# 实验五——动态路由协议 RIP,OSPF 和 BGP 观察——实验报告

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## 一. 实验目标

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。

## 二. 网络拓扑配置

| 节点名 | 虚拟设备名 | IP | Netmask |
|---|---|---|---|
| **Router0** | Vmnet0 | Eth0:192.168.2.1 | 255.255.255.0 |
| | Vmnet1 | Eth1:192.168.3.1 | 255.255.255.0 |
| **Router1** | Vmnet1 | Eth0:192.168.3.2 | 255.255.255.0 |
| | Vmnet2 | Eth1:192.168.4.1 | 255.255.255.0 |
| **Router2** | Vmnet2 | Eth0:192.168.4.2 | 255.255.255.0 |
| | Vmnet3 | Eth1:192.168.5.1 | 255.255.2255.0 |
| **Router3** | Vmnet0 | Eth2:192.168.2.2 | 255.255.255.0 |
| | Vmnet3 | Eth0:192.168.5.2 | 255.255.255.0 |
| | Vmnet4 | Eth1:192.168.6.1 | 255.255.255.0 |
| **Router4** | Vmnet4 | Eth0:192.168.6.2 | 255.255.255.0 |
| | Vmnet5 | Eth1:192.168.7.1 | 255.255.255.0 |
| **Router5** | Vmnet5 | Eth0:192.168.7.2 | 255.255.255.0 |
| | Vmnet6 | Eth1:192.168.8.1 | 255.255.255.0 |
| **Router6** | Vmnet6 | Eth0:192.168.8.2 | 255.255.255.0 |

