

# **Final Project:**

Implementing a Simple Router

CMPE 150L

Phu Le/phvle@ucsc.edu

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## **Section 1:**

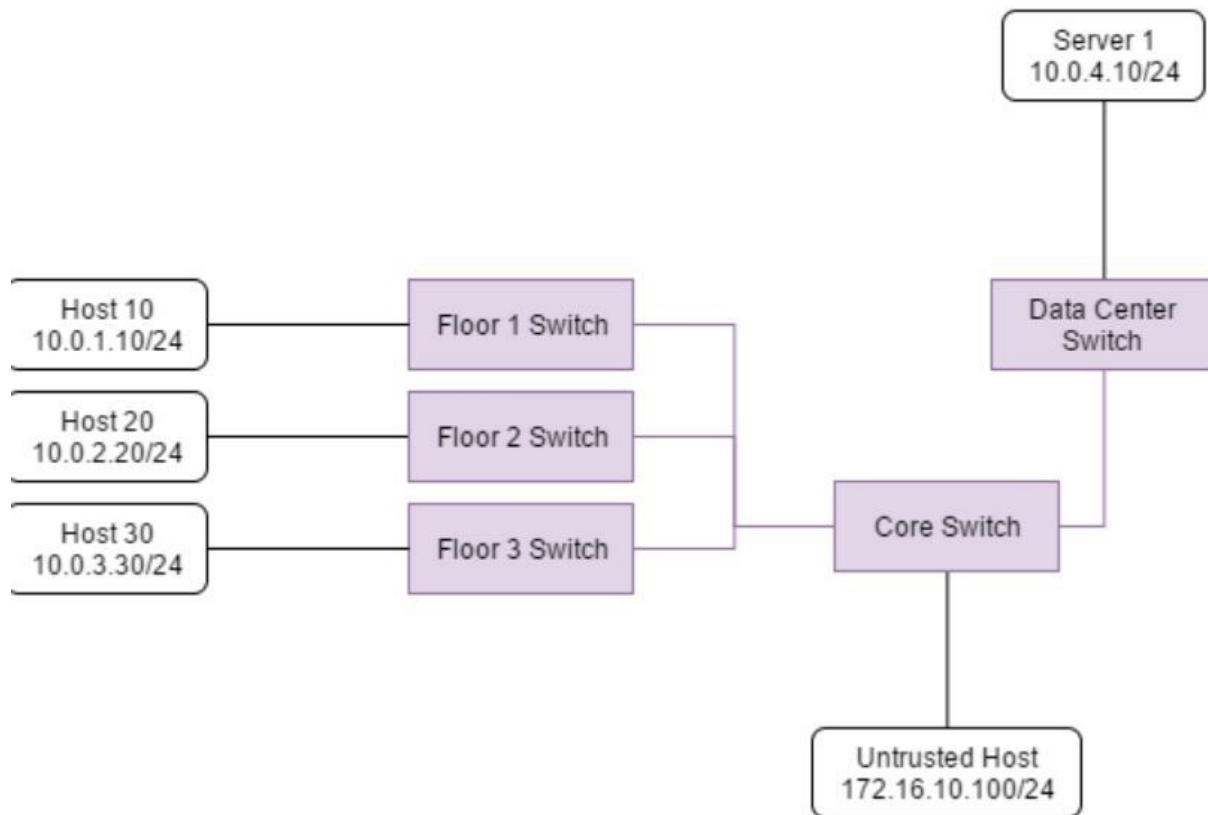
This final project, implementing a simple router, is a project based on prior knowledge of our previous labs, which involved creating firewalls as well as creating network topologies. In this project, we combined this knowledge together to implement routing between subnets and implementing firewalls for certain subnets.

In the scenario given to us, we are required to construct a network for a small company. This involves a 3 floor building where each floor has its own switch and subnet. In addition, the project requires that there is a switch and subnet for all the servers in the data center all connected by a core switch. All non-IP traffic would be flooded while IP traffic would be blocked going from the untrusted host to server 1. Also, all ICMP traffic would be blocked going from the untrusted host to any of the other hosts.

