- 3.
- a. Ping attempt was unsuccessful
- b. No rules have been installed
- c. The ping wasn't successful because the packet was sent to the controller and it didn't do anything with the packet, essentially discarding it and adding no match+action to the flow table. d.

```
mininet@mininet-vm:/m...a/sf_Project_3_Phase_3 = = ×
Unable to contact the remote controller at 127.0.0.1:6653
Connecting to remote controller at 127.0.0.1:6633
*** Adding hosts:
h1 h2 h3
*** Adding switches:
*** Adding links:
(h1, s1) (h2, s1) (h3, s1)
*** Configuring hosts
h1 h2 h3
*** Starting controller
*** Starting 1 switches
s1 ...
*** Starting CLI:
mininet> h1 ping h2 -c 1
PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data.
--- 10.0.0.2 ping statistics ---
1 packets transmitted, 0 received, 100% packet loss, time Oms
mininet> dpctl dump-flows
*** s1 -
mininet>
```

4.e

- i. In host 1 we can see that it sent and received 3 packets from h2.
 In host 2 we can see that it received 3 packets and replied 3 times.
 And in host 3 we can see that it received 1 packet and never replied back.
- ii. After the first Ping packet is sent and the flow rules are installed in s1, the latency for the other two packets are reduced by a lot because once the flow rules are installed, later packets matching those rules should be forwarded directly by the switch without involving the controller, thus reducing latency.

```
"Node: h1"
X
                                                                                                                               net.
root@mininet-vm:/media/sf_Project_3_Phase_3# ping 10.0.0.2 -c 3
PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data.
                                                                                                                                kie
    - 10.0.0.2 ping statistics ---
3 packets transmitted, 0 received, 100% packet loss, time 2040ms
root@mininet-vm:/media/sf_Project_3_Phase_3# ping 10.0.0.2 -c 3
PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data.
                                                                                                                                but
64 bytes from 10.0.0.2; icmp_seq=1 ttl=64 time=11.4 ms
64 bytes from 10.0.0.2; icmp_seq=2 ttl=64 time=2.70 ms
64 bytes from 10.0.0.2; icmp_seq=3 ttl=64 time=0.300 ms
  -- 10.0.0.2 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2004ms rtt min/avg/max/mdev = 0.300/4.799/11.403/4.770 ms
root@mininet-vm:/media/sf_Project_3_Phase_3# []
```

"Node: h2" _ D X oot@mininet-vm:/media/sf_Project_3_Phase_3# tcpdump -n -i h2-eth0 topdump: verbose output suppressed, use -v or -vv for full protocol decode listening on h2-eth0, link-type EN1OMB (Ethernet), capture size 262144 bytes 18:53:33.605373 IP 10.0.0.1 > 10.0.0.2: ICMP echo request, id 6407, seq 1, lengt ո 64 18:53:33.605432 IP 10.0.0.2 > 10.0.0.1: ICMP echo reply, id 6407, seq 1, length 18:53:34.600280 IP 10.0.0.1 > 10.0.0.2: ICMP echo request, id 6407, seq 2, lengt ո 64 l8:53:34.600424 IP 10.0.0.2 > 10.0.0.1: ICMP echo reply, id 6407, seq 2, length l8:53:35.600541 IP 10.0.0.1 > 10.0.0.2: ICMP echo request, id 6407, seq 3, lengt 18:53:35.600569 IP 10.0.0.2 > 10.0.0.1: ICMP echo reply, id 6407, seq 3, length

"Node: h3" root@mininet-vm:/media/sf_Project_3_Phase_3# tcpdump -n -i h3-eth0 tcpdump: verbose output suppressed, use -v or -vv for full protocol decode listening on h3-eth0, link-type EN1OMB (Ethernet), capture size 262144 bytes

_ D ×

18:53:33.605375 IP 10.0.0.1 > 10.0.0.2: ICMP echo request, id 6407, seq 1, lengt h 64

4.g

- i. iPerf did work for h1 and h2
- ii. 2 iperf packets were sent to the controller
- iii. 4 rules are now installed in s1? (2 more after doing iperf)
- iv. This could possibly happen because the flow tables are implemented by matching all fields of a packet, so when iperf was running, the packets had different fields to the ping packets so they had to go to the controller to add a new match+action entry in the flow table.

```
"Node: h1"
 oot@mininet-vm:/media/sf_Project_3_Phase_3# ping 10.0.0.2 -c 3
PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data.
  - 10.0.0.2 ping statistics ---
3 packets transmitted, O received, 100% packet loss, time 2040ms
root@mininet-vm:/media/sf_Project_3_Phase_3# ping 10.0.0.2 -c 3
PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data.
64 bytes from 10.0.0.2: icmp_seq=1 ttl=64 time=11.4 ms
64 bytes from 10.0.0.2: icmp_seq=2 ttl=64 time=2.70 ms
64 bytes from 10.0.0.2: icmp_seq=3 ttl=64 time=0.300 ms
  -- 10.0.0.2 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2004ms
rtt min/avg/max/mdev = 0.300/4.799/11.403/4.770 ms
 oot@mininet-vm:/media/sf_Project_3_Phase_3# iperf -c 10.0.0.2 -p 4000
Client connecting to 10.0.0.2, TCP port 4000
TCP window size: 153 KByte (default)
   5] local 10.0.0.1 port 54062 connected with 10.0.0.2 port 4000
  ID] Interval
                         Transfer
                                        Bandwidth
   5] 0.0-10.0 sec 26.5 GBytes
                                        22.8 Gbits/sec
 oot@mininet-vm:/media/sf_Project_3_Phase_3# 🛮
                                       "Node: h2"
                                                                                     _ O X
8:53:33.605432 IP 10.0.0.2 > 10.0.0.1: ICMP echo reply, id 6407, seq 1, length
8;53;34.600280 IP 10.0.0.1 > 10.0.0.2; ICMP echo request, id 6407, seq 2, lengt
8:53:34.600424 IP 10.0.0.2 > 10.0.0.1: ICMP echo reply, id 6407, seq 2, length
8:53:35.600541 IP 10.0.0.1 > 10.0.0.2: ICMP echo request, id 6407, seq 3, lengt
 64
.8:53:35.600569 IP 10.0.0.2 > 10.0.0.1: ICMP echo reply, id 6407, seq 3, length
 packets captured
 packets received by filter
 packets dropped by kernel
oot@mininet-vm:/media/sf_Project_3_Phase_3# iperf -s -p 4000
erver listening on TCP port 4000
CP window size: 85.3 KByte (default)
  6] local 10.0.0.2 port 4000 connected with 10.0.0.1 port 54062
                                       Bandwidth
 ID] Interval
                        Transfer
  6] 0.0-10.0 sec 26.5 GBytes 22.7 Gbits/sec
```

6.

