

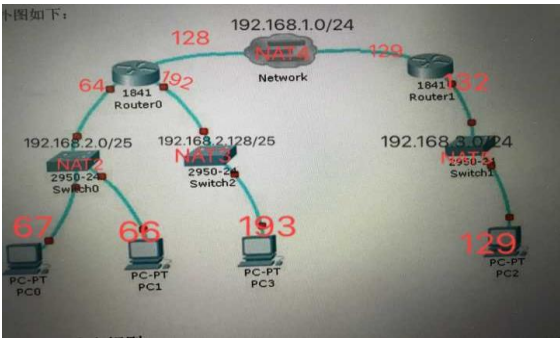
实验三 子网划分和 NAT 配置

一 . 实验目的

- 1.熟练配置静态多子网网络环境
- 2.理解子网划分的概念
- 3.学会 NAT 组网方式
- 4.为之后的实验对组网的要求打下基础

二 . 网络拓扑配置

节点名	虚拟设备名	ip	netmask
Router0	Router0	ens33:192.168.2.64	255.255.255.128
		ens38:192.168.2.192	255.255.255.128
		ens39:192.168.1.128	255.255.255.0
Route1	Router1	ens33:192.168.1.129	255.255.255.0
		ens38:192.168.3.132	255.255.255.0
PC0	PC0	192.168.2.67	255.255.255.128
PC1	PC1	192.168.2.66	255.255.255.128
PC2	PC2	192.168.3.129	255.255.255.0
PC3	PC3	192.168.2.193	255.255.255.128



三 . 路由规则配置

```
Route0:
sudo ip route add 192.168.3.0/24 via 192.168.1.129
sudo su
echo 1 > /proc/sys/net/ipv4/ip_forward
exit
```

```
Route1:
sudo ip route add 192.168.2.0/24 via 192.168.1.128
sudo su
echo 1 > /proc/sys/net/ipv4/ip_forward
exit
```

四 . NAT 设置命令

```
Route0:
```

```
sudo iptables -t nat -A POSTROUTING -o ens39 -s 192.168.2.0/24 -j SNAT --to 192.168.1.128
```

五、数据包截图：

(1) 设置 NAT 前

PC0 PING PC2

Source	Destination	Protocol
192.168.3.129	192.168.2.67	ICMP
192.168.2.66	192.168.2.1	TCP
192.168.2.64	192.168.2.1	TCP
192.168.2.67	192.168.3.129	ICMP
192.168.3.129	192.168.2.67	ICMP

PC0 PING PC3

Source	Destination	Protocol
192.168.2.66	192.168.2.1	TCP
192.168.2.66	192.168.2.1	DNS
Vmware_65:67:54	Vmware_5d:92:da	ARP
Vmware_5d:92:da	Vmware_65:67:54	ARP
192.168.2.67	192.168.2.193	ICMP
192.168.2.193	192.168.2.67	ICMP

PC2 PING PC0

Source	Destination	Protocol
192.168.2.66	192.168.2.1	TCP
192.168.2.64	192.168.2.1	TCP
192.168.3.129	192.168.2.67	ICMP
192.168.2.67	192.168.3.129	ICMP

PC3 PING PC0

Source	Destination	Protocol
192.168.2.67	192.168.2.193	ICMP
192.168.2.66	192.168.2.1	TCP
192.168.2.193	192.168.2.67	ICMP
192.168.2.67	192.168.2.193	ICMP

PC2 PING PC3

Source	Destination	Protocol
192.168.1.128	192.168.1.1	TCP
192.168.3.129	192.168.2.193	ICMP
192.168.2.193	192.168.3.129	ICMP
192.168.3.129	192.168.2.193	ICMP
192.168.2.193	192.168.3.129	ICMP

PC3 PING PC2

Source	Destination	Protocol
192.168.2.193	192.168.3.129	ICMP
192.168.3.129	192.168.2.193	ICMP

(2) 设置 NAT 后

PC0 PING PC2

Source	Destination	Protocol
192.168.1.129	192.168.1.1	TCP
192.168.1.128	192.168.3.129	ICMP
192.168.3.129	192.168.1.128	ICMP

