Software Defined Networking

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In this course, you will learn about software defined networking and how it is changing the way communications networks are managed, maintained, and secured.

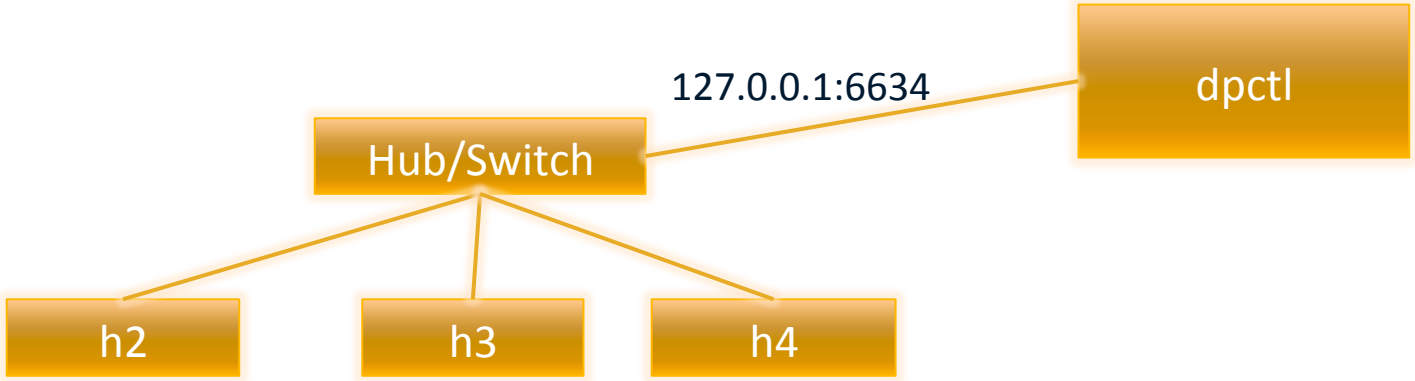
This Module: The Control Plane

- Three Lessons
  - Control Plane Basics (OpenFlow 1.0 and Beyond)
  - SDN Controllers
  - **Using SDN Controllers to Customize Control**
- Programming Assignment (and Quiz)
- Quiz

This Lesson: Customizing Control

- Review of hub and switch
- POX Controller and simple Mininet topology
- Two types of control
  - Hub
  - Learning switch
- Looking at flow tables with dpctl
- Code walkthrough

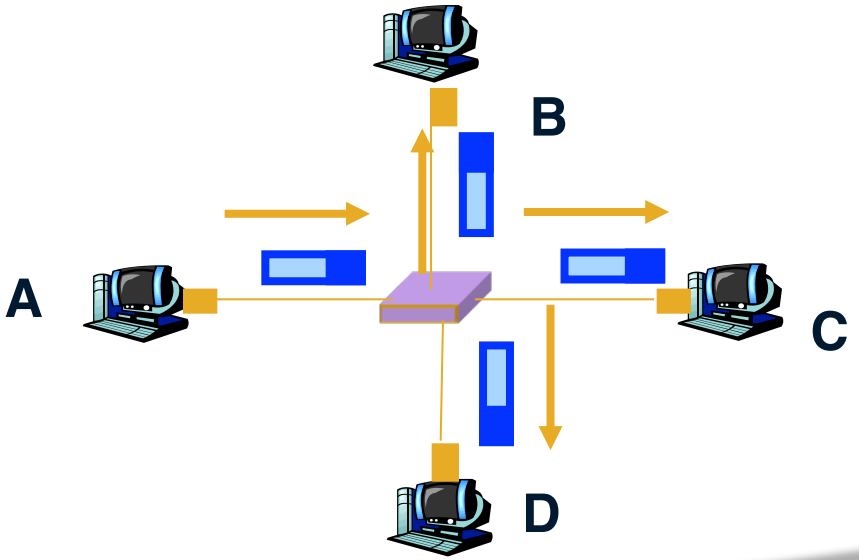
Example Topology



- `$ sudo mn --topo single,3 --mac --switch ovsk --controller remote`
- `dpctl` to communicate with switches
  - Switches listen on port 6634
  - Can inspect flow table entries, modify flows, etc.

