

Lab5

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实验目的	<ol style="list-style-type: none">1. 学习自治系统的相关概念2. 学习和理解内部网关协议（RIP 和 OSPF）3. 学习和理解边界网关协议（BGP）4. 学习 Quagga 软件的使用
网络拓扑配置	见附表及附图
路由配置文件	<p>Router0 中的 ripd.conf</p> <pre>!-*-rip-*- hostname ripd password zebra router rip network eth0 network eth1 log stdout ! </pre> <p>Router3 中的 ripf.conf</p> <pre>!-*-rip-*- hostname ripd password zebra router rip network eth0 network eth1 log stdout ! </pre> <p>Router3 中的 bgpd.conf</p> <pre>!-*-bgp-*- hostname bgpd password zebra router bgp 1 bgp router-id 192.168.5.1 network 192.168.1.0/24 network 192.168.2.0/24 network 192.168.3.0/24 network 192.168.4.0/24 neighbor 192.168.5.2 remote-as 2 log stdout ! </pre>

Router4 中的 ospf.conf

```
! *-ospf-*  
hostname ospfd  
password zebra  
router ospf  
  network 192.168.6.1/24 area 0  
log stdout  
!
```

Router4 中的 bgpd.conf

```
! *-ospf-*  
hostname ospfd  
password zebra  
router ospf  
  network 192.168.6.1/24 area 0  
log stdout  
!
```

Router6 中的 ospf.conf

```
! *-ospf-*  
hostname ospfd  
password zebra  
router ospf  
  network 192.168.7.2/24 area 0  
log stdout  
!
```

所有的 zebra.conf 均采用类似下列形式

```
! *-zebra-*  
hostname router  
password zebra  
enable password zebra  
log stdout  
!  
interface eth0  
  description Interface to Internal Network  
  ip address 192.168.7.2/24  
!
```

在 Router0 的 eth0 上抓取 RIP 报文

Capturing from eth0 [Wireshark 1.6.7]

Filter: rip

No.	Time	Source	Destination	Protocol	Length	Info
185	39.909757	192.168.2.2	224.0.0.9	RIPv2	86	Response
186	39.909850	192.168.3.1	224.0.0.9	RIPv2	86	Response
239	48.222611	192.168.1.2	224.0.0.9	RIPv2	66	Request
240	48.222703	192.168.2.1	224.0.0.9	RIPv2	66	Request
243	48.222805	192.168.2.2	192.168.2.1	RIPv2	86	Response
251	49.221126	192.168.1.2	224.0.0.9	RIPv2	106	Response
252	49.221243	192.168.2.1	224.0.0.9	RIPv2	66	Response
314	59.871512	192.168.3.2	224.0.0.9	RIPv2	66	Response
315	59.871524	192.168.4.2	224.0.0.9	RIPv2	106	Response
431	74.912315	192.168.2.2	224.0.0.9	RIPv2	86	Response
432	74.912429	192.168.3.1	224.0.0.9	RIPv2	86	Response
454	79.223737	192.168.1.2	224.0.0.9	RIPv2	106	Response

Frame 243: 86 bytes on wire (688 bits), 86 bytes captured (688 bits)

Ethernet II, Src: Vmware_99:6a:0c (00:0c:29:99:6a:0c), Dst: Vmware_17:db:9c (00:0c:29:17:db:9c)

Internet Protocol Version 4, Src: 192.168.2.2 (192.168.2.2), Dst: 192.168.2.1 (192.168.2.1)

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

Routing Information Protocol

0000 00 0c 29 17 db 9c 00 0c 29 99 6a 0c 08 00 45 c0 ..)...).j...E.
0010 00 48 00 00 40 00 40 11 b4 91 c0 a8 02 02 c0 a8 .H...@.
0020 02 01 02 08 02 08 00 34 ed c5 02 02 00 00 00 024
0030 00 00 c0 a8 03 00 ff ff ff 00 00 00 00 00 00
eth0: <live capture in progress> Filter: rip Packets: 1677 Disposed: 111 M... Profile: Default

数据包截图

在 Router4 的 eth1 上抓取 OSPF 报文

Capturing from eth1 [Wireshark 1.6.7]

