# Introduction to the labs

Andrea Bianco, Paolo Giaccone

http://www.telematica.polito.it/

# Labs

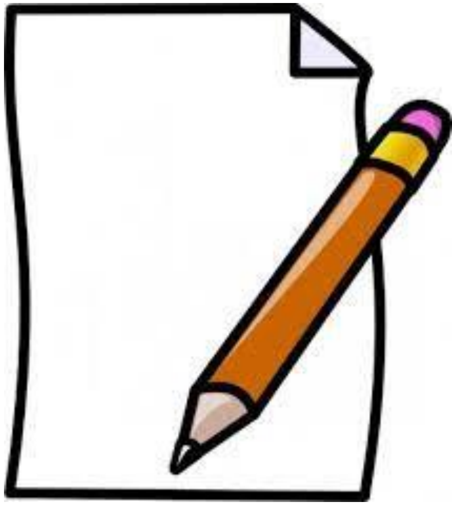
- Lab #1
  - 3 hours
  - Configuration
  - SDN and network routing
- Lab #2
  - 3 hours
  - Performance
  - QoS support: mainly scheduling
- Lab #3
  - 3 hours
  - Detailed analysis and implementation
  - Simulation of algorithms
- It is possible to work on the labs at home
  - assistance is provided only in presence during the lab

# Lab logistics

- LED2
  - 2nd floor south ”scavalco” on C.so Castelfidardo
- Monday 16:00-19:00 in LED2
- Dates specified on the portale
  - November 11th, November 18th, December 9th
- Please arrive 5 minutes earlier, so you can start the lab on time
- Use crownlabs
  - Working in a virtual environment
  - Use a Linux Virtual Machine
  - Using Linux terminal and shell commands

# Lab detailed instructions

- 3 pdf files, one for each lab
- Print the pdf at home and bring it into the lab
  - Better one copy for each student
- Bring pen and papers to take notes
  - required to be able to follow the lab
  - needed  to discuss labs during oral examination

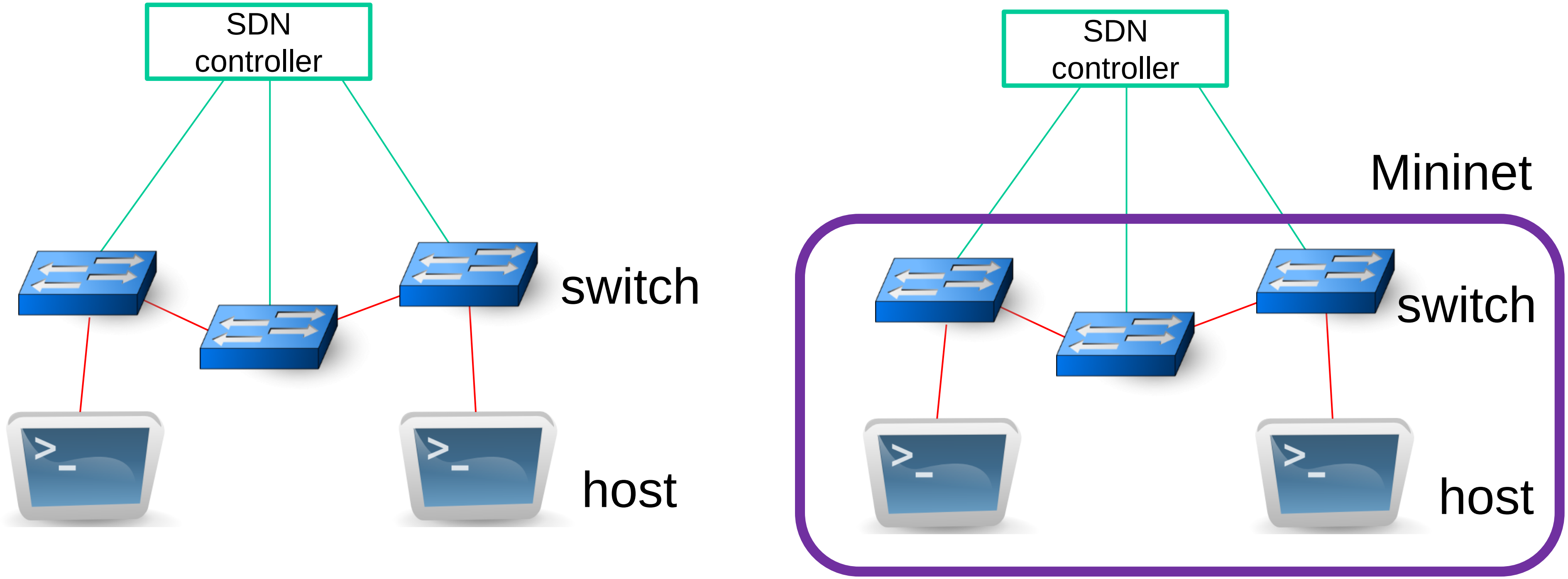


# Software tools

- In crownlabs VM
  - – Linux shell commands
  - – Browser
  - – Text editor
  - – Linux network applications
    - Traffic generators
- For the first two labs
  - – Main software tool: Mininet
  - – SDN Network emulator