Review: Hub

- No forwarding information stored at switch
- Every input packet is flooded out all ports



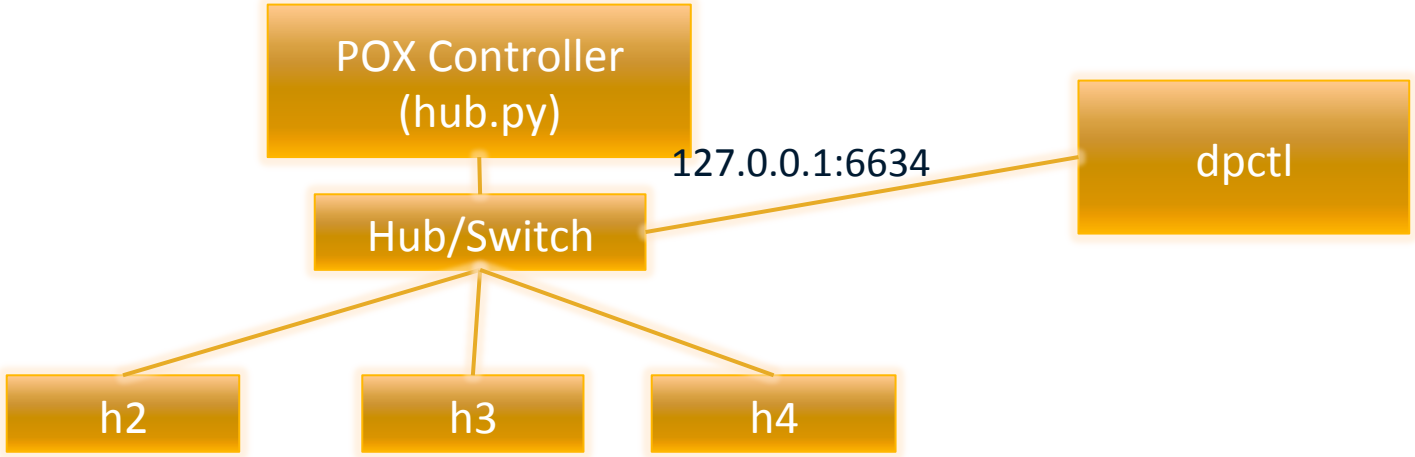
POX Hub

```
def _handle_ConnectionUp (event):
  msg = of.ofp_flow_mod()
  msg.actions.append(of.ofp_action_output(port = of.OFPP_FLOOD))
  event.connection.send(msg)
  log.info("Hubifying %s", dpidToStr(event.dpid))

def launch ():
  core.openflow.addListenerByName("ConnectionUp", _handle_ConnectionUp)
  log.info("Hub running.")
```

Code from hub.py POX distribution (James McCauley)

