

Hands-on Workshop on Open vSwitch and Software-defined Networking

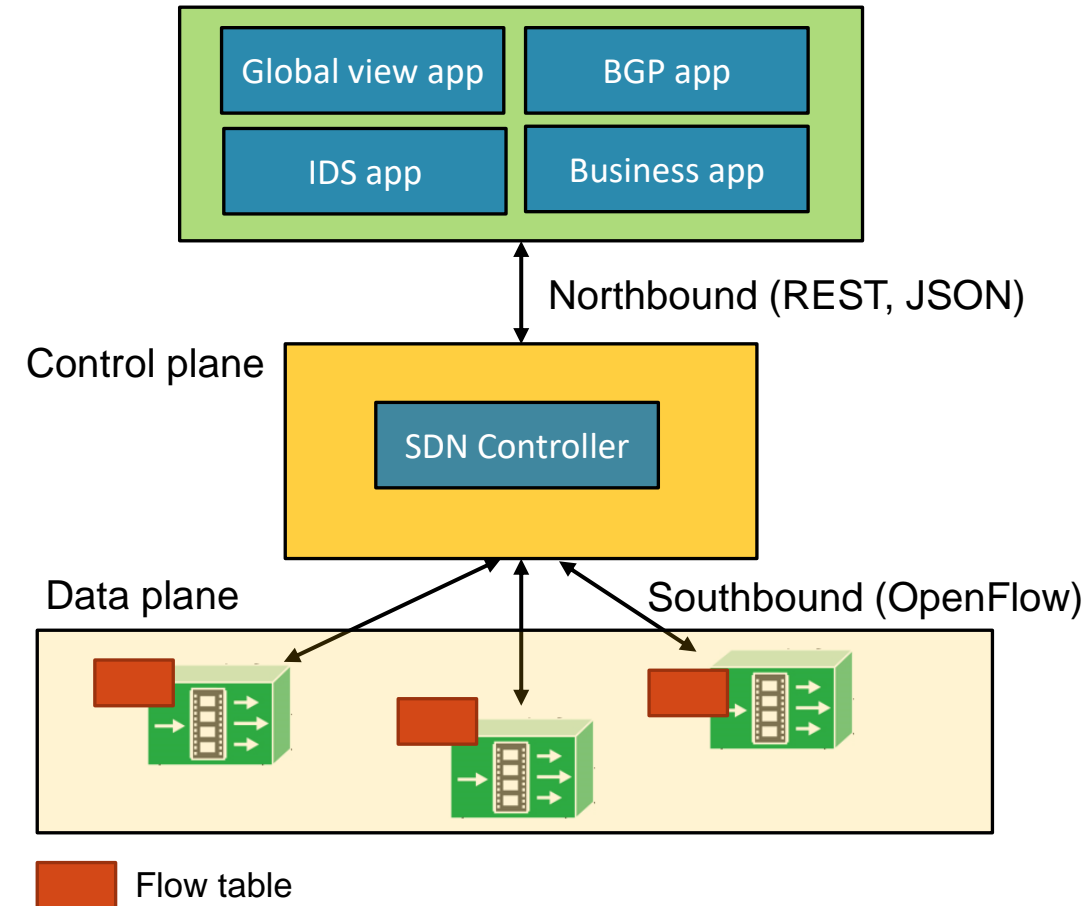
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Overview of Software Defined Networking (SDN)

