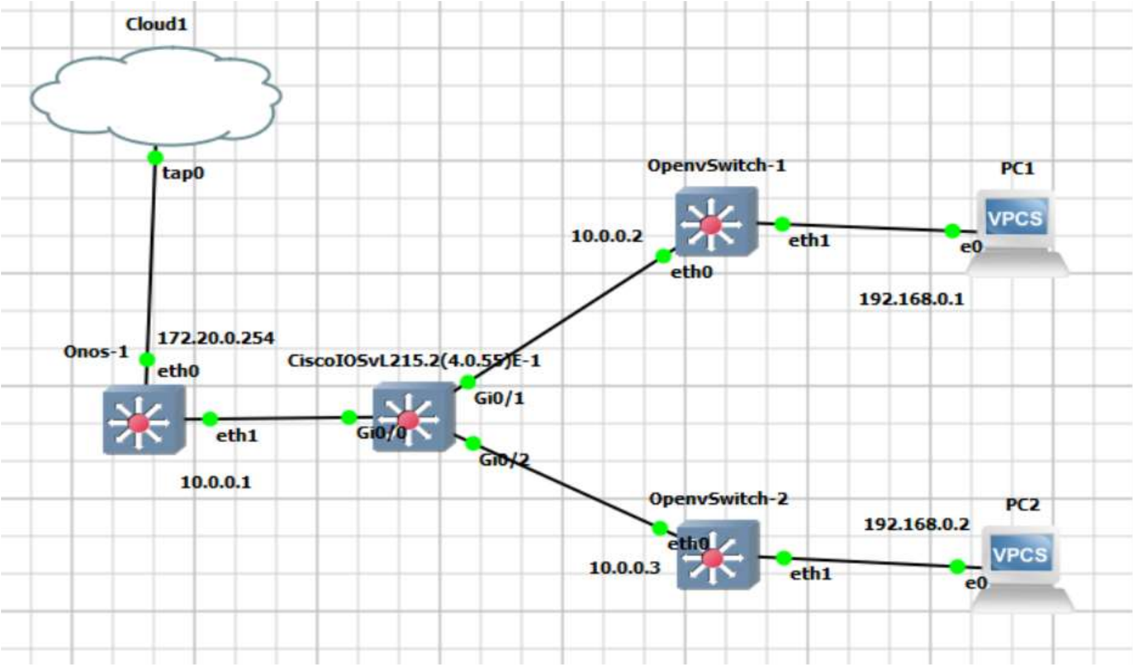
SDN-LAB (12-07)

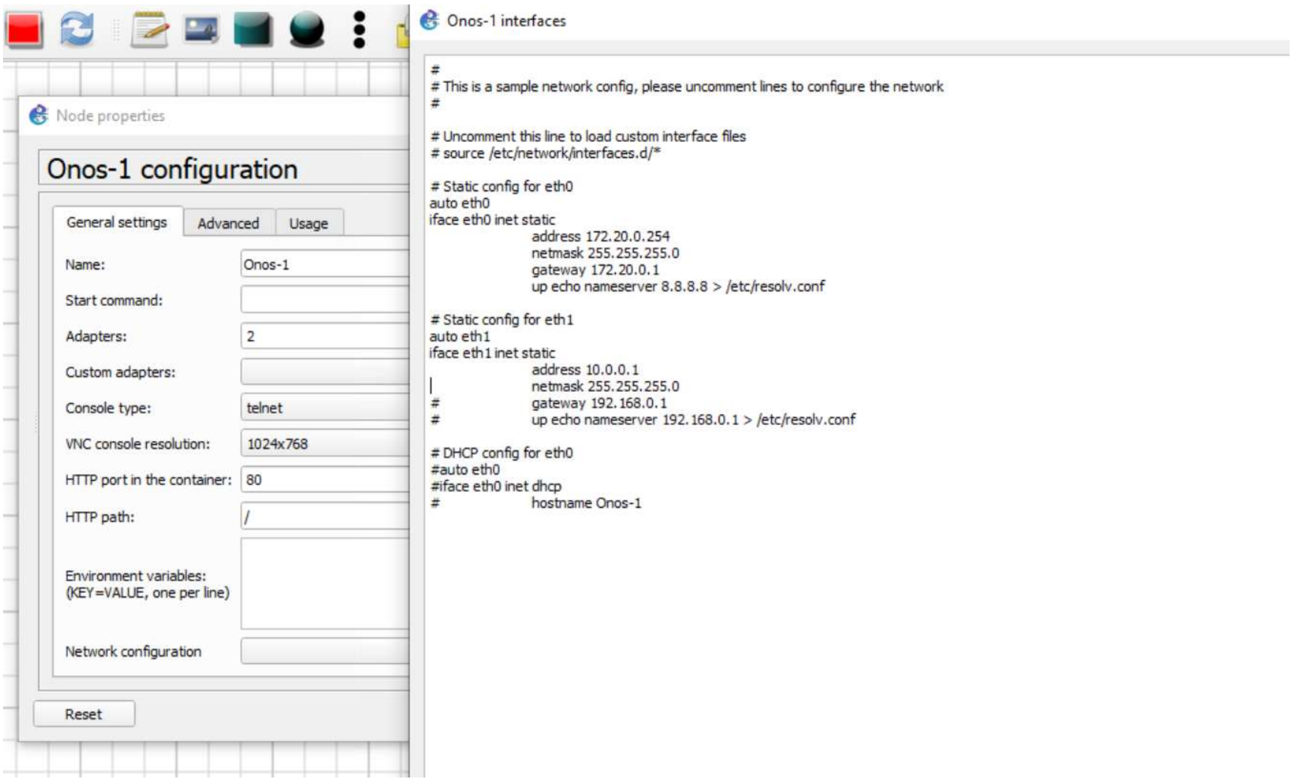
INTRODUCTION:

In this exercise, we are going to use a sample app called Reactive Forwarding. It is shipped with ONOS and is a simple application that installs flows in response to every miss packet in that arrives at the controller.

STEP 1: Network Topology:



STEP 2: Configure the ONOS Controller eth0 and eth1 IP address:



Node properties

Onos-1 configuration

General settings | Advanced | Usage

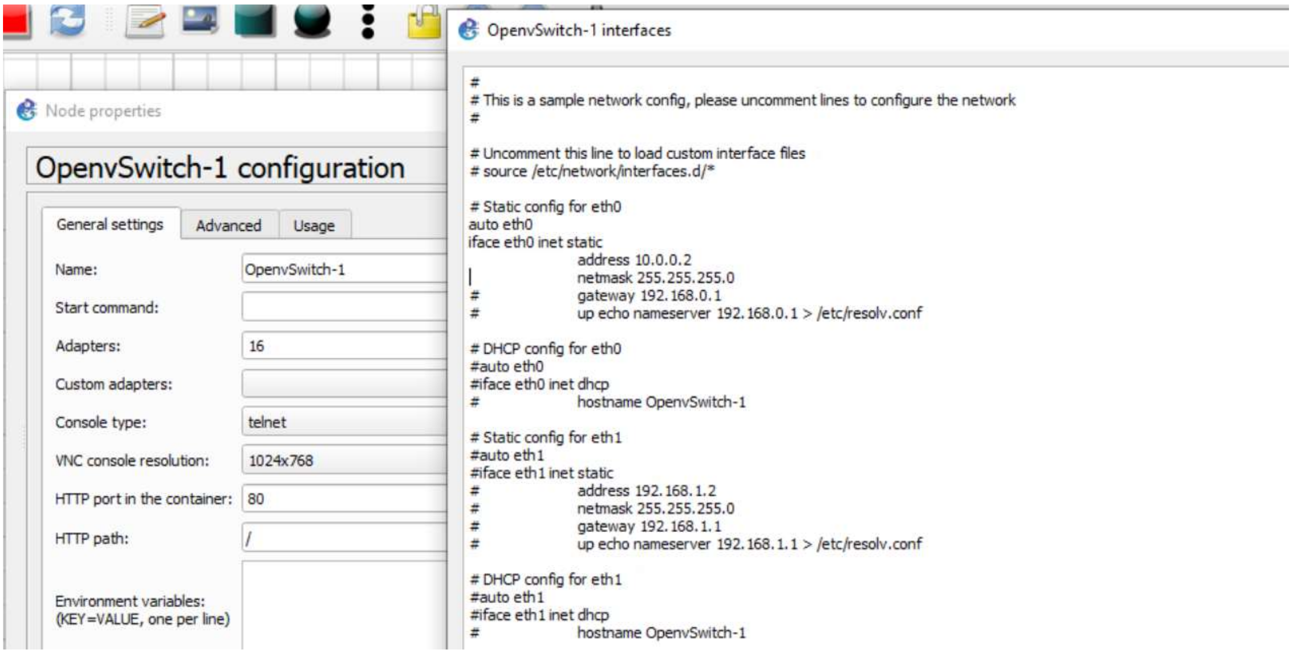
Name: Onos-1
Start command:
Adapters: 2
Custom adapters:
Console type: telnet
VNC console resolution: 1024x768
HTTP port in the container: 80
HTTP path: /
Environment variables:
(KEY=VALUE, one per line)
Network configuration

Reset

Onos-1 interfaces

```
#
# This is a sample network config, please uncomment lines to configure the network
#

# Uncomment this line to load custom interface files
# source /etc/network/interfaces.d/*

# Static config for eth0
auto eth0
iface eth0 inet static
                address 172.20.0.254
                netmask 255.255.255.0
                gateway 172.20.0.1
                up echo nameserver 8.8.8.8 > /etc/resolv.conf

# Static config for eth1
auto eth1
iface eth1 inet static
                address 10.0.0.1
                netmask 255.255.255.0
#               gateway 192.168.0.1
#               up echo nameserver 192.168.0.1 > /etc/resolv.conf

# DHCP config for eth0
#auto eth0
#iface eth0 inet dhcp
#               hostname Onos-1
```

STEP 3: Assign the static IP address on eth0 port of Open Switch -1:

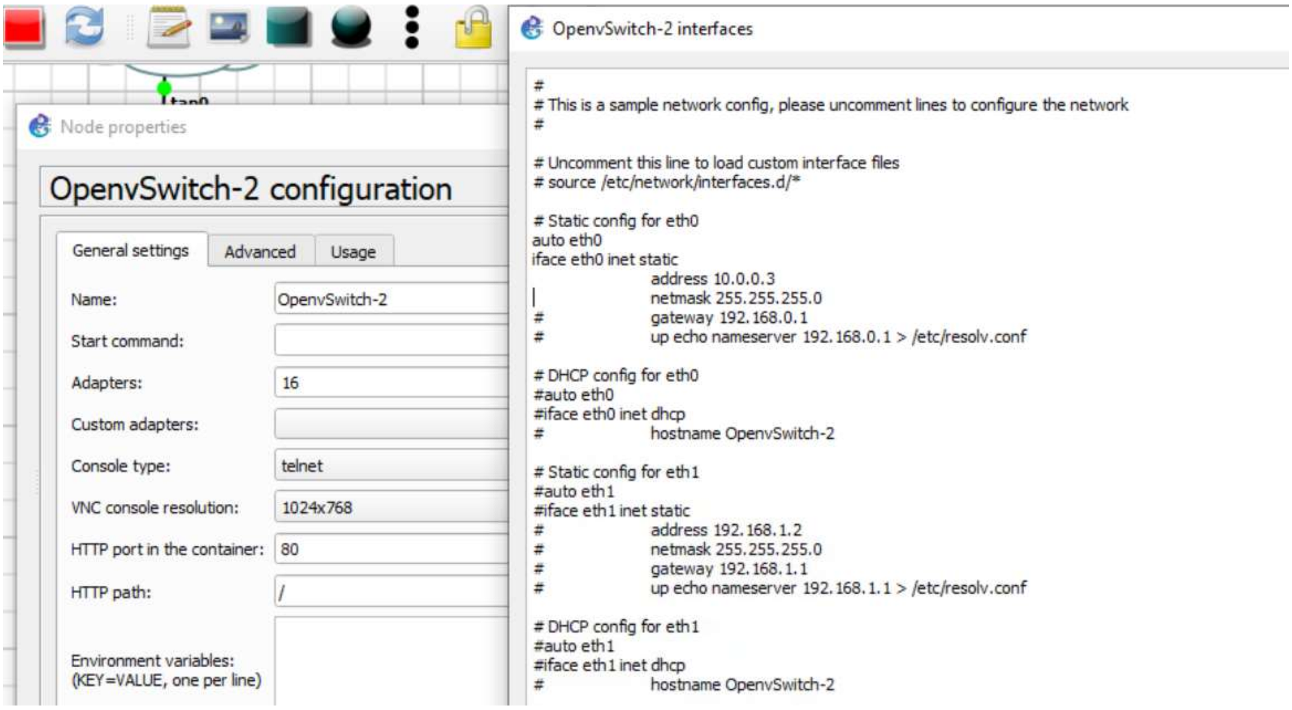


OpenvSwitch-1 configuration

Name: OpenvSwitch-1
Start command:
Adapters: 16
Custom adapters:
Console type: telnet
VNC console resolution: 1024x768
HTTP port in the container: 80
HTTP path: /
Environment variables:
(KEY=VALUE, one per line)

```
#
# This is a sample network config, please uncomment lines to configure the network
#

# Uncomment this line to load custom interface files
# source /etc/network/interfaces.d/*

# Static config for eth0
auto eth0
iface eth0 inet static
                address 10.0.0.2
                netmask 255.255.255.0
#               gateway 192.168.0.1
#               up echo nameserver 192.168.0.1 > /etc/resolv.conf

# DHCP config for eth0
#auto eth0
#iface eth0 inet dhcp
#               hostname OpenvSwitch-1

# Static config for eth1
#auto eth1
#iface eth1 inet static
#               address 192.168.1.2
#               netmask 255.255.255.0
#               gateway 192.168.1.1
#               up echo nameserver 192.168.1.1 > /etc/resolv.conf

# DHCP config for eth1
#auto eth1
#iface eth1 inet dhcp
#               hostname OpenvSwitch-1
```

STEP 4: Assign the static IP address on eth0 port of Open Switch -2:



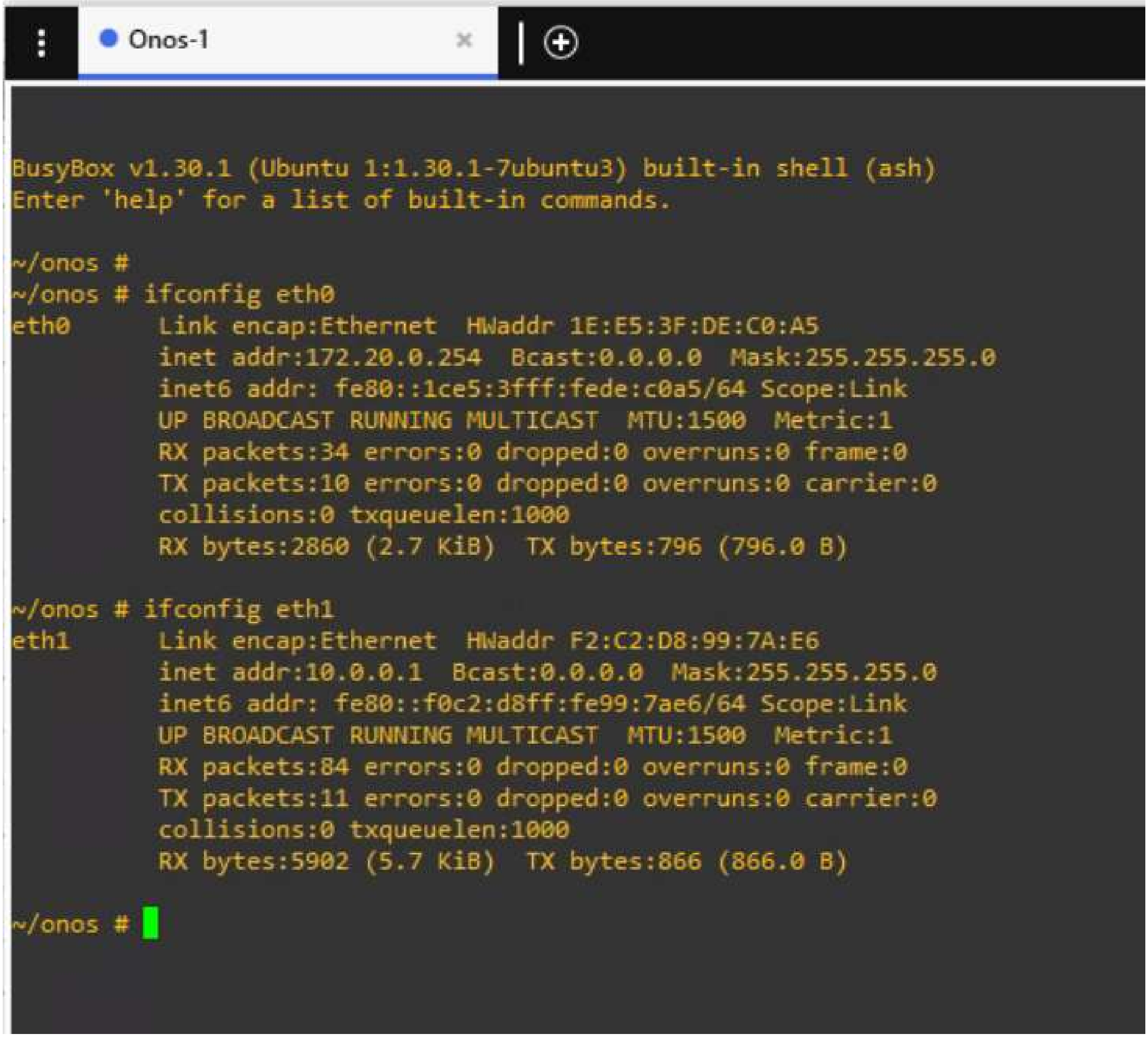
OpenvSwitch-2 configuration

Name: OpenvSwitch-2
Start command:
Adapters: 16
Custom adapters:
Console type: telnet
VNC console resolution: 1024x768
HTTP port in the container: 80
HTTP path: /
Environment variables:
(KEY=VALUE, one per line)

```
#
# This is a sample network config, please uncomment lines to configure the network
#

# Uncomment this line to load custom interface files
# source /etc/network/interfaces.d/*

# Static config for eth0
auto eth0
iface eth0 inet static
                address 10.0.0.3
                netmask 255.255.255.0
#               gateway 192.168.0.1
#               up echo nameserver 192.168.0.1 > /etc/resolv.conf

# DHCP config for eth0
#auto eth0
#iface eth0 inet dhcp
#               hostname OpenvSwitch-2

# Static config for eth1
#auto eth1
#iface eth1 inet static
#               address 192.168.1.2
#               netmask 255.255.255.0
#               gateway 192.168.1.1
#               up echo nameserver 192.168.1.1 > /etc/resolv.conf

# DHCP config for eth1
#auto eth1
#iface eth1 inet dhcp
#               hostname OpenvSwitch-2
```

STEP 5: Start the Cisco Switch first and wait till it come up.
STEP 6: Start the ONOS Controller once SW come up

STEP 7: Post ONOS come up, run the command ifconfig eth 0 and ifconfig eth1 and verify the IP:

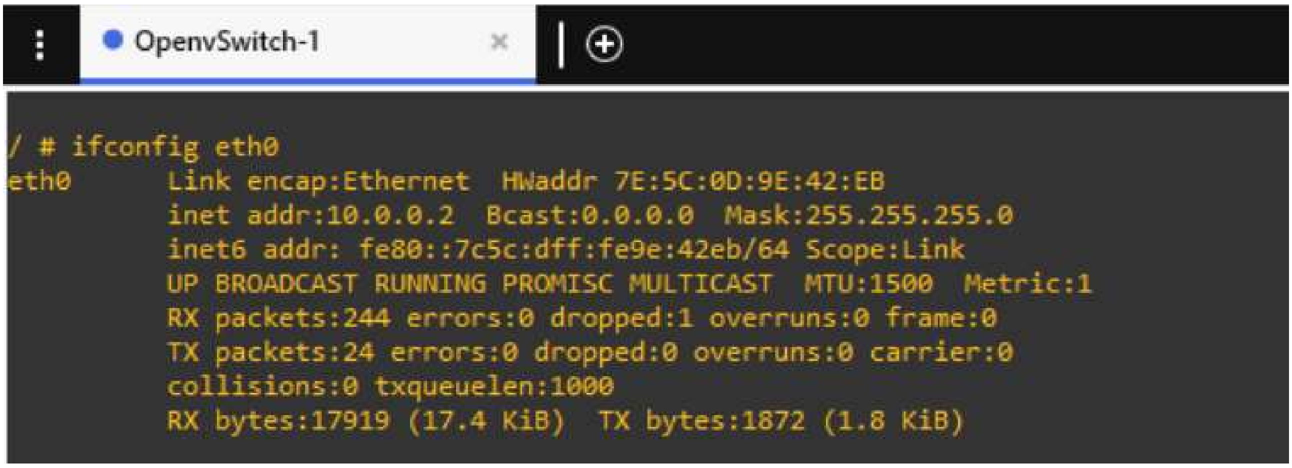


```
BusyBox v1.30.1 (Ubuntu 1:1.30.1-7ubuntu3) built-in shell (ash)
Enter 'help' for a list of built-in commands.

~/onos #
~/onos # ifconfig eth0
eth0      Link encap:Ethernet  HWaddr 1E:E5:3F:DE:C0:A5
          inet addr:172.20.0.254  Bcast:0.0.0.0  Mask:255.255.255.0
          inet6 addr: fe80::1ce5:3fff:fede:c0a5/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:34 errors:0 dropped:0 overruns:0 frame:0
          TX packets:10 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:2860 (2.7 KiB)  TX bytes:796 (796.0 B)

~/onos # ifconfig eth1
eth1      Link encap:Ethernet  HWaddr F2:C2:D8:99:7A:E6
          inet addr:10.0.0.1  Bcast:0.0.0.0  Mask:255.255.255.0
          inet6 addr: fe80::f0c2:d8ff:fe99:7ae6/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:84 errors:0 dropped:0 overruns:0 frame:0
          TX packets:11 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:5902 (5.7 KiB)  TX bytes:866 (866.0 B)

~/onos #
```