## 三. 配置文件

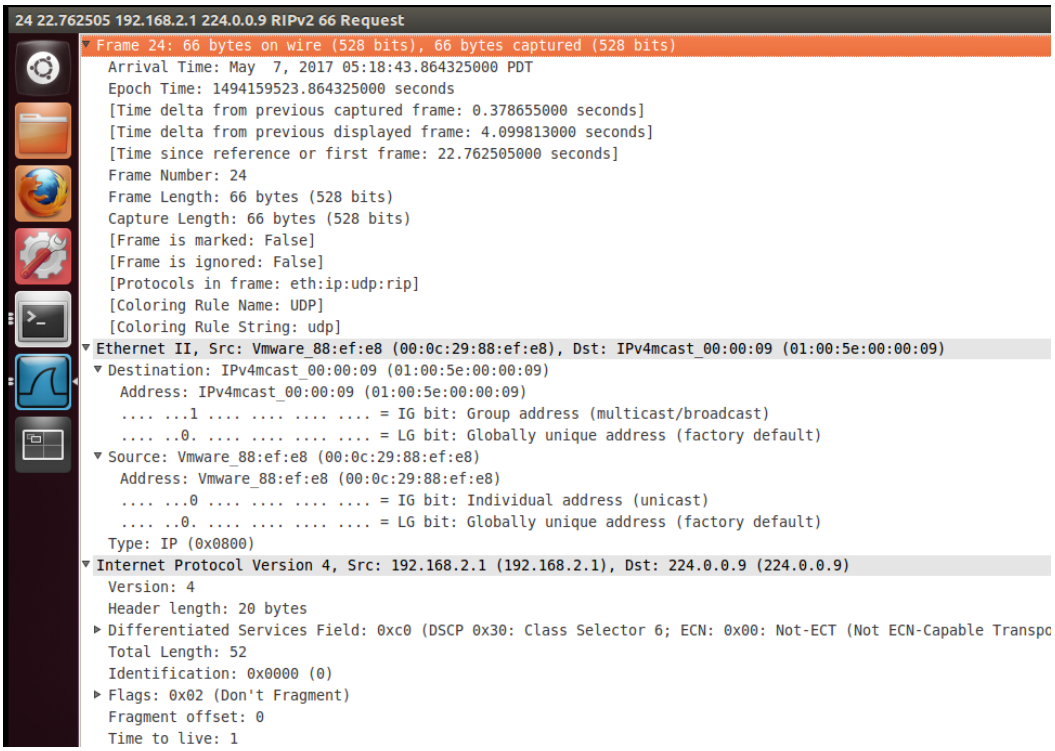
见文件夹 config

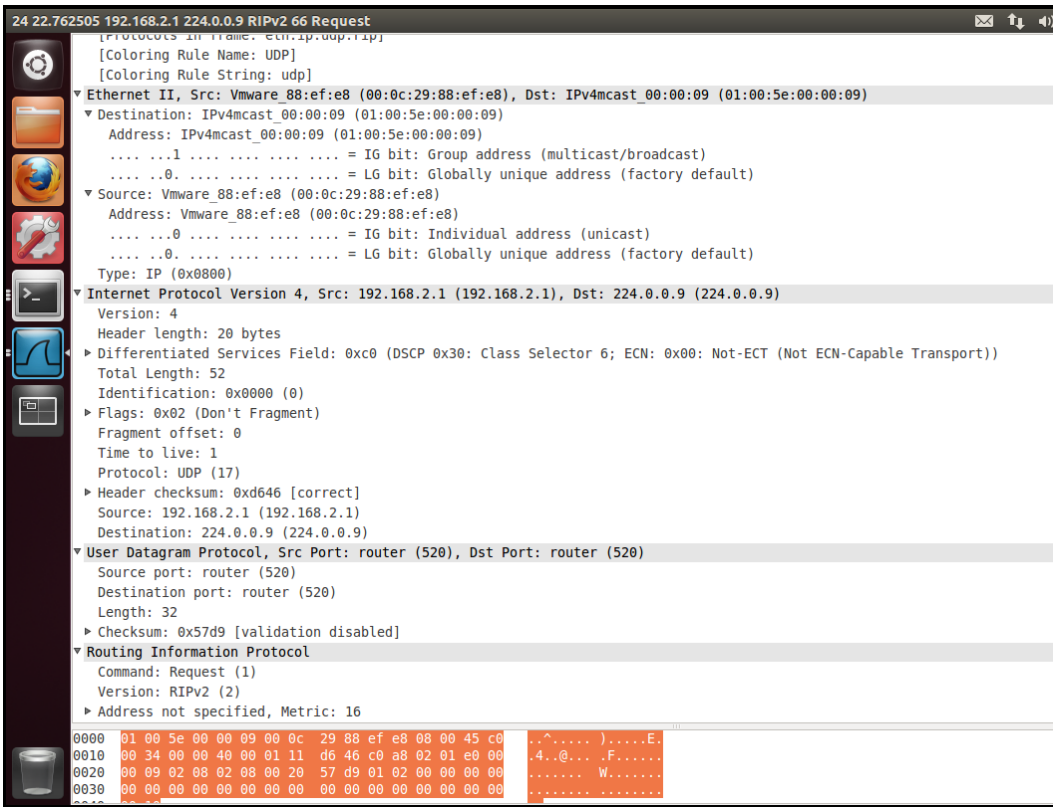
## 四. 数据包截图

### (1)RIP 截图

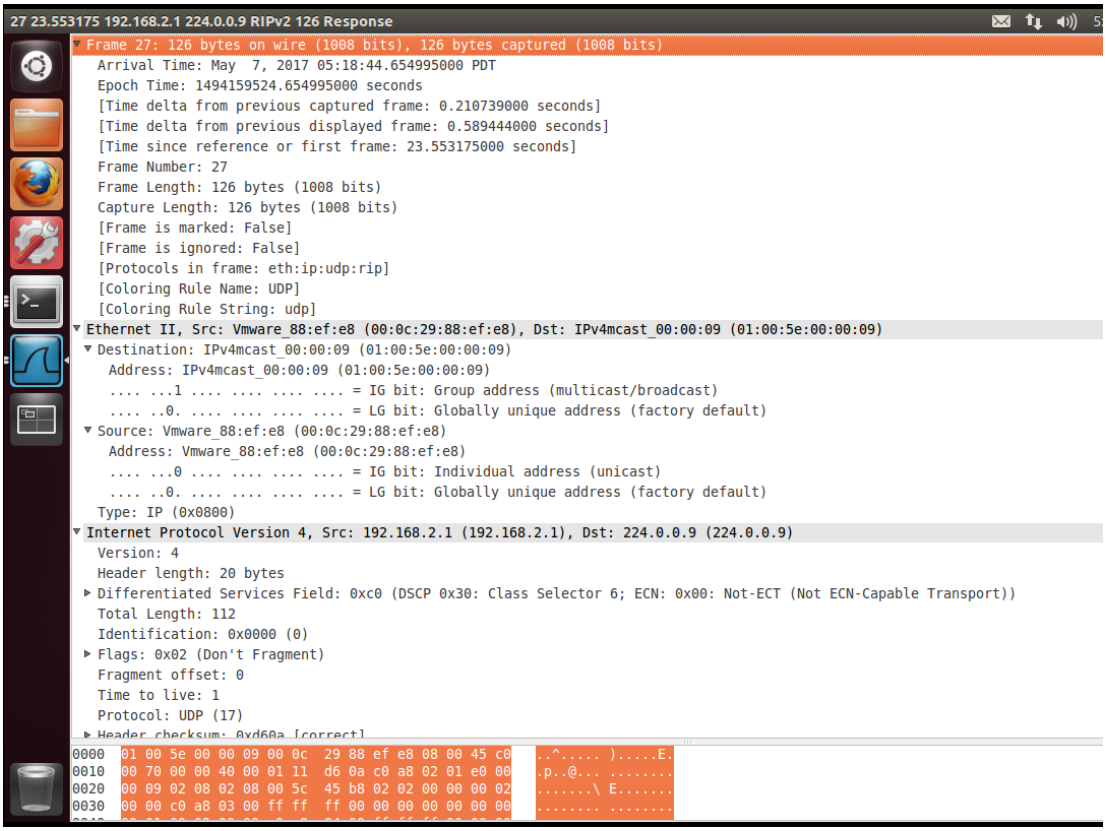
用 wireshark 观测 router0 的 eth0

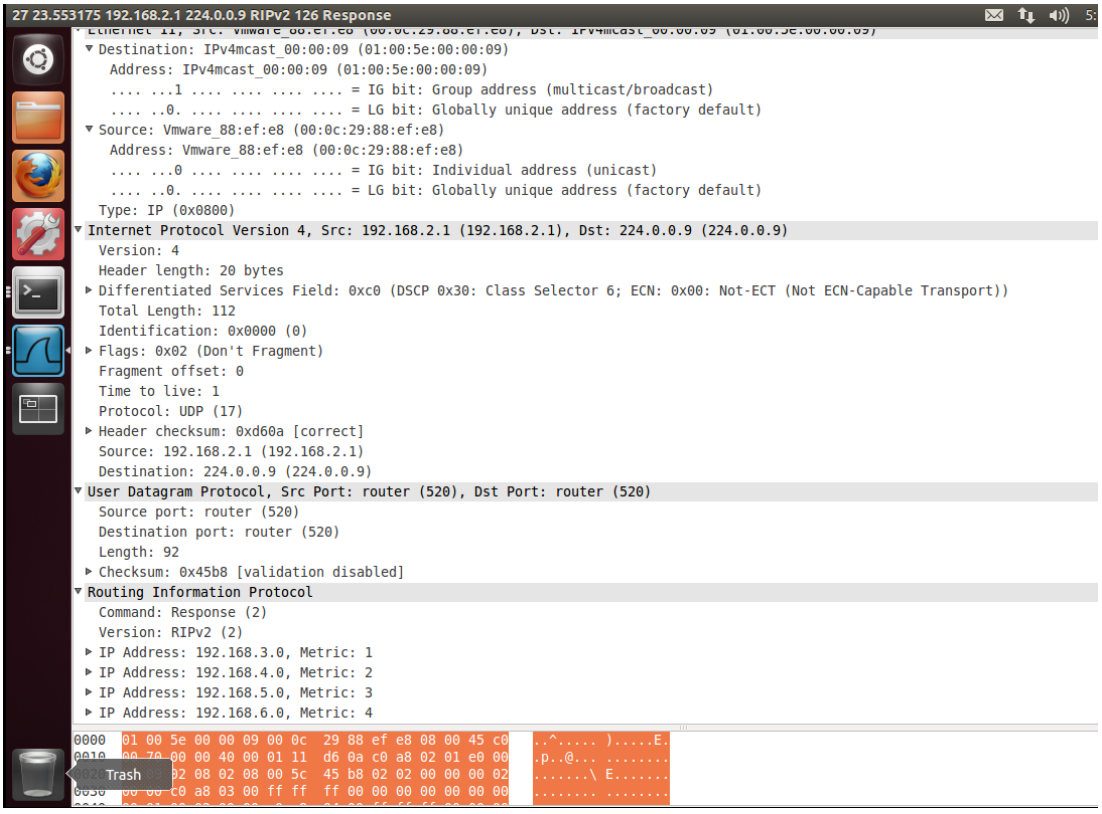
*request:*



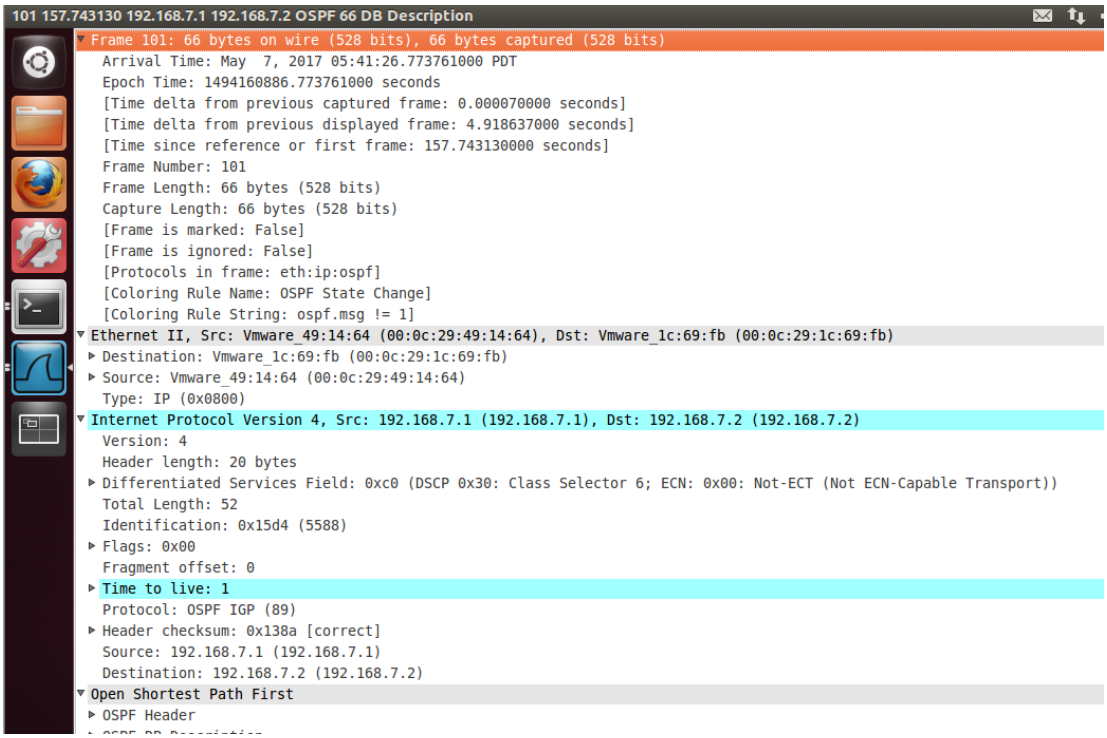
# *Respon:*

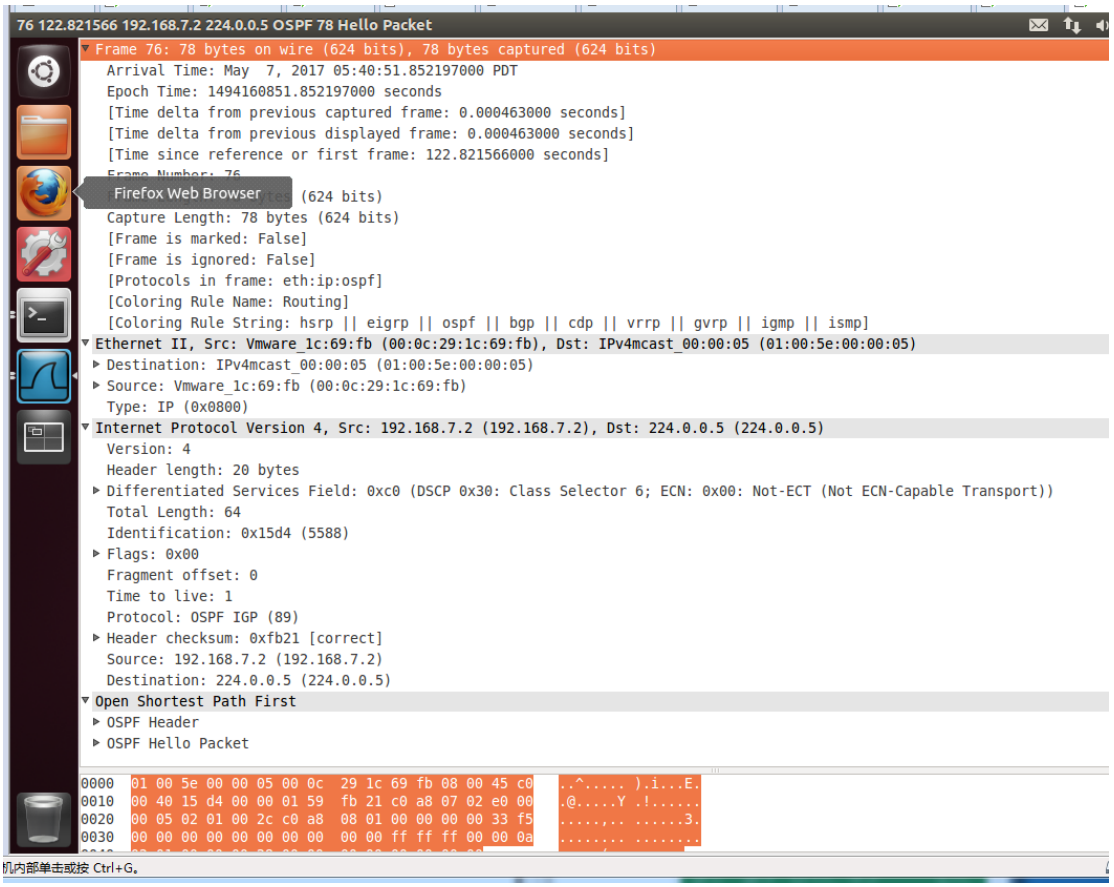

27 23.553175 192.168.2.1 224.0.0.9 RIPv2 126 Response
Frame 27: 126 bytes on wire (1008 bits), 126 bytes captured (1008 bits)
Arrival Time: May 7, 2017 05:18:44.654995000 PDT
Epoch Time: 1494159524.654995000 seconds
[Time delta from previous captured frame: 0.210739000 seconds]
[Time delta from previous displayed frame: 0.589444000 seconds]
