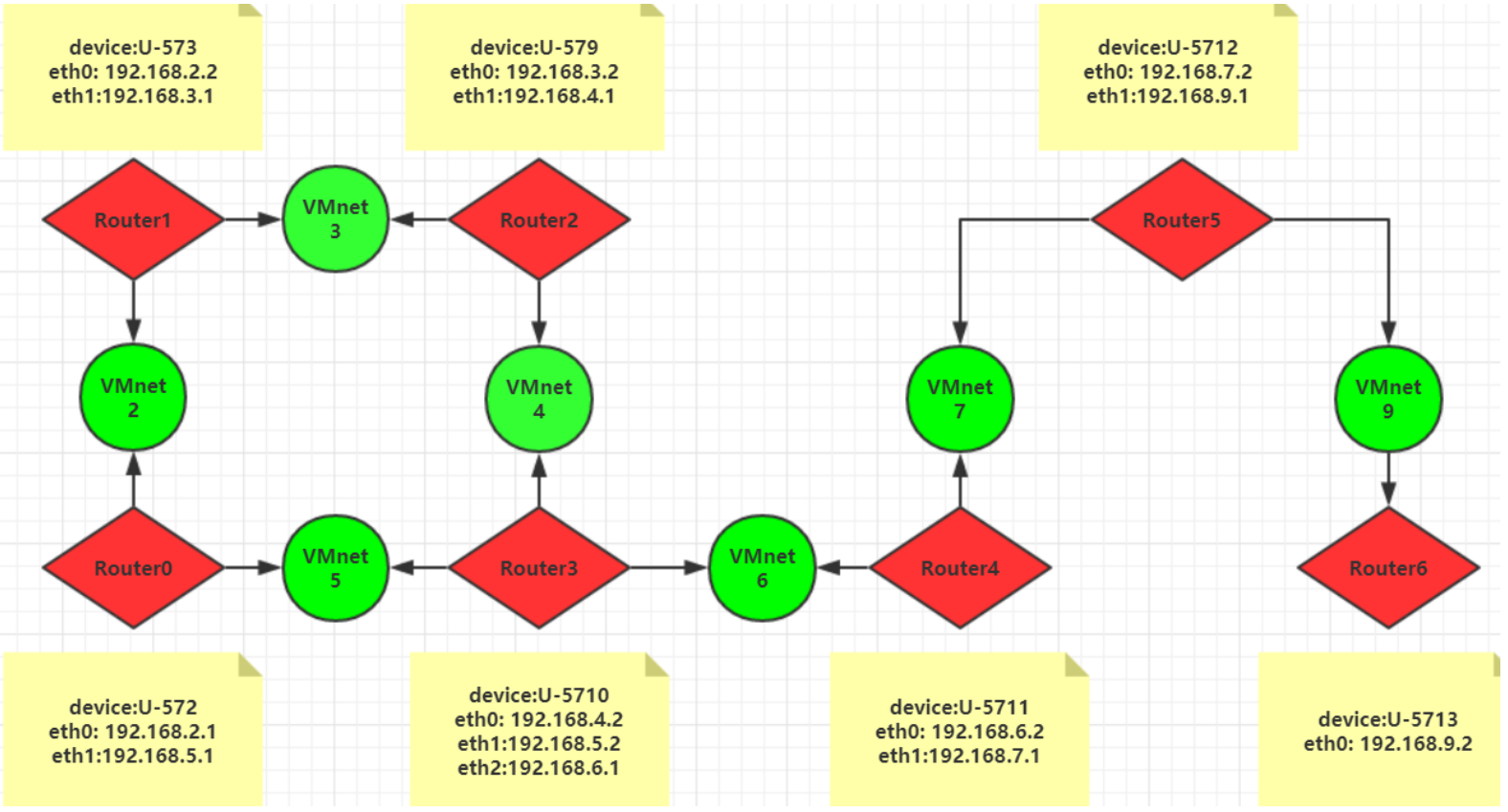
2、 观察在网络拓扑结构变更的情况下，路由表的自动更新过程。

二、 网络拓扑配置

表：

节点名	虚拟设备名	ip	netmask
Router0	U-572	eth0: 192.168.2.1	255.255.255.0
		eth1: 192.168.5.1	255.255.255.0
Router1	U-573	eth0: 192.168.2.2	255.255.255.0
		eth1: 192.168.3.1	255.255.255.0
Router2	U-579	eth0: 192.168.3.2	255.255.255.0
		eth1: 192.168.4.1	255.255.255.0
Router3	U-5710	eth0:192.168.4.2	255.255.255.0
		eth1: 192.168.5.2	255.255.255.0
		eth2: 192.168.6.1	255.255.255.0
Router4	U-5711	eth0: 192.168.6.2	255.255.255.0
		eth1: 192.168.7.1	255.255.255.0
Router5	U-5712	eth0: 192.168.7.2	255.255.255.0
		eth1: 192.168.9.1	255.255.255.0
Router6	U-5713	eth0: 192.168.9.2	255.255.255.0