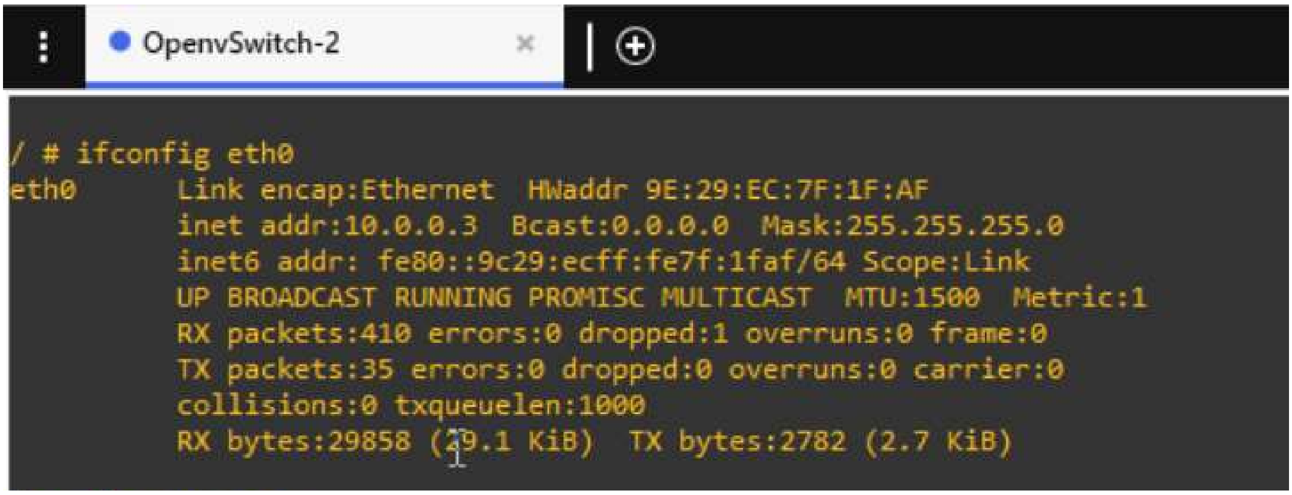
STEP 8: Go to browser and open the URL 172.20.0.254:8181/onos/ui
Username: onos
password: rocks

STEP 9: Start both the open vswitch

STEP 10: check the IP in both the switch via ifconfig eth0 command

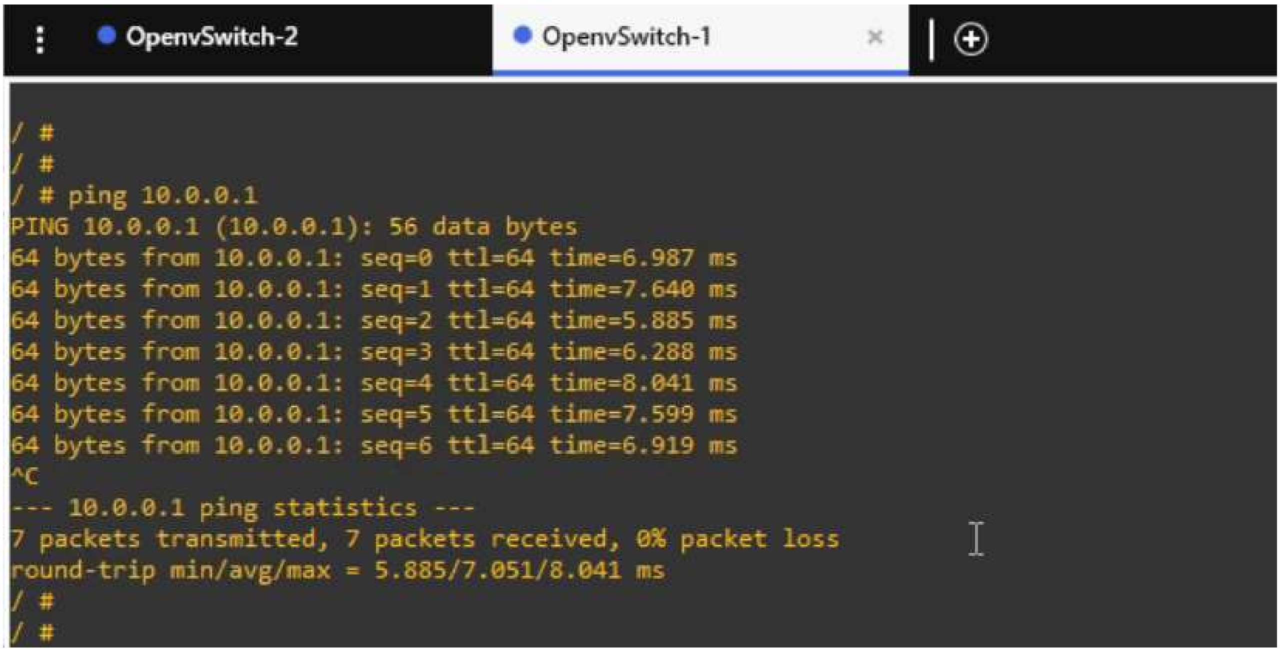


```
/ # ifconfig eth0
eth0      Link encap:Ethernet  HWaddr 7E:5C:0D:9E:42:EB
          inet addr:10.0.0.2  Bcast:0.0.0.0  Mask:255.255.255.0
          inet6 addr: fe80::7c5c:dff:fe9e:42eb/64 Scope:Link
          UP BROADCAST RUNNING PROMISC MULTICAST  MTU:1500  Metric:1
          RX packets:244 errors:0 dropped:1 overruns:0 frame:0
          TX packets:24 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:17919 (17.4 KiB)  TX bytes:1872 (1.8 KiB)
```

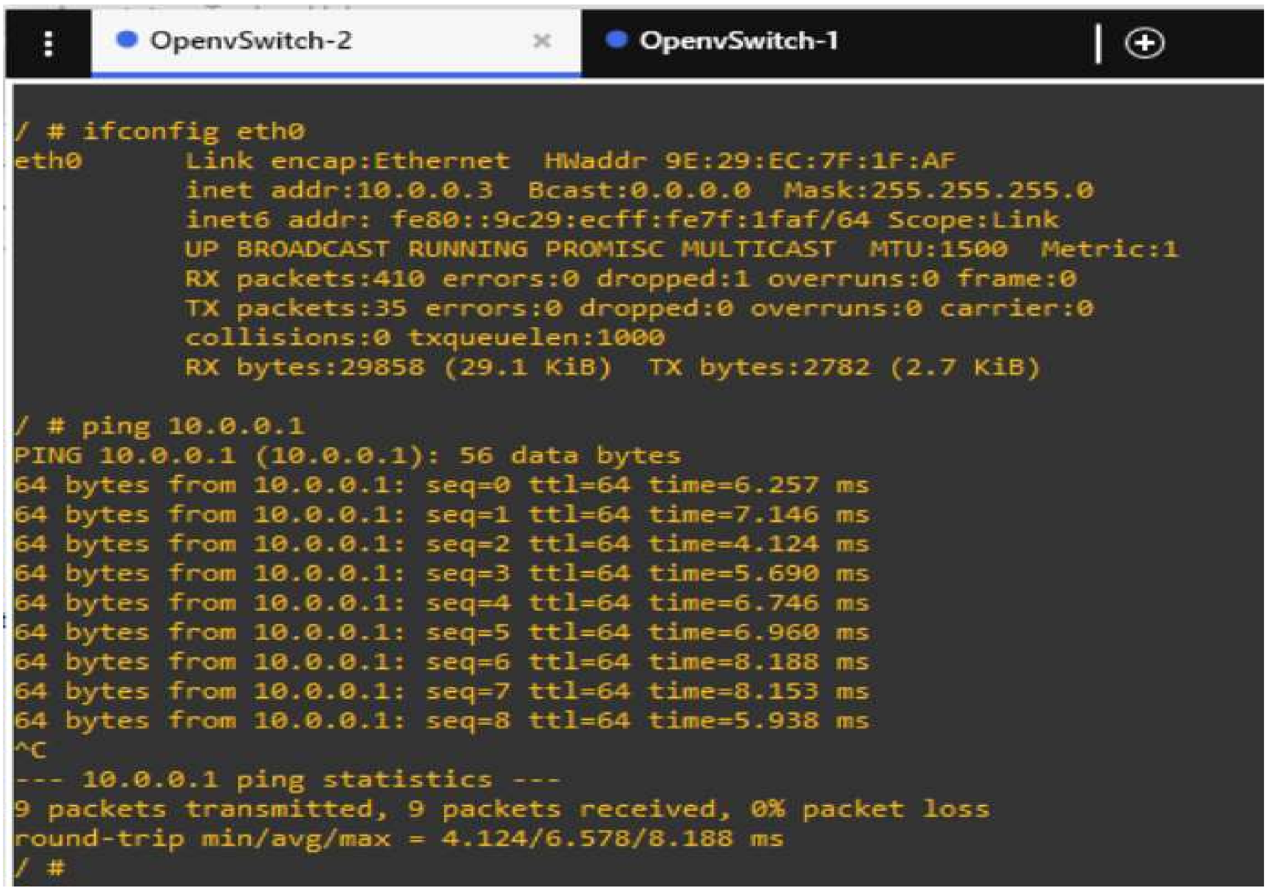


```
/ # ifconfig eth0
eth0      Link encap:Ethernet  HWaddr 9E:29:EC:7F:1F:AF
          inet addr:10.0.0.3  Bcast:0.0.0.0  Mask:255.255.255.0
          inet6 addr: fe80::9c29:ecff:fe7f:1faf/64 Scope:Link
          UP BROADCAST RUNNING PROMISC MULTICAST  MTU:1500  Metric:1
          RX packets:410 errors:0 dropped:1 overruns:0 frame:0
          TX packets:35 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:29858 (29.1 KiB)  TX bytes:2782 (2.7 KiB)
```

STEP 11: Ping the controller IP 10.0.0.1 from both the SW



```
/ #
/ #
/ # ping 10.0.0.1
PING 10.0.0.1 (10.0.0.1): 56 data bytes
64 bytes from 10.0.0.1: seq=0 ttl=64 time=6.987 ms
64 bytes from 10.0.0.1: seq=1 ttl=64 time=7.640 ms
64 bytes from 10.0.0.1: seq=2 ttl=64 time=5.885 ms
64 bytes from 10.0.0.1: seq=3 ttl=64 time=6.288 ms
64 bytes from 10.0.0.1: seq=4 ttl=64 time=8.041 ms
64 bytes from 10.0.0.1: seq=5 ttl=64 time=7.599 ms
64 bytes from 10.0.0.1: seq=6 ttl=64 time=6.919 ms
^C
--- 10.0.0.1 ping statistics ---
7 packets transmitted, 7 packets received, 0% packet loss
round-trip min/avg/max = 5.885/7.051/8.041 ms
/ #
/ #
```