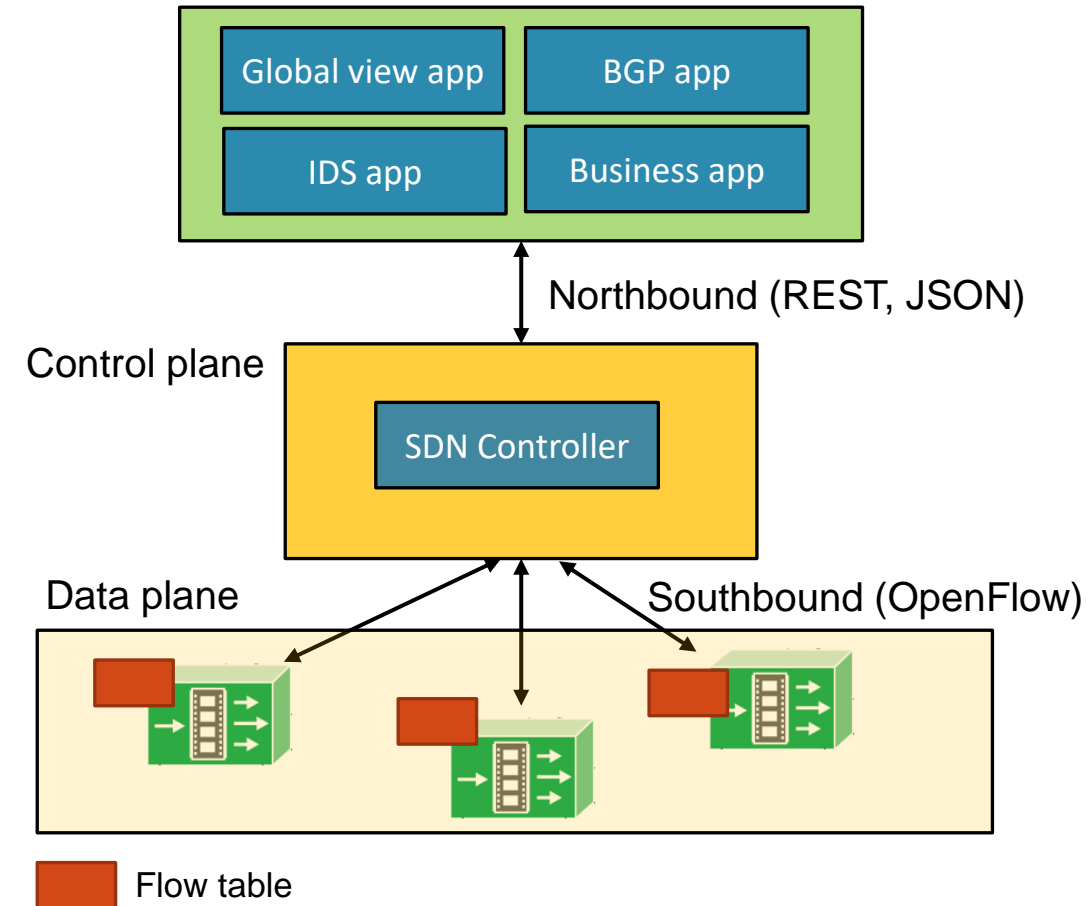
SDN Operation

- Basic components (bottom-up)
 - SDN switches (e.g. Open vswitches)
 - Controller (e.g., ONOS controller)
 - Applications (e.g., OpenFlow, forwarding)



