



UNIVERSITY OF  
CENTRAL FLORIDA



# Hands-on Session 5: SDN Concepts, Controllers, Flow Tables



Jose Gomez\*, Elie, Kfoury, Jorge Crichigno  
University of South Carolina (USC)

<https://research.cec.sc.edu/cyberinfra>

\*Fort Lewis College

University of Central Florida (UCF)  
Florida Lambda Rail (FLR)  
Engagement and Performance Operation Center (EPOC)  
Energy Sciences Network (ESnet)  
University of South Carolina (USC)

UCF / FLR Workshop on Networking Topics  
Thursday, May 22, 2025

# Software Defined Networking Lab Series

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- Lab experiments

Lab 1 Introduction to Mininet

Lab 2 Legacy Networks: BGP Example as a Distributed System and Autonomous Forwarding Decisions

Lab 3 Early efforts of SDN: MPLS Example of a Control Plane that Establishes Semi-static Forwarding Paths

Lab 4 Introduction to SDN

Lab 5 Configuring VXLAN to Provide Network Traffic Isolation

Lab 6 Introduction to OpenFlow

Lab 7 Routing within an SDN network

Lab 8 Interconnection between Legacy Networks and SDN Networks

Lab 9 Configuring Virtual Private LAN Service (VPLS)

Lab 10 Applying Equal-cost Multi-path Protocol (ECMP) within SDN networks

# Organization of the labs

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Each lab starts with a section *Overview*

- Objectives
- Lab topology
- Lab settings: passwords, device names
- Roadmap: organization of the lab

## *Section 1*

- Background information of the topic being covered (e.g., fundamentals of SDN)
- Section 1 is optional (i.e., the reader can skip this section and move to lab directions)

## *Section 2... n*

- Step-by-step directions

# Introduction to SDN

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Lab activities are described in Lab 4, Software Defined Networking Lab Library

# Hands-on Labs on Software Defined Networking

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- Webpage with PowerPoint presentations:

[https://research.cec.sc.edu/cyberinfra/ucf\\_flr\\_workshop](https://research.cec.sc.edu/cyberinfra/ucf_flr_workshop)

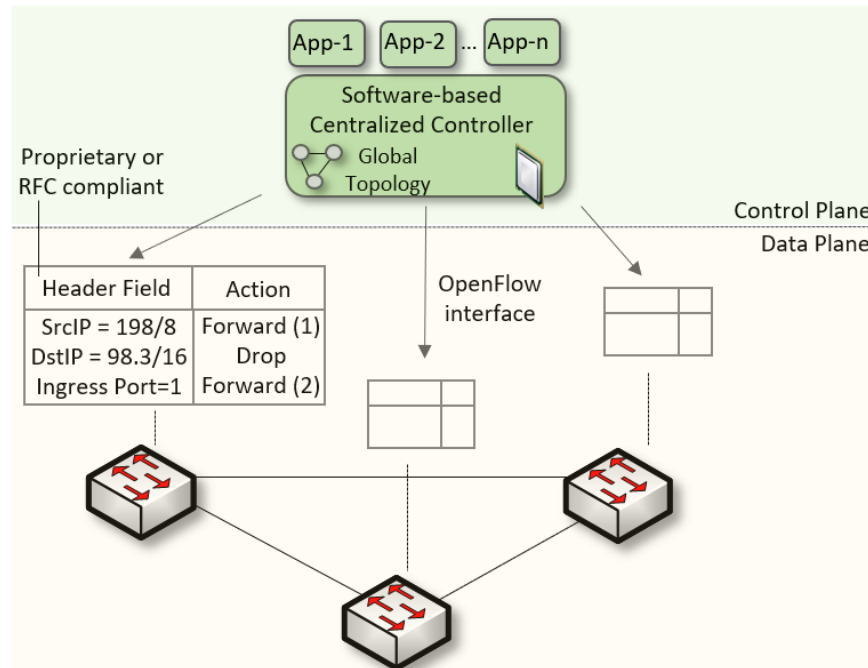
Hands-on session 5 (11:10AM-11:55AM): to access labs for Session 5 (Introduction to SDN).