- i. iPerf did work for h1 and h2
- ii. No iPerf packets were sent to the controller
- iii. 2 rules are installed in s1
- iv. No iperf packets were sent to the controller, thus no extra rules were added. No iperf packets were sent to the controller because they were matched solely by their source mac address and

destination mac address, which was implemented during ping, so the packets are forwarded directly by switches based on their existing flow rules, so the controller wasn't involved.

```
"Node: h1"
                                                                                        _ D X
root@mininet-vm:/media/sf_Project_3_Phase_3# ping 10.0.0.2 -c 3
PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data.
And bytes from 10.0.0.2: icmp_seq=1 ttl=64 time=8.38 ms
bytes from 10.0.0.2: icmp_seq=1 ttl=64 time=23.3 ms (DUP!)
bytes from 10.0.0.2: icmp_seq=2 ttl=64 time=0.223 ms
bytes from 10.0.0.2: icmp_seq=3 ttl=64 time=0.063 ms
  - 10.0.0.2 ping statistics ---
packets transmitted, 3 received, +1 duplicates, 0% packet loss, time 2031ms tt min/avg/max/mdev = 0.063/7.994/23.318/9.463 ms
oot@mininet-vm:/media/sf_Project_3_Phase_3# iperf -c 10.0.0.2 -p 4000
lient connecting to 10.0.0.2, TCP port 4000
CP window size: 340 KByte (default)
   5] local 10.0.0.1 port 37056 connected with 10.0.0.2 port 4000
  ID] Interval
                         Transfer
                                        Bandwidth
  5] 0.0-10.0 sec 23.0 GBytes 19.7 Gbits/sec
oot@mininet-vm:/media/sf_Project_3_Phase_3# [
                                      "Node: h2"
;13;58.472372 IP 10.0.0.2 > 10.0.0.1: ICMP echo reply, id 3547, seq 1, length
:13:59.469075 IP 10.0.0.1 > 10.0.0.2: ICMP echo request, id 3547, seq 2, lengt
;13;59.469095 IP 10.0.0.2 > 10.0.0.1; ICMP echo reply, id 3547, seq 2, length
:14:00.496439 IP 10.0.0.1 > 10.0.0.2: ICMP echo request, id 3547, seq 3, lengt
:14:00.496460 IP 10.0.0.2 > 10.0.0.1: ICMP echo reply, id 3547, seq 3, length
packets captured
packets received by filter
packets dropped by kernel
ot@mininet-vm:/media/sf_Project_3_Phase_3# iperf -s -p 4000
erver listening on TCP port 4000
CP window size: 85.3 KByte (default)
 6] local 10.0.0.2 port 4000 connected with 10.0.0.1 port 37056
ID] Interval
                        Transfer
                                       Bandwidth
 6] 0.0-10.0 sec 23.0 GBytes 19.7 Gbits/sec
```

- 7a. The Ping results that each host can reach all the other hosts. Do this by running the pingall command after running a topology.
- i. 7 packets were sent to the controller
- ii. See below
- iii. 4 messages flooded by the controller.
- b. No packets were sent to the controller during the second ping all. This is because after the first pingall, the controller successfully installed flow table entries and rules based on source and destination mac address. Thus during the second pingall, the switches would just follow these rules and forward the packets to their destination.

```
mininet@mininet-vm: /m...a/sf Project 3 Phase 3 _ = ×
mininet> pingall
*** Ping: testing ping reachability
h1 -> h2 h3
h2 -> h1 h3
h3 -> h1 h2
*** Results: 0% dropped (6/6 received)
mininet> dpctl dump-flows
  ** s1 -
cookie=0x0, duration=15.835s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0
0:00:00:02,dl_dst=00:00:00:00:00:01 actions=output:"s1-eth1"
 cookie=0x0, duration=15.830s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
:00:00:01,dl_dst=00:00:00:00:00:00 actions=output:"s1-eth2"
cookie=0x0, duration=15.808s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:03,dl_dst=00:00:00:00:01 actions=output:"s1-eth1"
 cookie=0x0, duration=15.802s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
:00:00:01,dl_dst=00:00:00:00:00:03 actions=output:"s1-eth3"
cookie=0x0, duration=15.757s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0:00:00:00:03,dl_dst=00:00:00:00:00:02 actions=output:"s1-eth2"
cookie=0x0, duration=15.757s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
 00:00:02,dl_dst=00:00:00:00:00:03 actions=output:"s1-eth3"
mininet> pingall
*** Ping: testing ping reachability
h1 -> h2 h3
h2 -> h1 h3
```

```
mininet@mininet-vm: ~/pox
                                                                   _ D X
INFO:samples.ethernet-learning:Installed rule in switch 12 to forward packet to
port 2
INFO;samples.ethernet-learning;Number of packets received so far: 6
INFO;samples.ethernet-learning;Number of messages flooded by controller so far:
INFO:samples.ethernet-learning:Packet has arrived: SRCMAC:00:00:00:00:00:03 DSTM
AC:00:00:00:00:00:02 from switch:12 in-port:3
INFO:samples.ethernet-learning:Installed rule in switch 12 to forward packet to
port 2
INFO:samples.ethernet-learning:Installed rule in switch 12 to forward packet to
port 3
INFO:samples.ethernet-learning:Number of packets received so far: 7
INFO:samples.ethernet-learning:Number of messages flooded by controller so far:
INFO;samples.ethernet-learning:Packet has arrived: SRCMAC:00:00:00:00:00:03 DSTM
AC:00:00:00:00:00:02 from switch:12 in-port:3
INFO:samples.ethernet-learning:Installed rule in switch 12 to forward packet to
port 2
INFO:samples.ethernet-learning:Installed rule in switch 12 to forward packet to
port 3
```

Topology-A

435 packets were sent to the controller 102 messages flooded by the controller

L1:

latency: 81.0/2 = 40.5 ms

throughput: 13.2 seconds to transfer 29.0MB, so a throughput of about 2.196 MB/s

L2:

latency: 21.371/2 = 10.687 ms

throughput: 12.9 seconds to transfer 56.9MB, so a throughput of about 4.422 MB/s

L3:

latency: 41.446/2 = 20.723 ms

throughput: 12.5 seconds to transfer 41.2MB, so a throughput of about 3.296 MB/s

L4:

latency: 61.358/2 = 30.679 ms

throughput: 12.5 seconds to transfer 27.6MB, so a throughput of about 2.208 MB/s

The performance is similar to the definition of each link in topology-a.py and are very similar to the results I estimated in Phase2. This is probably because this remote controller and the default controller behave similarly in installing flow table rules that match only on the source and destination MAC addresses, instead of all fields, of a given packet