Filter: ospf

No.	Time	Source	Destination	Protocol	Length	Info
4	1.210456	192.169.6.2	224.0.0.5	OSPF	82	Hello Packet
5	1.210499	192.169.7.1	224.0.0.5	OSPF	82	Hello Packet
17	4.684206	192.169.7.2	224.0.0.5	OSPF	82	Hello Packet
23	6.213411	192.169.7.2	192.169.7.1	OSPF	98	LS Update
27	6.889239	192.169.7.1	224.0.0.5	OSPF	78	LS Acknowled
36	7.010058	192.169.6.1	224.0.0.5	OSPF	82	Hello Packet
46	11.210756	192.169.6.2	224.0.0.5	OSPF	82	Hello Packet
47	11.210931	192.169.7.1	224.0.0.5	OSPF	82	Hello Packet
70	14.684389	192.169.7.2	224.0.0.5	OSPF	82	Hello Packet
84	17.006339	192.169.6.1	192.169.6.2	OSPF	66	DB Descripti
86	17.010320	192.169.6.1	224.0.0.5	OSPF	82	Hello Packet
124	21.209145	192.169.6.2	192.169.6.1	OSPF	66	DB Descripti
125	21.209163	192.169.7.1	224.0.0.5	OSPF	110	LS Update

Frame 4: 82 bytes on wire (656 bits), 82 bytes captured (656 bits)

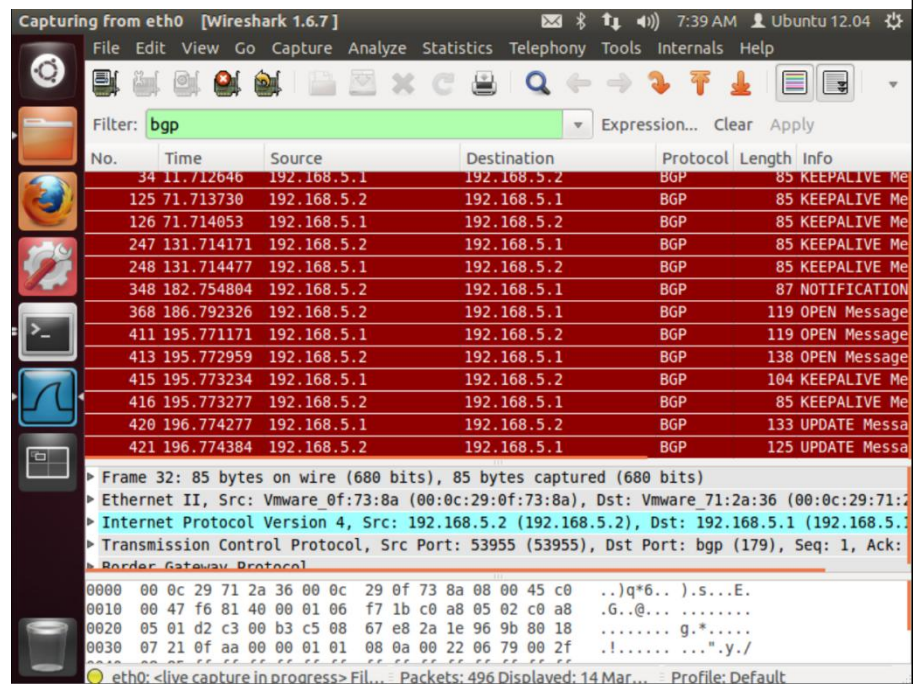
Ethernet II, Src: Vmware_6c:52:93 (00:0c:29:6c:52:93), Dst: IPv4mcast_00:00:05 (01:00:5e:00:00:05)

Internet Protocol Version 4, Src: 192.169.6.2 (192.169.6.2), Dst: 224.0.0.5 (224.0.0.5)

Open Shortest Path First

0000 01 00 5e 00 00 05 00 0c 29 6c 52 93 00 00 45 c0 ..^....)lR...E.
0010 00 44 bd 03 00 00 01 59 54 ed c0 a9 06 02 e0 00 .D....Y T.....
0020 00 05 02 01 00 30 c0 a9 07 01 00 00 00 6e 450.....nE
0030 00 00 00 00 00 00 00 00 00 ff ff ff 00 00 0a
eth1: <live capture in progress> Filter: ospf Packets: 595 Disposed: 80 Mar... Profile: Default