PC0 PING PC3

Source	Destination	Protocol
192.168.2.67	192.168.2.1	DNS
192.168.2.67	192.168.2.193	ICMP
192.168.2.193	192.168.2.67	ICMP

PC3 PING PC2

Source	Destination	Protocol
192.168.1.128	192.168.3.129	ICMP
192.168.3.129	192.168.1.128	ICMP

PC3 PING PC0

Source	Destination	Protocol
192.168.2.67	192.168.2.1	TCP
192.168.2.64	192.168.2.1	TCP
192.168.2.66	192.168.2.1	TCP
192.168.2.193	192.168.2.67	ICMP
192.168.2.67	192.168.2.193	ICMP

PC2 PING PC3

Source	Destination	Protocol
192.168.2.193	192.168.3.129	ICMP
192.168.1.129	192.168.1.1	TCP
192.168.3.129	192.168.2.193	ICMP
192.168.2.193	192.168.3.129	ICMP

PC2 PING PC0

Source	Destination	Protocol
Vmware_c0:00:02	Vmware_a4:92:60	ARP
Vmware_a4:92:60	Vmware_c0:00:02	ARP
192.168.2.67	192.168.2.1	DNS
192.168.2.67	192.168.2.1	TCP
192.168.3.129	192.168.2.67	ICMP
192.168.2.67	192.168.3.129	ICMP

六、协议报文分析

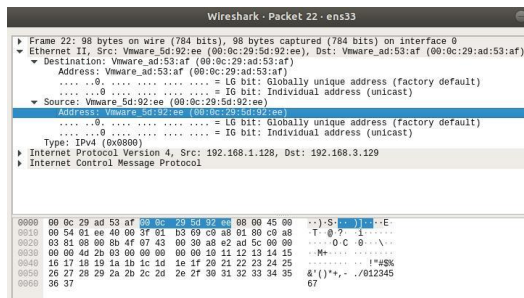
Nat 设置前的报文分析和实验一相同，现对 nat 设置后 pc0 ping pc2 的 icmp request 包进行字段分析

目标 mac 地址为 00: 0c:29:ad:53:af

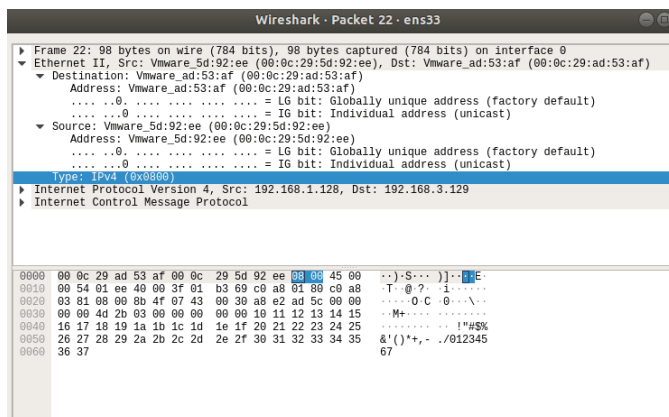
```
▶ Frame 22: 98 bytes on wire (784 bits), 98 bytes captured (784 bits) on interface 0
  ▶ Ethernet II, Src: Vmware_5d:92:ee (00:0c:29:5d:92:ee), Dst: Vmware_ad:53:af (00:0c:29:ad:53:af)
    ▼ Destination: Vmware_ad:53:af (00:0c:29:ad:53:af)
      Address: Vmware_ad:53:af (00:0c:29:ad:53:af)
      ....0. .... = LG bit: Globally unique address (factory default)
      ....0. .... = IG bit: Individual address (unicast)
    ▼ Source: Vmware_5d:92:ee (00:0c:29:5d:92:ee)
      Address: Vmware_5d:92:ee (00:0c:29:5d:92:ee)
      ....0. .... = LG bit: Globally unique address (factory default)
      ....0. .... = IG bit: Individual address (unicast)
    Type: IPv4 (0x0000)
  ▶ Internet Protocol Version 4, Src: 192.168.1.128, Dst: 192.168.3.129
  ▶ Internet Control Message Protocol
```

```
0000 00 0c 29 ad 53 af 00 0c 29 5d 92 ee 00 00 45 00  [E]...E
0010 00 54 01 ee 40 00 3f 01 b3 69 c0 a8 01 80 c0 a8 -I-0-?-.1....
0020 03 81 00 00 8b 4f 07 43 00 30 a8 e2 ad 5c 00 00 ....O.C.0...
0030 00 00 4d 2b 03 00 00 00 00 00 10 11 12 13 14 15 --M+-----
0040 16 17 18 19 1a 1b 1c 1d 1e 1f 20 21 22 23 24 25 .....!%$%
0050 26 27 28 29 2a 2b 2c 2d 2e 2f 30 31 32 33 34 35 &'()*+,-./012345
0060 36 37 67
```