The virtual platform (Netlab) is reachable through the following link:

<https://netlab.cec.sc.edu>

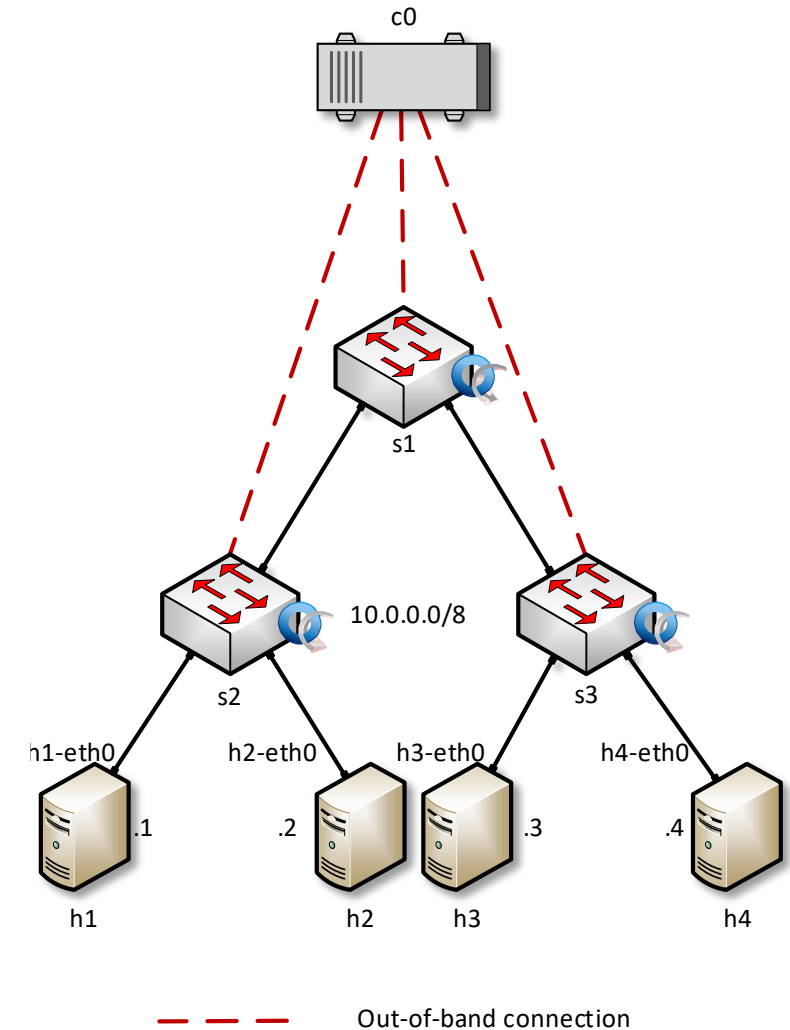
# Flow Tables

- Flow tables are the fundamental data structures in an SDN device
- They allow the device to evaluate incoming packets and take the appropriate action
- Flow tables consist of entries, each of which has match fields and actions
- OpenFlow explicitly specifies protocol headers on which it operates / matches



# Lab 4: Introduction to SDN

- The topology consists of:
  - The Open Network Operating System (ONOS) controller, an open source SDN controller
  - Open Virtual Switch (OVS) devices; OVS is an open source SDN switch
- Activities include
  - Run ONOS controller
  - Run simple SDN applications
  - Inspect flow tables
  - Interact with ONOS Graphical User Interface (GUI)



