

# 02-router

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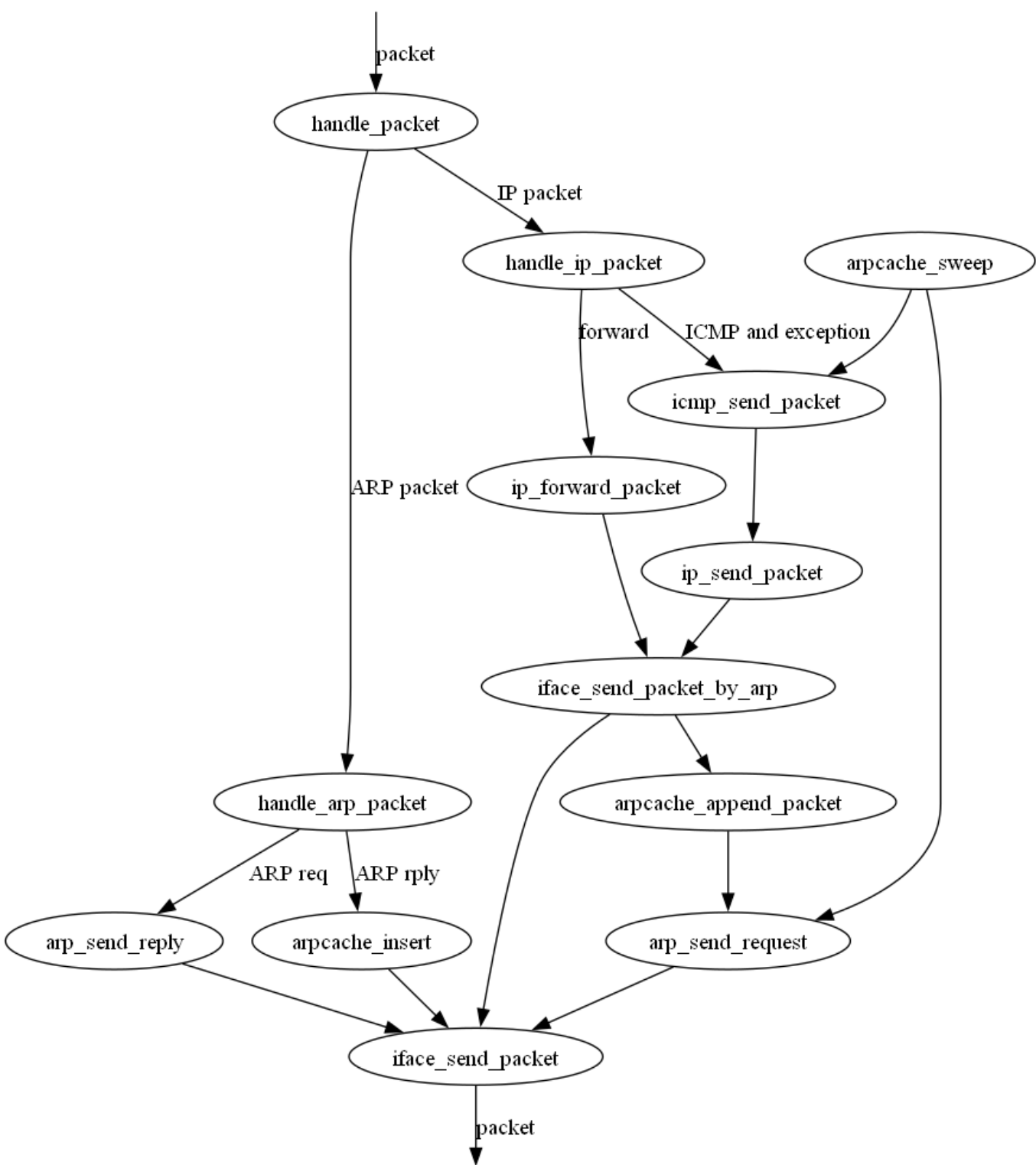
My Student ID: 211220180

This lab took me about 16 hours to do.

**Implementation Explanation:** 前言：本实现没有采用ppt给出的函数调用拓扑图，理由是认为框架代码原意并非是其图上描述的那样 见ip\_base.c:

```
// Different from forwarding packet, ip_send_packet sends packet generated  
by  
// router itself. This function is used to send ICMP packets.  
void ip_send_packet(char *packet, int len);
```

本实现函数调用拓扑图大致如下，略去部分细节



由于大部分函数实现实在是又臭又长，在此不贴源码占用空间，详见源文件及注释

**路由器** 路由器路由时，首先调用longest\_prefix\_match得到rt\_entry\_t（若NULL则发送不可达ICMP报文），否则查询gate way得到next hop（gw=0则说明在同一个LAN），通过next hop查询ARP表，得到目的MAC地址（查询失败则发送ARP req，并pending），最后将packet发送即可（通过iface\_send\_packet）