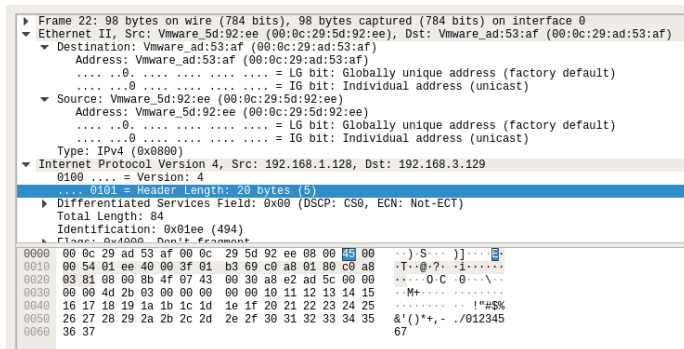
源 mac 地址: 00: 0c:29:5d:92:ee



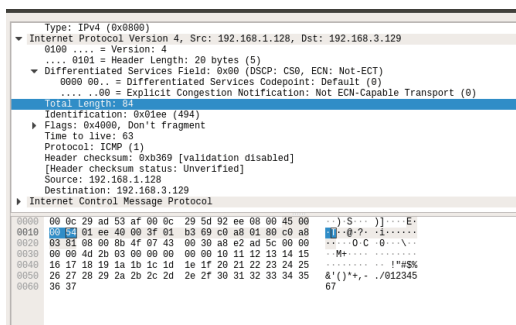
类型 ipv4



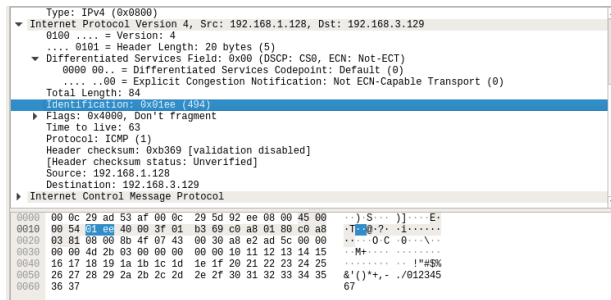
Ip 版本 4, 头长 20bytes



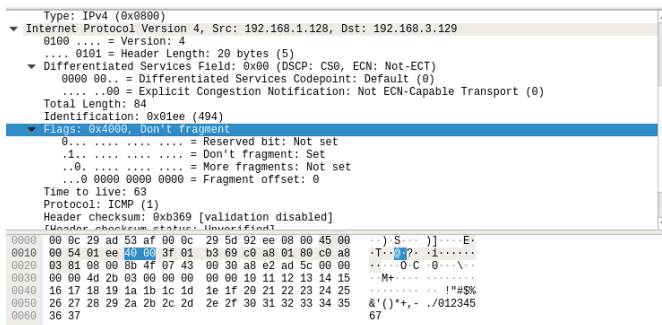
Ip 包总长 84bytes



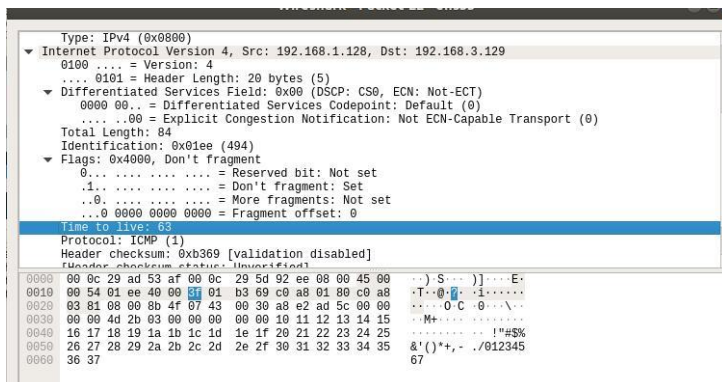
验证码 494



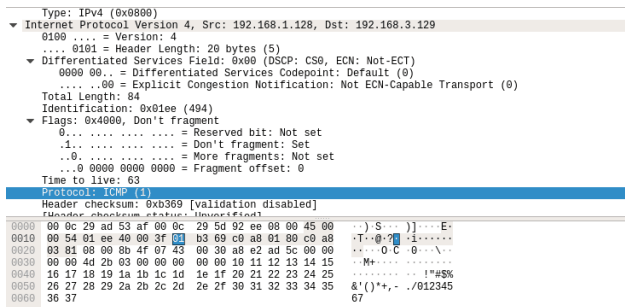
不分块



生存期 63



协议为 icmp 协议



校验和为 0xb369

```
▼ Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
  0000 00.. = Differentiated Services Codepoint: Default (0)
  ....00 = Explicit Congestion Notification: Not ECN-Capable Transport (0)
Total Length: 84
Identification: 0x01ee (494)
▼ Flags: 0x4000, Don't fragment
  0... .. = Reserved bit: Not set
  .1. .... = Don't fragment: Set
  ..0. .... = More fragments: Not set
  ...0 0000 0000 0000 = Fragment offset: 0
Time to live: 63
Protocol: ICMP (1)
Header checksum: 0xb369 [validation disabled]
[Header checksum status: Unverified]
Source: 192.168.1.128
Destination: 192.168.3.129
▶ Internet Control Message Protocol

0000 00 0c 29 ad 53 af 00 0c 29 5d 92 ee 08 00 45 00 --)S---}}....E-
0010 00 54 01 ee 40 00 3f 01 b3 69 c0 a8 01 80 c0 a8 -T-@?-.1.....
0020 03 81 08 00 8b 4f 07 43 00 30 a8 e2 ad 5c 00 00 -O-C-0-0-0-0-0-
0030 00 00 4d 2b 03 00 00 00 00 00 10 11 12 13 14 15 -M+-----