图：



三、 路由规则配置：

(1)Router0:

zebra.conf

```
!-*-zebra-*-
hostname router
password zebra
enable password zebra
log stdout
!
interface eth0
 description Interface to Internal Network
 ip address 192.168.2.1/24
!
interface eth1
 description Interface to Internal Network
 ip address 192.168.5.1/24
!
```

ripd.conf

```
!-*-rip-*-
hostname ripd
password zebra
router rip
 network eth0
 network eth1
log stdout
!
```

(2)Router3:

zebra.conf

```
!-*-zebra-*-
hostname router
password zebra
enable password zebra
log stdout
!
interface eth0
 description Interface to Internal Network
 ip address 192.168.4.2/24
!
interface eth1
 description Interface to Internal Network
 ip address 192.168.5.2/24
!
interface eth2
 description Interface to External Network
 ip address 192.168.6.1/24
!
```

ripd.conf

```
!-*-rip-*-
hostname ripd
password zebra
router rip
 network eth0
 network eth1
log stdout
!
```

bgpd.conf

```
!-*-bgp-*-
hostname bgpd
password zebra
router bgp 100
 bgp router-id 192.168.6.1
 network 192.168.2.0/24
 network 192.168.3.0/24
 network 192.168.4.0/24
 network 192.168.5.0/24
 neighbor 192.168.6.2 remote-as 101
log stdout
!
```

(3)Router4:

zebra.conf

```
!-*-zebra-*-
hostname router
password zebra
enable password zebra
log stdout
!
interface eth0
 description Interface to Internal Network
 ip address 192.168.6.2/24
!
interface eth1
 description Interface to Internal Network
 ip address 192.168.7.1/24
!
```

ospfd.conf

```
!-*-ospf-*-
hostname ospfd
password zebra
router ospf
 network 192.168.7.0/24 area 0
log stdout
!
```

bgpd.conf

```
!-*-bgp-*-
hostname bgpd
password zebra
router bgp 101
 bgp router-id 192.168.6.2
 network 192.168.7.0/24
 network 192.168.9.0/24
 neighbor 192.168.6.1 remote-as 100
log stdout
!
```

(4)Router6:

zebra.conf

```
!-*-zebra-*-
hostname router
password zebra
enable password zebra
log stdout
!
interface eth0
 description Interface to Internal Network
 ip address 192.168.9.2/24
!
```

ospfd.conf

```
!-*-ospf-*-
hostname ospfd
password zebra
router ospf
 network 192.168.9.0/24 area 0
log stdout
!
```

四、 数据包截图及协议报文分析

① AS1 的 RIP 协议（Router0 的 eth0 端口）

截图：

801	94714.48547(	192.168.2.2	224.0.0.9	RIPv2	86	Response
812	133488.5475:	192.168.2.2	224.0.0.9	RIPv2	86	Response
813	133513.5494:	192.168.2.2	224.0.0.9	RIPv2	86	Response
816	133543.5521:	192.168.2.2	224.0.0.9	RIPv2	86	Response
817	133575.5540:	192.168.2.2	224.0.0.9	RIPv2	86	Response
818	133610.5613:	192.168.2.2	224.0.0.9	RIPv2	86	Response
821	133623.0111!	192.168.2.1	224.0.0.9	RIPv2	66	Request
822	133623.0116:	192.168.2.2	192.168.2.1	RIPv2	86	Response
827	133634.5734(	192.168.2.2	224.0.0.9	RIPv2	86	Response

分析：

RIP 协议有 2 种形式，一种是 Request，还有一种是 Response，可以看出 Response 包的数量远大于 Request 包的数量，这符合 RIP 的功能，也就是了解路由器之间的信息。捕获这些信息后就可以更新路由表了。

② AS2 的 OSPF 协议（Router6 的 eth0 端口）

截图：

3358	590971.1874	192.168.9.1	192.168.9.2	OSPF	166	DB Description
3359	590971.1877	192.168.9.2	192.168.9.1	OSPF	86	DB Description
3360	590971.1879	192.168.9.1	224.0.0.5	OSPF	142	LS Update
3361	590971.1884	192.168.9.1	192.168.9.2	OSPF	66	DB Description
3362	590971.1886	192.168.9.1	192.168.9.2	OSPF	70	LS Request
3363	590971.1886	192.168.9.2	192.168.9.1	OSPF	70	LS Request
3364	590971.1888	192.168.9.2	224.0.0.5	OSPF	98	LS Update
3365	590971.1891	192.168.9.1	224.0.0.5	OSPF	94	LS Update
3366	590971.1896	192.168.9.2	224.0.0.5	OSPF	130	LS Update
3367	590971.1902	192.168.9.1	224.0.0.5	OSPF	110	LS Update
3368	590971.1903	192.168.9.1	224.0.0.5	OSPF	178	LS Update
3369	590971.5315	192.168.9.2	224.0.0.5	OSPF	138	LS Acknowledge
3370	590971.7026	192.168.9.1	224.0.0.5	OSPF	98	LS Acknowledge
3371	590976.1910	192.168.9.1	224.0.0.5	OSPF	98	LS Update
3374	590976.5369	192.168.9.2	224.0.0.5	OSPF	78	LS Acknowledge
3375	590980.1747	192.168.9.2	224.0.0.5	OSPF	82	Hello Packet
3376	590981.1862	192.168.9.1	224.0.0.5	OSPF	82	Hello Packet