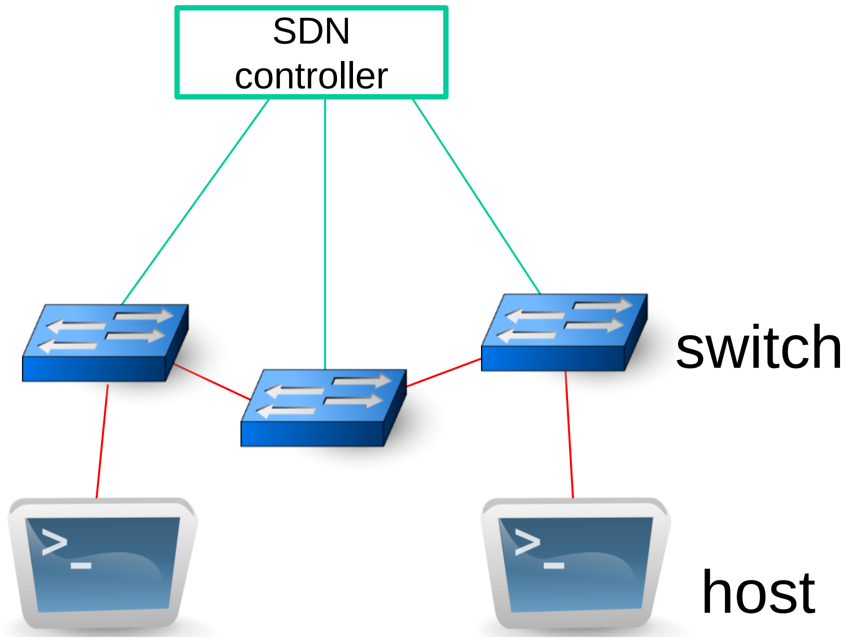
# Mininet

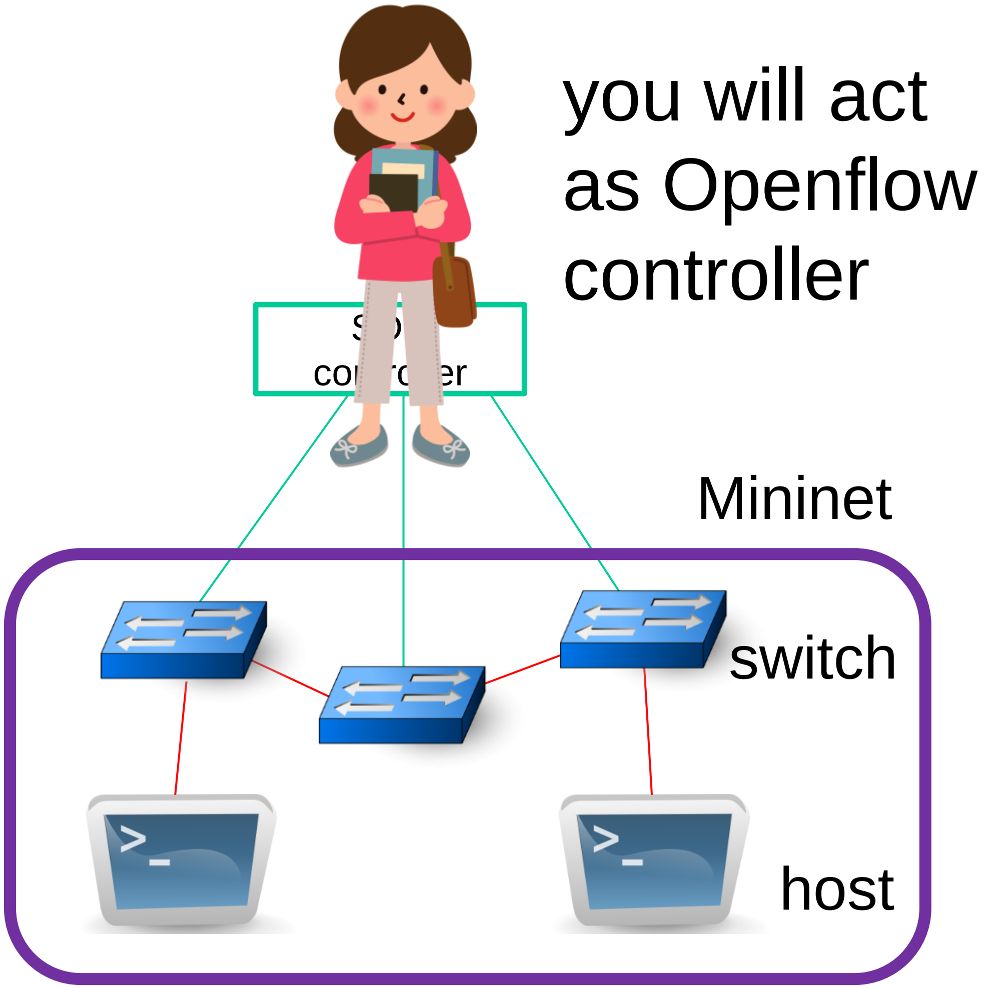
- Network emulator



# Mininet

- Network emulator





you will act as Openflow controller

# Mininet

- Network emulator
  - host
  - switch
  - SDN controller
- Linux container/process for each node
- Command line interface CLI
  - global commands for the emulator
  - local commands for the nodes

# Mininet global commands

- **nodes** display nodes
  - h1 -> host 1
  - s1 -> switch 1
- **links** display links
  - h1-eth0<->s1-eth1
- **net** display a summary of all the nodes and links
  - h1 h1-eth0:s1-eth1
- **dump** dump information about all nodes
  - <P4Host h1: h1-eth0:10.0.0.1 pid=12345>

# Mininet local commands

- local commands for the nodes
  - if the first string typed a host, switch or controller name, the command is executed on that node
- **h1 ifconfig** provides the list of the network interfaces attached to h1
- **h1 ping h2** sends ICMP packets from h1 to h2
- **h1 iperf3 –c 10.0.0.1** uses iperf to test the bandwidth towards 10.0.0.1
- **sh** allows to run a command outside mininet, while mininet is running; e.g., mininet> **sh ls**

# Network performance tool

- iperf3 to test the available bandwidth between two hosts
- client server application
  - client: generates the traffic (TCP/UDP)
  - server: receives the traffic (TCP/UDP)

- **iperf3 –c dest_IP** run the test as client
- **iperf3 –s** run the test as server
  - by default, each host is already running it in background
- many options are available: **iperf3 --help**

# Lab#1 – Initial step

- **Proceed step by step. Do not skip!**

- Shell command overview
  - Shortcuts

- Become familiar with Mininet and its commands