0040 16 17 18 19 1a 1b 1c 1d 1e 1f 20 21 22 23 24 25 .....!##$%
0050 26 27 28 29 2a 2b 2c 2d 2e 2f 30 31 32 33 34 35 &'()*+,-./012345
0060 36 37 67
```

源 ip:192.168.1.128(nat 转换后的 ip)

目的 ip: 192.168.3.129

```
▼ Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
  0000 00.. = Differentiated Services Codepoint: Default (0)
  ....00 = Explicit Congestion Notification: Not ECN-Capable Transport (0)
Total Length: 84
Identification: 0x01ee (494)
▼ Flags: 0x4000, Don't fragment
  0... .. = Reserved bit: Not set
  .1. .... = Don't fragment: Set
  ..0. .... = More fragments: Not set
  ...0 0000 0000 0000 = Fragment offset: 0
Time to live: 63
Protocol: ICMP (1)
Header checksum: 0xb369 [validation disabled]
[Header checksum status: Unverified]
Source: 192.168.1.128
Destination: 192.168.3.129
▶ Internet Control Message Protocol

0000 00 0c 29 ad 53 af 00 0c 29 5d 92 ee 08 00 45 00 --)S---}}....E-
0010 00 54 01 ee 40 00 3f 01 b3 69 c0 a8 01 80 c0 a8 -T-@?-.1.....
0020 03 81 08 00 8b 4f 07 43 00 30 a8 e2 ad 5c 00 00 -O-C-0-0-0-0-0-
0030 00 00 4d 2b 03 00 00 00 00 00 10 11 12 13 14 15 -M+-----
0040 16 17 18 19 1a 1b 1c 1d 1e 1f 20 21 22 23 24 25 .....!##$%
0050 26 27 28 29 2a 2b 2c 2d 2e 2f 30 31 32 33 34 35 &'()*+,-./012345
0060 36 37 67
```

