

实验五 动态路由协议 RIP, OSPF 和 BGP 的观察

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实验目的：

理解自治系统（AS），观察 RIP，OSPF 以及 BGP 动态路由协议的实际运行过程。在网络拓扑结构变更的情况下观察路由表的动态变更，通过实验理解路由选择算法。

网络拓扑配置

节点名	虚拟设备名	ip	netmask
router0	router0	eth0:192.168.2.1	255.255.255.0
		eth1:192.168.3.1	
router1	router1	eth0:192.168.3.2	
		eth1:192.168.4.1	
router2	router2	eth0:192.168.4.2	
		eth1:192.168.5.1	
router3	router3	eth0:192.168.5.2	
		eth1:192.168.6.1	
router4	router4	eth0:192.168.6.2	
		eth1:192.168.10.1	
router5	lrouter5	eth0:192.168.10.2	
		eth1:192.168.11.1	
router6	router6	eth0:192.168.11.2	

路由配置文件：

IP 均通过 ifconfig 指令进行配置

router0:

zebra.conf：

```

1 1 -*- zebra -*-
2 !
3 ! zebra sample configuration file
4 !
5 ! $Id: zebra.conf.sample,v 1.1 2002/12/13 20:15:30 paul Exp $
6 !
7 hostname Router
8 password zebra
9 enable password zebra
10 !
11 ! Interface's description.
12 !
13 !interface lo
14 ! description test of desc.
15 !
16 !interface sit0
17 ! multicast
18
19 !
20 ! Static default route sample.
21 !
22 !ip route 0.0.0.0/0 203.181.89.241
23 !
24
25 !log file /var/log/quagga/zebra.log

```

ripd.conf:

```

root@ubuntu: /home/user
1 1 -*-rip-*-
2 hostname ripd
3 password zebra
4 router rip
5     network eth0
6     network eth1
7 log stdout
8 !

```

router3:

zebra.conf

```

root@ubuntu: /home/user
3 ! zebra sample configuration file
4 !
5 ! $Id: zebra.conf.sample,v 1.1 2002/12/13 20:15:30 paul Exp $
6 !
7 hostname Router
8 password zebra
9 enable password zebra
10 !
11 ! Interface's description.
12 !
13 !interface lo
14 ! description test of desc.
15 !
16 !interface sit0
17 ! multicast
18
19 !
20 ! Static default route sample.
21 !
22 !ip route 0.0.0.0/0 203.181.89.241
23 !
24
25 !log file /var/log/quagga/zebra.log

```

ripd.conf:使用 rip 协议的串口为 eth0 和 eth2, eth1 使用 BGP 协议

```

root@ubuntu: /home/user
1 ! *-rip-*
2 hostname ripd
3 password zebra
4 router rip
5     network eth0
6     network eth2
7 log stdout
8 !

```

router4:

zebra.conf:

```

root@ubuntu: /home/user
1 ! *- zebra -*
2 !
3 ! zebra sample configuration file
4 !
5 ! $Id: zebra.conf.sample,v 1.1 2002/12/13 20:15:30
6 !
7 hostname Router
8 password zebra
9 enable password zebra
10 !
11 ! Interface's description.
12 !
13 !interface lo
14 ! description test of desc.
15 !
16 !interface sit0
17 ! multicast
18
19 !
20 ! Static default route sample.
21 !
22 !ip route 0.0.0.0/0 203.181.89.241
23 !
24
25 !log file /var/log/quagga/zebra.log

```

ospfd.conf: router4 只有一个设备 eth1 运行 OSPF 协议

```

root@ubuntu: /home/user
1 ! *-ospf-*
2 hostname ospfd
3 password zebra
4 router ospf
5     network 192.168.10.0/24 area 0
6 log stdout
7 !

```

bgpd.conf:

router bgp 2:

router4 所在的 AS 的 AS 2 号。

192.168.10.0/24 和 192.168.11.0/24 为 AS 内部的子网

192.168.6.1 为邻居边界路由器的 ip 地址，as 号为 1

```

root@ubuntu: /home/user
1 !*-bgp-*
2 hostname bgpd
3 password zebra
4 router bgp 2
5     bgp router-id 192.168.6.2
6     network 192.168.10.0/24
7     network 192.168.11.0/24
8     neighbor 192.168.6.1 remote-as 1
9 log stdout
10 !

