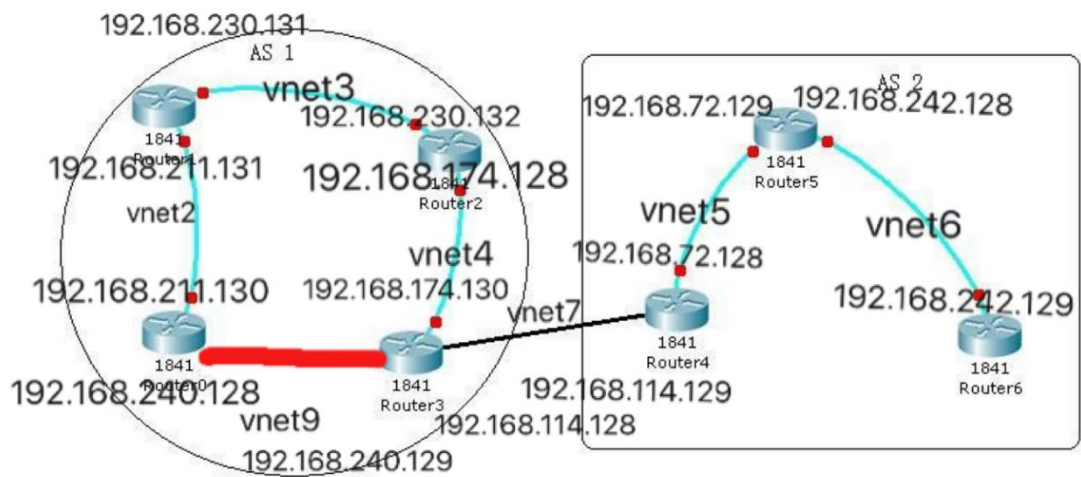


动态路由协议 RIP,OSPF,BGP 观察

- 一 . 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。
- 二 . 网络拓扑配置



节点名	虚拟设备名	Ip	netmask
Router0	R0	Ens33: 192.168.211.130	255.255.255.0
		Ens38: 192.168.240.128	255.255.255.0
Router1	R1	Ens33: 192.168.211.131	255.255.255.0
		Ens38: 192.168.230.131	255.255.255.0
Router2	R2	Ens33: 192.168.230.132	255.255.255.0
		Ens38: 192.168.174.128	255.255.255.0
Router3	R3	Ens33: 192.168.174.130	255.255.255.0
		Ens38: 192.168.114.128	255.255.255.0
		Ens39: 192.168.240.129	255.255.255.0
Router4	R4	Ens33: 192.168.114.129	255.255.255.0
		Ens38: 192.168.72.128	255.255.255.0
Router5	R5	Ens33: 192.168.72.129	255.255.255.0
		Ens38: 192.168.242.128	255.255.255.0
Router6	R6	Ens33: 192.168.242.129	255.255.255.0

三. 路由配置文件

R0: ripd.conf

```
user1@ubuntu: /etc/quagga
File Edit View Search Terminal Help
!-*-rip-*-
hostname ripd
password zebra
router rip
    network ens33
    network ens38
!
```

R0 zebra.conf

```
user1@ubuntu: /etc/quagga
File Edit View Search Terminal Help
hostname router
password zebra
enable password zebra
interface ens33
    description Interface to Internal Network
    ip address 192.168.211.130/24

interface ens38
    description Interface to Internal Network
    ip address 192.168.240.128/24
```

R3 ripd.conf

```
user1@ubuntu: /etc/quagga
File Edit View Search Terminal Help
!-*-rip-*-
hostname ripd
password zebra
router rip
    network ens33
    network ens39
!
```

R3 zebra.conf

```
user1@ubuntu: /etc/quagga
File Edit View Search Terminal Help
hostname router
password zebra
enable password zebra
interface ens33
    description Interface to Internal Network
    ip address 192.168.174.130/24

interface ens38
    description Interface to External Network
    ip address 192.168.114.128/24

interface ens39
    description Interface to Internal Network
    ip address 192.168.240.129/25
```