In the final.py file, I implemented the topology given to us. I first added the hosts as in Lab 1 including, this time, mac addresses for each host. With a total of 5 hosts, I also added 5 switches. From there, I would link together the switches and hosts and set port numbers accordingly.

In the final\_controller.py file, I designed a routing system based off of the type of protocol sent. I first obtained the mac addresses of the source and destinations and used the last number of the mac address to identify the host or switch. From there, I would look for TCP packets and if there were TCP packets between the untrusted host and server 1, they would be dropped. Otherwise, they were flooded. If packets found that were not ICMP and not IP, they were flooded as well. For IP packets, I set rules for each switch that basically forwarded the packets to the right destination switch or host. If there were packets between server 1 or the

untrusted host, they were dropped. Otherwise, the packets would be placed in their respective port and sent on their way. For ICMP packets, I did a similar action. If there happened to be ICMP packets from the untrusted host, they were dropped. Otherwise, they were put into the according ports.



## Section 2:

Pingall: as seen, all packets from and to h4 are dropped

```
mininet> pingall
*** Ping: testing ping reachability
h1 -> h2 h3 X h5
h2 -> h1 h3 X h5
h3 -> h1 h2 X h5
h4 -> X X X X
h5 -> h1 h2 h3 X
*** Results: 40% dropped (12/20 received)
```

Iperf: iperf commands between h2 and h4 work, and iperf commands between h1 and h4 work, however, iperf commands between h4 and h5 do not work, as seen in the screenshot, it stalls.

This makes sense because TCP is an IP call as well and IP packets are dropped between h4 and h5.

```
mininet> iperf h1 h2
*** Iperf: testing TCP bandwidth between h1 and h2
*** Results: ['11.4 Gbits/sec', '11.4 Gbits/sec']
mininet> iperf h1 h4
*** Iperf: testing TCP bandwidth between h1 and h4
*** Results: ['8.33 Gbits/sec', '8.33 Gbits/sec']
mininet> iperf h4 h5
*** Iperf: testing TCP bandwidth between h4 and h5
^C
Interrupt
```