All the rules in the switches:

```
s1
cookie=0x0, duration=74.667s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0
:00:00:02,dl_dst=00:00:00:00:00:01 actions=output:"s1-eth1"
cookie=0x0, duration=74.651s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
00:00:01,dl_dst=00:00:00:00:00:02 actions=output:"s1-eth2"
cookie=0x0, duration=74.552s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0
:00:00:03,dl_dst=00:00:00:00:00:01 actions=output:"s1-eth1"
cookie=0x0, duration=74.552s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
00:00:01,dl_dst=00:00:00:00:00:03 actions=output:"s1-eth3"
cookie=0x0, duration=74.422s, table=0, n_packets=4, n_bytes=392, dl_src=00:00:0:00:00:04,dl_dst=00:00:00:00:00:01 actions=output:"s1-eth1"
cookie=0x0, duration=74.422s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
00:00:01,dl_dst=00:00:00:00:00:04 actions=output:"s1-eth3"
cookie=0x0, duration=74.217s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0
:00:00:05,dl_dst=00:00:00:00:00:01 actions=output:"s1=eth1"
cookie=0x0, duration=74.217s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
00:00:01,dl_dst=00:00:00:00:00:05 actions=output:"s1-eth3"
cookie=0x0, duration=74.022s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0
:00:00:06,dl_dst=00:00:00:00:00:01 actions=output:"s1-eth1"
cookie=0x0, duration=74.022s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
00:00:01,dl_dst=00:00:00:00:00:06 actions=output:"s1-eth3"
cookie=0x0, duration=73.821s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0:00:00:07,dl_dst=00:00:00:00:01 actions=output:"s1=eth1"
cookie=0x0, duration=73.819s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
00:00:01,dl_dst=00:00:00:00:00:07 actions=output:"s1-eth3"
cookie=0x0, duration=73.325s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0
:00:00:09,dl_dst=00:00:00:00:00:01 actions=output:"s1-eth1"
cookie=0x0, duration=73.325s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
00:00:01,dl_dst=00:00:00:00:00:09 actions=output:"s1-eth3"
cookie=0x0, duration=73.305s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0:0:00:00:02,dl_dst=00:00:00:00:00:03 actions=output:"s1=eth3"
cookie=0x0, duration=73.305s, table=0, n_packets=9, n_bytes=882, dl_src=00:00:0
:00:00:03,dl_dst=00:00:00:00:00:00:02 actions=output:"s1-eth2"
cookie=0x0, duration=73.206s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0:00:00:02,dl_dst=00:00:00:00:04 actions=output:"s1-eth3"
cookie=0x0, duration=73.206s, table=0, n_packets=13, n_bytes=1274, dl_src=00:00
00:00:00:04,dl_dst=00:00:00:00:00:02 actions=output:"s1-eth2"
cookie=0x0, duration=73.074s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0
:00:00:02,dl_dst=00:00:00:00:00:05 actions=output:"s1-eth3"
cookie=0x0, duration=73.074s, table=0, n_packets=13, n_bytes=1274, dl_src=00:00
00:00:00:05,dl_dst=00:00:00:00:00:02 actions=output:"s1-eth2"
cookie=0x0, duration=72.683s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0:0:00:00:02,dl_dst=00:00:00:00:00:07 actions=output:"s1-eth3"
cookie=0x0, duration=72.683s, table=0, n_packets=33, n_bytes=3234, dl_src=00:00
cookie=0x0, duration=72.446s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0
:00:00:02,dl_dst=00:00:00:00:00:08 actions=output:"s1-eth3"
cookie=0x0, duration=72.446s, table=0, n_packets=33, n_bytes=3234, dl_src=00:00
00:00:00:08,dl_dst=00:00:00:00:00:02 actions=output:"s1-eth2"
cookie=0x0, duration=72.220s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0
:00:00:02,dl_dst=00:00:00:00:00:00 actions=output:"s1=eth3"
cookie=0x0, duration=72.220s, table=0, n_packets=21, n_bytes=2058, dl_src=00:00
00:00:00:09,dl_dst=00:00:00:00:00:02 actions=output:"s1-eth2"
cookie=0x0, duration=74.614s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0:0:00:03,dl_dst=00:00:00:00:00:01 actions=output:"s2-eth2"
cookie=0x0, duration=74.611s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
00:00:01,dl_dst=00:00:00:00:00:03 actions=output:"s2-eth1"
cookie=0x0, duration=74.480s, table=0, n_packets=4, n_bytes=392, dl_src=00:00:0:00:00:04,dl_dst=00:00:00:00:01 actions=output:"s2-eth2"
cookie=0x0, duration=74.479s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
00:00:01,dl_dst=00:00:00:00:00:04 actions=output:"s2-eth3"
cookie=0x0, duration=74.293s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0
:00:00:05,dl_dst=00:00:00:00:00:01 actions=output:"s2-eth2"
cookie=0x0, duration=74.293s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
```

```
cookie=0x0, duration=74.521s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0
0:00:00:04,dl_dst=00:00:00:00:00:01 actions=output:"s3-eth2"
 cookie=0x0, duration=74.513s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
:00:00:01,dl_dst=00:00:00:00:00:04 actions=output:"s3-eth1"
 cookie=0x0, duration=74.341s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0
0;00:00:05,dl_dst=00:00:00:00:00:01 actions=output:"s3-eth2"
cookie=0x0, duration=74.341s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
:00:00:01,dl_dst=00:00:00:00:00:05 actions=output:"s3-eth3"
cookie=0x0, duration=74.146s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:06,dl_dst=00:00:00:00:00:01 actions=output:"s3-eth2"
 cookie=0x0, duration=74.146s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
:00:00:01,dl_dst=00:00:00:00:00:06 actions=output:"s3-eth3'
cookie=0x0, duration=73.939s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:07,dl_dst=00:00:00:00:01 actions=output:"s3-eth2" cookie=0x0, duration=73.939s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
:00:00:01,dl_dst=00:00:00:00:00:07 actions=output:"s3-eth4"
 cookie=0x0, duration=73.714s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0
0:00:00:08,dl_dst=00:00:00:00:00:01 actions=output:"s3-eth2"
cookie=0x0, duration=73.714s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
:00:00:01,dl_dst=00:00:00:00:00:08 actions=output:"s3-eth4"
cookie=0x0, duration=73.454s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:09,dl_dst=00:00:00:00:01 actions=output:"s3-eth2"
 cookie=0x0, duration=73.454s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
 :00:00:01.dl_dst=00:00:00:00:00:09 actions=output:"s3-eth4
cookie=0x0, duration=73.175s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:00.dl_dst=00:00:00:00:00 actions=output:"s3-eth1"
cookie=0x0, duration=73.174s, table=0, n_packets=5, n_bytes=490, dl_src=00:00:00:00:00:04,dl_dst=00:00:00:00:02 actions=output:"s3-eth2"
 cookie=0x0, duration=73.017s, table=0, n_packets=5, n_bytes=490, dl_src=00:00:0
0:00:00:02,dl_dst=00:00:00:00:05 actions=output:"s3-eth3"
 cookie=0x0, duration=73.017s, table=0, n_packets=13, n_bytes=1274, dl_src=00:00
 :00:00:00:05,dl_dst=00:00:00:00:00:02 actions=output:"s3-eth2
cookie=0x0, duration=72.649s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0
0:00:00:02,dl_dst=00:00:00:00:00:07 actions=output:"s3-eth4"
