

Sept. 9th, 2020

## Exam of Switching technologies for data centers (2019/20)

**Rules for the exam.** It is **forbidden** to use notes, books or calculators. When needed, use approximations. The answers must be provided in correct English. Any notation must be defined.

**Time available: 70 minutes.**

### Problem A

Design of a data center, with an oversubscription equal to 4:1, built only with switches with 100 ports.

1. Design the largest possible two layers data center (i.e., leaf-spine).
2. Design the largest possible three layers data center.

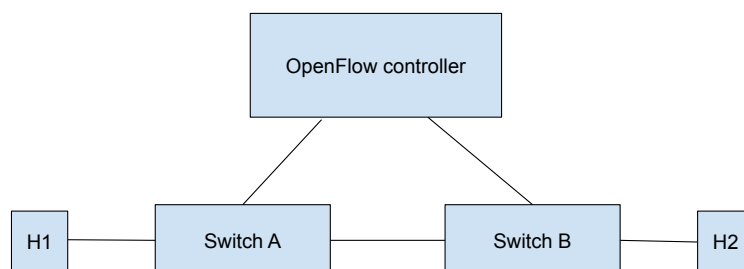
For each of the two data centers, show the interconnection topology and compute (i) the total number of supported servers, (ii) the total number of switches, (iii) the total number of required cables (including the ones required to connect the servers).

### Problem B

1. Consider a Cuckoo hash:
  - (a) What is its purpose?
  - (b) How does it work?
  - (c) Show an example of element relocation.
2. Consider a Cuckoo filter:
  - (a) What is its purpose?
  - (b) How does it work?
  - (c) What is the difference between a Cuckoo hash and a Cuckoo filter?

### Problem C

Consider the following network, connecting host H1 to host H2 through 2 Openflow switches (A and B).



Assume now that two Ethernet packets are sent from H1 to H2 and that all the flow tables in the switches are initially empty. Show the sequence of packets observed in all the links (both data plane and control plane), highlighting the role of pkt-in, pkt-out and flow-mod messages. Show the final flow tables in both switches.

### Hints for the solution

### Problem A

Topology	Servers	Switches	Cables
2 layer data center	$80 \times 100 = 8000$	$100 + 20 = 120$	$8000 + 20 \times 100 = 10000$
2 layer POD	$80 \times 50 = 4000$	$50 + 20 = 70$	$4000 + 20 \times 50 = 5000$
3 layer data center	$4000 \times 100 = 400000$	$70 \times 100 + 1000 = 8000$	$100 \times 5000 + 1000 \times 100 = 600000$