[Time since reference or first frame: 23.553175000 seconds]
Frame Number: 27
Frame Length: 126 bytes (1008 bits)
Capture Length: 126 bytes (1008 bits)
[Frame is marked: False]
[Frame is ignored: False]
[Protocols in frame: eth:ip:udp:rip]
[Coloring Rule Name: UDP]
[Coloring Rule String: udp]
Ethernet II, Src: Vmware_88:ef:e8 (00:0c:29:88:ef:e8), Dst: IPv4mcast_00:00:09 (01:00:5e:00:00:09)
Destination: IPv4mcast_00:00:09 (01:00:5e:00:00:09)
Address: IPv4mcast_00:00:09 (01:00:5e:00:00:09)
.... ...1 .... .... .... .... = IG bit: Group address (multicast/broadcast)
.... ..0. .... .... .... .... = LG bit: Globally unique address (factory default)
Source: Vmware_88:ef:e8 (00:0c:29:88:ef:e8)
Address: Vmware_88:ef:e8 (00:0c:29:88:ef:e8)
.... ...0 .... .... .... .... = IG bit: Individual address (unicast)
.... ..0. .... .... .... .... = LG bit: Globally unique address (factory default)
Type: IP (0x0800)
Internet Protocol Version 4, Src: 192.168.2.1 (192.168.2.1), Dst: 224.0.0.9 (224.0.0.9)
Version: 4
Header length: 20 bytes
Differentiated Services Field: 0xc0 (DSCP 0x30: Class Selector 6; ECN: 0x00: Not-ECT (Not ECN-Capable Transport))
Total Length: 112
Identification: 0x0000 (0)
Flags: 0x02 (Don't Fragment)
Fragment offset: 0
Time to live: 1
Protocol: UDP (17)
0000 01 00 5e 00 00 09 00 0c 29 88 ef e8 08 00 45 c0
0010 00 70 00 00 40 00 01 11 d6 0a c0 a8 02 01 e0 00
0020 00 09 02 08 02 08 00 5c 45 b8 02 02 00 00 00 02
0030 00 00 c0 a8 03 00 ff ff ff 00 00 00 00 00 00 00