cookie=0x0, duration=72.649s, table=0, n_packets=33, n_bytes=3234, dl_src=00:00:00:00:07,dl_dst=00:00:00:00:02 actions=output:"s3-eth2"
cookie=0x0, duration=72.429s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:00:dl_dst=00:00:00:00:00:08 actions=output:"s3-eth4"
 cookie=0x0, duration=72.429s, table=0, n_packets=33, n_bytes=3234, dl_src=00:00
:00:00:00:08,dl_dst=00:00:00:00:00:00:02 actions=output:"s3-eth2"
cookie=0x0, duration=72.202s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:02,dl_dst=00:00:00:00:00:09 actions=output:"s3-eth4"
cookie=0x0, duration=72.202s, table=0, n_packets=21, n_bytes=2058, dl_src=00:00
:00:00:00:09,dl_dst=00:00:00:00:00:02 actions=output:"s3-eth2"
cookie=0x0, duration=71.820s, table=0, n_packets=17, n_bytes=1666, dl_src=00:00
:00:00:00:05,dl_dst=00:00:00:00:00:03 actions=output:"s3-eth2"
 cookie=0x0, duration=71.709s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0
0:00:00:03,dl_dst=00:00:00:00:00:06 actions=output:"s3-eth3"
cookie=0x0, duration=71.709s, table=0, n_packets=13, n_bytes=1274, dl_src=00:00
 :00:00:00:06,dl_dst=00:00:00:00:00:03 actions=output:"s3-eth2'
 cookie=0x0, duration=71.606s, table=0, n_packets=4, n_bytes=392, dl_src=00:00:0
0:00:00:03,dl_dst=00:00:00:00:00:07 actions=output:"s3-eth4"
 cookie=0x0, duration=71.606s, table=0, n_packets=11, n_bytes=1078, dl_src=00:00
:00:00:00:07,dl_dst=00:00:00:00:00:03 actions=output:"s3-eth2
cookie=0x0, duration=71.494s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:03,dl_dst=00:00:00:00:00:08 actions=output:"s3-eth4"
cookie=0x0, duration=71.494s, table=0, n_packets=17, n_bytes=1666, dl_src=00:00
:00:00:00:08,dl_dst=00:00:00:00:00:03 actions=output:"s3-eth2"
cookie=0x0, duration=71.363s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:03,dl_dst=00:00:00:00:00:00 actions=output:"s3-eth4"
 cookie=0x0, duration=71.363s, table=0, n_packets=17, n_bytes=1666, dl_src=00:00
 :00:00:00:09,dl_dst=00:00:00:00:00:03 actions=output:"s3-eth2'
```

```
cookie=0x0, duration=74.415s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0:
:00:00:05,dl_dst=00:00:00:00:00:01 actions=output:"s4-eth3"
cookie=0x0, duration=74.414s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
00:00:01,dl_dst=00:00:00:00:00:05 actions=output:"s4-eth1"
cookie=0x0, duration=74.221s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0
:00:00:06,dl_dst=00:00:00:00:00:01 actions=output:"s4-eth3"
cookie=0x0, duration=74.221s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
00;00:01,dl_dst=00:00:00:00:00:06 actions=output:"s4-eth2"
cookie=0x0, duration=73.047s, table=0, n_packets=11, n_bytes=1078, dl_src=00:00
00:00:00:05,dl_dst=00:00:00:00:00:02 actions=output:"s4-eth3"
cookie=0x0, duration=73.047s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0
:00:00:02,dl_dst=00:00:00:00:00:05 actions=output:"s4-eth1"
cookie=0x0, duration=72.857s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0
:00:00:06,dl_dst=00:00:00:00:00:02 actions=output:"s4-eth3"
cookie=0x0, duration=72.854s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
00:00:02,dl_dst=00:00:00:00:00:06 actions=output:"s4-eth2"
cookie=0x0, duration=71.823s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0
:00:00:05,dl_dst=00:00:00:00:00:03 actions=output:"s4-eth3"
cookie=0x0, duration=71.823s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
00:00:03,dl_dst=00:00:00:00:00:00 actions=output:"s4-eth1"
cookie=0x0, duration=71.706s, table=0, n_packets=7, n_bytes=686, dl_src=00:00:0:00:00:06,dl_dst=00:00:00:00:00:03 actions=output:"s4-eth3"
cookie=0x0, duration=71.706s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
cookie=0x0, duration=70.999s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0:0:00:05,dl_dst=00:00:00:00:04 actions=output:"s4-eth3"
cookie=0x0, duration=70.999s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
00:00:04,dl_dst=00:00:00:00:00:05 actions=output:"s4-eth1"
cookie=0x0, duration=70.930s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0
:00:00:06,dl_dst=00:00:00:00:00:04 actions=output:"s4-eth3"
cookie=0x0, duration=70.929s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
cookie=0x0, duration=70.201s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0:00:00:00:06,dl_dst=00:00:00:00:00:05 actions=output:"s4-eth1"
cookie=0x0, duration=70.201s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
00:00:05,dl_dst=00:00:00:00:00:06 actions=output:"s4-eth2"
cookie=0x0, duration=70.051s, table=0, n_packets=7, n_bytes=686, dl_src=00:00:0:0:00:07,dl_dst=00:00:00:00:00:05 actions=output:"s4-eth1"
cookie=0x0, duration=70.051s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
00:00:05,dl_dst=00:00:00:00:00:07 actions=output:"s4-eth3"
cookie=0x0, duration=69.904s, table=0, n_packets=5, n_bytes=490, dl_src=00:00:0
:00:00:08,dl_dst=00:00:00:00:00:05 actions=output:"s4-eth1"
cookie=0x0, duration=69.904s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
00:00:05,dl_dst=00:00:00:00:00:08 actions=output:"s4-eth3"
cookie=0x0, duration=69.716s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0
:00:00:09,dl_dst=00:00:00:00:00:05 actions=output:"s4-eth1"
cookie=0x0, duration=69.716s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
00:00:05,dl_dst=00:00:00:00:00:09 actions=output:"s4-eth3"
cookie=0x0, duration=69.288s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0
:00:00:06,dl_dst=00:00:00:00:00:07 actions=output:"s4-eth3"
cookie=0x0, duration=69.288s, table=0, n_packets=11, n_bytes=1078, dl_src=00:00
00:00:00:07,dl_dst=00:00:00:00:00:06 actions=output:"s4-eth2"
cookie=0x0, duration=69.161s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0
:00:00:06,dl_dst=00:00:00:00:00:08 actions=output:"s4-eth3"
cookie=0x0, duration=69.160s, table=0, n_packets=17, n_bytes=1666, dl_src=00:00
00:00:00:08.dl_dst=00:00:00:00:00:06 actions=output:"s4-eth2"
cookie=0x0, duration=69.034s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0
:00:00:06,dl_dst=00:00:00:00:00:00:09 actions=output:"s4-eth3"
cookie=0x0, duration=69.034s, table=0, n_packets=13, n_bytes=1274, dl_src=00:00
00:00:00:09,dl_dst=00:00:00:00:00:06 actions=output:"s4-eth2"
 * s5 ·
cookie=0x0, duration=74.041s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0
:00:00:07,dl_dst=00:00:00:00:00:01 actions=output:"s5-eth4"
cookie=0x0, duration=74.041s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
00:00:01,dl_dst=00:00:00:00:00:07 actions=output:"s5-eth1"
cookie=0x0, duration=73.816s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0
:00:00:08,dl_dst=00:00:00:00:00:01 actions=output:"s5-eth4"
cookie=0x0, duration=73.816s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
00:00:01,dl_dst=00:00:00:00:00:08 actions=output:"s5-eth2"
 ookie=0x0, duration=73.566s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:0
:00:00:09,dl_dst=00:00:00:00:00:01 actions=output:"s5-eth4"
ookie=0x0, duration=73.558s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00
```