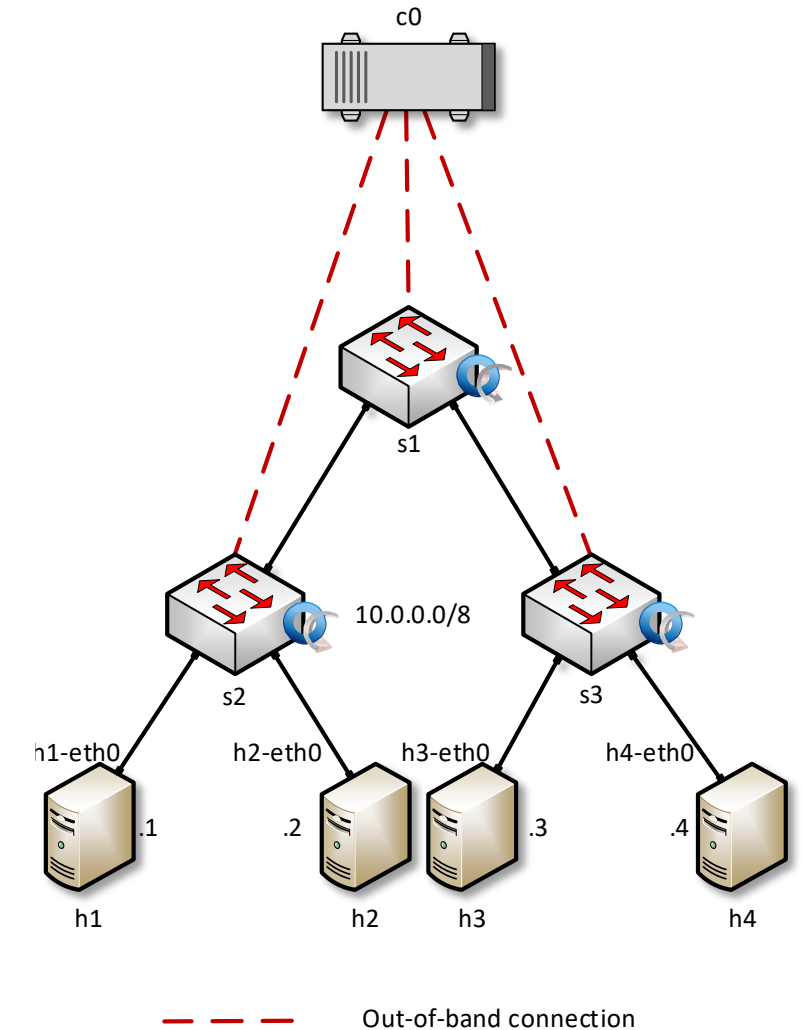
# Activating the OpenFlow Application

## Devices

```
sdn@admin: ~/SDN_Labs/lab4
File Actions Edit View Help
sdn@admin: ~/SDN_Labs/lab4
sdn@root > devices
16:35:23
id=of:0000000000000001, available=true, local-status=connected 3m28s ago, role=MASTER,
type=SWITCH, mfr=Nicira, Inc., hw=Open vSwitch, sw=2.12.0, serial=None, chassis=1, dr
iver=ovs, channelId=127.0.0.1:45148, managementAddress=127.0.0.1, protocol=OF_10
id=of:0000000000000002, available=true, local-status=connected 3m28s ago, role=MASTER,
type=SWITCH, mfr=Nicira, Inc., hw=Open vSwitch, sw=2.12.0, serial=None, chassis=2, dr
iver=ovs, channelId=127.0.0.1:45152, managementAddress=127.0.0.1, protocol=OF_10
id=of:0000000000000003, available=true, local-status=connected 3m28s ago, role=MASTER,
type=SWITCH, mfr=Nicira, Inc., hw=Open vSwitch, sw=2.12.0, serial=None, chassis=3, dr
iver=ovs, channelId=127.0.0.1:45150, managementAddress=127.0.0.1, protocol=OF_10
sdn@root >
16:35:35
```

## Hosts

```
sdn@admin: ~/SDN_Labs/lab4
File Actions Edit View Help
sdn@admin: ~/SDN_Labs/lab4
sdn@root > hosts
16:37:41
id=26:EA:BA:34:AA:D7/None, mac=26:EA:BA:34:AA:D7, locations=[of:0000000000000003/2], a
uxLocations=null, vlan=None, ip(s)=[10.0.0.4], innerVlan=None, outerTPID=unknown, prov
ider=of:org.onosproject.provider.host, configured=false
id=7A:4C:A7:9D:88:FF/None, mac=7A:4C:A7:9D:88:FF, locations=[of:0000000000000002/1], a
uxLocations=null, vlan=None, ip(s)=[10.0.0.1], innerVlan=None, outerTPID=unknown, prov
ider=of:org.onosproject.provider.host, configured=false
id=8E:0F:97:AC:3D:EB/None, mac=8E:0F:97:AC:3D:EB, locations=[of:0000000000000002/2], a
uxLocations=null, vlan=None, ip(s)=[10.0.0.2], innerVlan=None, outerTPID=unknown, prov
ider=of:org.onosproject.provider.host, configured=false
id=D2:19:CC:2E:E0:B7/None, mac=D2:19:CC:2E:E0:B7, locations=[of:0000000000000003/1], a
uxLocations=null, vlan=None, ip(s)=[10.0.0.3], innerVlan=None, outerTPID=unknown, prov
ider=of:org.onosproject.provider.host, configured=false
sdn@root >
16:41:31
```