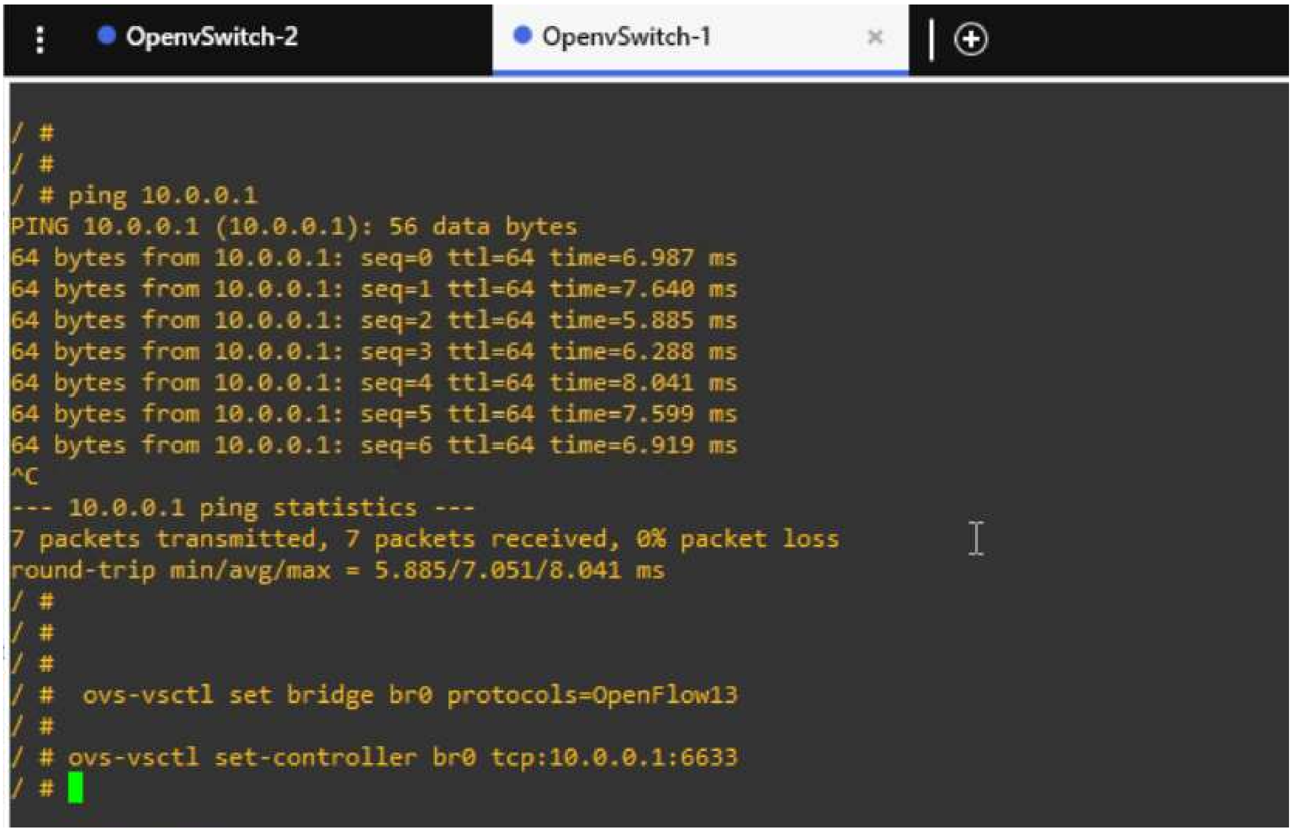


```
/ # ifconfig eth0
eth0      Link encap:Ethernet  HWaddr 9E:29:EC:7F:1F:AF
          inet addr:10.0.0.3  Bcast:0.0.0.0  Mask:255.255.255.0
          inet6 addr: fe80::9c29:ecff:fe7f:1faf/64 Scope:Link
          UP BROADCAST RUNNING PROMISC MULTICAST  MTU:1500  Metric:1
          RX packets:410 errors:0 dropped:1 overruns:0 frame:0
          TX packets:35 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:29858 (29.1 KiB)  TX bytes:2782 (2.7 KiB)

/ # ping 10.0.0.1
PING 10.0.0.1 (10.0.0.1): 56 data bytes
64 bytes from 10.0.0.1: seq=0 ttl=64 time=6.257 ms
64 bytes from 10.0.0.1: seq=1 ttl=64 time=7.146 ms
64 bytes from 10.0.0.1: seq=2 ttl=64 time=4.124 ms
64 bytes from 10.0.0.1: seq=3 ttl=64 time=5.690 ms
64 bytes from 10.0.0.1: seq=4 ttl=64 time=6.746 ms
64 bytes from 10.0.0.1: seq=5 ttl=64 time=6.960 ms
64 bytes from 10.0.0.1: seq=6 ttl=64 time=8.188 ms
64 bytes from 10.0.0.1: seq=7 ttl=64 time=8.153 ms
64 bytes from 10.0.0.1: seq=8 ttl=64 time=5.938 ms
^C
--- 10.0.0.1 ping statistics ---
9 packets transmitted, 9 packets received, 0% packet loss
round-trip min/avg/max = 4.124/6.578/8.188 ms
/ #
```

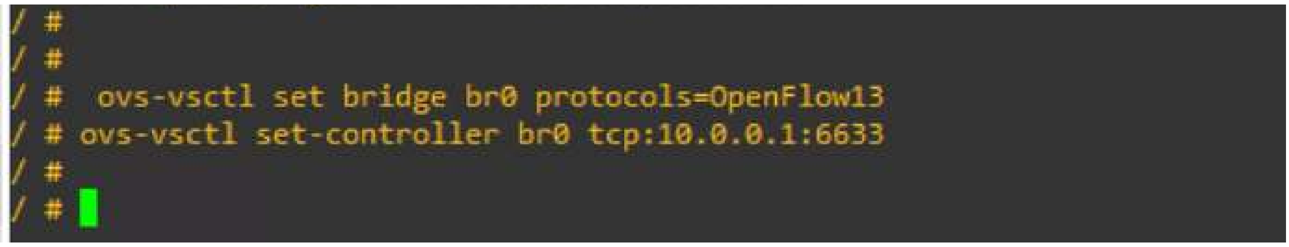
STEP 12: Configure the SW with controller information:

Setup protocol: ovs-vsctl set bridge br0 protocols=OpenFlow13

Setup controller: ovs-vsctl set-controller br0 tcp:10.0.0.1:6633



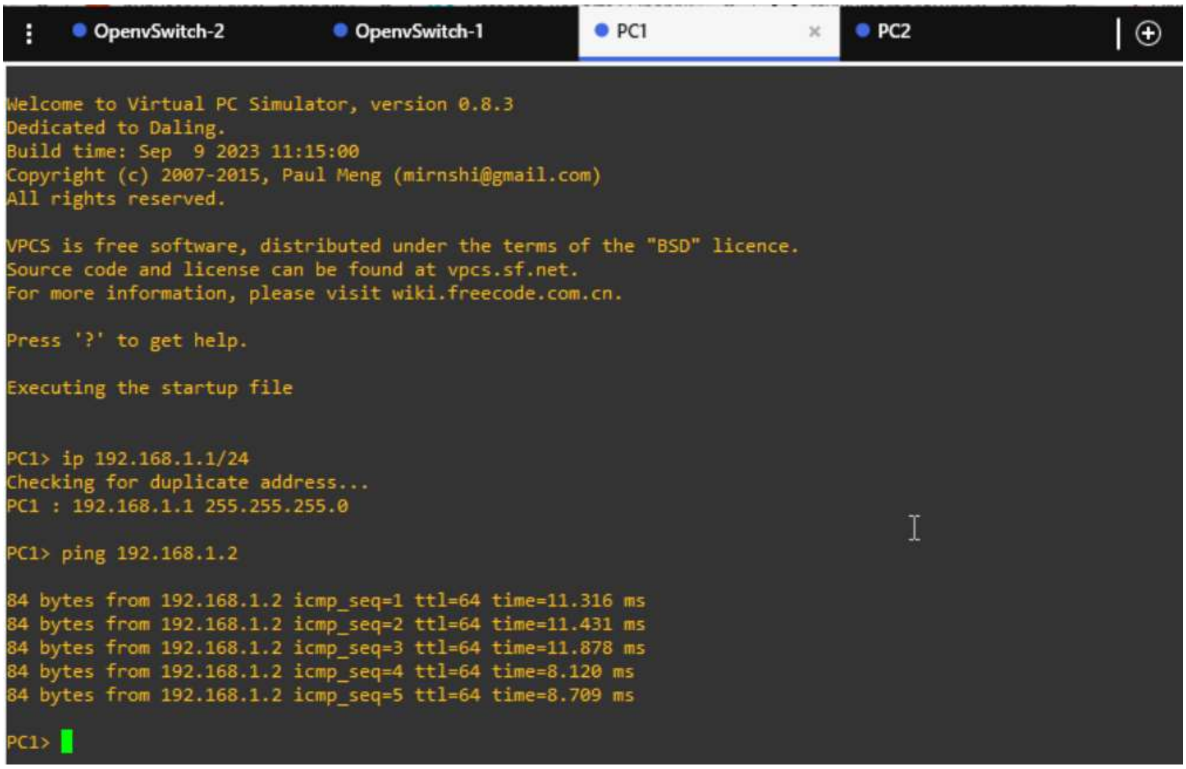
```
/ #
/ #
/ # ping 10.0.0.1
PING 10.0.0.1 (10.0.0.1): 56 data bytes
64 bytes from 10.0.0.1: seq=0 ttl=64 time=6.987 ms
64 bytes from 10.0.0.1: seq=1 ttl=64 time=7.640 ms
64 bytes from 10.0.0.1: seq=2 ttl=64 time=5.885 ms
64 bytes from 10.0.0.1: seq=3 ttl=64 time=6.288 ms
64 bytes from 10.0.0.1: seq=4 ttl=64 time=8.041 ms
64 bytes from 10.0.0.1: seq=5 ttl=64 time=7.599 ms
64 bytes from 10.0.0.1: seq=6 ttl=64 time=6.919 ms
^C
--- 10.0.0.1 ping statistics ---
7 packets transmitted, 7 packets received, 0% packet loss
round-trip min/avg/max = 5.885/7.051/8.041 ms
/ #
/ #
/ #
/ #  ovs-vsctl set bridge br0 protocols=OpenFlow13
/ #
/ # ovs-vsctl set-controller br0 tcp:10.0.0.1:6633
/ #
```



```
/ #
/ #
/ #  ovs-vsctl set bridge br0 protocols=OpenFlow13
/ # ovs-vsctl set-controller br0 tcp:10.0.0.1:6633
/ #
/ #
```

STEP 13: Set the IP on both the PC and PING – It will be successful:

PC1: ip 192.168.1.1/24
PC2: ip 192.168.1.2/24



```
Welcome to Virtual PC Simulator, version 0.8.3
Dedicated to Daling.
Build time: Sep  9 2023 11:15:00
Copyright (c) 2007-2015, Paul Meng (mirnshi@gmail.com)
All rights reserved.

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Source code and license can be found at vpcs.sf.net.
For more information, please visit wiki.freecode.com.cn.

Press '?' to get help.

Executing the startup file


PC1> ip 192.168.1.1/24
Checking for duplicate address...
PC1 : 192.168.1.1 255.255.255.0

PC1> ping 192.168.1.2

84 bytes from 192.168.1.2 icmp_seq=1 ttl=64 time=11.316 ms
84 bytes from 192.168.1.2 icmp_seq=2 ttl=64 time=11.431 ms
84 bytes from 192.168.1.2 icmp_seq=3 ttl=64 time=11.878 ms
84 bytes from 192.168.1.2 icmp_seq=4 ttl=64 time=8.120 ms
84 bytes from 192.168.1.2 icmp_seq=5 ttl=64 time=8.709 ms

PC1>
```