Topology-B

443 packets were sent to the controller 103 messages flooded by the controller

[h1, e1]:

latency: 42.891/4 = 10.722 ms

throughput: 12.3 seconds to transfer 13.9MB, so a throughput of about 1.13 MB/s

[e1, a1]:

latency: (124.36 - 42.891)/4 = 20.367

throughput: 13.6 seconds to transfer 15.1MB, so a throughput of about 1.11 MB/s

[a1, c1]:

latency: (246.693 - 124.36)/4 = 30.583 ms

throughput: 15.1 seconds to transfer 16.2MB, so a throughput of about 1.072 MB/s

The throughput performance is not similar to the definition of each link in topology-b.py because of the bottleneck link in Ivl3 causing the throughput to be less than specified, but both the latency and throughput performance is very similar to the results I estimated in Phase2. This is probably because this remote controller and the default controller behave similarly in installing flow table rules that match only on the source and destination MAC addresses, instead of all fields, of a given packet

All the rules in the switches:

```
nininet> dpctl dump-flows
cookie=0x0, duration=45.295s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:03,dl_dst=00:00:00:00:00:00:
actions=output:"a1-eth2'
cookie=0x0, duration=45,295s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00:00:00:01,dl_dst=00:00:00:00:00:00:00:00
actions=output:"a1-eth3"
cookie=0x0, duration=45.078s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:00:04,dl_dst=00:00:00:00:00:00:00
actions=output:"a1-eth2
cookie=0x0, duration=45.078s, table=0, n_packets=1, n_bytes=98, dl_src=00;00;00;00;00;01,dl_dst=00;00;00;00;00;00;00
actions=output:"a1-eth3'
actions=output:"a1-eth2
actions=output:"a1-eth1"
cookie=0x0, duration=44.426s, table=0, n_packets=6, n_bytes=588, dl_src=00:00:00:00:00:06,dl_dst=00:00:00:00:00:00:
actions=output:"a1-eth2
cookie=0x0, duration=44.426s, table=0, n_packets=1, n_bytes=98, dl_src=00;00;00;00;00;01,dl_dst=00;00;00;00;00;00;00
actions=output:"a1-eth1'
cookie=0x0, duration=44.085s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:00:01,dl_dst=00:00:00:00:00:00:00
actions=output: "a1-eth2
actions=output:"a1-eth1"
cookie=0x0, duration=43.758s, table=0, n_packets=4, n_bytes=392, dl_src=00:00:00:00:00:08,dl_dst=00:00:00:00:00:
actions=output:"a1-eth2"
cookie=0x0, duration=43,758s, table=0, n_packets=1, n_bytes=98, dl_src=00;00;00;00;00;01,dl_dst=00;00;00;00;00;00;00
actions=output:"a1-eth1"
cookie=0x0, duration=43.577s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:00:0d_ddt=00:00:00:00:00:00:
actions=output:"a1-eth3
cookie=0x0, duration=43.577s, table=0, n_packets=6, n_bytes=588, dl_src=00:00:00:00:00:00:03,dl_dst=00:00:00:00:00:
actions=output:"a1-eth2"
cookie=0x0, duration=43.420s, table=0, n_packets=3, n_bytes=294, dl_src=00;00;00;00;00;00;0d_dst=00;00;00;00;00;00;00
actions=output:"a1-eth3'
actions=output:"a1-eth2"
cookie=0x0, duration=43.254s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:00:02,dl_dst=00:00:00:00:00:00:
actions=output:"a1-eth1"
cookie=0x0, duration=43,254s, table=0, n_packets=27, n_bytes=2646, dl_src=00:00:00:00:00:05,dl_dst=00:00:00:00:0
)2 actions=output:"a1-eth2
actions=output:"a1-eth1"
cookie=0x0, duration=42,943s, table=0, n_packets=33, n_bytes=3234, dl_src=00:00:00:00:00:00:06,dl_dst=00:00:00:00:00:00
02 actions=output:"a1-eth2"
cookie=0x0, duration=42.583s, table=0, n_packets=3, n_bytes=294, d1_src=00:00:00:00:00:02,d1_dst=00:00:00:00:
actions=output: "a1-eth1'
cookie=0x0, duration=42.583s, table=0, n_packets=25, n_bytes=2450, dl_src=00:00:00:00:00:07,dl_dst=00:00:00:00:
cookie=0x0, duration=42.244s, table=0, n_packets=3, n_bytes=294, dl_src=00;00;00;00;00;02,dl_dst=00;00;00;00;
actions=output:"a1-eth1"
02 actions=output:"a1-eth2"
cookie=0x0, duration=42.244s, table=0, n_packets=23, n_bytes=2254, dl_src=00:00:00:00:00:00:08,dl_dst=00:00:00:00:00:00
02 actions=output:"a1-eth2'
cookie=0x0, duration=41.621s, table=0, n_packets=3, n_bytes=294, dl_src=00;00;00;00;00;03,dl_dst=00;00;00;00;00;00;00
actions=output:"a1-eth1
cookie=0x0, duration=41,621s, table=0, n_packets=17, n_bytes=1666, dl_src=00:00:00:00:00:00:05,dl_dst=00:00:00:00:00:
03 actions=output:"a1-eth3'
cookie=0x0, duration=41.290s, table=0, n_packets=3, n_bytes=294, dl_src=00;00;00;00;00;00,dl_dst=00;00;00;00;00;00;00
actions=output: "a1-eth1'
cookie=0x0, duration=41.290s, table=0, n_packets=8, n_bytes=784, dl_src=00:00:00:00:00:00:06,dl_dst=00:00:00:00:00:00:
actions=output:"a1-eth3'
actions=output:"a1-eth1"
cookie=0x0, duration=40.984s, table=0, n_packets=13, n_bytes=1274, dl_src=00:00:00:00:00:07,dl_dst=00:00:00:00:00:00
03 actions=output:"a1-eth3"
cookie=0x0, duration=40.655s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:00:03,dl_dst=00:00:00:00:00:00:00
actions=output:"a1-eth1"
03 actions=output:"a1-eth3"
04 actions=output:"a1-eth3"
cookie=0x0, duration=39,693s, table=0, n_packets=3, n_bytes=294, dl_src=00;00;00;00;00;04,dl_dst=00;00;00;00;00;00;00
actions=output:"a1-eth1"
cookie=0x0, duration=39.693s, table=0, n_packets=33, n_bytes=3234, dl_src=00:00:00:00:00:06.dl_dst=00:00:00:00:0
04 actions=output:"a1-eth3"
actions=output:"a1-eth1'
cookie=0x0, duration=39,387s, table=0, n_packets=24, n_bytes=2352, dl_src=00:00:00:00:00:07,dl_dst=00:00:00:00:00:0
04 actions=output:"a1-eth3'
cookie=0x0, duration=39.047s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:04,dl_dst=00:00:00:00:00:00:00