Screenshots:

- **sudo python ./router\_topo.py**

```
oslab@oslab-virtual-machine:~/Desktop/lab6-2023autumn-HistoriaY/02-router$ sudo python ./router_topo.py
mininet> xterm r1
mininet> h1 ping h2 -c 2
PING 10.0.2.22 (10.0.2.22) 56(84) bytes of data.
64 bytes from 10.0.2.22: icmp_seq=1 ttl=63 time=0.296 ms
64 bytes from 10.0.2.22: icmp_seq=2 ttl=63 time=0.157 ms

--- 10.0.2.22 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1027ms
rtt min/avg/max/mdev = 0.157/0.226/0.296/0.069 ms
mininet> h1 ping h3 -c 2
PING 10.0.3.33 (10.0.3.33) 56(84) bytes of data.
64 bytes from 10.0.3.33: icmp_seq=1 ttl=63 time=0.217 ms
64 bytes from 10.0.3.33: icmp_seq=2 ttl=63 time=0.189 ms

--- 10.0.3.33 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1013ms
rtt min/avg/max/mdev = 0.189/0.203/0.217/0.014 ms
mininet> h2 ping h1 -c 2
PING 10.0.1.11 (10.0.1.11) 56(84) bytes of data.
64 bytes from 10.0.1.11: icmp_seq=1 ttl=63 time=0.136 ms
64 bytes from 10.0.1.11: icmp_seq=2 ttl=63 time=0.080 ms

--- 10.0.1.11 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1015ms
rtt min/avg/max/mdev = 0.080/0.108/0.136/0.028 ms
mininet> h2 ping h3 -c 2
PING 10.0.3.33 (10.0.3.33) 56(84) bytes of data.
64 bytes from 10.0.3.33: icmp_seq=1 ttl=63 time=0.252 ms
64 bytes from 10.0.3.33: icmp_seq=2 ttl=63 time=0.106 ms

--- 10.0.3.33 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1020ms
rtt min/avg/max/mdev = 0.106/0.179/0.252/0.073 ms
mininet> h3 ping h1 -c 2
PING 10.0.1.11 (10.0.1.11) 56(84) bytes of data.
64 bytes from 10.0.1.11: icmp_seq=1 ttl=63 time=0.229 ms
64 bytes from 10.0.1.11: icmp_seq=2 ttl=63 time=0.078 ms

--- 10.0.1.11 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1031ms
rtt min/avg/max/mdev = 0.078/0.153/0.229/0.075 ms
mininet> h3 ping h2 -c 2
PING 10.0.2.22 (10.0.2.22) 56(84) bytes of data.
64 bytes from 10.0.2.22: icmp_seq=1 ttl=63 time=0.129 ms
64 bytes from 10.0.2.22: icmp_seq=2 ttl=63 time=0.108 ms

--- 10.0.2.22 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1032ms
rtt min/avg/max/mdev = 0.108/0.118/0.129/0.010 ms
mininet> []
```

```
"Node: r1"
root@oslab-virtual-machine:/home/oslab/Desktop/lab6-2023autumn-HistoriaY/02-router# sudo ./router
DEBUG: find the following interfaces: r1-eth0 r1-eth1 r1-eth2.
Routing table of 3 entries has been loaded.
```