Icmp 类型为 request

```
Header checksum: 0xb369 [validation disabled]
[Header checksum status: Unverified]
Source: 192.168.1.128
Destination: 192.168.3.129
▼ Internet Control Message Protocol
Type: 8 (Echo (ping) request)
Code: 0
Checksum: 0x8b4f [correct]
[Checksum Status: Good]
Identifier (BE): 1859 (0x0743)
Identifier (LE): 17159 (0x4307)
Sequence number (BE): 48 (0x0030)
Sequence number (LE): 12288 (0x3000)
[Response frame: 23]
Timestamp from icmp data: Apr 10, 2019 05:33:44.000000000 PDT
[Timestamp from icmp data (relative): 0.208700704 seconds]
▶ Data (48 bytes)

0000 00 0c 29 ad 53 af 00 0c 29 5d 92 ee 08 00 45 00 --)S---}}....E-
0010 00 54 01 ee 40 00 3f 01 b3 69 c0 a8 01 80 c0 a8 -T-@?-.1.....
0020 03 81 08 00 8b 4f 07 43 00 30 a8 e2 ad 5c 00 00 -O-C-0-0-0-0-0-
0030 00 00 4d 2b 03 00 00 00 00 00 10 11 12 13 14 15 -M+-----
0040 16 17 18 19 1a 1b 1c 1d 1e 1f 20 21 22 23 24 25 .....!##$%
0050 26 27 28 29 2a 2b 2c 2d 2e 2f 30 31 32 33 34 35 &'()*+,-./012345
0060 36 37 67
```

编码为 0

```
Header checksum: 0xb369 [validation disabled]
[Header checksum status: Unverified]
Source: 192.168.1.128
Destination: 192.168.3.129
▼ Internet Control Message Protocol
Type: 8 (Echo (ping) request)
Code: 0
Checksum: 0x8b4f [correct]
[Checksum Status: Good]
Identifier (BE): 1859 (0x0743)
Identifier (LE): 17159 (0x4307)
Sequence number (BE): 48 (0x0030)
Sequence number (LE): 12288 (0x3000)
[Response frame: 23]
Timestamp from icmp data: Apr 10, 2019 05:33:44.000000000 PDT
[Timestamp from icmp data (relative): 0.208700704 seconds]
▶ Data (48 bytes)

0000 00 0c 29 ad 53 af 00 0c 29 5d 92 ee 08 00 45 00 --)S---}}....E-
0010 00 54 01 ee 40 00 3f 01 b3 69 c0 a8 01 80 c0 a8 -T-@?-.1.....
0020 03 81 08 00 8b 4f 07 43 00 30 a8 e2 ad 5c 00 00 -O-C-0-0-0-0-0-
0030 00 00 4d 2b 03 00 00 00 00 00 10 11 12 13 14 15 -M+-----
0040 16 17 18 19 1a 1b 1c 1d 1e 1f 20 21 22 23 24 25 .....!##$%
0050 26 27 28 29 2a 2b 2c 2d 2e 2f 30 31 32 33 34 35 &'()*+,-./012345
0060 36 37 67
```

