

A. Linear

1. Topology creation

```
mungook@ubuntu:~/mininet$ sudo mn --topo linear,3 --switch ovs --controller remote
*** Creating network
*** Adding controller
Unable to contact the remote controller at 127.0.0.1:6653
Unable to contact the remote controller at 127.0.0.1:6633
Setting remote controller to 127.0.0.1:6653
*** Adding hosts:
h1 h2 h3
*** Adding switches:
s1 s2 s3
*** Adding links:
(h1, s1) (h2, s2) (h3, s3) (s2, s1) (s3, s2)
*** Configuring hosts
h1 h2 h3
*** Starting controller
c0
*** Starting 3 switches
s1 s2 s3 ...
*** Starting CLI:
mininet> links
h1-eth0<->s1-eth1 (OK OK)
h2-eth0<->s2-eth1 (OK OK)
h3-eth0<->s3-eth1 (OK OK)
s2-eth2<->s1-eth2 (OK OK)
s3-eth2<->s2-eth3 (OK OK)
```

i. Links

```
mininet> links
h1-eth0<->s1-eth1 (OK OK)
h2-eth0<->s2-eth1 (OK OK)
h3-eth0<->s3-eth1 (OK OK)
s2-eth2<->s1-eth2 (OK OK)
s3-eth2<->s2-eth3 (OK OK)
```

ii. ports

```
mininet> ports
s1 lo:0 s1-eth1:1 s1-eth2:2
s2 lo:0 s2-eth1:1 s2-eth2:2 s2-eth3:3
s3 lo:0 s3-eth1:1 s3-eth2:2
```

iii. net

```
mininet> net
h1 h1-eth0:s1-eth1
h2 h2-eth0:s2-eth1
h3 h3-eth0:s3-eth1
s1 lo: s1-eth1:h1-eth0 s1-eth2:s2-eth2
s2 lo: s2-eth1:h2-eth0 s2-eth2:s1-eth2 s2-eth3:s3-eth2
s3 lo: s3-eth1:h3-eth0 s3-eth2:s2-eth3
c0
```

2. setting switch forwarding table

i. switch configuration

```
mininet> sh ovs-ofctl add-flow s1 priority=20,in_port=1,actions=output:2
mininet> sh ovs-ofctl add-flow s1 priority=20,in_port=2,actions=output:1
mininet> sh ovs-ofctl add-flow s2 priority=20,in_port=2,actions=output:3
mininet> sh ovs-ofctl add-flow s2 priority=20,in_port=3,actions=output:2
mininet> sh ovs-ofctl add-flow s3 priority=20,in_port=1,actions=output:2
mininet> sh ovs-ofctl add-flow s3 priority=20,in_port=2,actions=output:1
```

ii. ping

1. before

```
mininet> h1 ping -c5 h3
PING 10.0.0.3 (10.0.0.3) 56(84) bytes of data.
From 10.0.0.1 icmp_seq=1 Destination Host Unreachable
From 10.0.0.1 icmp_seq=2 Destination Host Unreachable
From 10.0.0.1 icmp_seq=3 Destination Host Unreachable
From 10.0.0.1 icmp_seq=4 Destination Host Unreachable
From 10.0.0.1 icmp_seq=5 Destination Host Unreachable

--- 10.0.0.3 ping statistics ---
5 packets transmitted, 0 received, +5 errors, 100% packet loss, time 4093ms
pipe 4
```

2. after

```
mininet> pingall
*** Ping: testing ping reachability
h1 -> X h3
h2 -> X X
h3 -> h1 X
*** Results: 66% dropped (2/6 received)
mininet> h1 ping -c5 h3
PING 10.0.0.3 (10.0.0.3) 56(84) bytes of data.
64 bytes from 10.0.0.3: icmp_seq=1 ttl=64 time=0.061 ms
64 bytes from 10.0.0.3: icmp_seq=2 ttl=64 time=0.094 ms
64 bytes from 10.0.0.3: icmp_seq=3 ttl=64 time=0.077 ms
64 bytes from 10.0.0.3: icmp_seq=4 ttl=64 time=0.060 ms
64 bytes from 10.0.0.3: icmp_seq=5 ttl=64 time=0.102 ms

--- 10.0.0.3 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4079ms
rtt min/avg/max/mdev = 0.060/0.078/0.102/0.020 ms
```