27 23.553175 192.168.2.1 224.0.0.9 RIPv2 126 Response
Destination: IPv4mcast_00:00:09 (01:00:5e:00:00:09)
Address: IPv4mcast_00:00:09 (01:00:5e:00:00:09)
.... ...1 .... .... .... .... = IG bit: Group address (multicast/broadcast)
.... ..0. .... .... .... .... = LG bit: Globally unique address (factory default)
Source: Vmware_88:ef:e8 (00:0c:29:88:ef:e8)
Address: Vmware_88:ef:e8 (00:0c:29:88:ef:e8)
.... ...0 .... .... .... .... = IG bit: Individual address (unicast)
.... ..0. .... .... .... .... = LG bit: Globally unique address (factory default)
Type: IP (0x0800)
Internet Protocol Version 4, Src: 192.168.2.1 (192.168.2.1), Dst: 224.0.0.9 (224.0.0.9)
Version: 4
Header length: 20 bytes
Differentiated Services Field: 0xc0 (DSCP 0x30: Class Selector 6; ECN: 0x00: Not-ECT (Not ECN-Capable Transport))
Total Length: 112
Identification: 0x0000 (0)
Flags: 0x02 (Don't Fragment)
Fragment offset: 0
Time to live: 1
Protocol: UDP (17)
Header checksum: 0xd60a [correct]
Source: 192.168.2.1 (192.168.2.1)
Destination: 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: 92
Checksum: 0x45b8 [validation disabled]
Routing Information Protocol
Command: Response (2)
Version: RIPv2 (2)
IP Address: 192.168.3.0, Metric: 1
IP Address: 192.168.4.0, Metric: 2
IP Address: 192.168.5.0, Metric: 3
IP Address: 192.168.6.0, Metric: 4
0000 01 00 5e 00 00 09 00 0c 29 88 ef e8 08 00 45 c0
0010 00 70 00 00 40 00 01 11 d6 0a c0 a8 02 01 e0 00
Trash
0030 00 00 c0 a8 03 00 ff ff ff 00 00 00 00 00 00 00

