

实验五 动态路由协议 RIP， OSPF 和 BGP

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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	Ip	Netmask	虚拟设备名
Router0	Eth0:192.168.0.1	255.255.255.0	U-575
	Eth1:192.168.3.1	255.255.255.0	
Router1	Eth0:192.168.0.2	255.255.255.0	U-574
	Eth1:192.168.1.1	255.255.255.0	
Router2	Eth0:192.168.1.2	255.255.255.0	U-573
	Eth1:192.168.2.1	255.255.255.0	
Router3	Eth0:192.168.2.2	255.255.255.0	U-571
	Eth1:192.168.4.1	255.255.255.0	
	Eth2:192.168.3.2	255.255.255.0	
Router4	Eth0:192.168.4.2	255.255.255.0	U-572
	Eth1:192.168.5.1	255.255.255.0	
Router5	Eth0:192.168.5.2	255.255.255.0	U-576
	Eth1:192.168.6.1	255.255.255.0	
Router6	Eth0:192.168.6.2	255.255.255.0	U-577

路由配置文件

见附件。

数据包截图

RIP 报文 router2 eth0

No.	Time	Source	Destination	Protocol	Length	Info
16	24.087253	192.168.1.1	224.0.0.22	IGMP	60	V3 Membership Report / Join group 224.0.0.9 for any sources
17	39.886199	192.168.1.2	224.0.0.9	RIPv2	66	Response
18	43.671007	192.168.1.1	224.0.0.9	RIPv2	66	Response
19	67.911734	192.168.1.2	224.0.0.9	RIPv2	66	Response
20	79.685251	192.168.1.1	224.0.0.9	RIPv2	66	Response
21	92.914263	192.168.1.2	224.0.0.9	RIPv2	66	Response
22	103.697289	192.168.1.1	224.0.0.9	RIPv2	66	Response
23	128.941515	192.168.1.2	224.0.0.9	RIPv2	66	Response
24	130.702219	192.168.1.1	224.0.0.9	RIPv2	66	Response
25	159.733404	192.168.1.1	224.0.0.9	RIPv2	66	Response
26	160.738102	0.0.0.0	255.255.255.255	DHCP	342	DHCP Discover - Transaction ID 0x7bba231e
27	163.947672	192.168.1.2	224.0.0.9	RIPv2	66	Response
28	164.189482	0.0.0.0	255.255.255.255	DHCP	342	DHCP Discover - Transaction ID 0x7bba231e
▶ Frame 19: 66 bytes on wire (528 bits), 66 bytes captured (528 bits)						
▶ Ethernet II, Src: Vmware 49:d9:56 (00:0c:29:49:d9:56), Dst: IPv4mcast 00:00:09 (01:00:5e:00:00:09)						
▶ Internet Protocol Version 4, Src: 192.168.1.2 (192.168.1.2), 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 00 00 0c	29 49 d9 56 08 00 45 c0	..^.....)I.V..E.			
0010	00 34 00 00 40 00 01 11	d7 45 c0 a8 01 02 e0 00	.4..@... .E.....			
0020	00 09 02 08 02 00 00 20	96 3b 02 02 00 00 00 02j.....			
0030	00 00 c0 a8 02 00 ff ff	ff 00 00 00 00 00 00 00			
0040	00 01		..			

OSPF 报文 router4 eth1

No.	Time	Source	Destination	Protocol	Length	Info
32	59.803489	192.168.5.2	192.168.5.1	OSPF	80	DB Description
33	59.803947	192.168.5.1	192.168.5.2	OSPF	66	DB Description
34	59.804414	192.168.5.1	192.168.5.2	OSPF	70	LS Request
35	59.805620	192.168.5.2	224.0.0.5	OSPF	142	LS Update
36	59.806313	192.168.5.1	224.0.0.5	OSPF	98	LS Update
37	59.811932	192.168.5.2	224.0.0.5	OSPF	110	LS Update
38	59.812144	192.168.5.1	192.168.5.2	OSPF	78	LS Acknowledge
39	60.005192	192.168.5.1	224.0.0.5	OSPF	82	Hello Packet
40	60.009828	Vmware 5e:4e:61	Vmware 4f:38:18	ARP	60	Who has 192.168.5.1? Tell 192.168.5.2
41	60.009900	Vmware 4f:38:18	Vmware 5e:4e:61	ARP	42	192.168.5.1 is at 00:0c:29:4f:38:18
42	60.214597	192.168.5.1	224.0.0.5	OSPF	98	LS Acknowledge
43	60.009180	192.168.5.2	224.0.0.5	OSPF	78	LS Acknowledge
44	65.006199	192.168.5.2	224.0.0.5	OSPF	82	Hello Packet
45	70.005950	192.168.5.1	224.0.0.5	OSPF	82	Hello Packet
▶ Frame 39: 82 bytes on wire (656 bits), 82 bytes captured (656 bits)						
▶ Ethernet II, Src: Vmware 4f:38:18 (00:0c:29:4f:38:18), Dst: IPv4mcast 00:00:05 (01:00:5e:00:00:05)						
▶ Internet Protocol Version 4, Src: 192.168.5.1 (192.168.5.1), Dst: 224.0.0.5 (224.0.0.5)						
▶ Open Shortest Path First						
0000	01 00 5e 00 00 05 00 0c	29 4f 38 18 08 00 45 c0	..^.....)08...E.			
0010	00 44 49 0e 00 00 01 59	c9 e4 c0 a8 05 01 e0 00	.DI...Y			
0020	00 05 02 01 00 30 c0 a8	05 01 00 00 00 00 e4 f20..			
0030	00 00 00 00 00 00 00 00	00 00 ff ff 00 00 0a			
0040	02 01 00 00 28 c0 a8	05 02 c0 a8 05 01 c0 a8			
0050	06 01		..			