iii. switch information

```
mininet> sh ovs-ofctl show s1
OFPT_FEATURES_REPLY (xid=0x2): dpid:0000000000000001
n_tables:254, n_buffers:256
capabilities: FLOW_STATS TABLE_STATS PORT_STATS QUEUE_STATS ARP_MATCH_IP
actions: output enqueue set_vlan_vid set_vlan_pcp strip_vlan mod_dl_src mod_dl_dst mod_nw_src mod_nw_dst mod_nw_tos mod_tp_src mod_tp_dst
1(s1-eth1): addr:ea:52:85:33:12:0d
    config: 0
    state: 0
    current: 10GB-FD COPPER
    speed: 10000 Mbps now, 0 Mbps max
2(s1-eth2): addr:52:27:98:cb:ce:2c
    config: 0
    state: 0
    current: 10GB-FD COPPER
    speed: 10000 Mbps now, 0 Mbps max
LOCAL(s1): addr:ca:55:07:ae:a3:4b
    config: PORT_DOWN
    state: LINK_DOWN
    speed: 0 Mbps now, 0 Mbps max
OFPT_GET_CONFIG_REPLY (xid=0x4): frags=normal miss_send_len=0
mininet> sh ovs-ofctl show s2
OFPT_FEATURES_REPLY (xid=0x2): dpid:0000000000000002
n_tables:254, n_buffers:256
capabilities: FLOW_STATS TABLE_STATS PORT_STATS QUEUE_STATS ARP_MATCH_IP
actions: output enqueue set_vlan_vid set_vlan_pcp strip_vlan mod_dl_src mod_dl_dst mod_nw_src mod_nw_dst mod_nw_tos mod_tp_src mod_tp_dst
1(s2-eth1): addr:ee:21:c5:92:6a:62
    config: 0
    state: 0
    current: 10GB-FD COPPER
    speed: 10000 Mbps now, 0 Mbps max
2(s2-eth2): addr:2e:5e:4b:fb:0a:12
    config: 0
    state: 0
    current: 10GB-FD COPPER
    speed: 10000 Mbps now, 0 Mbps max
3(s2-eth3): addr:fa:82:b1:cb:58:60
    config: 0
    state: 0
    current: 10GB-FD COPPER
    speed: 10000 Mbps now, 0 Mbps max
LOCAL(s2): addr:36:b4:6f:ce:4d:4a
    config: PORT_DOWN
    state: LINK_DOWN
    speed: 0 Mbps now, 0 Mbps max
OFPT_GET_CONFIG_REPLY (xid=0x4): frags=normal miss_send_len=0
mininet> sh ovs-ofctl show s3
OFPT_FEATURES_REPLY (xid=0x2): dpid:0000000000000003
n_tables:254, n_buffers:256
capabilities: FLOW_STATS TABLE_STATS PORT_STATS QUEUE_STATS ARP_MATCH_IP
actions: output enqueue set_vlan_vid set_vlan_pcp strip_vlan mod_dl_src mod_dl_dst mod_nw_src mod_nw_dst mod_nw_tos mod_tp_src mod_tp_dst
1(s3-eth1): addr:fe:09:07:04:42:d6
    config: 0
    state: 0
    current: 10GB-FD COPPER
    speed: 10000 Mbps now, 0 Mbps max
2(s3-eth2): addr:5a:1a:c8:f5:2e:7a
    config: 0
    state: 0
    current: 10GB-FD COPPER
    speed: 10000 Mbps now, 0 Mbps max
LOCAL(s3): addr:72:07:79:87:a4:46
    config: PORT_DOWN
    state: LINK_DOWN
    speed: 0 Mbps now, 0 Mbps max
OFPT_GET_CONFIG_REPLY (xid=0x4): frags=normal miss_send_len=0
```