actions=output:"a1-eth1"
```

```
actions=output:"al-eth3
  a2
ookie=0x0, duration=44.912s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:00;01_dst=00:00:00:00:00:00:01
actions=output:"a2-eth1'
ookie=0x0, duration=44.912s, table=0, n_packets=1, n_bytes=98, dl_src=00;00;00;00;00;01,dl_dst=00;00;00;00;00;05
ctions=output:"a2-eth2
ookie=0x0, duration=44.573s, table=0, n_packets=4, n_bytes=392, dl_src=00:00:00:00:00:06,dl_dst=00:00:00:00:00:00:01
actions=output:"a2-eth1'
ookie=0x0, duration=44.573s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00:00:00:01,dl_dst=00:00:00:00:00:0
ctions=output:"a2-eth2'
:00kie=0x0, duration=44.273s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:07,dl_dst=00:00:00:00:00
ctions=output:"a2-eth1
:ookie=0x0, duration=44.273s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00:00:00:01,dl_dst=00:00:00:00:00:00
ctions=output:"a2-eth3"
ookie=0x0, duration=43.904s, table=0, n_packets=4, n_bytes=392, dl_src=00:00:00:00:00:00:08,dl_dst=00:00:00:00:00:00
actions=output:"a2-eth1
ookie=0x0, duration=43,904s, table=0, n_packets=1, n_bytes=98, dl_src=00;00:00:00:00:01,dl_dst=00:00:00:00:00:00
ctions=output:"a2-eth3"
ookie=0x0, duration=43.233s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:00:01_dst=00:00:00:00:00:00:00
actions=output:"a2-eth2'
ookie=0x0, duration=43,231s, table=0, n_packets=27, n_bytes=2646, dl_src=00;00;00;00;00;05,dl_dst=00;00;00;00;00;
 actions=output: "a2-eth1"
ookie=0x0, duration=42.933s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:00:01,dl_dst=00:00:00:00:00:00:00
actions=output:"a2-eth2
ookie=0x0, duration=42.932s, table=0, n_packets=33, n_bytes=3234, dl_src=00:00:00:00:00:00:06,dl_dst=00:00:00:00:00:
 actions=output:"a2-eth1"
ookie=0x0, duration=42.589s, table=0, n_packets=7, n_bytes=686, dl_src=00:00:00:00:00:00:01_dst=00:00:00:00:00:0
ctions=output:"a2-eth3"
cookie=0x0, duration=42,589s, table=0, n_packets=25, n_bytes=2450, dl_src=00:00:00:00:00:07,dl_dst=00:00:00:00:00:
 actions=output:"a2-eth1"
ookie=0x0, duration=42,223s, table=0, n_packets=3, n_bytes=294, dl_src=00;00;00;00;00;00;01_dst=00;00;00;00;00;00
actions=output:"a2-eth3"
ookie=0x0, duration=42,223s, table=0, n_packets=23, n_bytes=2254, dl_src=00:00:00:00:00:00:08,dl_dst=00:00:00:00:00:
 actions=output:"a2-eth1"
ookie=0x0, duration=41.626s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:00;03,dl_dst=00:00:00:00:00:05
actions=output:"a2-eth2
ookie=0x0, duration=41.626s, table=0, n_packets=17, n_bytes=1666, dl_src=00:00:00:00:00:00:05,dl_dst=00:00:00:00:00:
 actions=output:"a2-eth1"
ookie=0x0, duration=41,292s, table=0, n_packets=6, n_bytes=588, dl_src=00;00;00;00;00;03,dl_dst=00;00;00;00;00;06
actions=output:"a2-eth2
ookie=0x0, duration=41.291s, table=0, n_packets=8, n_bytes=784, dl_src=00:00:00:00:00:00:06,dl_dst=00:00:00:00:00:00:0
actions=output:"a2-eth1'
ookie=0x0, duration=40.930s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:03,dl_dst=00:00:00:00:00:00:07
ctions=output:"a2-eth3'
cookie=0x0, duration=40.930s, table=0, n_packets=13, n_bytes=1274, dl_src=00:00:00:00:00:07,dl_dst=00:00:00:00:
actions=output:"a2-eth1"
 ookie=0x0, duration=40,645s, table=0, n_packets=3, n_bytes=294, dl_src=00;00;00;00;00;03,dl_dst=00;00;00;00;00
actions=output:"a2-eth3"
ookie=0x0, duration=40.645s, table=0, n_packets=11, n_bytes=1078, dl_src=00:00:00:00:00:00:08,dl_dst=00:00:00:00:00:
 actions=output: "a2-eth1"
cookie=0x0, duration=39.980s, table=0, n_packets=6, n_bytes=588, dl_src=00:00:00:00:00:00:04,dl_dst=00:00:00:00:00:05
actions=output:"a2-eth2"
ookie=0x0, duration=39,980s, table=0, n_packets=13, n_bytes=1274, dl_src=00:00:00:00:00:05,dl_dst=00:00:00:00:
4 actions=output:"a2-eth1"
ookie=0x0, duration=39.683s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:00:04,dl_dst=00:00:00:00:00:00
actions=output:"a2-eth2
ookie=0x0, duration=39.682s, table=0, n_packets=33, n_bytes=3234, dl_src=00:00:00:00:00:06,dl_dst=00:00:00:00:
actions=output:"a2-eth1"
ookie=0x0, duration=39.258s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:04,dl_dst=00:00:00:00:00:0
ctions=output:"a2-eth3'
cookie=0x0, duration=39,257s, table=0, n_packets=20, n_bytes=1960, dl_src=00:00:00:00:00:07,dl_dst=00:00:00:00:00:
actions=output:"a2-eth1"
ookie=0x0, duration=38.983s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:00:04,dl_dst=00:00:00:00:00:00
actions=output:"a2-eth3"
ookie=0x0, duration=38.976s, table=0, n_packets=21, n_bytes=2058, dl_src=00:00:00:00:00:00:08,dl_dst=00:00:00:00:00:
actions=output:"a2-eth1
ookie=0x0, duration=37.733s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:00:01.dst=00:00:00:00:00:00:00
actions=output:"a2-eth3'
cookie=0x0, duration=37.733s, table=0, n_packets=5, n_bytes=490, dl_src=00:00:00:00:00:07,dl_dst=00:00:00:00:05
actions=output:"a2-eth2"
ookie=0x0, duration=37.586s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:00:01,dl_dst=00:00:00:00:00:00:00
actions=output:"a2-eth3'
ookie=0x0, duration=37.586s, table=0, n_packets=5, n_bytes=490, dl_src=00:00:00:00:00:00:08,dl_dst=00:00:00:00:00:00
ctions=output:"a2-eth3'
ookie=0x0, duration=36.304s, table=0, n_packets=9, n_bytes=882, dl_src=00:00:00:00:00:00;07,dl_dst=00:00:00:00:00:00:06
actions=output:"a2-eth2'
ookie=0x0, duration=36.152s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:00:06,dl_dst=00:00:00:00:00:00
actions=output:"a2-eth3"
```