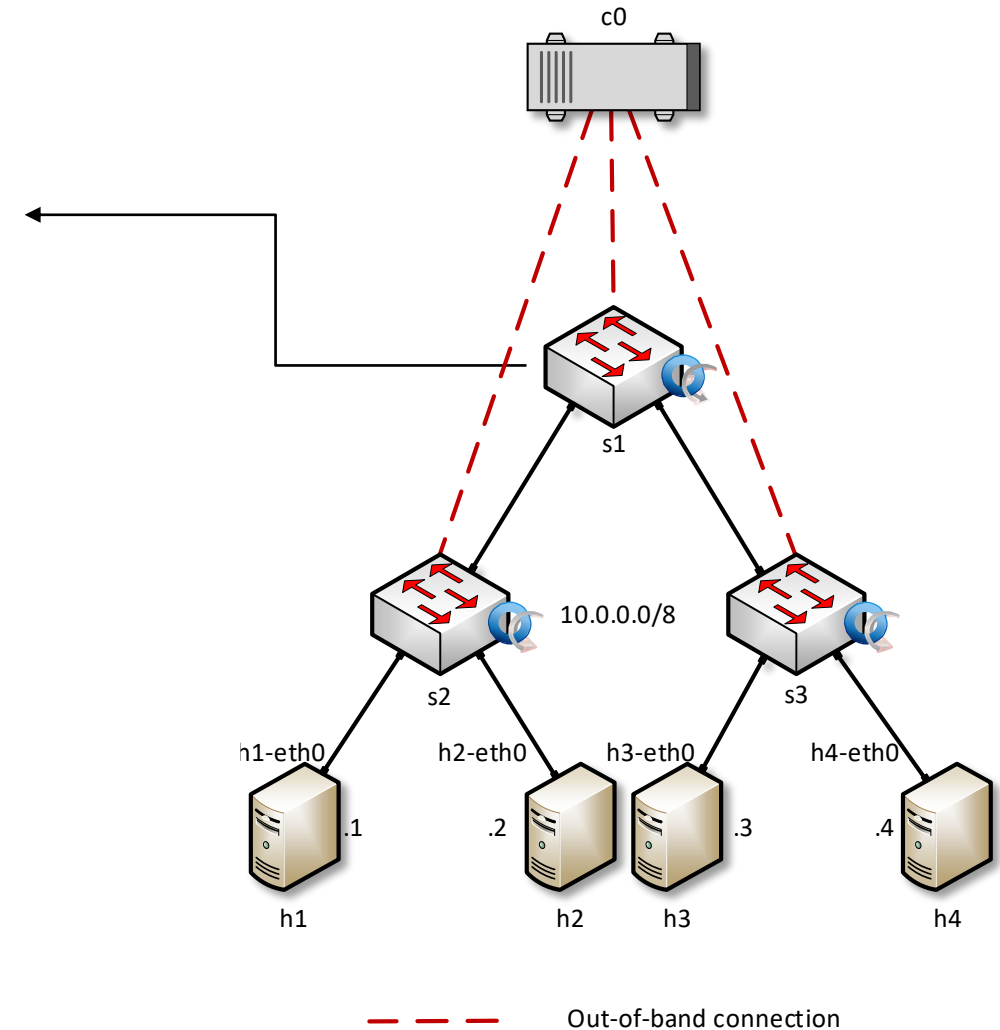
Out-of-band connection



# Activating the Forwarding Application

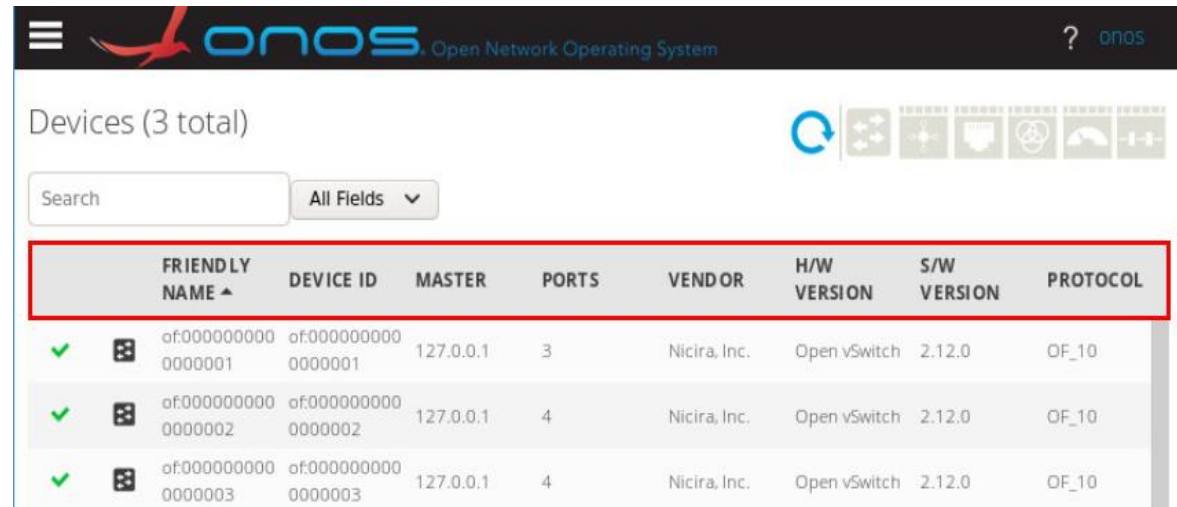
Flows on switch s1

```
sdn@admin: ~/SDN_Labs/lab4
File Actions Edit View Help
sdn@admin: ~/SDN_Labs/lab4
sdn@root > flows added of:0000000000000001 16:46:14
deviceId=of:0000000000000001, flowRuleCount=4
  id=100007a585b6f, state=ADDED, bytes=75616, packets=544, duration=845, liveType=UNKNOWN, priority=40000, tableId=0, appId=org.onosproject.core, selector=[ETH_TYPE:bddp], treatment=DefaultTrafficTreatment{immediate=[OUTPUT:CONTROLLER], deferred=[], transition=None, meter=[], cleared=true, StatTrigger=null, metadata=null}
  id=100009465555a, state=ADDED, bytes=75616, packets=544, duration=845, liveType=UNKNOWN, priority=40000, tableId=0, appId=org.onosproject.core, selector=[ETH_TYPE:lldp], treatment=DefaultTrafficTreatment{immediate=[OUTPUT:CONTROLLER], deferred=[], transition=None, meter=[], cleared=true, StatTrigger=null, metadata=null}
  id=10000ea6f4b8e, state=ADDED, bytes=0, packets=0, duration=845, liveType=UNKNOWN, priority=40000, tableId=0, appId=org.onosproject.core, selector=[ETH_TYPE:arp], treatment=DefaultTrafficTreatment{immediate=[OUTPUT:CONTROLLER], deferred=[], transition=None, meter=[], cleared=true, StatTrigger=null, metadata=null}