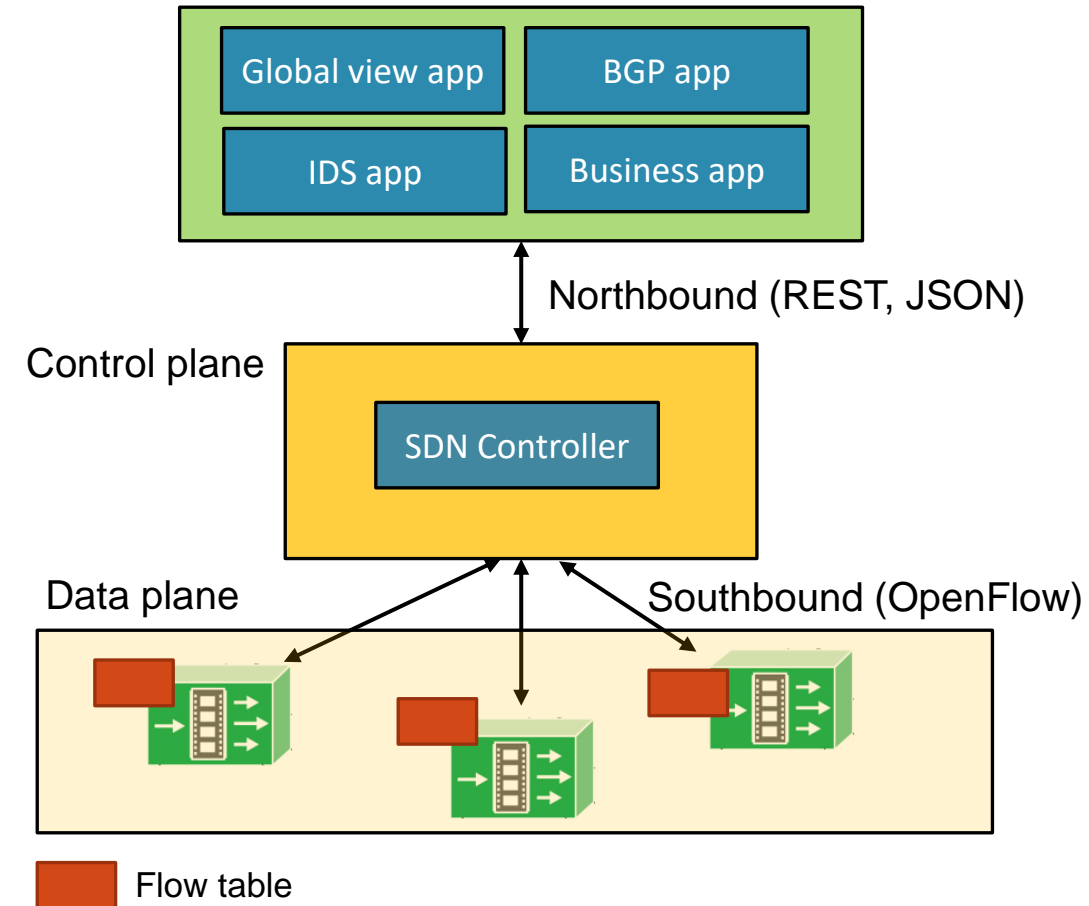
SDN Operation – Switches

- SDN devices contain forwarding functionality
- Forwarding information is stored in flow tables
- The flow tables reside on the network device and consist of a series of flow entries and actions to perform when a packet matches an entry
- If the SDN device finds a match, it takes the appropriate configured action (e.g. forward)
- If it does not find a match, it can either drop the packet or pass it to the controller