dpctl dump-flows: as seen, arp packets are flooded between hosts and ip packets not involving h4 and h5 are directed to its according port while ip and icmp packets going to h5 and any other host respectively are dropped.

```
mininet> dpctl dump-flows
```

```
*** s1 -----
NXST_FLOW reply (xid=0x4):
  cookie=0x0, duration=11.858s, table=0, n_packets=1, n_bytes=98, idle_timeout=30
, hard_timeout=30, idle_age=11, icmp,vlan_tci=0x0000,dl_src=00:00:00:00:00:05,dl
dst=00:00:00:00:00:01,nw_src=10.0.4.10,nw_dst=10.0.1.10,nw_tos=0,icmp_type=8,ic
mp_code=0 actions=output:1
  cookie=0x0, duration=11.855s, table=0, n_packets=1, n_bytes=98, idle_timeout=30
, hard_timeout=30, idle_age=11, icmp,vlan_tci=0x0000,dl_src=00:00:00:00:00:01,dl
dst=00:00:00:00:00:05,nw_src=10.0.1.10,nw_dst=10.0.4.10,nw_tos=0,icmp_type=0,ic
mp_code=0 actions=output:2
  cookie=0x0, duration=16.8s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
hard_timeout=30, idle_age=16, arp,vlan_tci=0x0000,dl_src=00:00:00:00:00:05,dl ds
t=00:00:00:00:00:04,arp_spa=10.0.4.10,arp_tpa=172.16.10.100,arp_op=2 actions=FL0
OD
  cookie=0x0, duration=16.813s, table=0, n_packets=1, n_bytes=42, idle_timeout=30
, hard_timeout=30, idle_age=16, arp,vlan_tci=0x0000,dl_src=00:00:00:00:00:04,dl
dst=00:00:00:00:00:05,arp_spa=172.16.10.100,arp_tpa=10.0.4.10,arp_op=1 actions=F
L0OD
  cookie=0x0, duration=6.762s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,dl_src=00:00:00:00:00:03,dl ds
t=00:00:00:00:00:05,arp_spa=10.0.3.30,arp_tpa=10.0.4.10,arp_op=1 actions=FL0OD
  cookie=0x0, duration=6.824s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,dl_src=00:00:00:00:00:01,dl ds
t=00:00:00:00:00:05,arp_spa=10.0.1.10,arp_tpa=10.0.4.10,arp_op=2 actions=FL0OD
  cookie=0x0, duration=6.69s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,dl_src=00:00:00:00:00:05,dl dst
=00:00:00:00:00:03,arp_spa=10.0.4.10,arp_tpa=10.0.3.30,arp_op=2 actions=FL0OD
  cookie=0x0, duration=6.831s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,dl_src=00:00:00:00:00:05,dl ds
t=00:00:00:00:00:01,arp_spa=10.0.4.10,arp_tpa=10.0.1.10,arp_op=1 actions=FL0OD
  cookie=0x0, duration=6.768s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,dl_src=00:00:00:00:00:05,dl ds
t=00:00:00:00:00:01,arp_spa=10.0.4.10,arp_tpa=10.0.1.10,arp_op=2 actions=FL0OD
  cookie=0x0, duration=6.747s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,dl_src=00:00:00:00:00:04,dl ds
t=00:00:00:00:00:05,arp_spa=172.16.10.100,arp_tpa=10.0.4.10,arp_op=2 actions=FL0
OD
  cookie=0x0, duration=6.81s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,dl_src=00:00:00:00:00:02,dl dst
=00:00:00:00:00:05,arp_spa=10.0.2.20,arp_tpa=10.0.4.10,arp_op=2 actions=FL0OD
  cookie=0x0, duration=6.84s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,dl_src=00:00:00:00:00:01,dl dst
=00:00:00:00:00:05,arp_spa=10.0.1.10,arp_tpa=10.0.4.10,arp_op=1 actions=FL0OD
  cookie=0x0, duration=6.752s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,dl_src=00:00:00:00:00:05,dl ds
t=00:00:00:00:00:04,arp_spa=10.0.4.10,arp_tpa=172.16.10.100,arp_op=1 actions=FL0
OD
  cookie=0x0, duration=6.821s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
```



```

00
  cookie=0x0, duration=6.81s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
  hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,d_l_src=00:00:00:00:00:02,d_l_dst