R3 bgpd.conf

```
user1@ubuntu: /etc/quagga
File Edit View Search Terminal Help
hostname bgpd
password zebra
router bgp 100
    bgp router-id 192.168.114.128
    network 192.168.211.0/24
    network 192.168.230.0/24
    network 192.168.174.0/24
    neighbor 192.168.114.129 remote-as 101
```

R4 ospfd.conf

```
user1@ubuntu: /etc/quagga
File Edit View Search Terminal Help
hostname ospfd
password zebra
router ospf
    network 192.168.72.128/24 area 0
```

R4 zebra.conf

```
user1@ubuntu: /etc/quagga
File Edit View Search Terminal Help
hostname router
password zebra
enable password zebra
interface ens33
    description Interface to Internal Network
    ip address 192.168.72.128/24
interface ens38
    description Interface to External Network
    ip address 192.168.114.129/24
```

R4 bgpd.conf

```
user1@ubuntu: /etc/quagga
File Edit View Search Terminal Help
hostname bgpd
password zebra
router bgp 101
    bgp router-id 192.168.114.129
    network 192.168.72.0/24
    network 192.168.242.0/24
    neighbor 192.168.114.128 remote-as 100
```

R6 ospfd.conf

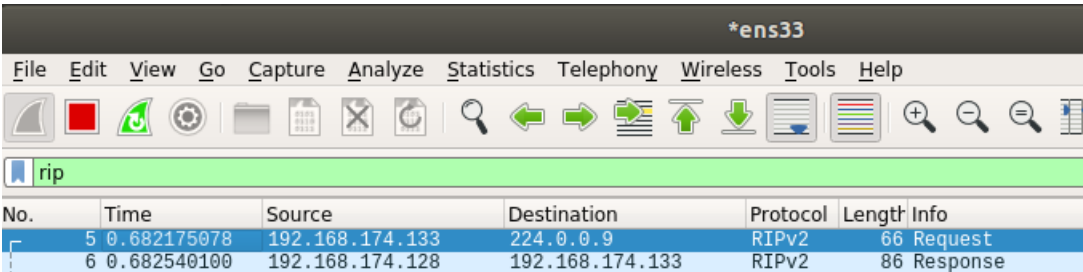
```
user1@ubuntu: /etc/quagga
File Edit View Search Terminal Help
hostname ospfd
password zebra
router ospf
    network 192.168.242.129/24 area 0
~
~
```

R6 zebra.conf

```
user1@ubuntu: /etc/quagga
File Edit View Search Terminal Help
hostname router
password zebra
enable password zebra
interface ens33
    description Interface to Internal Network
    ip address 192.168.242.129/24
```

四 . 数据包截图

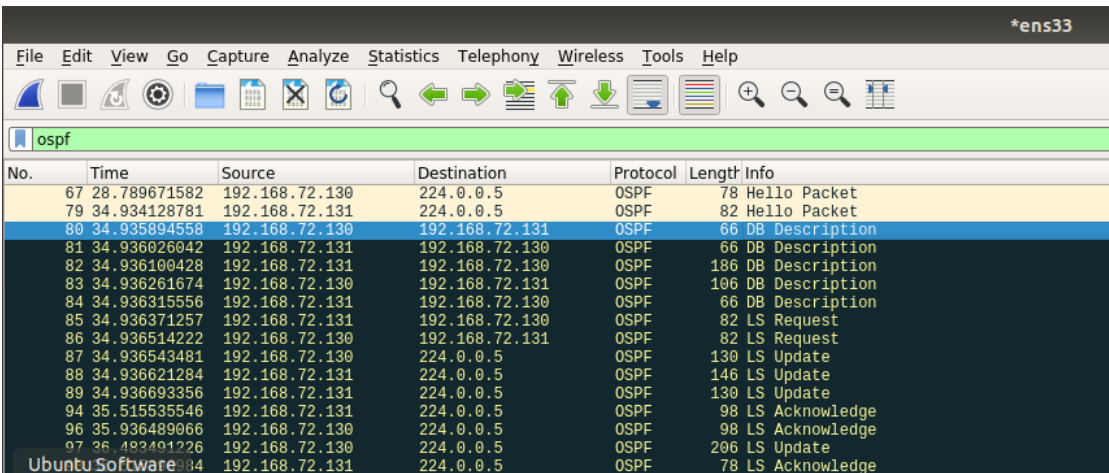
(一) Rip 报文 (r3 ens33 端口抓包)