ookie=0x0, duration=36.152s, table=0, n_packets=9, n_bytes=882, dl_src=00:00:00:00:00:00:08,dl_dst=00:00:00:00:00:00:00

```
cookie=0x0, duration=44.908s, table=0, n_packets=5, n_bytes=490, dl_src=00;00:00:00:00:00:5,dl_dst=00:00:00:00:00:00:00
actions=output:"c1-eth1'
cookie=0x0, duration=44.908s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00:00:00:01,dl_dst=00:00:00:00:00:00:05
ctions=output:"c1-eth2"
cookie=0x0, duration=44.562s, table=0, n_packets=4, n_bytes=392, dl_src=00;00;00;00;00;06,dl_dst=00;00;00;00;00;00;01
actions=output:"c1-eth1"
cookie=0x0, duration=44.554s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00:00:00:01,dl_dst=00:00:00:00:00:00
ctions=output:"c1-eth2"
cookie=0x0, duration=44.268s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00:00:00:01,dl_dst=00:00:00:00:00:00:07
ctions=output:"c1-eth2"
cookie=0x0, duration=43.901s, table=0, n_packets=4, n_bytes=392, dl_src=00;00;00;00;00;00,dl_dst=00;00;00;00;00;00;00
actions=output:"c1-eth1'
cookie=0x0, duration=43.901s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00:00:00:01,dl_dst=00:00:00:00:00:00
ctions=output:"c1-eth2"
cookie=0x0, duration=43.319s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:00:0d.dl_dst=00:00:00:00:00:00:00:00:00
actions=output:"c1-eth2
ookie=0x0, duration=43.309s, table=0, n_packets=27, n_bytes=2646, dl_src=00:00:00:00:00:05,dl_dst=00:00:00:00:
2 actions=output:"c1-eth1"
cookie=0x0, duration=43.014s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:00:01_dl_dst=00:00:00:00:00:00:00
actions=output:"c1-eth2"
cookie=0x0, duration=43.014s, table=0, n_packets=33, n_bytes=3234, dl_src=00:00:00:00:00:06,dl_dst=00:00:00:00:
2 actions=output:"c1-eth1"
cookie=0x0, duration=42.642s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:00:01_dst=00:00:00:00:00:00:0
actions=output:"c1-eth2
cookie=0x0, duration=42.641s, table=0, n_packets=25, n_bytes=2450, dl_src=00:00:00:00:00:00;07,dl_dst=00:00:00:00:00:
2 actions=output:"c1-eth1'
cookie=0x0, duration=42,315s, table=0, n_packets=3, n_bytes=294, dl_src=00;00;00;00;00;02,dl_dst=00;00;00;00;00;00;00
actions=output:"c1-eth2
cookie=0x0, duration=42.315s, table=0, n_packets=23, n_bytes=2254, dl_src=00:00:00:00:00:08,dl_dst=00:00:00:00:00:00:
2 actions=output:"c1-eth1'
cookie=0x0, duration=41.694s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:00:0d.dl_dst=00:00:00:00:00:00:00
actions=output:"c1-eth2
cookie=0x0, duration=41.694s, table=0, n_packets=17, n_bytes=1666, dl_src=00:00:00:00:00:00:0dl_dst=00:00:00:00:00:00:
3 actions=output:"c1-eth1"
ookie=0x0, duration=41.350s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:00:0d.dd_dst=00:00:00:00:00:00:00
actions=output:"c1-eth2
cookie=0x0, duration=41.350s, table=0, n_packets=8, n_bytes=784, dl_src=00:00:00:00:00:06,dl_dst=00:00:00:00:00:00:0
actions=output:"c1-eth1"
cookie=0x0, duration=41.056s, table=0, n_packets=3, n_bytes=294, dl_src=00;00:00:00:00:03,dl_dst=00:00:00:00:00:00:0
actions=output:"c1-eth2'
cookie=0x0, duration=41.056s, table=0, n_packets=13, n_bytes=1274, dl_src=00:00:00:00:00:00:07,dl_dst=00:00:00:00:00:
3 actions=output:"c1-eth1"
cookie=0x0, duration=40.726s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:03,dl_dst=00:00:00:00:00:00:0
actions=output:"c1-eth2'
cookie=0x0, duration=40.726s, table=0, n_packets=11, n_bytes=1078, dl_src=00:00:00:00:00:00:08,dl_dst=00:00:00:00:00:00:
3 actions=output:"c1-eth1'
cookie=0x0, duration=40.044s, table=0, n_packets=6, n_bytes=588, dl_src=00:00:00:00:00:00:04,dl_dst=00:00:00:00:00:00:00
actions=output:"c1-eth2'
ookie=0x0, duration=40.045s, table=0, n_packets=13, n_bytes=1274, dl_src=00:00:00:00:00:05,dl_dst=00:00:00:00:00:00:
4 actions=output:"c1-eth1"
cookie=0x0, duration=39.767s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:04,dl_dst=00:00:00:00:00
actions=output:"c1-eth2
cookie=0x0, duration=39.767s, table=0, n_packets=33, n_bytes=3234, dl_src=00:00:00:00:00:06,dl_dst=00:00:00:00:
4 actions=output:"c1-eth1'
cookie=0x0, duration=39.446s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:04,dl_dst=00:00:00:00:00:00:0
actions=output:"c1-eth2"
ookie=0x0, duration=39.443s, table=0, n_packets=24, n_bytes=2352, dl_src=00:00:00:00:00:00:01,dl_dst=00:00:00:00:00:
4 actions=output:"c1-eth1'
cookie=0x0, duration=39.123s, table=0, n_packets=5, n_bytes=490, dl_src=00:00:00:00:00:00:04,dl_dst=00:00:00:00:00:00:00
actions=output:"c1-eth2'
cookie=0x0, duration=39.123s, table=0, n_packets=21, n_bytes=2058, dl_src=00:00:00:00:00:08,dl_dst=00:00:00:00:00:00:
4 actions=output:"c1-eth1"
```

```
e1
cookie=0x0, duration=45.588s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:00:0.dl_dst=00:00:00:00:00:00:00:
actions=output:"e1-eth1'
cookie=0x0, duration=45.588s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00:00:00:01,dl_dst=00:00:00:00:00:00:00
actions=output:"e1-eth2"
cookie=0x0, duration=45.365s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:00:03,dl_dst=00:00:00:00:00:0
actions=output:"e1-eth1"
cookie=0x0, duration=45,365s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00:00:00:01,dl_dst=00:00:00:00:00:00
actions=output:"e1-eth3'
cookie=0x0, duration=45.161s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:04,dl_dst=00:00:00:00:00:00:0
actions=output:"e1-eth1
cookie=0x0, duration=45.161s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00:00:00:01,dl_dst=00:00:00:00:00:00:00
ctions=output:"e1-eth3"
cookie=0x0, duration=44.838s, table=0, n_packets=3, n_bytes=294, dl_src=00;00;00;00;00;00;05,dl_dst=00;00;00;00;00;00;00
actions=output:"e1-eth1'
cookie=0x0, duration=44.838s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00:00:00:00;01,dl_dst=00:00:00:00:00:00:05
actions=output:"e1-eth3"
cookie=0x0, duration=44.532s, table=0, n_packets=5, n_bytes=490, dl_src=00:00:00:00:00:06,dl_dst=00:00:00:00:0
actions=output:"e1-eth1
cookie=0x0, duration=44.532s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00:00:00:01,dl_dst=00:00:00:00:00:00
actions=output:"e1-eth3"
actions=output:"e1-eth1"
cookie=0x0, duration=44.142s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00:00:00:01,dl_dst=00:00:00:00:00:00:00
actions=output:"e1-eth3"
actions=output:"e1-eth1'
cookie=0x0, duration=43.867s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00:00:00:01,dl_dst=00:00:00:00:00:00:08
actions=output:"e1-eth3"
actions=output:"e1-eth3
cookie=0x0, duration=43.748s, table=0, n_packets=6, n_bytes=588, dl_src=00;00:00:00:00:00:0,dl_dst=00:00:00:00:00:0
actions=output:"e1-eth2"
cookie=0x0, duration=43.581s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:00:00.dl_dst=00:00:00:00:00:00:
actions=output:"e1-eth3"
cookie=0x0, duration=43.581s, table=0, n_packets=9, n_bytes=882, dl_src=00:00:00:00:00:04,dl_dst=00:00:00:00:00:00:00
actions=output:"e1-eth2"
cookie=0x0, duration=43.416s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:00:0.dl_dst=00:00:00:00:00:00:00:
actions=output:"e1-eth3"
cookie=0x0, duration=43.415s, table=0, n_packets=27, n_bytes=2646, dl_src=00:00:00:00:00:00:0d.dst=00:00:00:00:00:00
2 actions=output:"e1-eth2
cookie=0x0, duration=43,103s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:00:00:0dl_dst=00:00:00:00:00:00:00
actions=output:"e1-eth3'
cookie=0x0, duration=43.103s, table=0, n_packets=33, n_bytes=3234, dl_src=00:00:00:00:00:00:06,dl_dst=00:00:00:00:00
02 actions=output:"e1-eth2
actions=output:"e1-eth3
cookie=0x0, duration=42.742s, table=0, n_packets=25, n_bytes=2450, dl_src=00:00:00:00:00:07,dl_dst=00:00:00:00:00
02 actions=output:"e1-eth2'
actions=output:"e1-eth3"
cookie=0x0, duration=42.405s, table=0, n_packets=23, n_bytes=2254, dl_src=00:00:00:00:00:00:08,dl_dst=00:00:00:00:00
02 actions=output:"e1-eth2
** e2 -
actions=output:"e2-eth3"
cookie=0x0, duration=45.494s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00:00:00:00;01,dl_dst=00:00:00:00:00:00:0
actions=output:"e2-eth1"
cookie=0x0, duration=45.270s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:04,dl_dst=00:00:00:00:00:00:0
actions=output:"e2-eth3'
cookie=0x0, duration=45.269s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00:00:00:01,dl_dst=00:00:00:00:00:00
actions=output:"e2-eth2"
cookie=0x0, duration=43.729s, table=0, n_packets=6, n_bytes=588, dl_src=00:00:00:00:00:00:0.dl_dst=00:00:00:00:00:00:
actions=output:"e2-eth1"
cookie=0x0, duration=43.729s, table=0, n_packets=6, n_bytes=588, dl_src=00;00;00;00;00;00;0d,dl_dst=00;00;00;00;00;0
actions=output:"e2-eth3'
cookie=0x0, duration=43.555s, table=0, n_packets=3, n_bytes=294, dl_src=00;00;00;00;00;02,dl_dst=00;00;00;00;00;00;00
actions=output:"e2-eth2
cookie=0x0, duration=43.544s, table=0, n_packets=9, n_bytes=882, dl_src=00:00:00:00:00:04,dl_dst=00:00:00:00:00:00:00
actions=output:"e2-eth3'
cookie=0x0, duration=41.863s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:00:03,dl_dst=00:00:00:00:00:00:00
actions=output:"e2-eth2"
cookie=0x0, duration=41.863s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:04,dl_dst=00:00:00:00:00:00:
actions=output: "e2-eth1"
cookie=0x0, duration=41.510s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:05,dl_dst=00:00:00:00:0
actions=output:"e2-eth1
cookie=0x0, duration=41.509s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00:00:00:00;03,dl_dst=00:00:00:00:00:00:00
actions=output:"e2-eth3'
cookie=0x0, duration=41.191s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:06,dl_dst=00:00:00:00:00:00:0
```