=00:00:00:00:00:05,arp_spa=10.0.2.20,arp_tpa=10.0.4.10,arp_op=2 actions=FL00D
  cookie=0x0, duration=6.84s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
  hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,d_l_src=00:00:00:00:00:01,d_l_dst
=00:00:00:00:00:05,arp_spa=10.0.1.10,arp_tpa=10.0.4.10,arp_op=1 actions=FL00D
  cookie=0x0, duration=6.752s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
  hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,d_l_src=00:00:00:00:00:05,d_l_ds
t=00:00:00:00:00:04,arp_spa=10.0.4.10,arp_tpa=172.16.10.100,arp_op=1 actions=FL0
0D
  cookie=0x0, duration=6.821s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
  hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,d_l_src=00:00:00:00:00:05,d_l_ds
t=00:00:00:00:00:02,arp_spa=10.0.4.10,arp_tpa=10.0.2.20,arp_op=1 actions=FL00D
*** s2 -----
NXST_FLOW reply (xid=0x4):
  cookie=0x0, duration=11.834s, table=0, n_packets=1, n_bytes=98, idle_timeout=30
, hard_timeout=30, idle_age=11, icmp,vlan_tci=0x0000,d_l_src=00:00:00:00:00:02,d_l
dst=00:00:00:00:00:05,nw_src=10.0.2.20,nw_dst=10.0.4.10,nw_tos=0,icmp_type=0,ic
mp_code=0 actions=output:3
  cookie=0x0, duration=11.837s, table=0, n_packets=1, n_bytes=98, idle_timeout=30
, hard_timeout=30, idle_age=11, icmp,vlan_tci=0x0000,d_l_src=00:00:00:00:00:05,d_l
dst=00:00:00:00:00:02,nw_src=10.0.4.10,nw_dst=10.0.2.20,nw_tos=0,icmp_type=8,ic
mp_code=0 actions=output:2
  cookie=0x0, duration=16.806s, table=0, n_packets=1, n_bytes=42, idle_timeout=30
, hard_timeout=30, idle_age=16, arp,vlan_tci=0x0000,d_l_src=00:00:00:00:00:05,d_l
dst=00:00:00:00:00:04,arp_spa=10.0.4.10,arp_tpa=172.16.10.100,arp_op=2 actions=F
L00D
  cookie=0x0, duration=16.82s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
  hard_timeout=30, idle_age=16, arp,vlan_tci=0x0000,d_l_src=00:00:00:00:00:04,d_l_d
st=00:00:00:00:00:05,arp_spa=172.16.10.100,arp_tpa=10.0.4.10,arp_op=1 actions=FL
00D
  cookie=0x0, duration=6.767s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
  hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,d_l_src=00:00:00:00:00:03,d_l_ds
t=00:00:00:00:00:05,arp_spa=10.0.3.30,arp_tpa=10.0.4.10,arp_op=1 actions=FL00D
  cookie=0x0, duration=6.813s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
  hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,d_l_src=00:00:00:00:00:01,d_l_ds
t=00:00:00:00:00:05,arp_spa=10.0.1.10,arp_tpa=10.0.4.10,arp_op=2 actions=FL00D
  cookie=0x0, duration=6.695s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
  hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,d_l_src=00:00:00:00:00:05,d_l_ds
t=00:00:00:00:00:03,arp_spa=10.0.4.10,arp_tpa=10.0.3.30,arp_op=2 actions=FL00D
  cookie=0x0, duration=6.833s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
  hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,d_l_src=00:00:00:00:00:05,d_l_ds
t=00:00:00:00:00:01,arp_spa=10.0.4.10,arp_tpa=10.0.1.10,arp_op=1 actions=FL00D
  cookie=0x0, duration=6.774s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
  hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,d_l_src=00:00:00:00:00:05,d_l_ds
t=00:00:00:00:00:01,arp_spa=10.0.4.10,arp_tpa=10.0.1.10,arp_op=2 actions=FL00D
  cookie=0x0, duration=6.75s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
  hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,d_l_src=00:00:00:00:00:04,d_l_dst