校验和为 0x8b4f

Header checksum: 0xb369 [validation disabled]	
[Header checksum status: Unverified]	
Source: 192.168.1.128	
Destination: 192.168.3.129	
▼ Internet Control Message Protocol	
Type: 8 (Echo (ping) request)	
Code: 0	
Checksum: 0x8b4f [correct]	
[Checksum Status: Good]	
Identifier (BE): 1859 (0x0743)	
Identifier (LE): 17159 (0x4307)	
Sequence number (BE): 48 (0x0030)	
Sequence number (LE): 12288 (0x3000)	
[Response frame: 23]	
Timestamp from icmp data: Apr 10, 2019 05:33:44.000000000 PDT	
[Timestamp from icmp data (relative): 0.208700704 seconds]	
► Data (48 bytes)	
0000	00 0c 29 ad 53 af 00 0c 29 5d 92 ee 00 00 45 00 ...S...))...E
0010	00 54 01 ee 40 00 3f 01 b3 69 c0 a8 01 80 c0 a8 ...T.0?..1.....
0020	03 81 08 00 8d 4f 07 43 00 30 a8 e2 ad 5c 00 00C-0.....
0030	00 00 4d 2b 03 00 00 00 00 00 10 11 12 13 14 15 ...M+.....
0040	16 17 18 19 1a 1b 1c 1d 1e 1f 20 21 22 23 24 25!#\$%&
0050	26 27 28 29 2a 2b 2c 2d 2e 2f 30 31 32 33 34 35 &'()*+,-./012345
0060	36 37 67

验证码为 BE:0X0743 LE:0X4307

序列号为 BE:0X0030 LE:0X3000

Header checksum: 0xb369 [validation disabled]	
[Header checksum status: Unverified]	
Source: 192.168.1.128	
Destination: 192.168.3.129	
▼ Internet Control Message Protocol	
Type: 8 (Echo (ping) request)	
Code: 0	
Checksum: 0x8b4f [correct]	
[Checksum Status: Good]	
Identifier (BE): 1859 (0x0743)	
Identifier (LE): 17159 (0x4307)	
Sequence number (BE): 48 (0x0030)	
Sequence number (LE): 12288 (0x3000)	
[Response frame: 23]	
Timestamp from icmp data: Apr 10, 2019 05:33:44.000000000 PDT	
[Timestamp from icmp data (relative): 0.208700704 seconds]	
► Data (48 bytes)	
0000	00 0c 29 ad 53 af 00 0c 29 5d 92 ee 00 00 45 00 ...S...))...E
0010	00 54 01 ee 40 00 3f 01 b3 69 c0 a8 01 80 c0 a8 ...T.0?..1.....
0020	03 81 08 00 8b 4f 07 43 00 30 a8 e2 ad 5c 00 00 ...-0...0.....
0030	00 00 4d 2b 03 00 00 00 00 00 10 11 12 13 14 15 ...M+.....
0040	16 17 18 19 1a 1b 1c 1d 1e 1f 20 21 22 23 24 25!#\$%&
0050	26 27 28 29 2a 2b 2c 2d 2e 2f 30 31 32 33 34 35 &'()*+,-./012345
0060	36 37 67

数据段为 0x4d2b03...3637

Source: 192.168.1.128	
Destination: 192.168.3.129	
▼ Internet Control Message Protocol	
Type: 8 (Echo (ping) request)	
Code: 0	
Checksum: 0x8b4f [correct]	
[Checksum Status: Good]	
Identifier (BE): 1859 (0x0743)	
Identifier (LE): 17159 (0x4307)	
Sequence number (BE): 48 (0x0030)	
Sequence number (LE): 12288 (0x3000)	
[Response frame: 23]	
Timestamp from icmp data: Apr 10, 2019 05:33:44.000000000 PDT	
[Timestamp from icmp data (relative): 0.208700704 seconds]	
▼ Data (48 bytes)	
Data: 4d2b030000000000101112131415161718191a1b1c1d1e1f...	
[Length: 48]	
0000	00 0c 29 ad 53 af 00 0c 29 5d 92 ee 00 00 45 00 ...S...))...E
0010	00 54 01 ee 40 00 3f 01 b3 69 c0 a8 01 80 c0 a8 ...T.0?..1.....
0020	03 81 08 00 8b 4f 07 43 00 30 a8 e2 ad 5c 00 00 ...-0...C-0.....
0030	00 00 4d 2b 03 00 00 00 00 00 10 11 12 13 14 15 ...M+.....
0040	16 17 18 19 1a 1b 1c 1d 1e 1f 20 21 22 23 24 25!#\$%&
0050	26 27 28 29 2a 2b 2c 2d 2e 2f 30 31 32 33 34 35 &'()*+,-./012345
0060	36 37 67