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：lzh、lsp、wcx

学院	**计算机科学与技术系**	专业（方向）	计算机科学与技术系
学号	211220027	姓名	王秋博
Email	211220027@nju.edu.cn	开始/完成日期	10.13/10.24

1. 实验名称

Lab1: **Respond to ARP**

2. 实验目的

实现响应分配给路由器上接口的地址的 ARP（地址解析协议）请求。

3. 实验内容

Task 2：**Handle ARP Request**

Step 1: Coding

实现响应 ARP 请求的逻辑如图：

```
my_interfaces=self.net.interfaces()
arp=packet.get_header(Arp)
if arp is not None:
    for intf in my_interfaces:
        if intf.ipaddr== arp.targetprotoaddr:
            response=create_ip_arp_reply(intf.ethaddr,arp.senderhwaddr,intf.ipaddr,arp.senderprotoaddr)
            self.net.send_packet(intf.name,response)
```

（判断 arp 目标 ip 地址是否在分配给路由器接口的 ip 地址中，若在，从该接口按照 arp 中的发送地址发回即可）

Step 2: Testing

路由器测试结果如图：

```
Results for test scenario ARP request: 6 passed, 0 failed, 0 pending


Passed:
1   ARP request for 192.168.1.1 should arrive on router-eth0
2   Router should send ARP response for 192.168.1.1 on router-
    eth0
3   An ICMP echo request for 10.10.12.34 should arrive on
    router-eth0, but it should be dropped (router should only
    handle ARP requests at this point)
4   ARP request for 10.10.1.2 should arrive on router-eth1, but
    the router should not respond.
5   ARP request for 10.10.0.1 should arrive on on router-eth1
6   Router should send ARP response for 10.10.0.1 on router-eth1


All tests passed!
```

运行修改后的 mininet 网络拓扑可得

Step 3: Deploying：

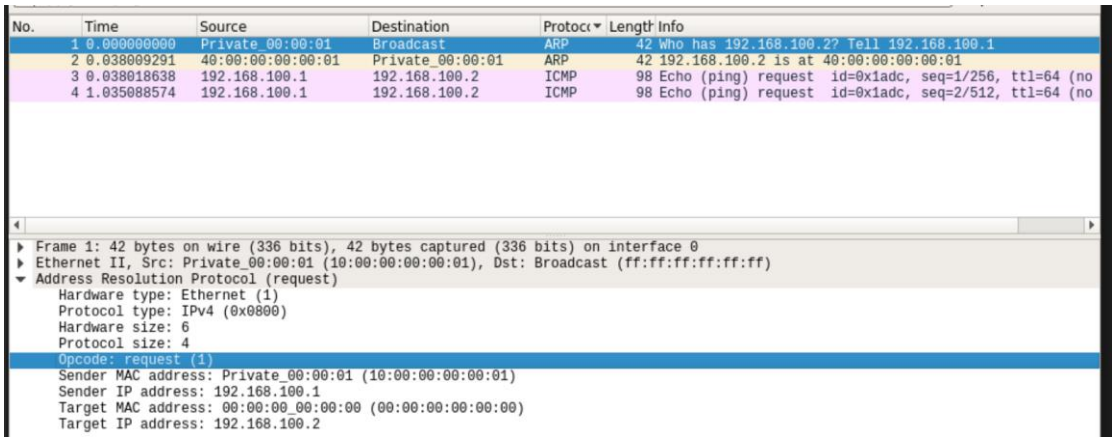
过程：如下图

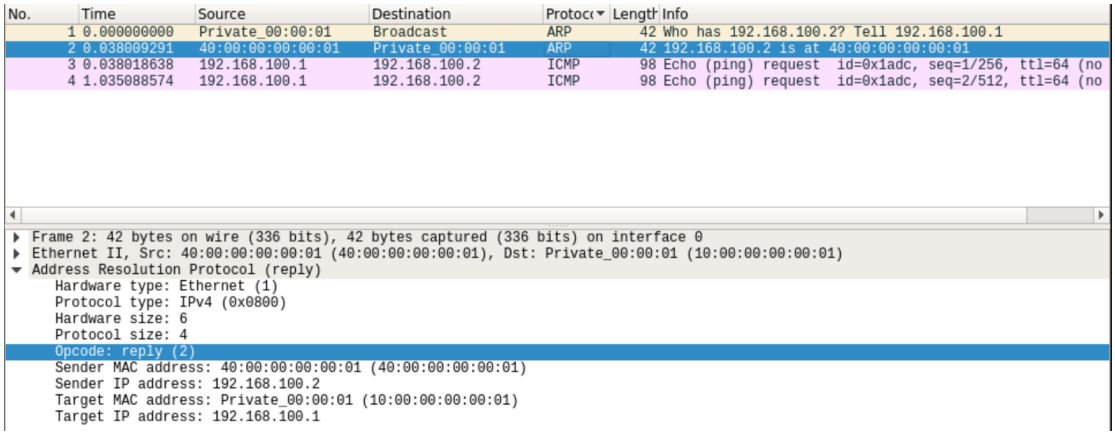
```
mininet> nodes
available nodes are:
client router server1 server2
mininet> xterm server1
mininet> xterm router
```

```
root@njucs-VirtualBox:~/workspace# source ./syenv/bin/activate
(syenv) root@njucs-VirtualBox:~/workspace# cd lab-3-Dexter2008
(syenv) root@njucs-VirtualBox:~/workspace/lab-3-Dexter2008# swyard myrouter.py
00:16:05 2023/10/24     INFO Saving iptables state and installing switchyard rul
es
00:16:05 2023/10/24     INFO Using network devices: router-eth1 router-eth0 rout
er-eth2
```

```
ping -c2 192.168.100.2
PING 192.168.100.2 (192.168.100.2) 56(84) bytes of data.

--- 192.168.100.2 ping statistics ---
2 packets transmitted, 0 received, 100% packet loss, time 1035ms
```

