Software Defined Networking

Lab Work 3 Introduction

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Exploring OpenFlow 1.3

Run a simple_switch with OpenFlow 1.0

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- Test with OpenFlow 1.0
  - First terminal: ssh session 1:

```
~$ ryu-manager ryu.app.simple_switch
```

  - Second terminal: ssh session 2

```
~$ mn --topo single,3 --mac --arp --switch ovsk \
    --controller=remote,ip=127.0.0.1
mininet> h1 ping h2
```

  - Third terminal: ssh session 3
    - Note the new tool: ovs-ofctl (google „man ovs-ofctl“ for details)

```
~$ sudo ovs-ofctl dump-flows s1
```

- Note the debug output in session 1
  - Investigate the source code
  - Find out the meaning of the log messages

Run a simple_switch with OpenFlow 1.3

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- Test with OpenFlow 1.3
  - First terminal: ssh session 1:

```
~$ ryu-manager ryu.app.simple_switch_13
```

  - Second terminal: ssh session 2

```
~$ mn --topo single,3 --mac --arp \
        --switch ovsk,protocols=OpenFlow13 \
        --controller=remote,ip=127.0.0.1
mininet> h1 ping h2
```

  - Third terminal: ssh session 3

```
~$ sudo ovs-ofctl dump-flows s1
2014-11-24T11:47:01Z|00001|vconn|WARN|unix:/var/run/openvswitch/s1.mgmt: version negotiation
failed (we support version 0x01, peer supports version 0x04)
ovs-ofctl: s1: failed to connect to socket (Broken pipe)
```

Run a simple_switch with OpenFlow 1.3

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- Third terminal: ssh session 3

```
~$ sudo ovs-ofctl dump-flows s1
2014-11-24T11:47:01Z|00001|vconn|WARN|unix:/var/run/openvswitch/s1.mgmt: version negotiation failed (we support version 0x01, peer supports version 0x04)
ovs-ofctl: s1: failed to connect to socket (Broken pipe)
```

- Version negotiation failed
  - We (ovs-ofctl) support version 0x01 (OpenFlow 1.0)
  - Peer (Open vSwitch) supports version 0x04 (OpenFlow 1.3)
  - ➡ note the version notation

```
~$ sudo ovs-ofctl dump-flows -O Openflow13 s1
OFPST_FLOW reply (OF1.3) (xid=0x2):
 cookie=0x0, duration=13.922s, table=0, n_packets=13, n_bytes=1274, priority=1,in_port=2,dl_dst=00:00:00:00:00:01 actions=output:1
 cookie=0x0, duration=12.924s, table=0, n_packets=12, n_bytes=1176, priority=1,in_port=1,dl_dst=00:00:00:00:00:02 actions=output:2
 cookie=0x0, duration=14.541s, table=0, n_packets=6, n_bytes=588, priority=0 actions=CONTROLLER:65535
```

- Specify the OpenFlow version "`-O OpenFlow1X`"

Task 1

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- Look at the source code of the Ryu modules simple_switch.py and simple_switch_13.py.
  - Describe and explain the differences between the OpenFlow 1.0 and OpenFlow 1.3 version of simple_switch.

Task 2 (1)

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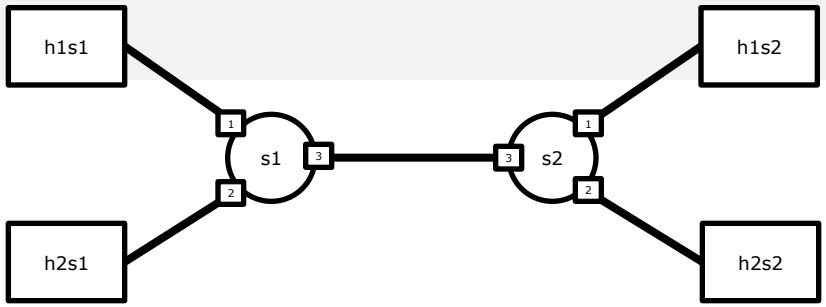
1. Have a look at the OpenFlow 1.0-based filtering switch simple_switch_filter.py.
   1. The basic forwarding method is again layer 2 switching.
   2. We increase security by allowing only one host per port
   3. This rule does not apply to inter-switch links
   4. Run the topology:

```
sudo mn --topo linear,n=2,k=2 --mac --arp --switch ovsk \
        --controller=remote,ip=127.0.0.1
mininet> h1s1 ping h2s2
```



2. Verify
   1. Install and run MAC spoofing tool

```
sudo apt-get update && sudo apt-get install nmap
mininet> h1s1 nmap --spoof-mac 00:00:00:00:00:33 10.0.0.2
```

   2. You should see the following message in your controller output:

```
dropping spoofed packet on s1 src=00:00:00:00:00:33 dst=ff:ff:ff:ff:ff:ff in_port=1
```

Task 2 (2)

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3. Have a look at the OpenFlow 1.0 based program that implements the filtering switch described in the last slide: simple_switch_filter.py.

4. Create an OpenFlow 1.3 version called simple_switch_filter_13.py.
    1. Base your implementation on simple_switch_13.py and simple_switch_filter.py
    2. Use two flow tables for the OpenFlow 1.3 version
        1. Use the first flow table for matching input ports and source MAC address
        2. Use the second flow table for sending the packets out the correct port.

5. Describe and discuss the differences regarding the number of flow rules used
    1. Consider different topologies and number of hosts for the sake of discussion even though running them with the simple_switch_filter.py is not possible
    2. Mathematically describe an upper bound for the number of flow rules
        1. For the OpenFlow 1.0 version
        2. For the OpenFlow 1.3 version

Tools

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- Looking for a Python IDE?
  - Eclipse with PyDev plugin
    - http://pydev.org/
  - PyCharm (free for Student for research purposes)
    https://www.jetbrains.com/student/

- Things to be aware of
  - Ryu relies on a concurrent networking library called Eventlet (http://eventlet.net)
  - Debugging Eventlet requires special support and does currently neither work with PyDev nor with PyCharm out of the box