actions=output:"e2-eth1"

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cookie=0x0, duration=45.086s, table=0, n_packets=3, n_bytes=294, dl_src=00;00;00;00;00;05,dl_dst=00;00;00;00;00;01
actions=output:"e3-eth3
cookie=0x0, duration=45.086s, table=0, n_packets=1, n_bytes=98, dl_src=00;00;00;00;00;01,dl_dst=00;00;00;00;00;00
actions=output:"e3-eth1"
cookie=0x0, duration=44.759s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:06,dl_dst=00:00:00:00:00:00:00
actions=output:"e3-eth3'
cookie=0x0, duration=44.739s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00:00:00:01,dl_dst=00:00:00:00:00:00:00
actions=output:"e3-eth2"
cookie=0x0, duration=43,371s, table=0, n_packets=9, n_bytes=882, dl_src=00:00:00:00:00:00:0d_dst=00:00:00:00:00:00:00
actions=output:"e3-eth1'
02 actions=output:"e3-eth3"
cookie=0x0, duration=42.954s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:00:0d_dst=00:00:00:00:00:00:00:00
actions=output: "e3-eth2"
cookie=0x0, duration=42.954s, table=0, n_packets=11, n_bytes=1078, dl_src=00:00:00:00:00:00:06,dl_dst=00:00:00:00:00:00:
)2 actions=output:"e3-eth3'
cookie=0x0, duration=41.740s, table=0, n_packets=3, n_bytes=294, dl_src=00;00;00;00;00;00;0d,dl_dst=00;00;00;00;00;00;00
actions=output:"e3-eth1'
cookie=0x0, duration=41.740s, table=0, n_packets=17, n_bytes=1666, dl_src=00:00:00:00:00:05,dl_dst=00:00:00:00:00:00:
03 actions=output:"e3-eth3
cookie=0x0, duration=41.414s, table=0, n_packets=6, n_bytes=588, dl_src=00:00:00:00:00:00:dl_dst=00:00:00:00:00:00:00
actions=output: "e3-eth2
cookie=0x0, duration=41.414s, table=0, n_packets=8, n_bytes=784, dl_src=00;00;00;00;00;06,dl_dst=00;00;00;00;00;00;00
actions=output:"e3-eth3"
actions=output: "e3-eth1"
cookie=0x0, duration=40.089s, table=0, n_packets=13, n_bytes=1274, dl_src=00:00:00:00:00:00:05,dl_dst=00:00:00:00:00:00:00:
04 actions=output:"e3-eth3"
cookie=0x0, duration=39.787s, table=0, n_packets=6, n_bytes=588, dl_src=00:00:00:00:00:04,dl_dst=00:00:00:00:00:00
actions=output:"e3-eth2"
04 actions=output:"e3-eth3
actions=output: "e3-eth2
actions=output:"e3-eth3"
cookie=0x0, duration=37.619s, table=0, n_packets=3, n_bytes=294, dl_src=00;00;00;00;00;08,dl_dst=00;00;00;00;00;00
actions=output:"e3-eth1"
cookie=0x0, duration=37.618s, table=0, n_packets=1, n_bytes=98, dl_src=00;00:00:00:00:00:01,dl_dst=00:00:00:00:00:00:00
actions=output:"e3-eth3"
cookie=0x0, duration=36,476s, table=0, n_packets=3, n_bytes=294, dl_src=00;00;00;00;00;06,dl_dst=00;00;00;00;00;00
actions=output:"e3-eth3'
cookie=0x0, duration=36.476s, table=0, n_packets=9, n_bytes=882, dl_src=00:00:00:00:00:07,dl_dst=00:00:00:00:00:00:00
actions=output:"e3-eth2
cookie=0x0, duration=36,325s, table=0, n_packets=3, n_bytes=294, dl_src=00;00;00;00;00;06,dl_dst=00;00;00;00;00;00
actions=output:"e3-eth3
cookie=0x0, duration=36,325s, table=0, n_packets=9, n_bytes=882, dl_src=00;00;00;00;00;08,dl_dst=00;00;00;00;00
actions=output: "e3-eth2"
** e4 -
cookie=0x0, duration=44.492s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:07,dl_dst=00:00:00:00:00:00:01
actions=output: "e4-eth3
cookie=0x0, duration=44.492s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00:00:00:01,dl_dst=00:00:00:00:00:00:00
actions=output:"e4-eth1"
cookie=0x0, duration=44.120s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:00:08,dl_dst=00:00:00:00:00:00:00
actions=output:"e4-eth3
cookie=0x0, duration=44.117s, table=0, n_packets=1, n_bytes=98, dl_src=00:00:00:00:00:01,dl_dst=00:00:00:00:00:00:00
actions=output:"e4-eth2"
cookie=0x0, duration=42.701s, table=0, n_packets=3, n_bytes=294, dl_src=00:00:00:00:00:02,dl_dst=00:00:00:00:00:07
actions=output:"e4-eth1'
cookie=0x0, duration=42,700s, table=0, n_packets=5, n_bytes=490, dl_src=00:00:00:00:00:00:01,dl_dst=00:00:00:00:00:00:00
actions=output:"e4-eth3'
cookie=0x0, duration=42,395s, table=0, n_packets=6, n_bytes=588, dl_src=00:00:00:00:00:00:0d_dst=00:00:00:00:00:00:00
actions=output: "e4-eth2
cookie=0x0, duration=42.394s, table=0, n_packets=23, n_bytes=2254, dl_src=00:00:00:00:00:08,dl_dst=00:00:00:00:00:00:
02 actions=output:"e4-eth3"
cookie=0x0, duration=41.086s, table=0, n_packets=7, n_bytes=686, dl_src=00:00:00:00:00:03,dl_dst=00:00:00:00:00:00:00
actions=output: "e4-eth1'
cookie=0x0, duration=41.086s, table=0, n_packets=11, n_bytes=1078, dl_src=00;00;00;00;00;07,dl_dst=00;00;00;00;00;00;00
03 actions=output:"e4-eth3"
actions=output:"e4-eth2'
03 actions=output:"e4-eth3
cookie=0x0, duration=39.477s, table=0, n_packets=5, n_bytes=490, dl_src=00:00:00:00:00:04,dl_dst=00:00:00:00:00:00:00
actions=output: "e4-eth1"
04 actions=output:"e4-eth3"
```