在 Router4 的 eth0 上抓取 BGP 报文



No.	Time	Source	Destination	Protocol	Length	Info
34	11.712646	192.168.5.1	192.168.5.2	BGP	85	KEEPALIVE Message
125	71.713730	192.168.5.2	192.168.5.1	BGP	85	KEEPALIVE Message
126	71.714053	192.168.5.1	192.168.5.2	BGP	85	KEEPALIVE Message
247	131.714171	192.168.5.2	192.168.5.1	BGP	85	KEEPALIVE Message
248	131.714477	192.168.5.1	192.168.5.2	BGP	85	KEEPALIVE Message
348	182.754804	192.168.5.2	192.168.5.1	BGP	87	NOTIFICATION Message
368	186.792326	192.168.5.2	192.168.5.1	BGP	119	OPEN Message
411	195.771171	192.168.5.1	192.168.5.2	BGP	119	OPEN Message
413	195.772959	192.168.5.2	192.168.5.1	BGP	138	OPEN Message
415	195.773234	192.168.5.1	192.168.5.2	BGP	104	KEEPALIVE Message
416	195.773277	192.168.5.2	192.168.5.1	BGP	85	KEEPALIVE Message
420	196.774277	192.168.5.1	192.168.5.2	BGP	133	UPDATE Message
421	196.774384	192.168.5.2	192.168.5.1	BGP	125	UPDATE Message

Frame 32: 85 bytes on wire (680 bits), 85 bytes captured (680 bits) on eth0
Ethernet II, Src: Vmware 0f:73:8a (00:0c:29:0f:73:8a), Dst: Vmware 71:2a:36 (00:0c:29:71:2a:36)
Internet Protocol Version 4, Src: 192.168.5.2 (192.168.5.2), Dst: 192.168.5.1 (192.168.5.1)
Transmission Control Protocol, Src Port: 53955 (53955), Dst Port: bgp (179), Seq: 1, Ack: 1, Len: 85
Border Gateway Protocol

0000 00 0c 29 71 2a 36 00 0c 29 0f 73 8a 08 00 45 c0 ..)q*6..).s...E.
0010 00 47 f6 81 40 00 01 06 f7 1b c0 a8 05 02 c0 a8 .G..@... ..
0020 05 01 d2 c3 00 b3 c5 08 67 e8 2a 1e 96 9b 80 18 g.*.....
0030 07 21 0f aa 00 00 01 01 08 0a 00 22 06 79 00 2f .!.....".y./

eth0: <live capture in progress> Filter: ... Packets: 496 Displayed: 14 Mar... Profile: Default

RIP 报文分析

RIP 有两种类型，Request 和 Response，RIP 的 request 消息在特殊情况下发送，当路由器需要时它可以提供即时的路由信息，它可以请求全部的路由条目也可以请求具体的某些路由条目。最常见的例子是当路由器第一次加入网络时，通常会发送 request 消息，以要求获取相邻路由器的最新路由。当 RIP 接收到 request 消息，将处理并发送一个 response 消息。消息包含自己的整个路由或请求要求的条目，正常情况下路由器通常不会发送对路由信息有特殊要求的请求消息。RIP 会每 30 秒发送一个 response 消息，用于路由表更新。

OSPF 报文分析

OSPF 有五种类型，Hello Packet、DB Description、LS Request、LS Update 和 LS Acknowledge。Hello Packet 用于建立和维持邻居关系，可以看到其目的 IP 是 224.0.0.5，是 OSPF 规定的多播地址。DB Description 用于初始化路由，路由器利用它交换链路状态。LS Request 用于向别的路由器请求获得链路状态，别的路由器收到 LS Request 后发送 LS Update 回复相应信息，或者在链路状态更新时用 LS Update 广播。LS Acknowledge 则用于收到 LS Update 后进行确认。