  id=10000021b41dc, state=ADDED, bytes=0, packets=0, duration=56, liveType=UNKNOWN, priority=5, tableId=0, appId=org.onosproject.core, selector=[ETH_TYPE:ipv4], treatment=DefaultTrafficTreatment{immediate=[OUTPUT:CONTROLLER], deferred=[], transition=None, meter=[], cleared=true, StatTrigger=null, metadata=null}
sdn@root > 16:46:16
```



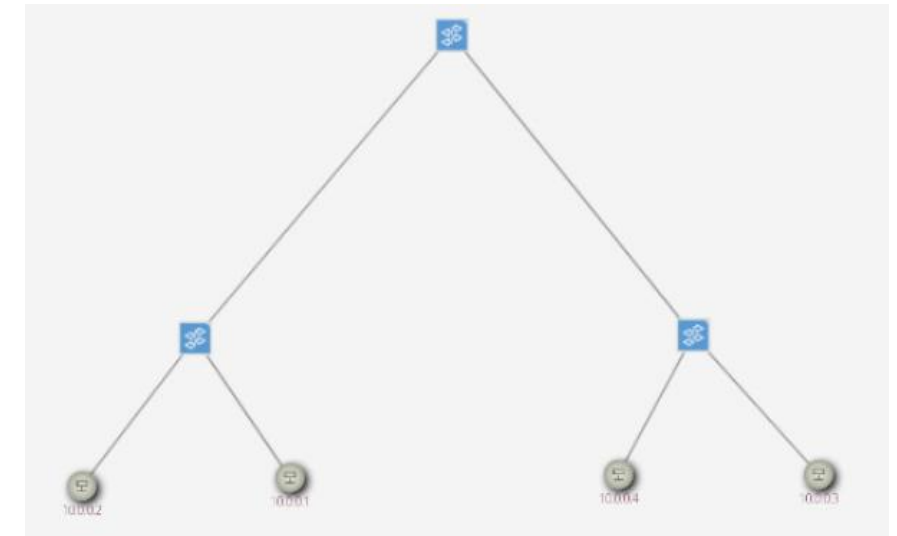
# ONOS GUI

## Devices



	FRIENDLY NAME ▲	DEVICE ID	MASTER	PORTS	VENDOR	H/W VERSION	S/W VERSION	PROTOCOL
✓	of:000000000000000001	of:000000000000000001	127.0.0.1	3	Nicira, Inc.	Open vSwitch	2.12.0	OF_10
✓	of:000000000000000002	of:000000000000000002	127.0.0.1	4	Nicira, Inc.	Open vSwitch	2.12.0	OF_10
✓	of:000000000000000003	of:000000000000000003	127.0.0.1	4	Nicira, Inc.	Open vSwitch	2.12.0	OF_10

## Topology (ONOS GUI view)



# Accessing the Platform

We will use the NETLAB virtual platform:

- **URL:** <https://netlab.cec.sc.edu/>
- **Username:** <email address used for the registration>
- **Temporary Password:** nsf-2025