The screenshot shows a Wireshark capture of two RIPv2 packets on the ens33 interface. The first packet is a request (No. 5) and the second is a response (No. 6). Both originate from 192.168.174.133. The response packet is 86 bytes long.

No.	Time	Source	Destination	Protocol	Length	Info
5	0.682175078	192.168.174.133	224.0.0.9	RIPv2	66	Request
6	0.682540100	192.168.174.128	192.168.174.133	RIPv2	86	Response

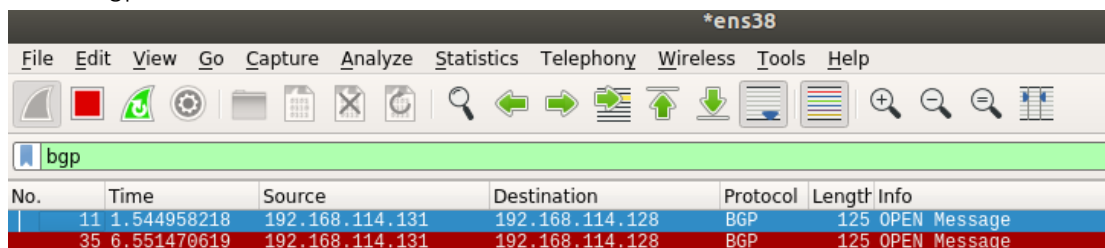
(二) ospfd 报文 (r4 ens33 端口抓包)



The screenshot shows a Wireshark capture of multiple OSPF packets on the ens33 interface. The capture includes Hello packets, Database Description (DB) packets, and Link State (LS) packets. The packets are numbered 67 through 98. The destinations are either 224.0.0.5 (all routers) or 192.168.72.131 (specific neighbor).

No.	Time	Source	Destination	Protocol	Length	Info
67	28.789671582	192.168.72.130	224.0.0.5	OSPF	78	Hello Packet
79	34.934128781	192.168.72.131	224.0.0.5	OSPF	82	Hello Packet
80	34.935894558	192.168.72.130	192.168.72.131	OSPF	66	DB Description
81	34.936026042	192.168.72.131	192.168.72.130	OSPF	66	DB Description
82	34.936100428	192.168.72.131	192.168.72.130	OSPF	186	DB Description
83	34.936261674	192.168.72.130	192.168.72.131	OSPF	106	DB Description
84	34.936315556	192.168.72.131	192.168.72.130	OSPF	66	DB Description
85	34.936371257	192.168.72.131	192.168.72.130	OSPF	82	LS Request
86	34.936514222	192.168.72.130	192.168.72.131	OSPF	82	LS Request
87	34.936543481	192.168.72.130	224.0.0.5	OSPF	130	LS Update
88	34.936621284	192.168.72.131	224.0.0.5	OSPF	146	LS Update
89	34.936693356	192.168.72.131	224.0.0.5	OSPF	130	LS Update
94	35.515535546	192.168.72.131	224.0.0.5	OSPF	98	LS Acknowledge
96	35.936489066	192.168.72.130	224.0.0.5	OSPF	98	LS Acknowledge
97	36.482491226	192.168.72.130	224.0.0.5	OSPF	206	LS Update
98	36.482491226	192.168.72.131	224.0.0.5	OSPF	78	LS Acknowledge

(三) bgp 报文 (r3 ens38 端口抓包)



The image shows a Wireshark packet capture window for the interface *ens38. The packet list shows two BGP messages. The first message is a BGP OPEN message from 192.168.114.131 to 192.168.114.128, with a length of 125 bytes. The second message is also a BGP OPEN message from 192.168.114.131 to 192.168.114.128, with a length of 125 bytes.