分析：

OSPF 协议的包的种类包括 DB Description, LS Update, LS Request, LS Acknowledge, Hello 这 5 种包，实现的是路由器之间的相互访问信息，并且依据得到的信息来更新相应的路由表。

③ AS1 和 AS2 之间的 BGP 协议（Router3 的 eth2 端口）

截图：

38	54.853179	192.168.6.1	192.168.6.2	BGP	119 OPEN Message
40	54.853657	192.168.6.2	192.168.6.1	BGP	138 OPEN Message, KEEPALIVE Message
42	54.853831	192.168.6.1	192.168.6.2	BGP	104 KEEPALIVE Message, KEEPALIVE Messa
43	54.854178	192.168.6.2	192.168.6.1	BGP	85 KEEPALIVE Message
45	55.855013	192.168.6.1	192.168.6.2	BGP	129 UPDATE Message
46	55.855693	192.168.6.2	192.168.6.1	BGP	125 UPDATE Message
51	83.614855	192.168.6.1	192.168.6.2	BGP	87 NOTIFICATION Message
58	92.687157	192.168.6.1	192.168.6.2	BGP	119 OPEN Message
64	99.018276	192.168.6.2	192.168.6.1	BGP	119 OPEN Message
66	99.018533	192.168.6.1	192.168.6.2	BGP	138 OPEN Message, KEEPALIVE Message

646	44233.77027	192.168.6.2	192.168.6.1	BGP	85 KEEPALIVE Message
650	500466.8995	192.168.6.1	192.168.6.2	BGP	85 KEEPALIVE Message
651	500467.1009	192.168.6.1	192.168.6.2	BGP	85 [TCP Retransmission] KEEPALIVE Messa
652	500467.5093	192.168.6.1	192.168.6.2	BGP	85 [TCP Retransmission] KEEPALIVE Messa
653	500468.3253	192.168.6.1	192.168.6.2	BGP	85 [TCP Retransmission] KEEPALIVE Messa
654	500469.9608	192.168.6.1	192.168.6.2	BGP	85 [TCP Retransmission] KEEPALIVE Messa
655	500473.2288	192.168.6.1	192.168.6.2	BGP	85 [TCP Retransmission] KEEPALIVE Messa

分析：

BGP 协议的包的种类包括 Open，Keepalive，Update，Notification，TCP Retransmission 这 5 种包，实现的是 2 个 AS 的边际路由器之间的相互访问信息，并且依据得到的信息来更新相应的边际路由器的路由表，最终可以实现忽略不同 AS 内部的路由算法而使得不同 AS 之间可以通信。

五、 观察路由表的变更

① 网络拓扑改变之前

Router0 的路由表：

```
root@ubuntu:/home/user# route -n
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
192.168.2.0     0.0.0.0         255.255.255.0   U     0      0        0 eth0
192.168.3.0     192.168.2.2     255.255.255.0   UG    2      0        0 eth0
192.168.4.0     192.168.2.2     255.255.255.0   UG    3      0        0 eth0
192.168.5.0     0.0.0.0         255.255.255.0   U     0      0        0 eth1
```

从 Router0 到 Router3 使用 tracepath：

```
root@ubuntu:/home/user# tracepath 192.168.4.2
 1:  ubuntu.local                                          0.143ms pmtu 1500
 1:  ubuntu-2.local                                        1.332ms
 1:  ubuntu-2.local                                        0.285ms
 2:  192.168.3.2                                           0.690ms
 3:  192.168.4.2                                           1.980ms reached
     Resume: pmtu 1500 hops 3 back 62
```

② 网络拓扑改变之后

Router0 的路由表：

```
root@ubuntu:/home/user# route -n
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
192.168.2.0     0.0.0.0         255.255.255.0   U     0      0        0 eth0
192.168.3.0     192.168.2.2     255.255.255.0   UG    2      0        0 eth0
192.168.4.0     192.168.5.2     255.255.255.0   UG    2      0        0 eth1
192.168.5.0     0.0.0.0         255.255.255.0   U     0      0        0 eth1
```

从 Router0 到 Router3 使用 tracepath：

```
root@ubuntu:/home/user# tracepath 192.168.4.2
 1:  ubuntu.local                                          0.119ms pmtu 1500
 1:  192.168.4.2                                           0.510ms reached
 1:  192.168.4.2                                           0.786ms reached
     Resume: pmtu 1500 hops 1 back 64
```