(2)OSPF 截图

用 wireshark 观测 Router6 的 eth0

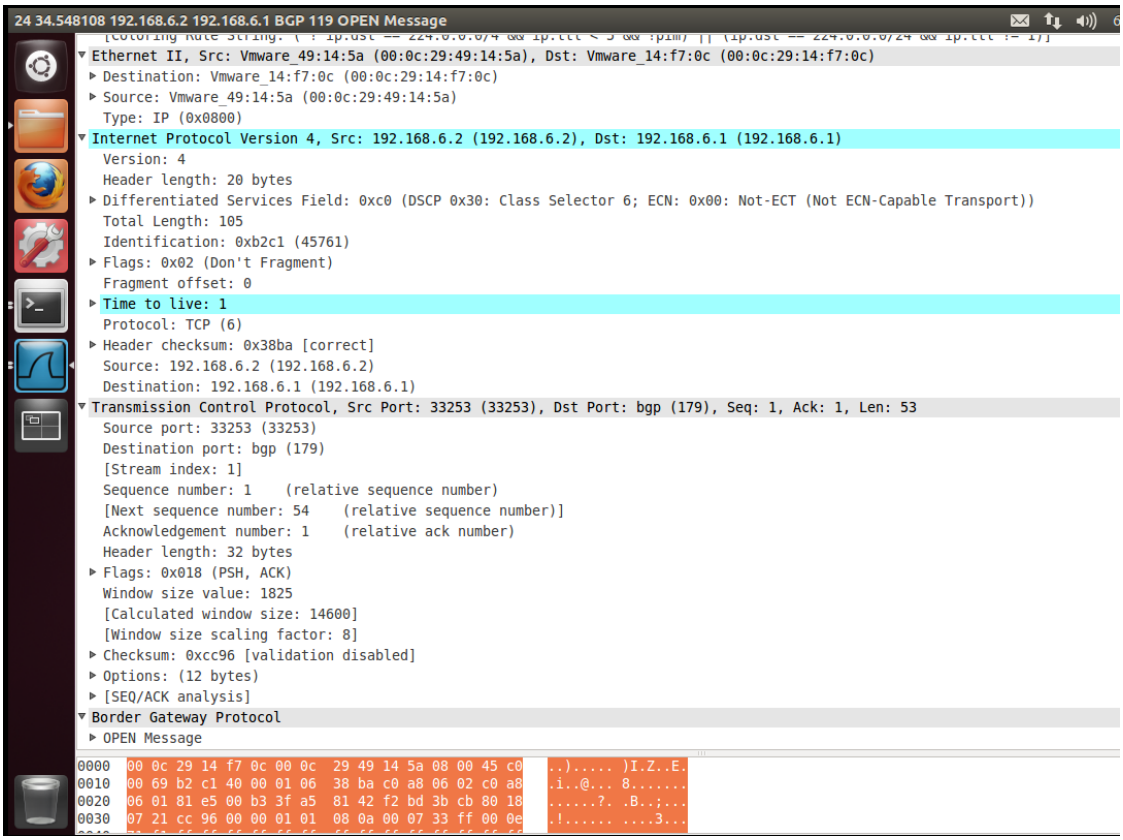


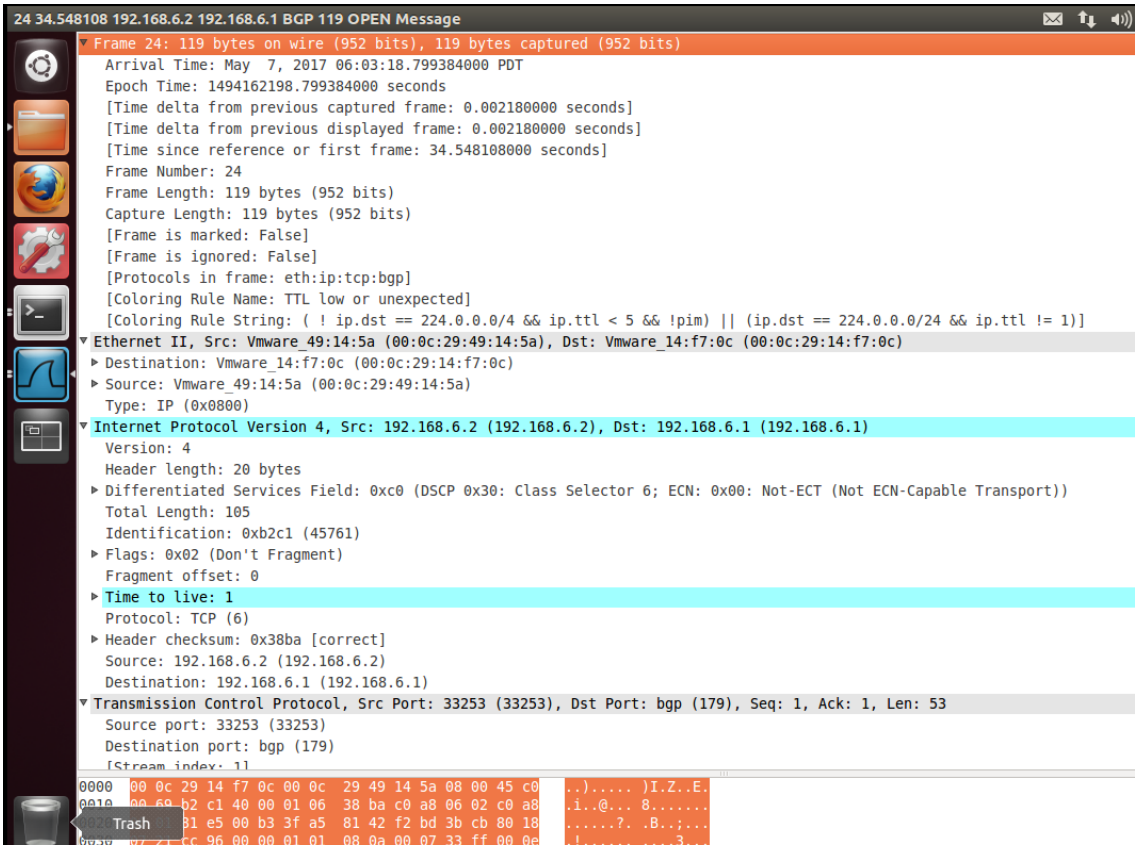



(3) BGP 截图

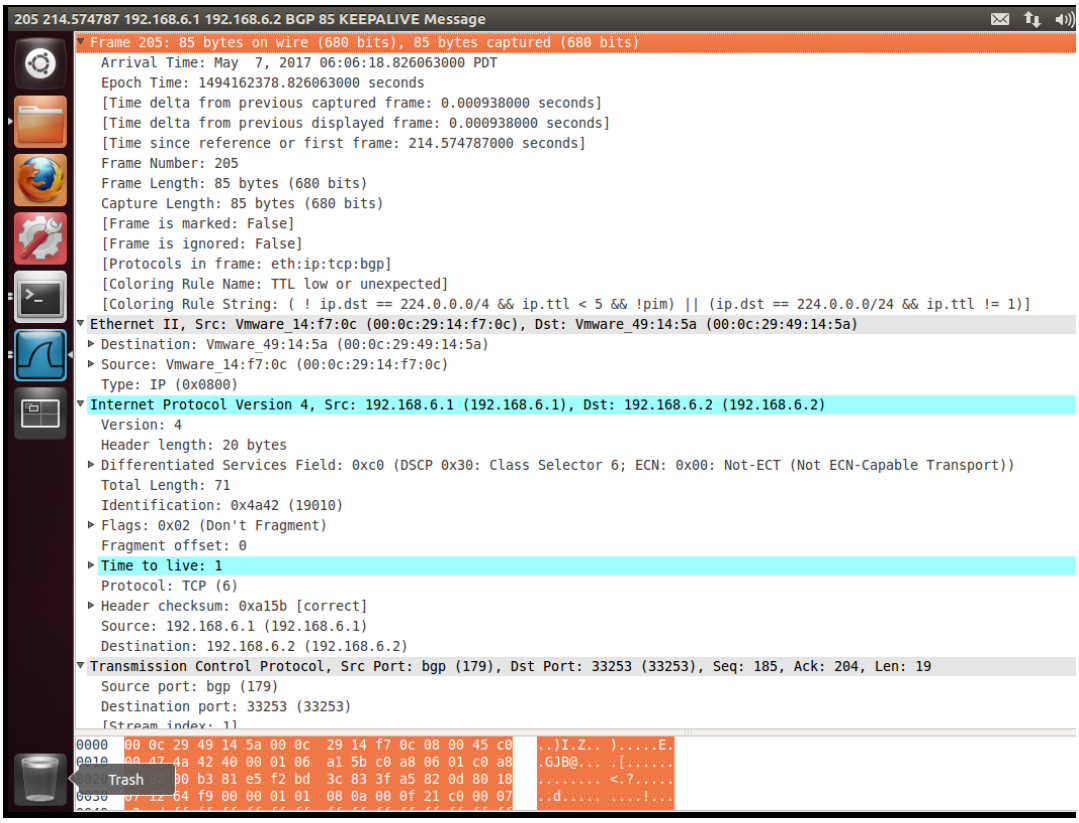
用 wireshark 观测 Router5 的 eth0

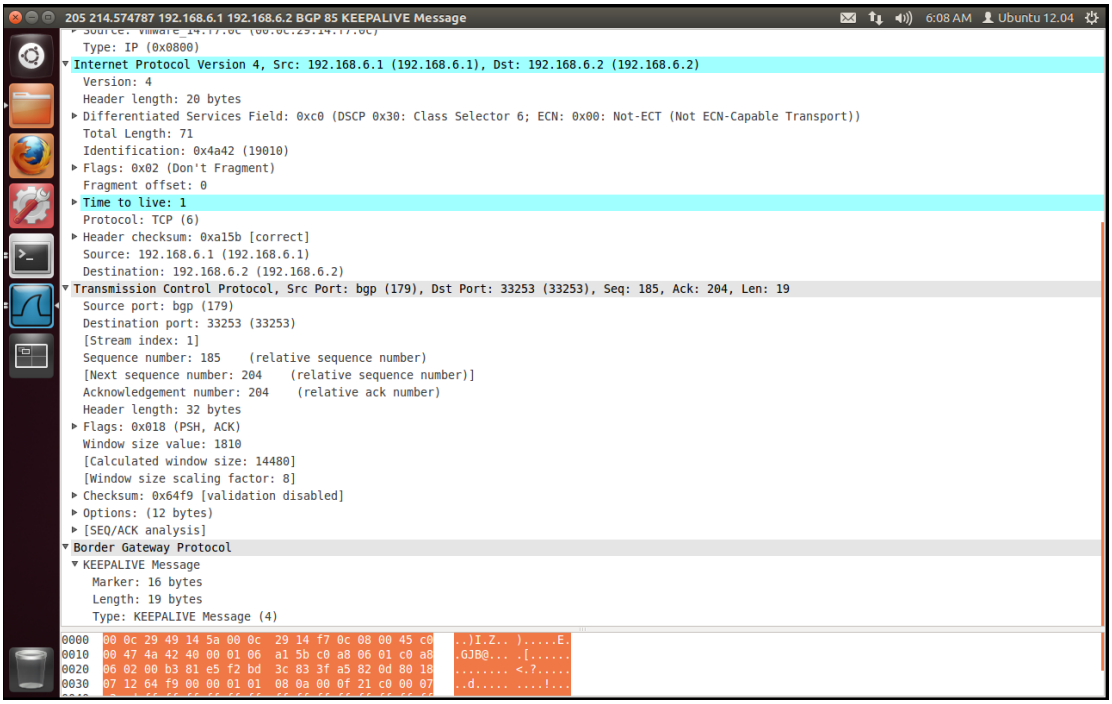
*Request:*


24 34.548108 192.168.6.2 192.168.6.1 BGP 119 OPEN Message
Ethernet II, Src: Vmware_49:14:5a (00:0c:29:49:14:5a), Dst: Vmware_14:f7:0c (00:0c:29:14:f7:0c)
Destination: Vmware_14:f7:0c (00:0c:29:14:f7:0c)
Source: Vmware_49:14:5a (00:0c:29:49:14:5a)
Type: IP (0x0800)
Internet Protocol Version 4, Src: 192.168.6.2 (192.168.6.2), Dst: 192.168.6.1 (192.168.6.1)
Version: 4
Header length: 20 bytes
Differentiated Services Field: 0xc0 (DSCP 0x30: Class Selector 6; ECN: 0x00: Not-ECT (Not ECN-Capable Transport))
Total Length: 105
Identification: 0xb2c1 (45761)
Flags: 0x02 (Don't Fragment)
Fragment offset: 0
Time to live: 1
Protocol: TCP (6)
Header checksum: 0x38ba [correct]
Source: 192.168.6.2 (192.168.6.2)
Destination: 192.168.6.1 (192.168.6.1)
Transmission Control Protocol, Src Port: 33253 (33253), Dst Port: bgp (179), Seq: 1, Ack: 1, Len: 53
Source port: 33253 (33253)
Destination port: bgp (179)
[Stream index: 1]
Sequence number: 1 (relative sequence number)
[Next sequence number: 54 (relative sequence number)]
Acknowledgement number: 1 (relative ack number)
Header length: 32 bytes
Flags: 0x018 (PSH, ACK)