BGP 报文 router3 eth1

No.	Time	Source	Destination	Protocol	Length	Info
6	16.464943	192.168.4.1	192.168.4.2	BGP	119	OPEN Message
7	16.465688	192.168.4.2	192.168.4.1	TCP	66	bgp > 49731 [ACK] Seq=1 Ack=54 Win=14480 Len=0 TSval=1176607 TSecr=3734860
8	16.467326	192.168.4.2	192.168.4.1	BGP	138	OPEN Message, KEEPALIVE Message
9	16.467358	192.168.4.1	192.168.4.2	TCP	66	49731 > bgp [ACK] Seq=54 Ack=73 Win=14600 Len=0 TSval=3734860 TSecr=1176608
10	16.469793	192.168.4.1	192.168.4.2	BGP	104	KEEPALIVE Message, KEEPALIVE Message
11	16.471328	192.168.4.2	192.168.4.1	BGP	85	KEEPALIVE Message
12	16.511560	192.168.4.1	192.168.4.2	TCP	66	49731 > bgp [ACK] Seq=92 Ack=92 Win=14600 Len=0 TSval=3734872 TSecr=1176609
13	17.473406	192.168.4.2	192.168.4.1	BGP	121	UPDATE Message
14	17.473458	192.168.4.1	192.168.4.2	TCP	66	49731 > bgp [ACK] Seq=92 Ack=147 Win=14600 Len=0 TSval=3735112 TSecr=1176859
15	17.484280	192.168.4.1	192.168.4.2	BGP	121	UPDATE Message
16	17.522509	192.168.4.2	192.168.4.1	TCP	66	bgp > 49731 [ACK] Seq=147 Ack=147 Win=14480 Len=0 TSval=1176872 TSecr=3735115
▶ Frame 6: 119 bytes on wire (952 bits), 119 bytes captured (952 bits)						
▶ Ethernet II, Src: Vmware 95:57:d9 (00:0c:29:95:57:d9), Dst: Vmware 4f:38:0e (00:0c:29:4f:38:0e)						
▶ Internet Protocol Version 4, Src: 192.168.4.1 (192.168.4.1), Dst: 192.168.4.2 (192.168.4.2)						
▶ Transmission Control Protocol, Src Port: 49731 (49731), Dst Port: bgp (179), Seq: 1, Ack: 1, Len: 53						
▶ Border Gateway Protocol						
0000	00 0c 29 4f 38 0e 00 0c	29 95 57 d9 08 00 45 c0	...)08...).W...E.			
0010	00 69 83 98 40 00 01 06	6b e3 c0 a8 04 01 c0 a8	...@...k.....			
0020	04 02 c2 43 00 b3 9e 93	7e d4 fc 6a c4 2d 80 18	...C....~.j....			
0030	07 21 f5 9a 00 00 01 01	08 0a 00 38 fd 4c 00 11	.l......8.L..			
0040	f4 1b ff ff ff ff ff ff	ff ff ff ff ff ff ff ff			
0050	ff ff 00 35 01 04 00 64	00 b4 c0 a8 04 01 18 02	...5...d			
0060	06 01 04 00 01 00 01 02	02 08 00 02 02 02 00 02			
0070	06 41 04 00 00 00 64		.A....d			

协议报文分析

RIP 报文:

RIP 报文使用 IP、UDP 及 RIP 协议，它与普通报文同有关于 source、destination 等信息，它使用 UDP 的 520 端口进行接收和发送报文。

OSPF 报文:

OSPF 报文使用 IP 协议，同有 source、destination 等信息，并通过多播地址来发送包，并对连接进行状态更新，area: 0.0.0.0，用以更新这一区域内所有的路由器。

BGP 报文:

BGP 报文使用 IP、TCP 和 BGP 协议，同有关于 source、destination 等信息，但它通过 TCP 的 179 端口来发送接收报文，它的报文类型有许多，包括 Open Message、KeepAlive Message、Update Message 等等。

观察动态路由

实验第一阶段：Router0、1、2、3，Router0 与 Router3 未连

```
user@ubuntu:/etc/quagga$ tracepath 192.168.2.2
  1:  192.168.0.1                0.096ms pmtu 1500
  1:  192.168.0.2                0.606ms
  1:  192.168.0.2                0.262ms
  2:  192.168.1.2                0.925ms
  3:  192.168.2.2                0.737ms reached
    Resume: pmtu 1500 hops 3 back 62
user@ubuntu:/etc/quagga$ _
```

实验第二阶段：Router0、1、2、3，Router0 与 Router3 相连接

```
user@ubuntu:/etc/quagga$ tracepath 192.168.3.2
  1:  192.168.3.1                0.072ms pmtu 1500
  1:  192.168.3.2                0.422ms reached
  1:  192.168.3.2                0.299ms reached
    Resume: pmtu 1500 hops 1 back 64
user@ubuntu:/etc/quagga$ _
```

建立 Router0 和 Router3 的连接之后，可以发现 Router0 直接通过 192.168.3.0/24 来到达 Router3，对应跳数由 3 变成了 1。

遇到的问题

1. 更新源花了挺大功夫 对虚拟机的操作还是不很熟悉。
2. 在写配置文件的时候, 有些文件需要写多条“*network network*”, 我一开始将多条写到了一行, 结果在启动 *quagga* 的时候报错, 耽误了不少时间。