分析：





如图 1，server1 先广播发送 ARP 请求包寻找目标，此时只知道目标 ip 地址不知道 mac 地址，router 接收到后发送 ARP 回复包，此时可以看到 mac 地址已被填上。其后发送 ICMP 包进行点对点的 ping 操作

Task 2：Cached ARP Table

Step 1: Coding

加入一个字典，以 ip 为 key，mac 为 value 即可，如图

```
def __init__(self, net: switchyard.llnetbase.LLNetBase):
    self.net = net
    self.arptable={}
    # other initialization stuff here

def handle_packet(self, recv: switchyard.llnetbase.ReceivedPacket):
    timestamp, ifaceName, packet = recv
    # TODO: your logic here
    my_interfaces=self.net.interfaces()
    arp=packet.get_header(Arp)
    if arp is not None:
        if(self.arptable.get(arp.senderprotoaddr)==None):
            self.arptable[arp.senderprotoaddr]=arp.senderhwaddr
            for key,value in self.arptable.items():
                log_info("{}  \t{}".format(key,value))
            print()
        for intf in my_interfaces:
            if intf.ipaddr== arp.targetprotoaddr:
                response=create_ip_arp_reply(intf.ethaddr,arp.senderh
```

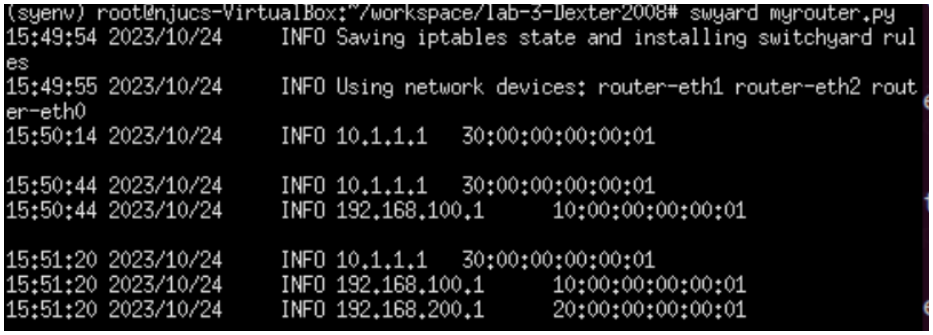
Step 2: Testing

在 router 节点打开 xterm，观察输出

然后分别用 client，server1，server2 进行 ping 操作

```
mininet> xterm router
mininet> client ping -c2 10.1.1.2
PING 10.1.1.2 (10.1.1.2) 56(84) bytes of data.

--- 10.1.1.2 ping statistics ---
2 packets transmitted, 0 received, 100% packet loss, time 1005ms

mininet> server1 ping -c2 router
PING 192.168.100.2 (192.168.100.2) 56(84) bytes of data.

--- 192.168.100.2 ping statistics ---
2 packets transmitted, 0 received, 100% packet loss, time 1029ms

mininet> server2 ping -c2 router
PING 192.168.100.2 (192.168.100.2) 56(84) bytes of data.

--- 192.168.100.2 ping statistics ---
2 packets transmitted, 0 received, 100% packet loss, time 1003ms

mininet> server1 ping -c2 router
PING 192.168.100.2 (192.168.100.2) 56(84) bytes of data.

--- 192.168.100.2 ping statistics ---
2 packets transmitted, 0 received, 100% packet loss, time 1041ms
```

可以在 router 节点上看到输出



可以看到 ping 完 client 后与 client 相连的接口 ip 地址对应的 mac 地址被填充，同理，server1 和 server2 ping 操作时 arp 缓存表也进行更新，最后在进行 ping 时 arp 缓存表没有新的更新，不会再进行输出。

4. 实验结果

本节实验结果基本于实验过程中阐述，不再赘述

5. 核心代码

同实验结果

6. 总结与感想

本次实验主要响应分配给路由器上接口的地址的 ARP（地址解析协议）请求。
通过本次实验，对 Arp 数据报有了更深入的了解，仍然希望以后实验顺利。