```



```

cookie=0x0, duration=6.822s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,d_l_src=00:00:00:00:00:02,d_l_ds
t=00:00:00:00:00:05,arp_spa=10.0.2.20,arp_tpa=10.0.4.10,arp_op=2 actions=FL00D
cookie=0x0, duration=6.832s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,d_l_src=00:00:00:00:00:01,d_l_ds
t=00:00:00:00:00:05,arp_spa=10.0.1.10,arp_tpa=10.0.4.10,arp_op=1 actions=FL00D
cookie=0x0, duration=6.758s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,d_l_src=00:00:00:00:00:05,d_l_ds
t=00:00:00:00:00:04,arp_spa=10.0.4.10,arp_tpa=172.16.10.100,arp_op=1 actions=FL00D
cookie=0x0, duration=6.825s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,d_l_src=00:00:00:00:00:05,d_l_ds
t=00:00:00:00:00:02,arp_spa=10.0.4.10,arp_tpa=10.0.2.20,arp_op=1 actions=FL00D
*** s3 -----
NXST_FLOW reply (xid=0x4):
cookie=0x0, duration=11.812s, table=0, n_packets=1, n_bytes=98, idle_timeout=30,
hard_timeout=30, idle_age=11, icmp,vlan_tci=0x0000,d_l_src=00:00:00:00:00:03,d_l_
dst=00:00:00:00:00:05,nw_src=10.0.3.30,nw_dst=10.0.4.10,nw_tos=0,icmp_type=0,ic
mp_code=0 actions=output:4
cookie=0x0, duration=11.815s, table=0, n_packets=1, n_bytes=98, idle_timeout=30,
hard_timeout=30, idle_age=11, icmp,vlan_tci=0x0000,d_l_src=00:00:00:00:00:05,d_l_
dst=00:00:00:00:00:03,nw_src=10.0.4.10,nw_dst=10.0.3.30,nw_tos=0,icmp_type=8,ic
mp_code=0 actions=output:3
cookie=0x0, duration=16.812s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
hard_timeout=30, idle_age=16, arp,vlan_tci=0x0000,d_l_src=00:00:00:00:00:05,d_l_
dst=00:00:00:00:00:04,arp_spa=10.0.4.10,arp_tpa=172.16.10.100,arp_op=2 actions=F
LOOD
cookie=0x0, duration=16.825s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
hard_timeout=30, idle_age=16, arp,vlan_tci=0x0000,d_l_src=00:00:00:00:00:04,d_l_
dst=00:00:00:00:00:05,arp_spa=172.16.10.100,arp_tpa=10.0.4.10,arp_op=1 actions=F
LOOD
cookie=0x0, duration=6.785s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,d_l_src=00:00:00:00:00:03,d_l_ds
t=00:00:00:00:00:05,arp_spa=10.0.3.30,arp_tpa=10.0.4.10,arp_op=1 actions=FL00D
cookie=0x0, duration=6.823s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,d_l_src=00:00:00:00:00:01,d_l_ds
t=00:00:00:00:00:05,arp_spa=10.0.1.10,arp_tpa=10.0.4.10,arp_op=2 actions=FL00D
cookie=0x0, duration=6.702s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,d_l_src=00:00:00:00:00:05,d_l_ds
t=00:00:00:00:00:03,arp_spa=10.0.4.10,arp_tpa=10.0.3.30,arp_op=2 actions=FL00D
cookie=0x0, duration=6.843s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,d_l_src=00:00:00:00:00:05,d_l_ds
t=00:00:00:00:00:01,arp_spa=10.0.4.10,arp_tpa=10.0.1.10,arp_op=1 actions=FL00D
cookie=0x0, duration=6.773s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,d_l_src=00:00:00:00:00:05,d_l_ds
t=00:00:00:00:00:01,arp_spa=10.0.4.10,arp_tpa=10.0.1.10,arp_op=2 actions=FL00D
cookie=0x0, duration=6.721s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,d_l_src=00:00:00:00:00:04,d_l_ds