BGP 报文分析

BGP 有四种类型，OPEN、KEEPALIVE、UPDATE 和 NOTIFICATION。OPEN 用于打开和对方路由器的消息连接。连接完成后，用 KEEPALIVE 来保持仍处在活动的连接和废除已经退出的连接。

协议报文分析

	<p>UPDATE 则用于更新、删除、添加路由信息。另外 NOTIFICATION 没有观察到，因为她只有在出错时才会出现。</p>
观察动态路由	<p>RIP 观察 在 Router0 与 Router3 没有直接连接之前，Router0 的路由信息</p> <pre>user@ubuntu:~\$ route -n Kernel IP routing table Destination Gateway Genmask Flags Metric Ref Use Iface 192.168.1.0 0.0.0.0 255.255.255.0 U 0 0 0 eth0 192.168.2.0 192.168.1.2 255.255.255.0 UG 2 0 0 eth0 192.168.3.0 192.168.1.2 255.255.255.0 UG 3 0 0 eth0 192.168.4.0 0.0.0.0 255.255.255.0 U 0 0 0 eth1</pre> <p>在 Router0 与 Router3 直接连接之后，Router0 的路由信息</p> <pre>user@ubuntu:~\$ route -n Kernel IP routing table Destination Gateway Genmask Flags Metric Ref Use Iface 192.168.1.0 0.0.0.0 255.255.255.0 U 0 0 0 eth0 192.168.2.0 192.168.1.2 255.255.255.0 UG 2 0 0 eth0 192.168.3.0 192.168.4.2 255.255.255.0 UG 2 0 0 eth1 192.168.4.0 0.0.0.0 255.255.255.0 U 0 0 0 eth1</pre> <p>OSPF 观察 运行 OSPF 之后 Router4 的路由信息</p> <pre>user@ubuntu:~\$ route -n Kernel IP routing table Destination Gateway Genmask Flags Metric Ref Use Iface 0.0.0.0 192.168.1.1 0.0.0.0 UG 0 0 0 eth0 169.254.0.0 0.0.0.0 255.255.0.0 U 1000 0 0 eth0 192.169.5.0 0.0.0.0 255.255.255.0 U 0 0 0 eth0 192.169.6.0 0.0.0.0 255.255.255.0 U 0 0 0 eth1 192.169.7.0 192.169.6.2 255.255.255.0 UG 20 0 0 eth1</pre> <p>BGP 观察 运行 BGP 之后 Router4 的路由信息</p> <pre>user@ubuntu:~\$ route -n Kernel IP routing table Destination Gateway Genmask Flags Metric Ref Use Iface 192.168.1.0 192.168.5.1 255.255.255.0 UG 0 0 0 eth0 192.168.2.0 192.168.5.1 255.255.255.0 UG 0 0 0 eth0 192.168.3.0 192.168.5.1 255.255.255.0 UG 0 0 0 eth0 192.168.4.0 192.168.5.1 255.255.255.0 UG 0 0 0 eth0 192.168.5.0 0.0.0.0 255.255.255.0 U 0 0 0 eth0 192.168.6.0 0.0.0.0 255.255.255.0 U 0 0 0 eth1 192.168.7.0 192.168.6.2 255.255.255.0 UG 20 0 0 eth1</pre>

附表（实验使用自行克隆的虚拟机，故设备名与节点名一致）

节点名	设备名	ip	netmask
Router0	Router0	eth0:192.168.1.1	255.255.255.0
		eth1:192.168.4.1	255.255.255.0
Router1	Router1	eth0:192.168.1.2	255.255.255.0
		eth1:192.168.2.1	255.255.255.0

Router2	Router2	eth0:192.168.2.2	255.255.255.0
		eth1:192.168.3.1	255.255.255.0
Router3	Router3	eth0:192.168.3.2	255.255.255.0
		eth1:192.168.4.2	255.255.255.0
		eth2:192.168.5.1	255.255.255.0
Router4	Router4	eth0:192.168.5.2	255.255.255.0
		eth1:192.168.6.1	255.255.255.0
Router5	Router5	eth0:192.168.6.2	255.255.255.0
		eth1:192.168.7.1	255.255.255.0
Router6	Router6	eth0:192.168.7.2	255.255.255.0

附图