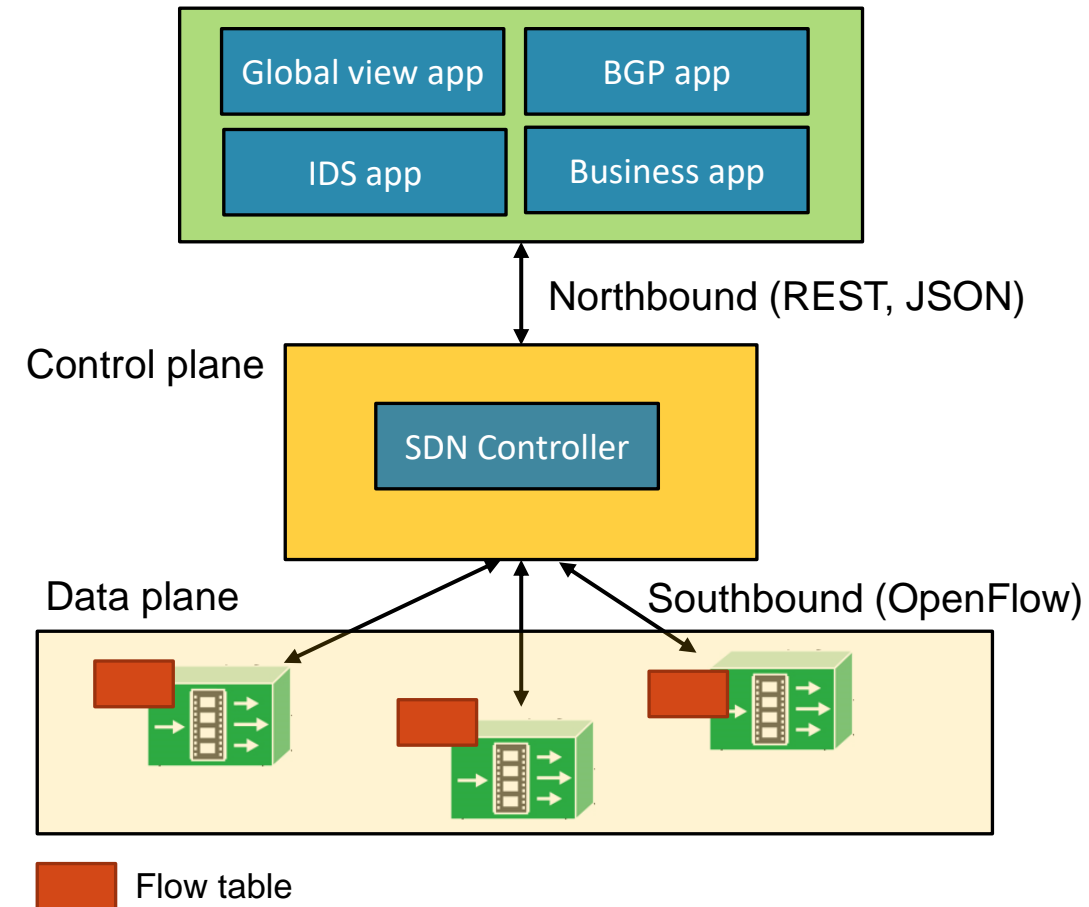
SDN Operation – Controller

- SDN controller implements control plane functionality
- It presents an abstraction of the network to the SDN applications running above
- It allows the SDN application to define flows on devices and to help the application to respond to packets which are forwarded to the controller by devices
- It maintains a view of the entire network (global network view)



SDN Operation – Applications

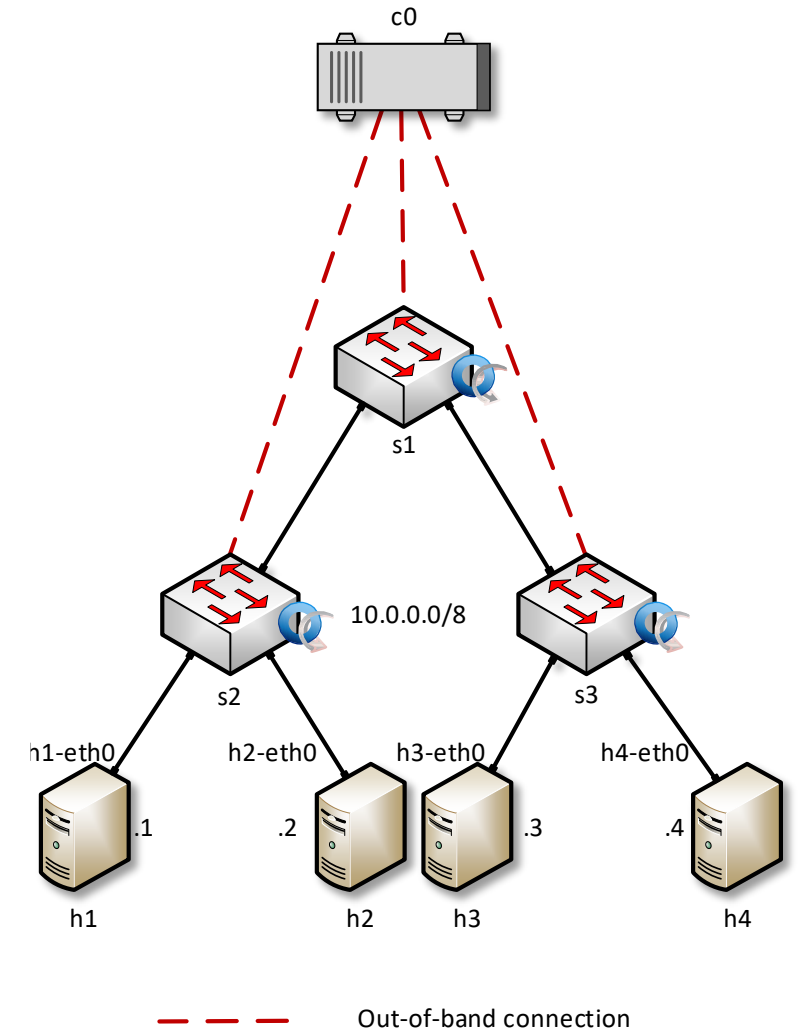
- SDN applications are built on top of the controller
- Software applications can implement forwarding, routing, overlay, multipath, access control, etc.
- The application is driven by events coming from the controller and from external inputs
- External inputs could include network monitoring systems, Netflow, IDS, or BGP peers



Lab 4: Introduction to SDN

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)