- **sudo python ./my\_router\_topo.py**

```
oslab@oslab-virtual-machine:~/Desktop/lab6-2023autumn-HistoriaY/02-router$ sudo python ./my_router_topo.py
mininet> xterm r1
mininet> xterm r2
mininet> xterm r3
mininet> xterm r4
mininet> h1 ping h2 -c 3
PING 10.5.0.22 (10.5.0.22) 56(84) bytes of data.
64 bytes from 10.5.0.22: icmp_seq=1 ttl=60 time=0.928 ms
64 bytes from 10.5.0.22: icmp_seq=2 ttl=60 time=0.561 ms
64 bytes from 10.5.0.22: icmp_seq=3 ttl=60 time=0.792 ms

--- 10.5.0.22 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2036ms
rtt min/avg/max/mdev = 0.561/0.760/0.928/0.151 ms
mininet> h2 ping h1 -c 3
PING 10.1.0.11 (10.1.0.11) 56(84) bytes of data.
64 bytes from 10.1.0.11: icmp_seq=1 ttl=60 time=0.434 ms
64 bytes from 10.1.0.11: icmp_seq=2 ttl=60 time=0.502 ms
64 bytes from 10.1.0.11: icmp_seq=3 ttl=60 time=0.598 ms

--- 10.1.0.11 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2035ms
rtt min/avg/max/mdev = 0.434/0.511/0.598/0.067 ms
mininet> h1 traceroute h2
traceroute to 10.5.0.22 (10.5.0.22), 30 hops max, 60 byte packets
 1 10.1.0.1 (10.1.0.1) 0.296 ms 0.254 ms 0.242 ms
 2 10.2.0.2 (10.2.0.2) 0.639 ms 0.629 ms 0.618 ms
 3 10.3.0.3 (10.3.0.3) 0.761 ms 0.740 ms 0.730 ms
 4 10.4.0.4 (10.4.0.4) 1.376 ms 1.382 ms 1.376 ms
 5 10.5.0.22 (10.5.0.22) 1.367 ms 1.360 ms 1.353 ms
mininet> h2 traceroute h1
traceroute to 10.1.0.11 (10.1.0.11), 30 hops max, 60 byte packets
 1 10.5.0.4 (10.5.0.4) 0.351 ms 0.301 ms 0.288 ms
 2 10.4.0.3 (10.4.0.3) 0.799 ms 0.789 ms 0.789 ms
 3 10.3.0.2 (10.3.0.2) 0.775 ms 0.749 ms 0.735 ms
 4 10.2.0.1 (10.2.0.1) 0.722 ms 0.698 ms 1.105 ms
 5 10.1.0.11 (10.1.0.11) 1.095 ms 1.080 ms 1.067 ms
mininet> []
```

```
"Node: r1"
root@oslab-virtual-machine:/home/oslab/Desktop/lab6-2023autumn-HistoriaY/02-router# sudo ./router
DEBUG: find the following interfaces: r1-eth0 r1-eth1.
Routing table of 3 entries has been loaded.
```

```
"Node: r2"
root@oslab-virtual-machine:/home/oslab/Desktop/lab6-2023autumn-HistoriaY/02-router# sudo ./router
DEBUG: find the following interfaces: r2-eth0 r2-eth1.
Routing table of 4 entries has been loaded.
```

```
"Node: r3"
root@oslab-virtual-machine:/home/oslab/Desktop/lab6-2023autumn-HistoriaY/02-router# sudo ./router
DEBUG: find the following interfaces: r3-eth0 r3-eth1.
Routing table of 4 entries has been loaded.
```

```
"Node: r4"
root@oslab-virtual-machine:/home/oslab/Desktop/lab6-2023autumn-HistoriaY/02-router# sudo ./router
DEBUG: find the following interfaces: r4-eth0 r4-eth1.
Routing table of 3 entries has been loaded.
```

拓扑结构：h1-r1-r2-r3-r4-h2 IP地址配置和路由表配置如下（详见my\_router\_topo.py）：

```
h1.cmd('ifconfig h1-eth0 10.1.0.11/24')
h2.cmd('ifconfig h2-eth0 10.5.0.22/24')

r1.cmd('ifconfig r1-eth0 10.1.0.1/24')
r1.cmd('ifconfig r1-eth1 10.2.0.1/24')

r2.cmd('ifconfig r2-eth0 10.2.0.2/24')
r2.cmd('ifconfig r2-eth1 10.3.0.2/24')
```

```
r3.cmd('ifconfig r3-eth0 10.3.0.3/24')
r3.cmd('ifconfig r3-eth1 10.4.0.3/24')

r4.cmd('ifconfig r4-eth0 10.4.0.4/24')
r4.cmd('ifconfig r4-eth1 10.5.0.4/24')

h1.cmd('route add default gw 10.1.0.1')
h2.cmd('route add default gw 10.5.0.4')

r1.cmd('route add -net 10.1.0.0 netmask 255.255.255.0 gw 0.0.0.0 dev
r1-eth0')
r1.cmd('route add -net 10.5.0.0 netmask 255.255.255.0 gw 10.2.0.2 dev
r1-eth1')

r2.cmd('route add -net 10.1.0.0 netmask 255.255.255.0 gw 10.2.0.1 dev
r2-eth0')
r2.cmd('route add -net 10.5.0.0 netmask 255.255.255.0 gw 10.3.0.3 dev
r2-eth1')

r3.cmd('route add -net 10.1.0.0 netmask 255.255.255.0 gw 10.3.0.2 dev
r3-eth0')
r3.cmd('route add -net 10.5.0.0 netmask 255.255.255.0 gw 10.4.0.4 dev
r3-eth1')

r4.cmd('route add -net 10.1.0.0 netmask 255.255.255.0 gw 10.4.0.3 dev
r4-eth0')
r4.cmd('route add -net 10.5.0.0 netmask 255.255.255.0 gw 0.0.0.0 dev
r4-eth1')
```

**Remaining Bugs:** 本次实验测试全部通过，无遗留bug