```



```

hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,dl_src=00:00:00:00:00:05,dl_dst=00:00:00:00:00:02,arp_spa=10.0.4.10,arp_tpa=10.0.2.20,arp_op=1 actions=FL00D
*** s5 -----
NXST_FLOW reply (xid=0x4):
  cookie=0x0, duration=11.821s, table=0, n_packets=1, n_bytes=98, idle_timeout=30,
  hard_timeout=30, idle_age=11, icmp,vlan_tci=0x0000,dl_src=00:00:00:00:00:03,dl_dst=00:00:00:00:00:05,nw_src=10.0.3.30,nw_dst=10.0.4.10,nw_tos=0,icmp_type=0,icmp_code=0 actions=output:5
  cookie=0x0, duration=11.852s, table=0, n_packets=1, n_bytes=98, idle_timeout=30,
  hard_timeout=30, idle_age=11, icmp,vlan_tci=0x0000,dl_src=00:00:00:00:00:02,dl_dst=00:00:00:00:00:05,nw_src=10.0.2.20,nw_dst=10.0.4.10,nw_tos=0,icmp_type=0,icmp_code=0 actions=output:5
  cookie=0x0, duration=11.895s, table=0, n_packets=1, n_bytes=98, idle_timeout=30,
  hard_timeout=30, idle_age=11, icmp,vlan_tci=0x0000,dl_src=00:00:00:00:00:05,dl_dst=00:00:00:00:00:01,nw_src=10.0.4.10,nw_dst=10.0.1.10,nw_tos=0,icmp_type=8,icmp_code=0 actions=output:6
  cookie=0x0, duration=11.814s, table=0, n_packets=0, n_bytes=0, idle_timeout=30,
  hard_timeout=30, idle_age=11, icmp,vlan_tci=0x0000,dl_src=00:00:00:00:00:05,dl_dst=00:00:00:00:00:04,nw_src=10.0.4.10,nw_dst=172.16.10.100,nw_tos=0,icmp_type=8,icmp_code=0 actions=drop
  cookie=0x0, duration=11.871s, table=0, n_packets=1, n_bytes=98, idle_timeout=30,
  hard_timeout=30, idle_age=11, icmp,vlan_tci=0x0000,dl_src=00:00:00:00:00:01,dl_dst=00:00:00:00:00:05,nw_src=10.0.1.10,nw_dst=10.0.4.10,nw_tos=0,icmp_type=0,icmp_code=0 actions=output:5
  cookie=0x0, duration=11.84s, table=0, n_packets=1, n_bytes=98, idle_timeout=30,
  hard_timeout=30, idle_age=11, icmp,vlan_tci=0x0000,dl_src=00:00:00:00:00:05,dl_dst=00:00:00:00:00:03,nw_src=10.0.4.10,nw_dst=10.0.3.30,nw_tos=0,icmp_type=8,icmp_code=0 actions=output:6
  cookie=0x0, duration=11.867s, table=0, n_packets=1, n_bytes=98, idle_timeout=30,
  hard_timeout=30, idle_age=11, icmp,vlan_tci=0x0000,dl_src=00:00:00:00:00:05,dl_dst=00:00:00:00:00:02,nw_src=10.0.4.10,nw_dst=10.0.2.20,nw_tos=0,icmp_type=8,icmp_code=0 actions=output:6
  cookie=0x0, duration=16.839s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
  hard_timeout=30, idle_age=16, arp,vlan_tci=0x0000,dl_src=00:00:00:00:00:05,dl_dst=00:00:00:00:00:04,arp_spa=10.0.4.10,arp_tpa=172.16.10.100,arp_op=2 actions=FL00D
  cookie=0x0, duration=16.842s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
  hard_timeout=30, idle_age=16, arp,vlan_tci=0x0000,dl_src=00:00:00:00:00:04,dl_dst=00:00:00:00:00:05,arp_spa=172.16.10.100,arp_tpa=10.0.4.10,arp_op=1 actions=FL00D
  cookie=0x0, duration=6.781s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
  hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,dl_src=00:00:00:00:00:03,dl_dst=00:00:00:00:00:05,arp_spa=10.0.3.30,arp_tpa=10.0.4.10,arp_op=1 actions=FL00D
  cookie=0x0, duration=6.84s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
  hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,dl_src=00:00:00:00:00:01,dl_dst=00:00:00:00:00:05,arp_spa=10.0.1.10,arp_tpa=10.0.4.10,arp_op=2 actions=FL00D
  cookie=0x0, duration=6.739s, table=0, n_packets=1, n_bytes=42, idle_timeout=30,
  hard_timeout=30, idle_age=6, arp,vlan_tci=0x0000,dl_src=00:00:00:00:00:05,dl_dst=00:00:00:00:00:03,arp_spa=10.0.4.10,arp_tpa=10.0.3.30,arp_op=2 actions=FL00D

```