  - two hosts and one (software) Openflow switch
  - understand the performance of software switches

# Lab #1 – Single switch

- Topology discovery
  - in terms of node graph and IP addresses
- Test connectivity
- Add the proper match-action rules in the flow table to route the traffic
  - based on source port only
  - based on destination port only
- Observe the traffic through **tshark**

- Remind the notation: IP 1.2.3.4/24 = 1.2.3.4/255.255.255.0

# Lab #1 – Linear two switches

- Topology discovery
  - in terms of node graph and IP addresses
- Test connectivity
- Fix the routing

# Lab #1– Mesh topology

- Topology discovery
  - in terms of node graph and IP addresses
- Test connectivity and fix the routing
- Multipath routing
  - route UDP and TCP flows between the same pairs of hosts on different paths
- Dynamic routing
  - Flow rerouting from main path to a backup
  - “flow-mod messages” issued “by the controller”
    - investigate whether the sequence of the messages matters or not for a completely transparent rerouting process (i.e., no losses)
- Fault-tolerant rerouting (OPTIONAL)
  - detect a link failure and apply the backup path

# Lab #2

- Analyze performance of various schedulers
  - FIFO, Round Robin, Weighted Round Robin, Priority
- In different scenarios
  - Underload and overload
  - Two flows
    - single bottleneck
  - Multiple flows
    - Dingle bottleneck
    - Mesh network
- Compare with max min fair solution
- Have a look at transient behaviour

# Lab #3

- Analyze various schedulers
  - RR, DRR, WRR; Virtual Clock, WFQ …
- Interactive python environment
- Need to set up some parameters to understand scheduler behaviour
- Write some code to customize scheduler behaviour