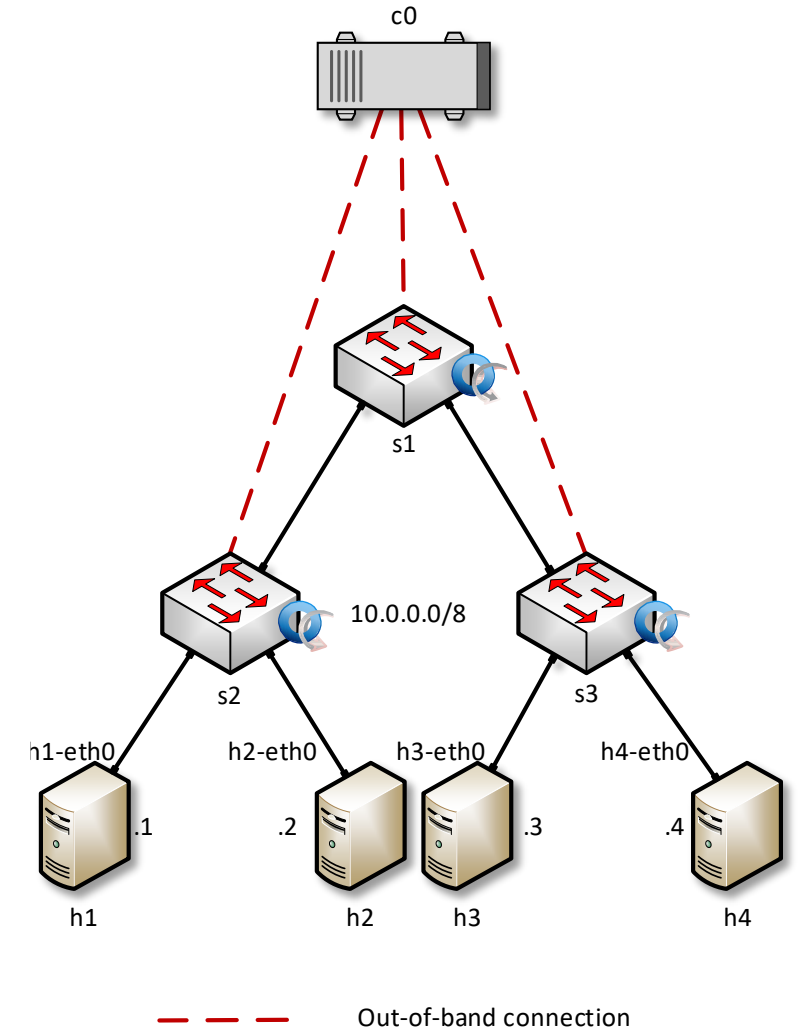
Activating the OpenFlow Application

Devices

```
sdn@admin: ~/SDN_Labs/lab4
File Actions Edit View Help
sdn@admin: ~/SDN_Labs/lab4
sdn@root > devices
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 >
```