```

router6:

zebra.conf:

```

root@ubuntu: /home/user
1 ! *- zebra *-
2 !
3 ! zebra sample configuration file
4 !
5 ! $Id: zebra.conf.sample,v 1.1 2002/12/13 20:15:30 paul Exp $
6 !
7 hostname Router
8 password zebra
9 enable password zebra
10 !
11 ! Interface's description.
12 !
13 !interface lo
14 ! description test of desc.
15 !
16 !interface sit0
17 ! multicast
18 !
19 !
20 ! Static default route sample.
21 !
22 !ip route 0.0.0.0/0 203.181.89.241
23 !
24
25 !log file /var/log/quagga/zebra.log

```

ospfd.conf: router6 只有一个设备运行 OSPF 协议。

```

root@ubuntu: /home/user
1 !*-ospf-*
2 hostname ospfd
3 password zebra
4 router ospf
5     network 192.168.11.0/24 area 0
6 log stdout
7 !

```

数据包截图：

RIP 协议：在 router0 的 eth1 上抓到的 RIP 包，从 router0 上发出，源 ip 地址为 router0 的 eth1 的 ip 地址，目的地址为广播地址。

7	17.216014	192.168.3.1	224.0.0.9	RIPv2	60 Response
8	19.299304	192.168.3.1	224.0.0.22	IGMP	54 V3 Membership Report / Join group 2
9	21.632422	Vmware_e8:cc:50	Vmware_76:30:25	ARP	60 Who has 192.168.3.1? Tell 192.168.3
10	21.632434	Vmware_76:30:25	Vmware_e8:cc:50	ARP	42 192.168.3.1 is at 00:0c:29:76:30:25
11	40.428128	192.168.3.2	224.0.0.9	RIPv2	86 Response

▶ Frame 1: 66 bytes on wire (528 bits), 66 bytes captured (528 bits)

▶ Ethernet II, Src: Vmware_76:30:25 (00:0c:29:76:30:25), Dst: IPv4mcast_00:00:09 (01:00:5e:00:00:09)

▶ Internet Protocol Version 4, Src: 192.168.3.1 (192.168.3.1), Dst: 224.0.0.9 (224.0.0.9)

▶ User Datagram Protocol, Src Port: router (520), Dst Port: router (520)

▶ Routing Information Protocol

0000	01 00 5e 00 00 09 00 0c 29 76 30 25 08 00 45 c0	..^....)v0%..E.
0010	00 34 00 00 40 00 01 11 d5 46 c0 a8 03 01 e0 00	.4..@... .F.....
0020	00 09 02 08 02 08 00 20 94 3c 02 02 00 00 00 02<.....
0030	00 00 c0 a8 02 00 ff ff ff 00 00 00 00 00 00 00<.....

⊙ Ethernet (eth), 14 bytes Packets: 11 Displayed: 11 Marked: 0 Profile: Default

UDP 包中，源和目的端口都是 520 端口，RIP 使用 UDP 的 520 端口来收发 RIP 报文。

▶ Internet Protocol Version 4, Src: 192.168.3.1 (192.168.3.1), Dst: 224.0.0.9 (224.0.0.9)

▼ User Datagram Protocol, Src Port: router (520), Dst Port: router (520)

Source port: router (520)

Destination port: router (520)

Length: 32

▶ Checksum: 0x943c [validation disabled]

▶ Routing Information Protocol

0020	00 09 02 08 02 08 00 20 94 3c 02 02 00 00 00 02<.....
0030	00 00 c0 a8 02 00 ff ff ff 00 00 00 00 00 00 00<.....
0040	00 01	..

RIP 包中，标注了此 RIP 包为请求报文。

▶ User Datagram Protocol, Src Port: router (520), Dst Port: router (520)

▼ Routing Information Protocol

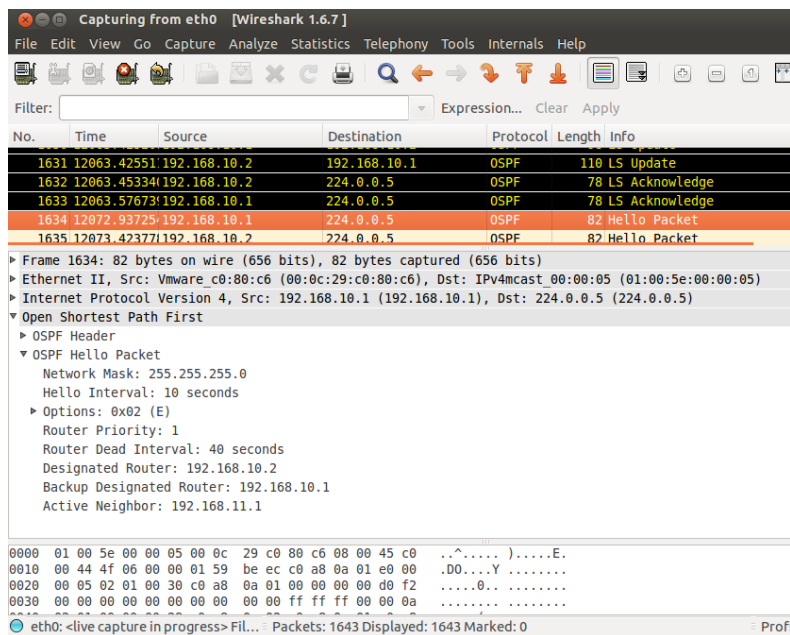
Command: Response (2)

Version: RIPv2 (2)

▶ IP Address: 192.168.2.0, Metric: 1

0020	00 09 02 08 02 08 00 20 94 3c 02 02 00 00 00 02<.....
0030	00 00 c0 a8 02 00 ff ff ff 00 00 00 00 00 00 00<.....
0040	00 01	..