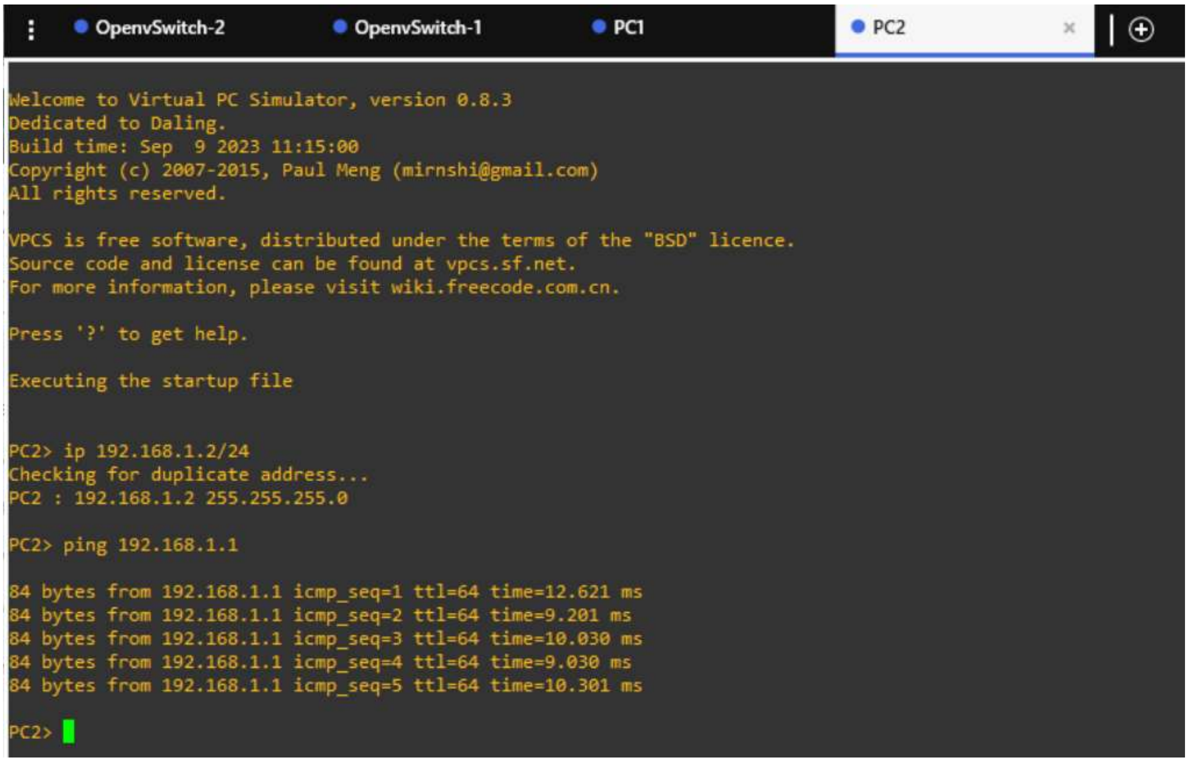

```
Welcome to Virtual PC Simulator, version 0.8.3
Dedicated to Daling.
Build time: Sep  9 2023 11:15:00
Copyright (c) 2007-2015, Paul Meng (mirnshi@gmail.com)
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For more information, please visit wiki.freecode.com.cn.

Press '?' to get help.

Executing the startup file


PC2> ip 192.168.1.2/24
Checking for duplicate address...
PC2 : 192.168.1.2 255.255.255.0

PC2> ping 192.168.1.1

84 bytes from 192.168.1.1 icmp_seq=1 ttl=64 time=12.621 ms
84 bytes from 192.168.1.1 icmp_seq=2 ttl=64 time=9.201 ms
84 bytes from 192.168.1.1 icmp_seq=3 ttl=64 time=10.030 ms
84 bytes from 192.168.1.1 icmp_seq=4 ttl=64 time=9.030 ms
84 bytes from 192.168.1.1 icmp_seq=5 ttl=64 time=10.301 ms

PC2>
```
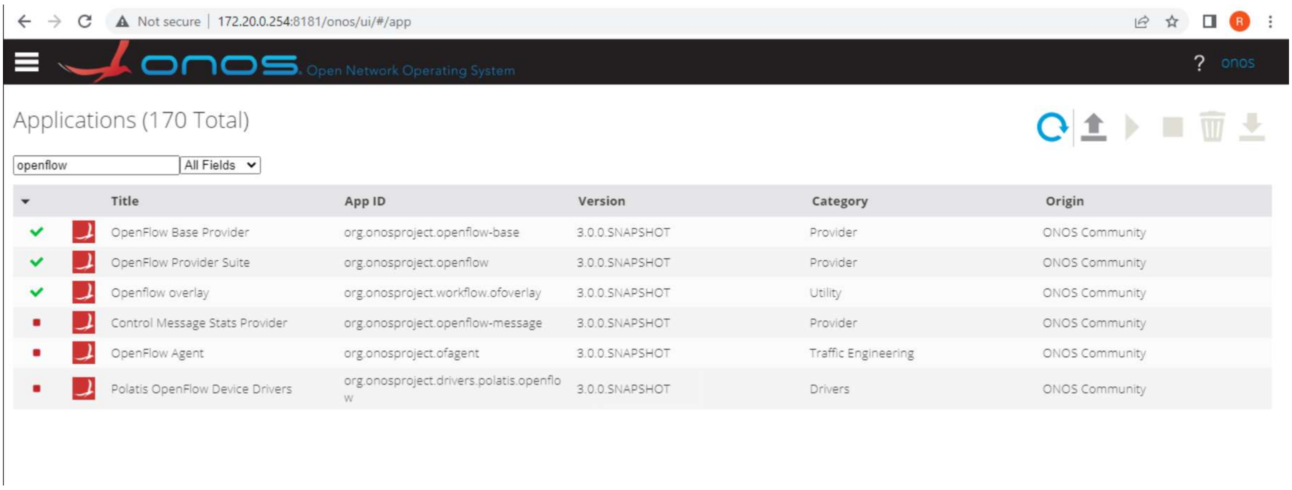

STEP 14: Go to ONOS GUI and enable the OpenFlow base application, provider suit and OpenFlow overlay in application TAB

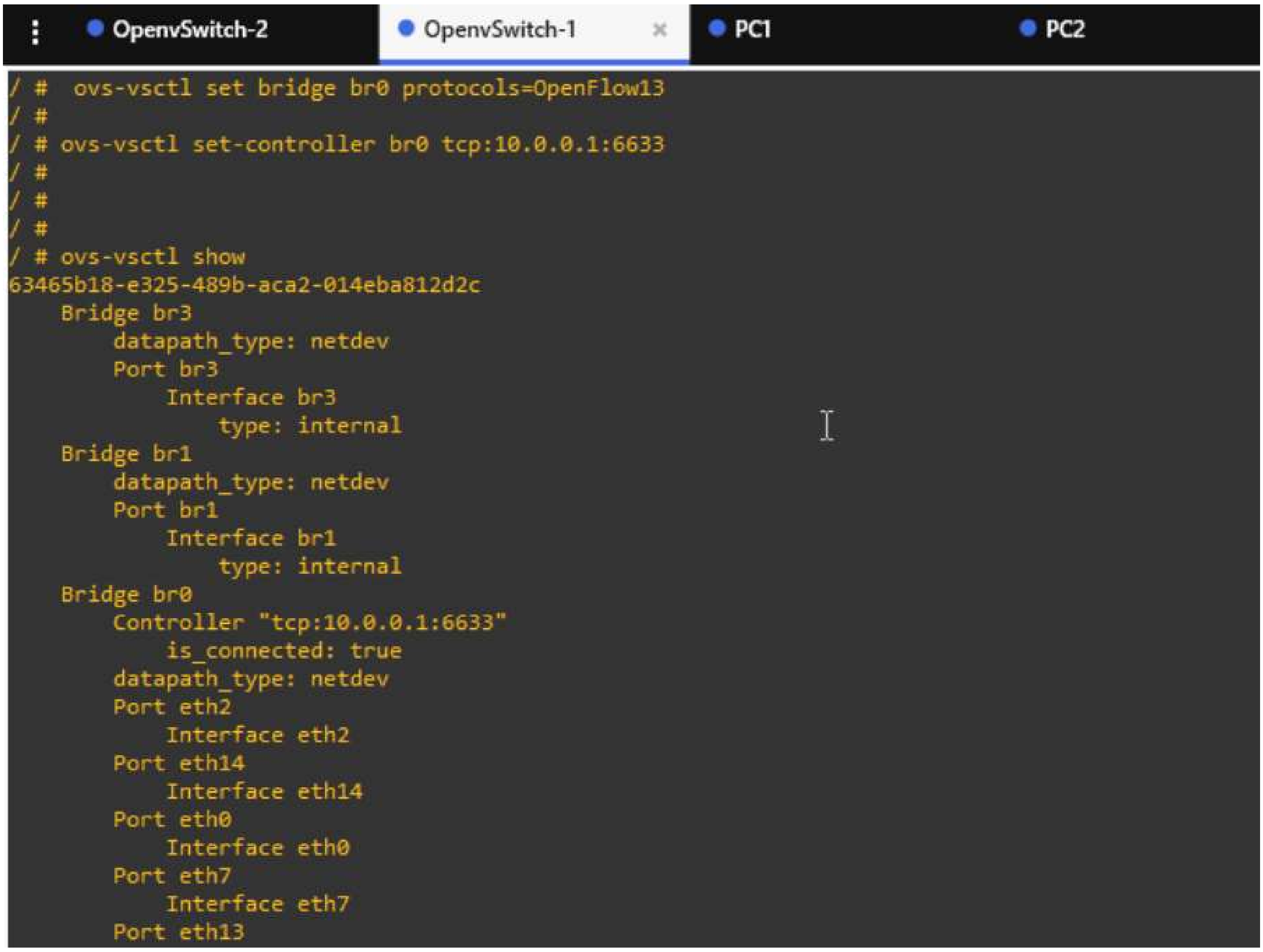

Not secure | 172.20.0.254:8181/onos/ui/#/app
onos Open Network Operating System
? onos

Applications (170 Total)