Window size value: 1825
[Calculated window size: 14600]
[Window size scaling factor: 8]
Checksum: 0xcc96 [validation disabled]
Options: (12 bytes)
[SEQ/ACK analysis]
Border Gateway Protocol
OPEN Message
0000 00 0c 29 14 f7 0c 00 0c 29 49 14 5a 08 00 45 c0 ..)..... )I.Z..E.
0010 00 69 b2 c1 40 00 01 06 38 ba c0 a8 06 02 c0 a8 .i..@... 8.....
0020 06 01 81 e5 00 b3 3f a5 81 42 f2 bd 3b cb 80 18 ......?. .B..;...
0030 07 21 cc 96 00 00 01 01 08 0a 00 07 33 ff 00 0e .!...... ....3...


24 34.548108 192.168.6.2 192.168.6.1 BGP 119 OPEN Message
Frame 24: 119 bytes on wire (952 bits), 119 bytes captured (952 bits)
Arrival Time: May 7, 2017 06:03:18.799384000 PDT
Epoch Time: 1494162198.799384000 seconds
[Time delta from previous captured frame: 0.002180000 seconds]
[Time delta from previous displayed frame: 0.002180000 seconds]
[Time since reference or first frame: 34.548108000 seconds]
Frame Number: 24
Frame Length: 119 bytes (952 bits)
Capture Length: 119 bytes (952 bits)
[Frame is marked: False]
[Frame is ignored: False]
[Protocols in frame: eth:ip:tcp:bgp]
[Coloring Rule Name: TTL low or unexpected]
[Coloring Rule String: ( ! ip.dst == 224.0.0.0/4 && ip.ttl < 5 && !pim) || (ip.dst == 224.0.0.0/24 && ip.ttl != 1)]
Ethernet II, Src: Vmware_49:14:5a (00:0c:29:49:14:5a), Dst: Vmware_14:f7:0c (00:0c:29:14:f7:0c)
Destination: Vmware_14:f7:0c (00:0c:29:14:f7:0c)
Source: Vmware_49:14:5a (00:0c:29:49:14:5a)