No.	Time	Source	Destination	Protocol	Length	Info
11	1.544958218	192.168.114.131	192.168.114.128	BGP	125	OPEN Message
35	6.551470619	192.168.114.131	192.168.114.128	BGP	125	OPEN Message

五 . 协议报文分析

(一) Rip 报文

```
▼ Routing Information Protocol
  Command: Response (2)
  Version: RIPv2 (2)
  ▼ IP Address: 192.168.211.0, Metric: 2
    Address Family: IP (2)
    Route Tag: 0
    IP Address: 192.168.211.0
    Netmask: 255.255.255.0
    Next Hop: 0.0.0.0
    Metric: 2
  ▼ IP Address: 192.168.230.0, Metric: 1
    Address Family: IP (2)
    Route Tag: 0
    IP Address: 192.168.230.0
    Netmask: 255.255.255.0
    Next Hop: 0.0.0.0
    Metric: 1
```

报文命令：请求 reply

版本：Ripv2

Ip 地址：192.168.211.0

地址家族：ip

路由标志：0

子网掩码：255.255.255.0

下一跳：0.0.0.0

跳跃点数：2

Ip 地址：192.168.230.0

地址家族：ip

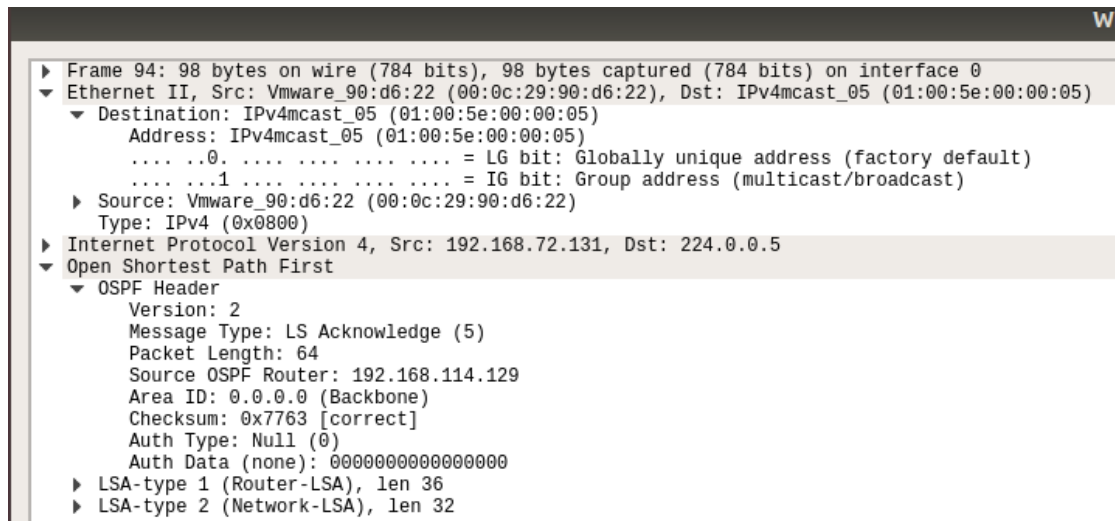
路由标志：0

子网掩码：255.255.255.0

下一跳：0.0.0.0

跳跃点数：1

(二) ospfd 报文



版本：2

信息类型：ls 确认

包长：64

源 ospf 路由器：192.168.114.129

区域号：0（就是在文件中设置的 area 0）

校验和：0x7763

Auth type 为 0

（注：auth type：为 0 时表示不认证，为 1 时表示简单的明文密码认证；为 2 时表示加密 MD5 认证）

Auth data（认证所需信息）：无

(三) bgp 报文

```
[Next sequence number: 60      (relative sequence number)]
Acknowledgment number: 1      (relative ack number)
1000 .... = Header Length: 32 bytes (8)
▶ Flags: 0x018 (PSH, ACK)
Window size value: 229
[Calculated window size: 29312]
[Window size scaling factor: 128]
Checksum: 0x83f3 [unverified]
[Checksum Status: Unverified]
Urgent pointer: 0
▶ Options: (12 bytes), No-Operation (NOP), No-Operation (NOP), Timestamps
▶ [SEQ/ACK analysis]
▶ [Timestamps]
TCP payload (59 bytes)
▼ Border Gateway Protocol - OPEN Message
Marker: ffffffffffffffffffffffffffffffffff
Length: 59
Type: OPEN Message (1)
Version: 4
My AS: 101
Hold Time: 180
BGP Identifier: 192.168.114.129
Optional Parameters Length: 30