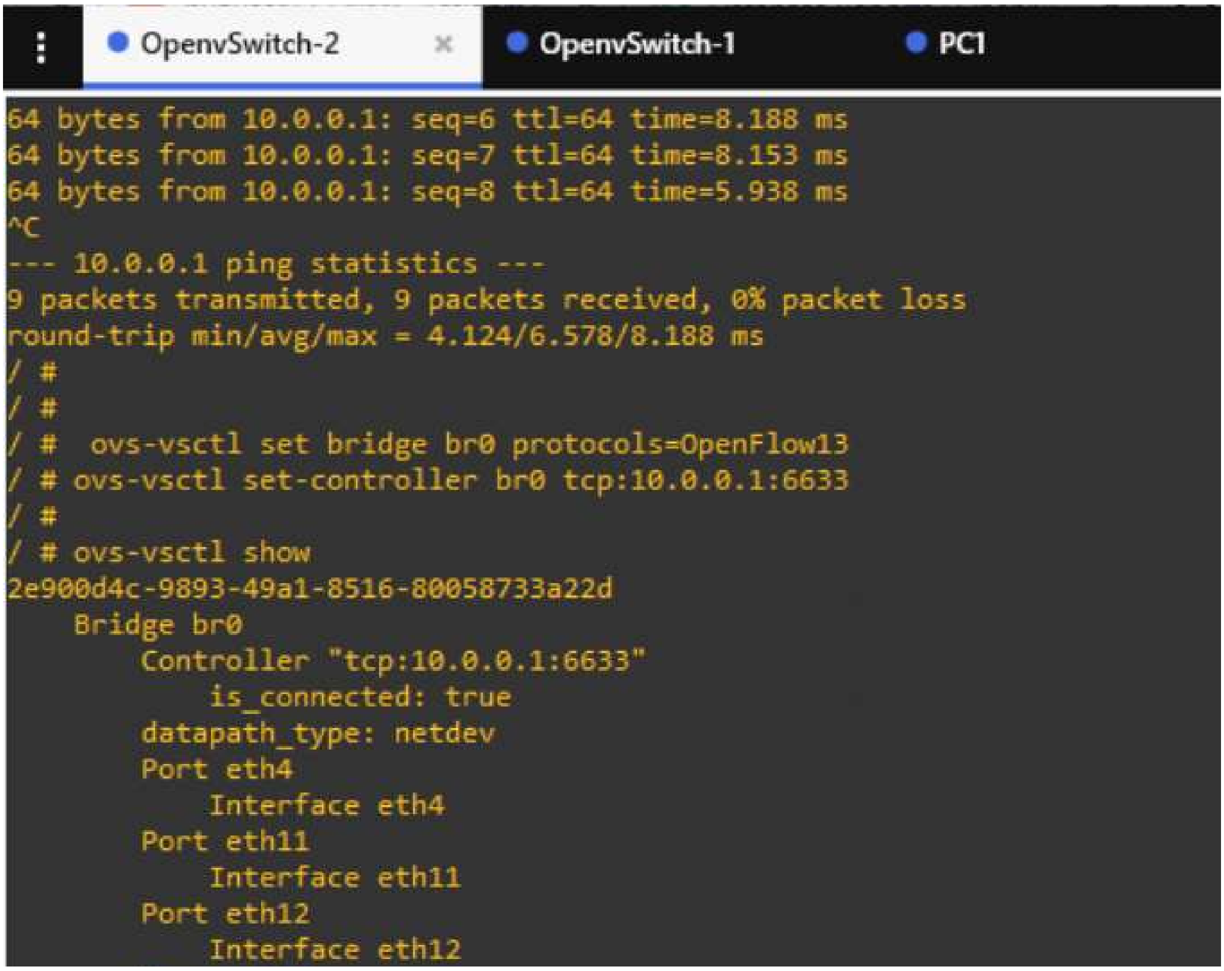
openflow | All Fields

		Title	App ID	Version	Category	Origin
✓		OpenFlow Base Provider	org.onosproject.openflow-base	3.0.0.SNAPSHOT	Provider	ONOS Community
✓		OpenFlow Provider Suite	org.onosproject.openflow	3.0.0.SNAPSHOT	Provider	ONOS Community
✓		Openflow overlay	org.onosproject.workflow.ofoverlay	3.0.0.SNAPSHOT	Utility	ONOS Community
■		Control Message Stats Provider	org.onosproject.openflow-message	3.0.0.SNAPSHOT	Provider	ONOS Community
■		OpenFlow Agent	org.onosproject.ofagent	3.0.0.SNAPSHOT	Traffic Engineering	ONOS Community
■		Polatis OpenFlow Device Drivers	org.onosproject.drivers.polatis.openflow	3.0.0.SNAPSHOT	Drivers	ONOS Community

STEP 15: Check in Open switch , controller in connected mode and Ping from PC1 to PC2 fail ovs-vsctl show

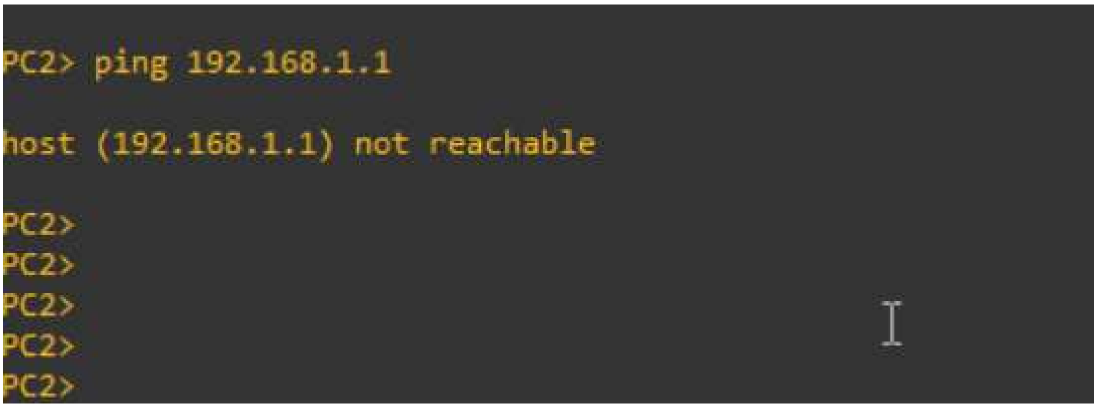


```
/ #  ovs-vsctl set bridge br0 protocols=OpenFlow13
/ #
/ # ovs-vsctl set-controller br0 tcp:10.0.0.1:6633
/ #
/ #
/ #
/ # ovs-vsctl show
63465b18-e325-489b-aca2-014eba812d2c
    Bridge br3
        datapath_type: netdev
        Port br3
            Interface br3
                type: internal
    Bridge br1
        datapath_type: netdev
        Port br1
            Interface br1
                type: internal
    Bridge br0
        Controller "tcp:10.0.0.1:6633"
            is_connected: true
        datapath_type: netdev
        Port eth2
            Interface eth2
        Port eth14
            Interface eth14
        Port eth0
            Interface eth0
        Port eth7
            Interface eth7
        Port eth13
```

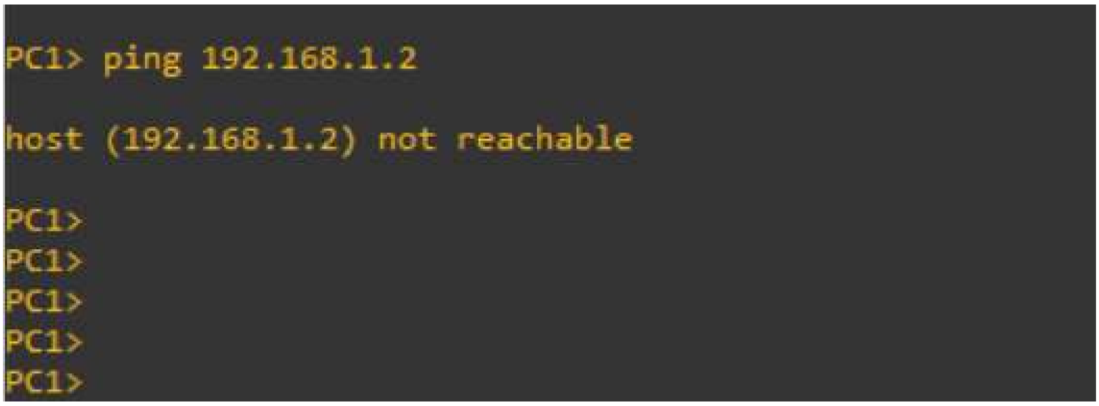


```
64 bytes from 10.0.0.1: seq=6 ttl=64 time=8.188 ms
64 bytes from 10.0.0.1: seq=7 ttl=64 time=8.153 ms
64 bytes from 10.0.0.1: seq=8 ttl=64 time=5.938 ms
^C
--- 10.0.0.1 ping statistics ---
9 packets transmitted, 9 packets received, 0% packet loss
round-trip min/avg/max = 4.124/6.578/8.188 ms
/ #
/ #
/ #  ovs-vsctl set bridge br0 protocols=OpenFlow13
/ # ovs-vsctl set-controller br0 tcp:10.0.0.1:6633
/ #
/ # ovs-vsctl show
2e900d4c-9893-49a1-8516-80058733a22d
    Bridge br0
        Controller "tcp:10.0.0.1:6633"
            is_connected: true
        datapath_type: netdev
        Port eth4
            Interface eth4
        Port eth11
            Interface eth11
        Port eth12
            Interface eth12
```

STEP 16: Ping PC1 to PC2 – Ping Fail as Open V switch is connected with ONOS Controller and all the forwarding decision is not moved to ONOS Controller.

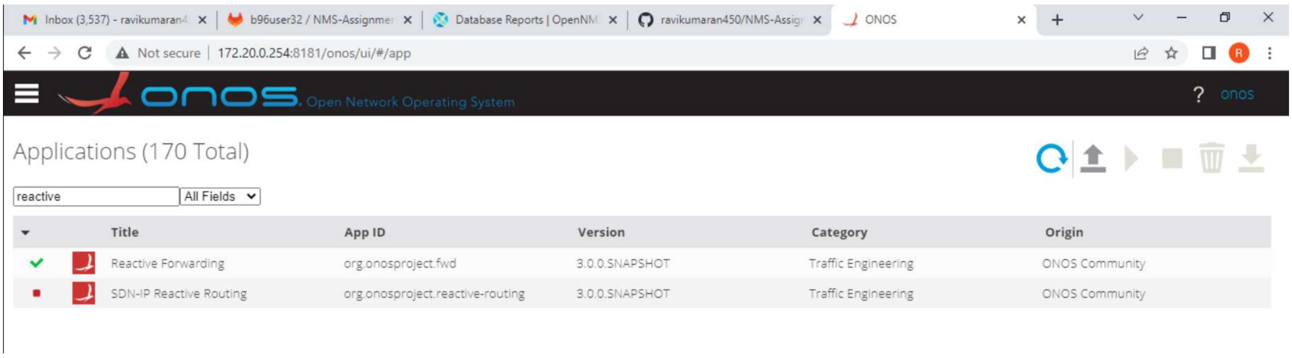


```
PC2> ping 192.168.1.1

host (192.168.1.1) not reachable

PC2>
PC2>
PC2>
PC2>
PC2>
```



```
PC1> ping 192.168.1.2

host (192.168.1.2) not reachable

PC1>
PC1>
PC1>
PC1>
PC1>
```

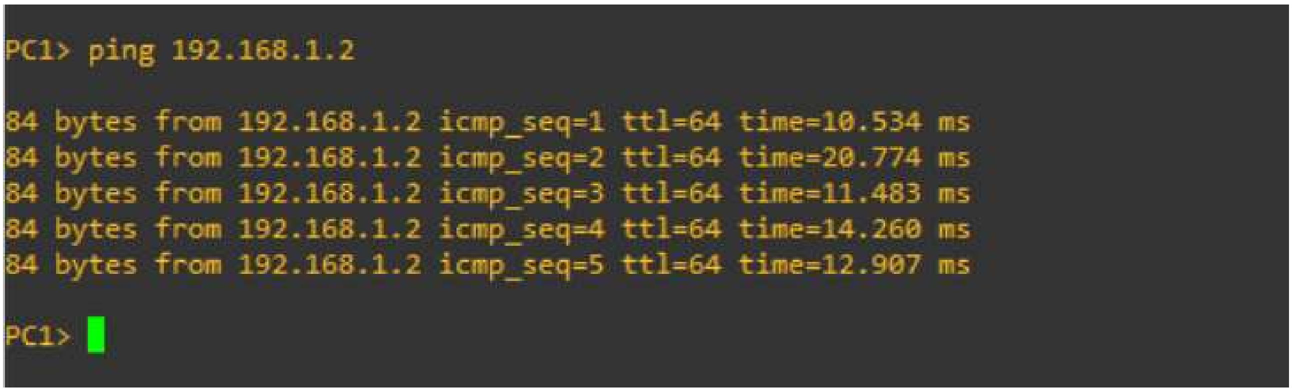
STEP 17: Enable reactive forwarding in application and check, PC1 to PC2 ping should be successful.