Type: IP (0x0800)
Internet Protocol Version 4, Src: 192.168.6.2 (192.168.6.2), Dst: 192.168.6.1 (192.168.6.1)
Version: 4
Header length: 20 bytes
Differentiated Services Field: 0xc0 (DSCP 0x30: Class Selector 6; ECN: 0x00: Not-ECT (Not ECN-Capable Transport))
Total Length: 105
Identification: 0xb2c1 (45761)
Flags: 0x02 (Don't Fragment)
Fragment offset: 0
Time to live: 1
Protocol: TCP (6)
Header checksum: 0x38ba [correct]
Source: 192.168.6.2 (192.168.6.2)
Destination: 192.168.6.1 (192.168.6.1)
Transmission Control Protocol, Src Port: 33253 (33253), Dst Port: bgp (179), Seq: 1, Ack: 1, Len: 53
Source port: 33253 (33253)
Destination port: bgp (179)
0000 00 0c 29 14 f7 0c 00 0c 29 49 14 5a 08 00 45 c0 ..)..... )I.Z..E.
0010 00 69 b2 c1 40 00 01 06 38 ba c0 a8 06 02 c0 a8 .i..@... 8.....
Trash

*Respon:*




# 五. 协议报文分析

## (1) RIP:

过程分析：

对于截图的 rip 报文分析，首先会发送 IGMP 报文让路由器加入一个组播组，地址

为 224.0.0.9,然后发送 ripv2 的请求报文到组播中，然后其他加入该组播的路由器收到请求报文，并返回自己的报文。

Rip 报文结构分析

主要有版本号，长度，header，路由标记，网络地址，路由器地址，子网掩码等。

### (2)OSPF：

过程分析：

根据上面的截图，可知先加入组播地址 224.0.0.5，然后发送 OSPF Hello Packet 通知该组播组中的其他路由器，其他路由器会进行回应

结构分析：

版本号：1/type:1/length:2/路由 ip:4/id:4/checksum:2/认证字段：4

### (3)BGP

过程分析：

根据上面的截图，两个子网可以相互知道对方的存在。

结构分析：

Type:1/length:2/info:16

## 六. 观察动态路由

RIP 实现了 AS1 的内部自治，子网 1 中的路由器能够自主选择路由路径，并选择合适的算法，OSPF 实现了 AS2 的内部自治，与 RIP 相比，两者是不同的内部路由选择。BGP 则实现了 AS1 和 AS2 两个子网间的相互通信。