南京大学本科生实验报告

课程名称：**计算机网络**   任课教师：田臣/李文中   助教：

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1. 实验名称

Respond to ICMP

2. 实验目的

实现回应 **ICMP request** 与处理 **ICMP error message**

3. 实验内容

ICMP request 回应：

```
                    break
for intf in all_intf:
    if intf.ipaddr == ipvfour.dst:
        if getic and getic.icmptype == 8:#It's a request
            print("It's a ICMP request")
            reply_icmp = ICMP()
            reply_icmp.icmpdata.sequence = getic.icmpdata.sequence
            reply_icmp.icmpcode = getic.icmpcode
            reply_icmp.icmptype = 0
            reply_icmp.icmpdata.identifier = getic.icmpdata.identifier
            reply_icmp.icmpdata.data = getic.icmpdata.data
            packet[1].dst = packet[1].src
            packet[1].src = intf.ipaddr
            index = packet.get_header_index(ICMP)
            packet[index] = reply_icmp
            packet[IPv4].ttl = 40
            break
```

检查目的地址是否为端口地址，同时还需满足包类型为 **request**，之后复制 **squence**、**icmpcode**、**identifier**、**data** 构造一个 **reply** 包。将原 **packet** 包的 **ICMP** 替换为新建的 **reply**，替换 **IP** 的源地址与目的地址。最后对新包处理发包。

2.路由器不应回复任何 ICMP error 包，为了保证安全性与资源的

有效利用。防止网络攻击暴露路由器的信息。

3.处理 ICMP error 逻辑

在出现路由表不匹配、**ttl-1<=0**、目的地址为端口 **ip** 但不是 **request**、**arp** 查询发送超过 **5** 次时候，先检查包是否是 **ICMP error** 包，若是则丢包不处理，若不是，则生成对应的 **ICMP error** 包发回源地址。

（路由表无匹配）

```
                match = key
                print("we find the maxlen")
if aganst == -1:
    if getic and int(getic.icmptype) in wrong_num:
        print("NO match ERROR in aganst")
        aganst = -1
        break
    else:
        print("against error make")
        packet = self.makeicmp(in_intf,packet,ICMPType.DestinationUnreachable,0)
```

makeicmp 函数：构造对应类型 **ICMP** 头，然后把原包中 **Ethernet** 去除后复制 **data**，再构造 **IP** 头，调换 **dst** 与 **src**，最后组合成新包。

```
                    wait_repty.append(pkt)
def makeicmp(self,intf,packet,newtype,code):
    print("======in makeicmp=========")
    err = ICMP()
    err.icmptype = newtype
    err.icmpcode = code
    cpkt = deepcopy(packet)
    index = packet.get_header_index(Ethernet)
    if index >=0 :
        del cpkt[index]
    err.icmpdata.data = cpkt.to_bytes()[:28]
    err.icmpdata.origdgramlen = len(cpkt)
    ip = IPv4()
    ip.protocol = IPProtocol.ICMP
    ip.dst = packet[1].src
    ip.src = intf.ipaddr
    ip.ttl = 40
    pkt = Ethernet() + ip + err
    return pkt
```
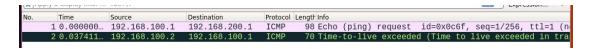
测试样例通过


```
File  Edit  View  Search  Terminal  Help
67   The router should not do anything
68   An ICMP message should arrive on eth1
69   An arp request message should out on eth0
70   An arp request message should out on eth0
71   An arp request message should out on eth0
72   An arp request message should out on eth0
73   An arp request message should out on eth0
74   The router should not do anything
75   An ICMP message should arrive on eth0
76   An icmp message should out on eth0
10:00:31 2023/05/16  WARNING Tried to find non-existent header for output format
ting <class 'switchyard.lib.packet.tcp.TCP'> (test scenario probably needs fixin
g)

77   An TCP message should arrive on eth2
78   An icmp error message should out on eth0
79   An UDP message should arrive on eth2
80   An icmp error message should out on eth0


All tests passed!


(syenv) njucs@njucs-VirtualBox:~/lab-5-ondshh$
```

部署

Server1 ping eth1，先发 arp 包询问，之后发 ICMP request 包

Router 处理后发现目的地为端口地址则发回 reply 包


```
No.    Time          Source             Destination        Protocol  Length Info
  1 0.000000…  Private_00:00:…  Broadcast          ARP       42 Who has 192.168.100.2? Tell 192.168.100.1
  2 0.086143…  40:00:00:00:00…  Private_00:00:…  ARP       42 192.168.100.2 is at 40:00:00:00:00:01
  3 0.086160…  192.168.100.1    192.168.200.2    ICMP      98 Echo (ping) request  id=0x0c59, seq=1/256, ttl=64
  4 0.191856…  192.168.200.2    192.168.100.1    ICMP      98 Echo (ping) reply    id=0x0c59, seq=0/0, ttl=39
```

Server1 ping -t 1 server2，server1 发包给路由器，路由器处理 ttl-1

后发现错误，于是发回 Time error 包。


```
No.    Time          Source             Destination        Protocol  Length Info
  1 0.000000…  192.168.100.1    192.168.200.1    ICMP      98 Echo (ping) request  id=0x0c6f, seq=1/256, ttl=1 (n
  2 0.037411…  192.168.100.2    192.168.100.1    ICMP      70 Time-to-live exceeded (Time to live exceeded in tra
```

Server1 ping -c 1 192.168.200.3 ,路由器在 5 次 arp 询问后回发

unreachable error


```
  3 210.5400…  192.168.100.1    192.168.200.3    ICMP      98 Echo (ping) request  id=0x0c78, seq=1/256, ttl=64 (
  4 215.5581…  192.168.100.2    192.168.100.1    ICMP      70 Destination unreachable (Host unreachable)
```

Traceroute 测试

```
No.    Time        Source          Destination     Protocol  Length  Info
  1 0.000000...  192.168.100.1   192.168.200.1   UDP       51 40286 → 33434 Len=9
  2 0.091621...  40:00:00:00:00… Broadcast       ARP       42 Who has 192.168.100.1? Tell 192.168.100.2
  3 0.091656...  Private_00:00:…  40:00:00:00:00… ARP       42 192.168.100.1 is at 10:00:00:00:00:01
  4 0.183894...  192.168.200.2   192.168.100.1   ICMP      70 Time-to-live exceeded (Time to live exceeded in
  5 0.184141...  192.168.100.1   192.168.200.1   UDP       51 40286 → 33434 Len=9
  6 0.290837...  192.168.100.2   192.168.100.1   ICMP      70 Time-to-live exceeded (Time to live exceeded in
  7 0.291012...  192.168.100.1   192.168.200.1   UDP       51 40286 → 33434 Len=9
  8 0.394161...  192.168.100.2   192.168.100.1   ICMP      70 Time-to-live exceeded (Time to live exceeded in
  9 0.394433...  192.168.100.1   192.168.200.1   UDP       51 40286 → 33435 Len=9
```

```
root@njucs-VirtualBox:~# traceroute 192.168.200.1
traceroute to 192.168.200.1 (192.168.200.1), 64 hops max
 1   192.168.100.2  183.979ms  106.744ms  103.240ms
 2   192.168.100.2  238.147ms  *  *
```

4. 实验结果

实现了 lab-5 的路由器功能