▶ Optional Parameters
```

Marker: 信息包含信息接收端可预测值: 全 f

Length: 协议头信息长度 59

Type: 打开分组, 用来和相邻的另一个 BGP 发言人建立联系

Version: 版本号 4

My as 号: 101

Hold time: 180 秒, 如果 180 秒内没收到 keepalive 消息则删除 bgp 邻居

Bgp identifier: 192.168.114.129 即发送者 bgp 的 router ip

可选参数长度: 30

可选参数内容

六．观察动态路由

以 R0 ping R3 来观察

(一) 追踪添加“R0<----->R3”前后的路由路径

(1) 添加之前

```
user1@ubuntu:/etc/quagga$ tracepath 192.168.174.130
 1?: [LOCALHOST] pmtu 1500
 1: 192.168.211.131 0.469ms
 1: 192.168.211.131 0.699ms
 2: 192.168.230.132 0.618ms
 3: 192.168.174.130 1.280ms reached
• Resume: pmtu 1500 hops 3 back 3
• user1@ubuntu:/etc/quagga$
```

(2) 添加之后

```
user1@ubuntu:/etc/quagga$ tracepath 192.168.174.130
 1?: [LOCALHOST] pmtu 1500
 1: 192.168.174.130 0.537ms reached
 1: 192.168.174.130 0.636ms reached
Resume: pmtu 1500 hops 1 back 1
user1@ubuntu:/etc/quagga$ route
```

(二) 对比添加“R0<----->R3”前后的路由表变化

(1) 添加之前

```
user1@ubuntu:/etc/quagga$ route
Kernel IP routing table
Destination Gateway Genmask Flags Metric Ref Use Iface
link-local 0.0.0.0 255.255.0.0 U 1000 0 0 ens33
192.168.174.0 192.168.211.131 255.255.255.0 UG 20 0 0 ens33
192.168.211.0 0.0.0.0 255.255.255.0 U 100 0 0 ens33
192.168.211.0 0.0.0.0 255.255.255.0 U 100 0 0 ens33
192.168.211.0 0.0.0.0 255.255.255.0 U 100 0 0 ens33
192.168.230.0 192.168.211.131 255.255.255.0 UG 20 0 0 ens33
```

注：里面有一些重复的表项

(2) 添加之后

```
user1@ubuntu:/etc/quagga$ route
Kernel IP routing table
Destination Gateway Genmask Flags Metric Ref Use Iface
link-local 0.0.0.0 255.255.0.0 U 1000 0 0 ens33
192.168.174.0 192.168.240.131 255.255.255.0 UG 20 0 0 ens38
192.168.211.0 0.0.0.0 255.255.255.0 U 100 0 0 ens33
192.168.211.0 0.0.0.0 255.255.255.0 U 100 0 0 ens33
192.168.230.0 192.168.211.131 255.255.255.0 UG 20 0 0 ens33
192.168.240.0 0.0.0.0 255.255.255.0 U 101 0 0 ens38
```

注：里面有一些重复的表项