Hosts

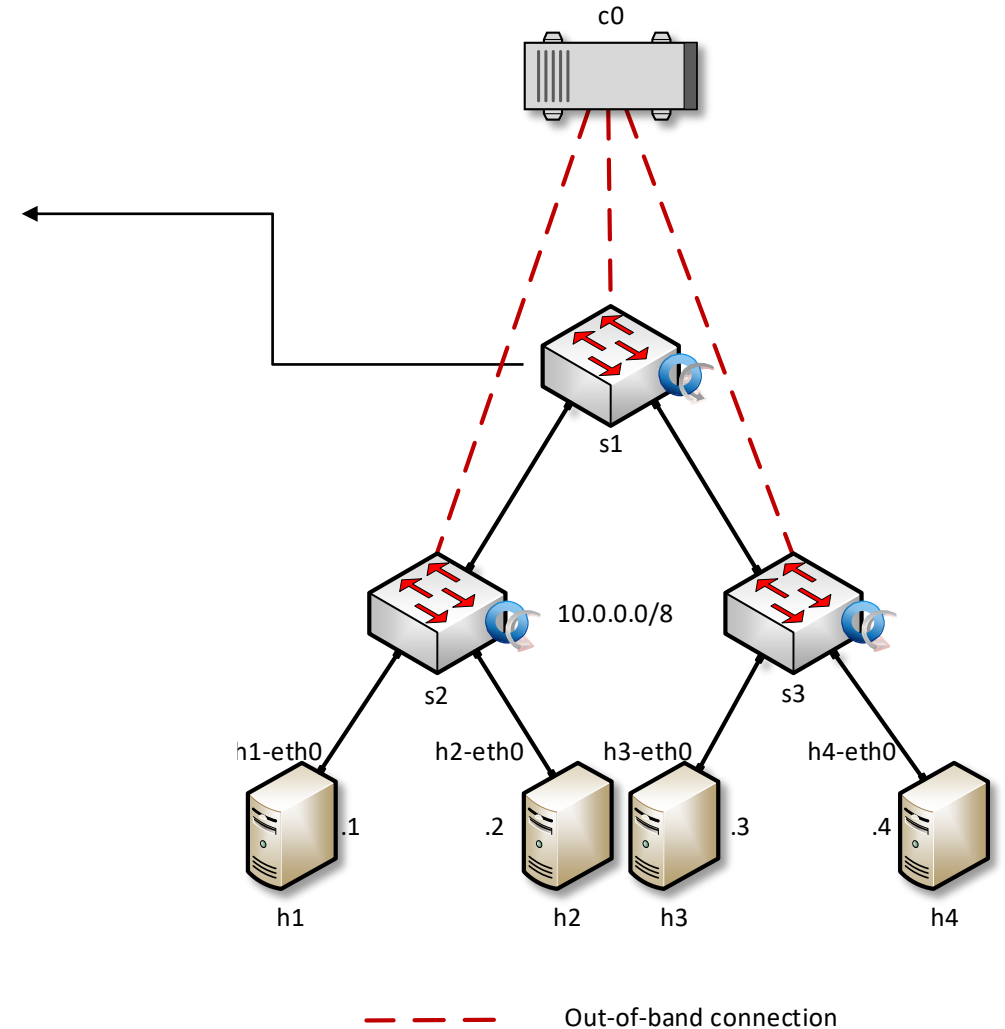
```
sdn@admin: ~/SDN_Labs/lab4
File Actions Edit View Help
sdn@admin: ~/SDN_Labs/lab4
sdn@root > hosts
id=26:EA:BA:34:AA:D7/None, mac=26:EA:BA:34:AA:D7, locations=[of:0000000000000003/2], a
uxLocations=null, vlan=None, ip(s)=[10.0.0.4], innerVlan=None, outerTPID=unknown, prov
ider=of:org.onosproject.provider.host, 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 >
```



Activating the Forwarding Application

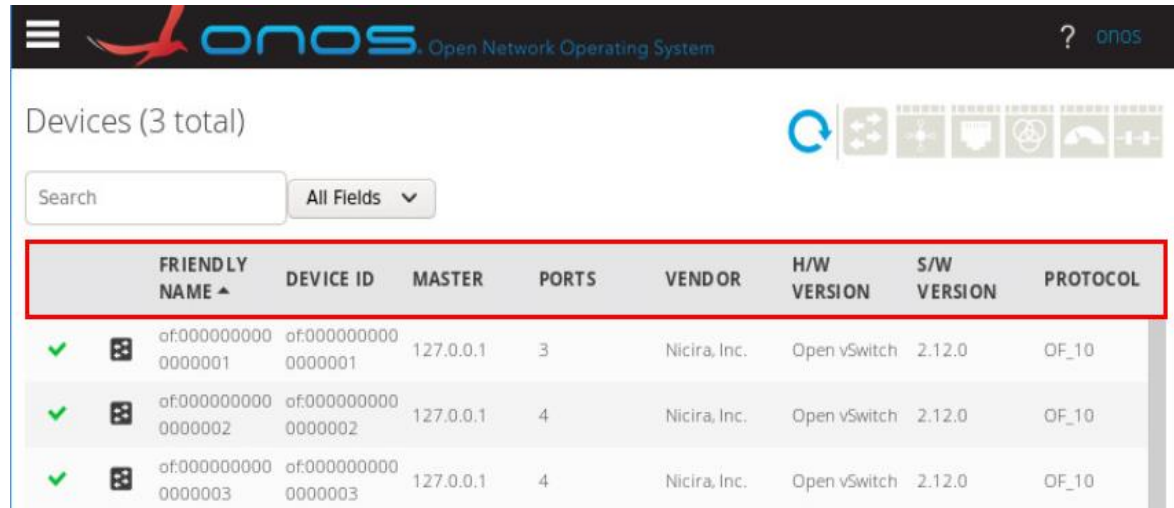
Flows on switch s1

```
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 >
```



ONOS GUI

Devices



Devices (3 total)

	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)