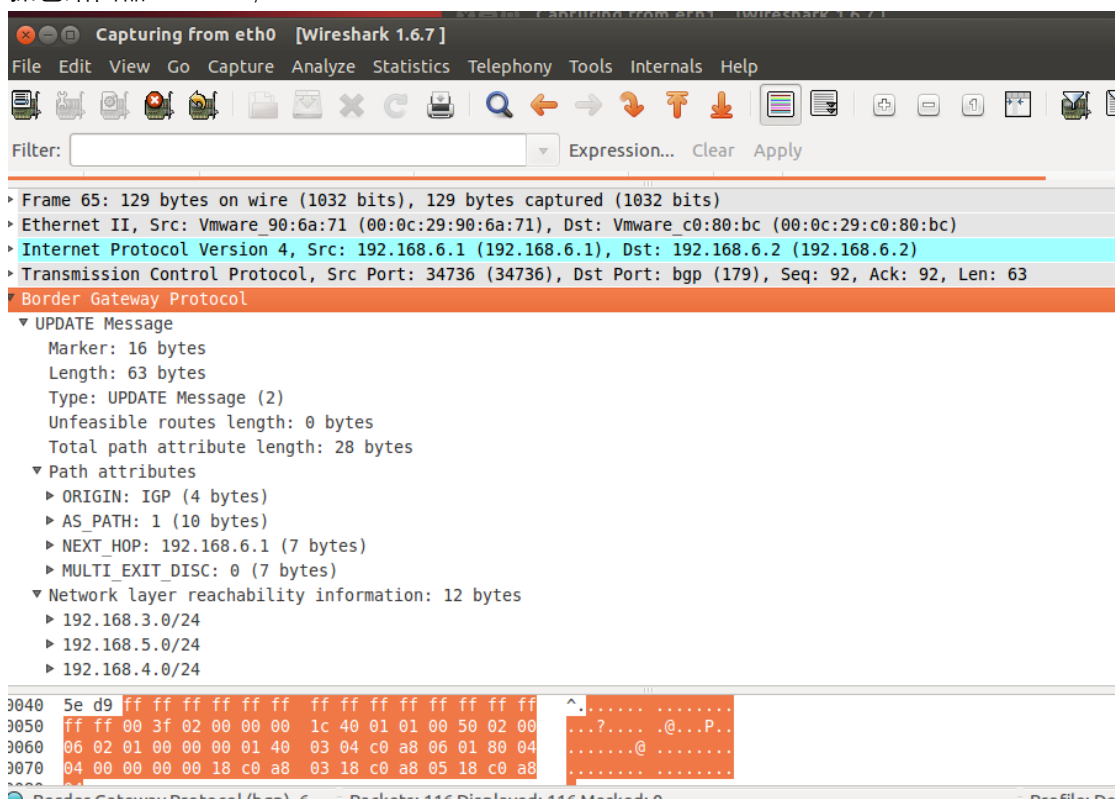
OSPF 协议：在 router5 的 eth1 上抓到的 OSPF 的 Hello Packet。



源 IP 地址为 192.168.10.2，Hello Packet 中给出了 192.168.10.2 的邻居 IP 地址 192.168.11.1 以及指定路由器的备用 IP 地址 192.168.10.1

BGP 协议：

抓包路由器: router4，eth0



观察动态路由：

改变拓扑前，router0 到 router3 的包需经过 3 跳，改变后只需要一跳。

改变前：

```
root@ubuntu:/home/user# tracepath 192.168.5.2
 1:  ubuntu-2.local                                0.095ms pmtu 1500
 1:  ubuntu.local                                  0.576ms
 1:  ubuntu.local                                  0.459ms
 2:  192.168.4.2                                    0.899ms
 3:  192.168.5.2                                    0.897ms reached
Resume: pmtu 1500 hops 3 back 62
```

改变后：

```
root@ubuntu:/home/user# tracepath 192.168.5.2
 1:  ubuntu-2.local                                0.058ms pmtu 1500
 1:  192.168.5.2                                    0.547ms reached
 1:  192.168.5.2                                    0.367ms reached
Resume: pmtu 1500 hops 1 back 64
```