Inbox (3,537) - ravikumaran4
b96user32 / NMS-Assignme
Database Reports | OpenNM
ravikumaran450/NMS-Assig
ONOS
Not secure
172.20.0.254:8181/onos/ui/#/app
Open Network Operating System
onos

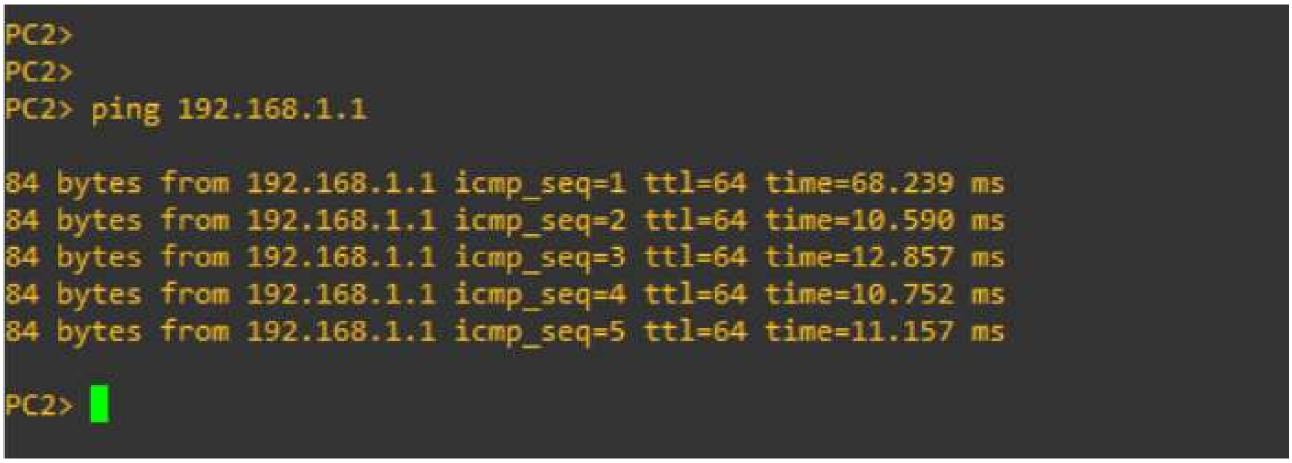
Applications (170 Total)

reactive | All Fields

		Title	App ID	Version	Category	Origin
✓		Reactive Forwarding	org.onosproject.fwd	3.0.0.SNAPSHOT	Traffic Engineering	ONOS Community
■		SDN-IP Reactive Routing	org.onosproject.reactive-routing	3.0.0.SNAPSHOT	Traffic Engineering	ONOS Community

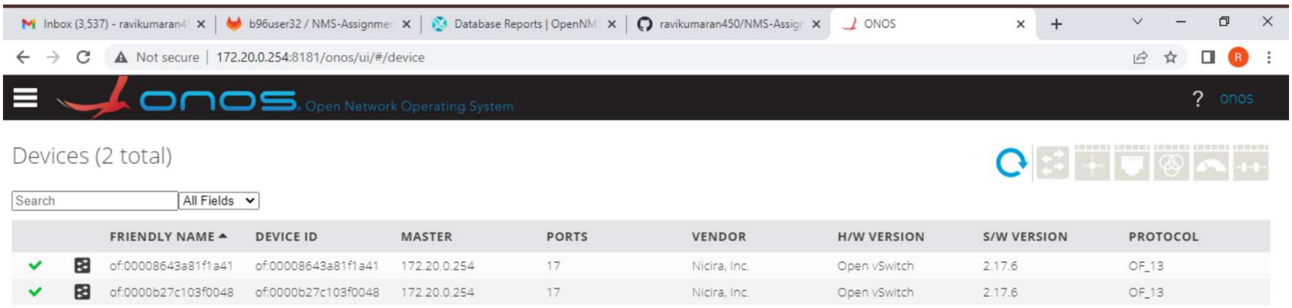


```
PC1> ping 192.168.1.2

84 bytes from 192.168.1.2 icmp_seq=1 ttl=64 time=10.534 ms
84 bytes from 192.168.1.2 icmp_seq=2 ttl=64 time=20.774 ms
84 bytes from 192.168.1.2 icmp_seq=3 ttl=64 time=11.483 ms
84 bytes from 192.168.1.2 icmp_seq=4 ttl=64 time=14.260 ms
84 bytes from 192.168.1.2 icmp_seq=5 ttl=64 time=12.907 ms

PC1>
```



```
PC2>
PC2>
PC2> ping 192.168.1.1

84 bytes from 192.168.1.1 icmp_seq=1 ttl=64 time=68.239 ms
84 bytes from 192.168.1.1 icmp_seq=2 ttl=64 time=10.590 ms
84 bytes from 192.168.1.1 icmp_seq=3 ttl=64 time=12.857 ms
84 bytes from 192.168.1.1 icmp_seq=4 ttl=64 time=10.752 ms
84 bytes from 192.168.1.1 icmp_seq=5 ttl=64 time=11.157 ms

PC2>
```

STEP 18: Check the Devices , Topology on ONOS GUI


Inbox (3,537) - ravikumaran4
b96user32 / NMS-Assignme
Database Reports | OpenNM
ravikumaran450/NMS-Assig
ONOS
Not secure
172.20.0.254:8181/onos/ui/#/device
Open Network Operating System
onos

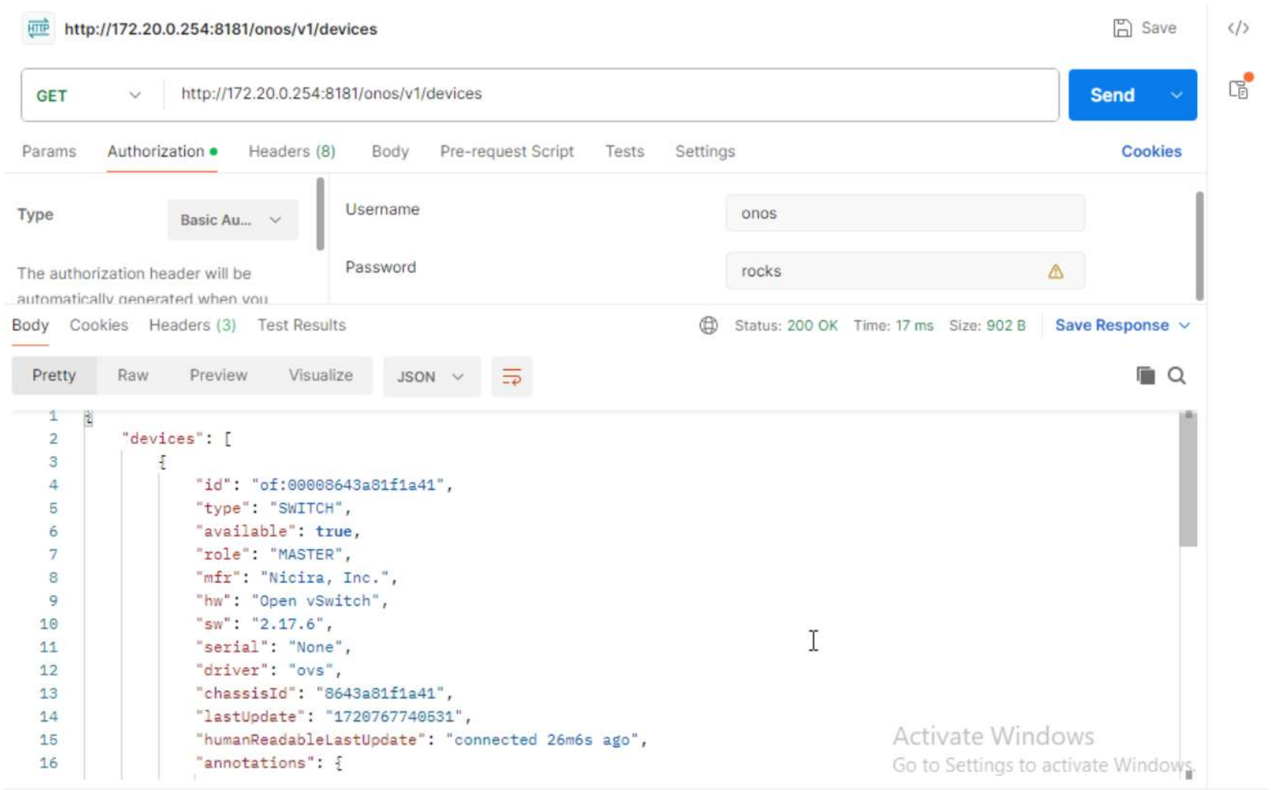
Devices (2 total)

Search | All Fields

		FRIENDLY NAME ▲	DEVICE ID	MASTER	PORTS	VENDOR	H/W VERSION	S/W VERSION	PROTOCOL
✓		of:00008643a81f1a41	of:00008643a81f1a41	172.20.0.254	17	Nicira, Inc.	Open vSwitch	2.17.6	OF_13
✓		of:0000b27c103f0048	of:0000b27c103f0048	172.20.0.254	17	Nicira, Inc.	Open vSwitch	2.17.6	OF_13

STEP 19: Connect to Postman:

http://172.20.0.254:8181/onos/v1/devices
http://172.20.0.254:8181/onos/v1/flows
http://172.20.0.254:8181/onos/v1/links
http://172.20.0.254:8181/onos/v1/topology



http://172.20.0.254:8181/onos/v1/devices

GET http://172.20.0.254:8181/onos/v1/devices Send

Type: Basic Au...