Example Topology



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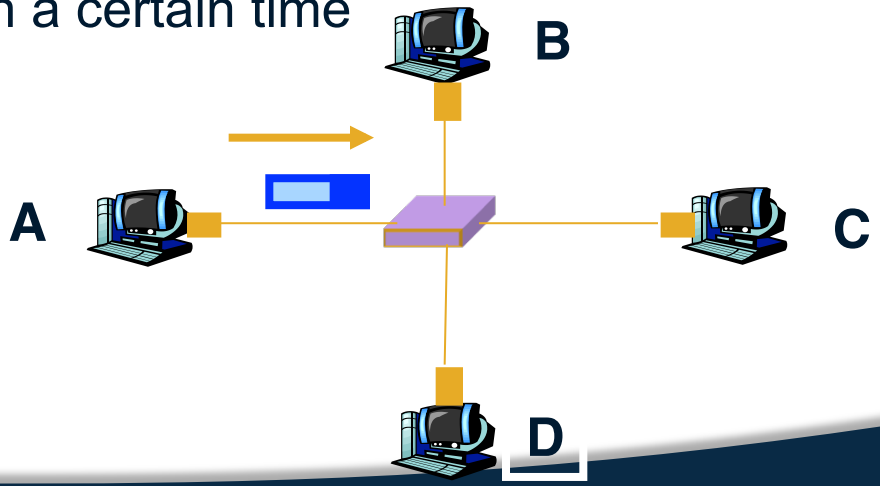
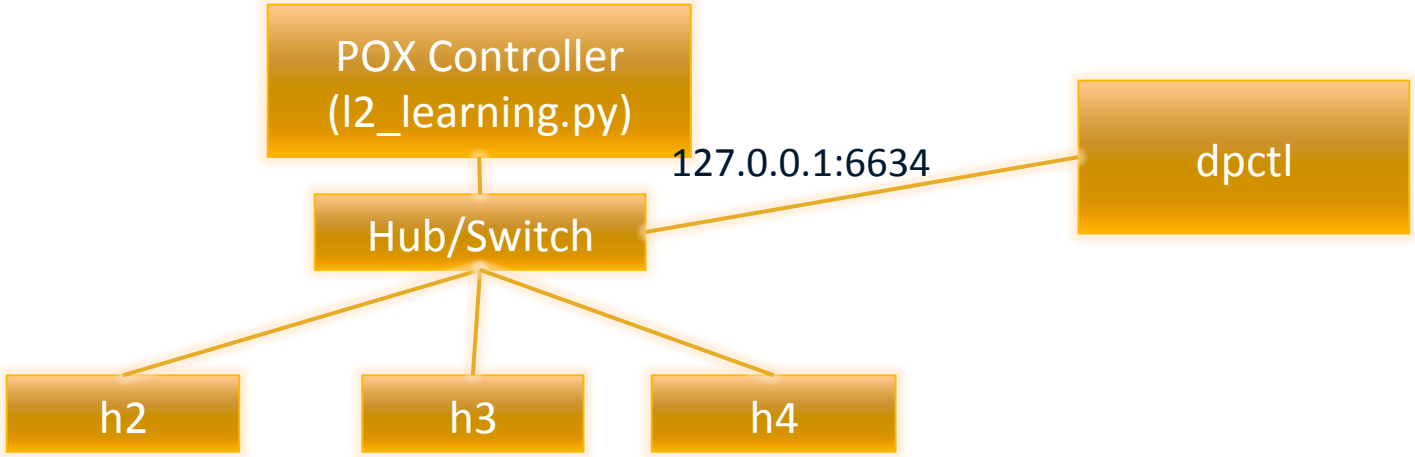
Review: Learning Switch

- Switch table is initially empty
- For each incoming frame, store
  - The incoming interface from which the frame arrived
  - The time at which that frame arrived
  - Delete the entry if no frames with a particular source address arrive within a certain time



Switch learns how to reach A.

Example Topology



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POX Learning Switch Algorithm

- Use source address and switch port to update address/port table
- Is transparent = False and either Ethertype is LLDP or the packet's destination address is a Bridge Filtered address? If yes, DROP
- Is destination multicast? If so, FLOOD.
- Is port for destination address in our address/port table? If not, FLOOD.
- Is output port the same as input port? If yes, DROP
- Install flow table entry in the switch so that this flow goes out the appropriate port. Send the packet out appropriate port.

Important Concept: Listeners

- `connection.addListeners(self)` ensures that the controller will hear PacketIn messages

- `_handle_PacketIn` works all of the magic for handling a packet that arrives at the controller

Important Concept: Flow Mods

- Must define a **match** and **action**
- Must send the message to the switch
- Timeouts define how long a flow table entry remains in the table

```
msg = of.ofp_flow_mod()
msg.match = of.ofp_match.from_packet(packet, event.port)
msg.idle_timeout = 10
msg.hard_timeout = 30
msg.actions.append(of.ofp_action_output(port = port))
msg.data = event.ofp
self.connection.send(msg)
```

Summary

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