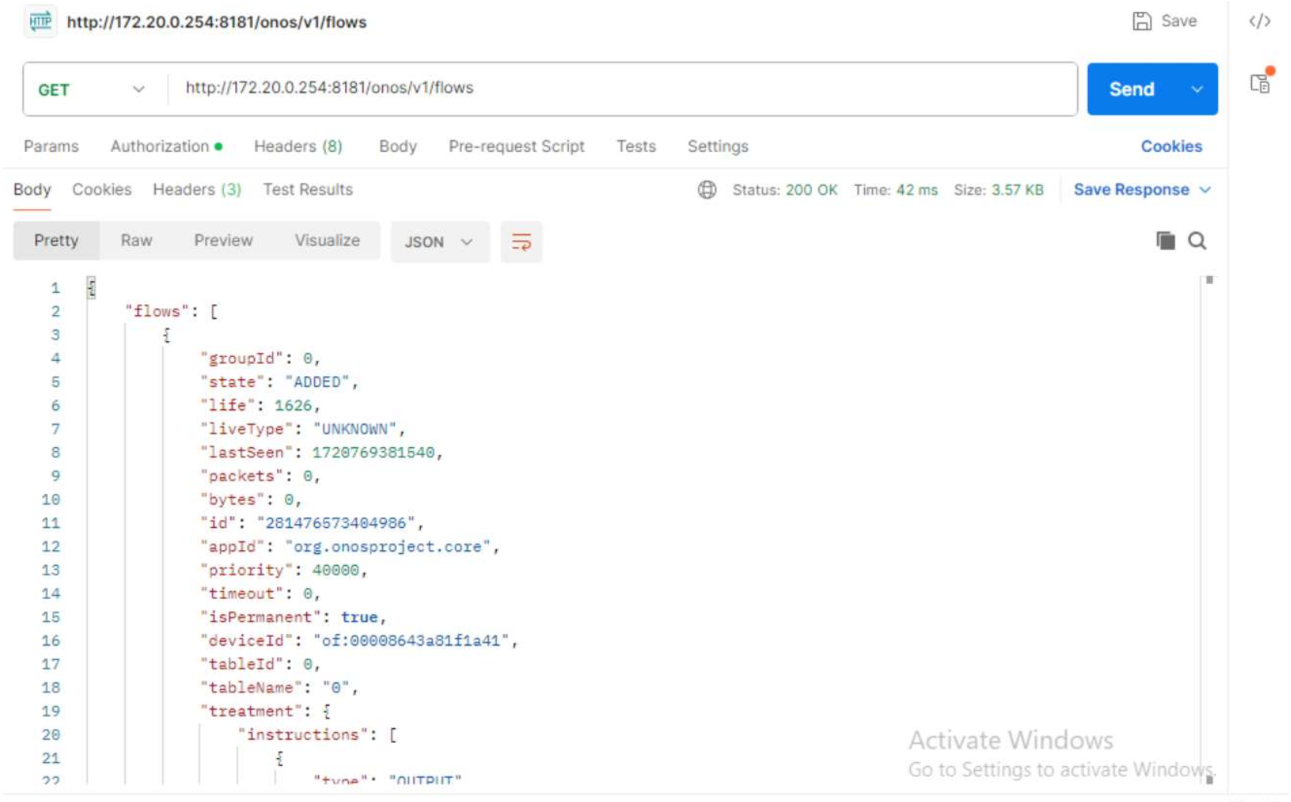
The authorization header will be automatically generated when you

Username: onos

Password: rocks

Status: 200 OK Time: 17 ms Size: 902 B

```
{
    "devices": [
        {
            "id": "of:00008643a81f1a41",
            "type": "SWITCH",
            "available": true,
            "role": "MASTER",
            "mfr": "Nicira, Inc.",
            "hw": "Open vSwitch",
            "sw": "2.17.6",
            "serial": "None",
            "driver": "ovs",
            "chassisId": "8643a81f1a41",
            "lastUpdate": "1720767740531",
            "humanReadableLastUpdate": "connected 26m6s ago",
            "annotations": {
```

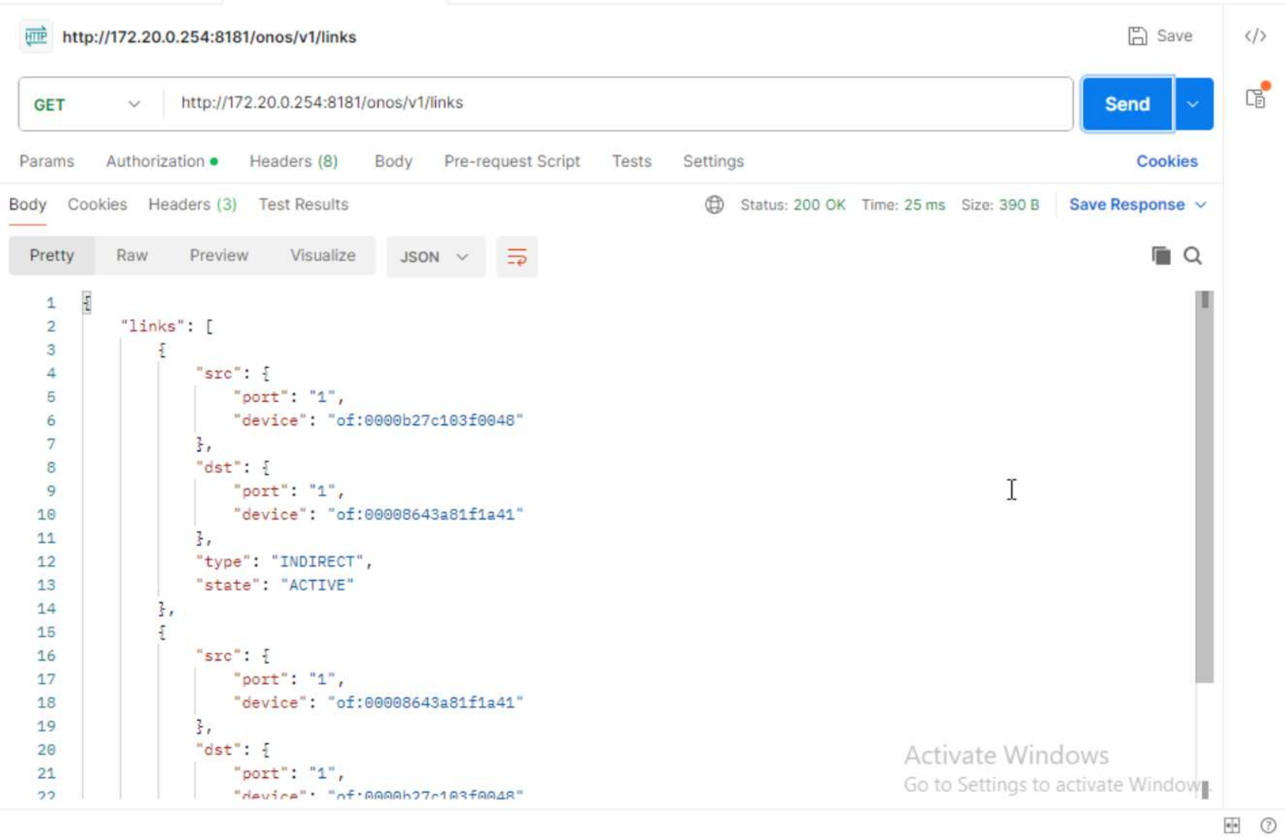


http://172.20.0.254:8181/onos/v1/flows

GET http://172.20.0.254:8181/onos/v1/flows Send

Status: 200 OK Time: 42 ms Size: 3.57 KB

```
{
    "flows": [
        {
            "groupId": 0,
            "state": "ADDED",
            "life": 1626,
            "liveType": "UNKNOWN",
            "lastSeen": 1720769381540,
            "packets": 0,
            "bytes": 0,
            "id": "281476573404986",
            "appId": "org.onosproject.core",
            "priority": 40000,
            "timeout": 0,
            "isPermanent": true,
            "deviceId": "of:00008643a81f1a41",
            "tableId": 0,
            "tableName": "0",
            "treatment": {
                "instructions": [
                    {
                        "type": "OUTPUT"
```

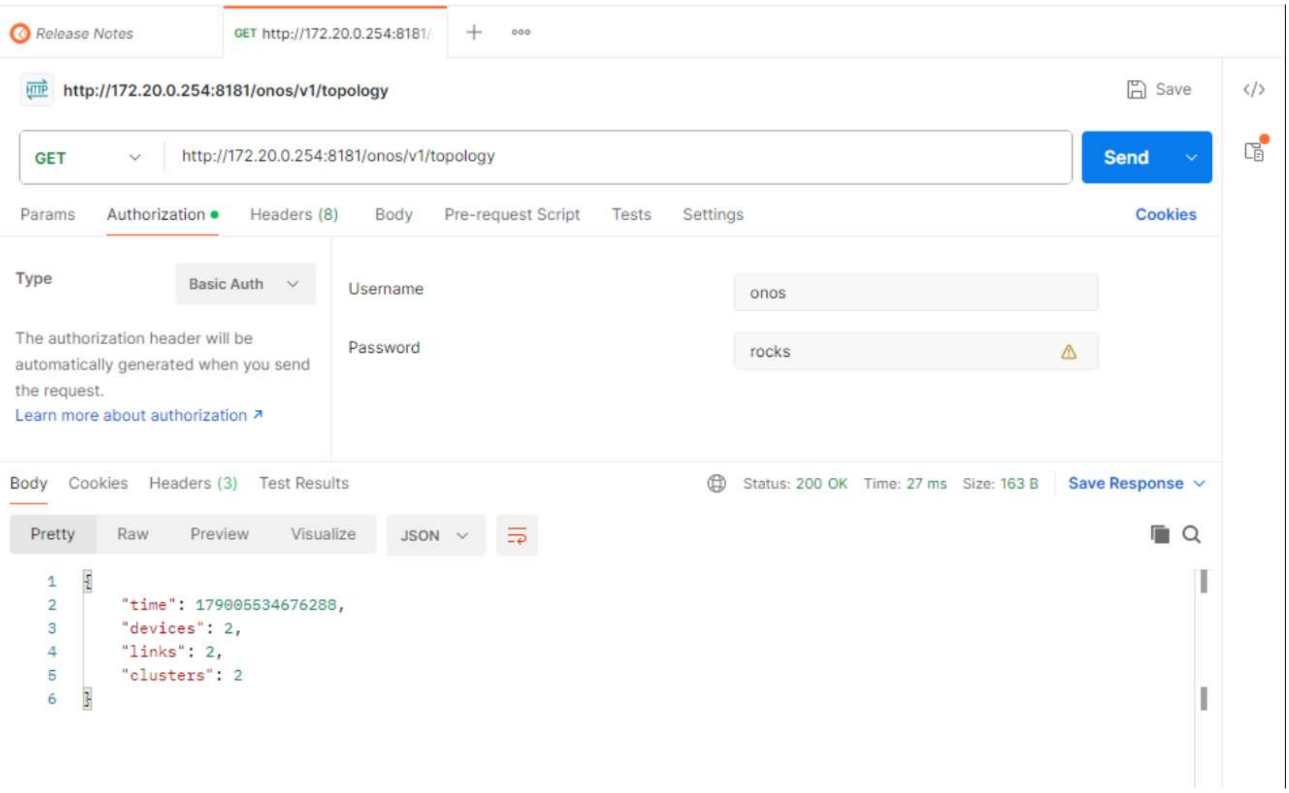


http://172.20.0.254:8181/onos/v1/links

GET http://172.20.0.254:8181/onos/v1/links

Status: 200 OK Time: 25 ms Size: 390 B

```
{
    "links": [
        {
            "src": {
                "port": "1",
                "device": "of:0000b27c103f0048"
            },
            "dst": {
                "port": "1",
                "device": "of:00008643a81f1a41"
            },
            "type": "INDIRECT",
            "state": "ACTIVE"
        },
        {
            "src": {
                "port": "1",
                "device": "of:00008643a81f1a41"
            },
            "dst": {
                "port": "1",
                "device": "of:0000b27c103f0048"
```



http://172.20.0.254:8181/onos/v1/topology

GET http://172.20.0.254:8181/onos/v1/topology

Type: Basic Auth

The authorization header will be automatically generated when you send the request.

Username: onos

Password: rocks

Status: 200 OK Time: 27 ms Size: 163 B

```
{
    "time": 179005534676288,
    "devices": 2,
    "links": 2,
    "clusters": 2
}
```