



Eidgenössische Technische Hochschule Zürich  
Swiss Federal Institute of Technology Zurich

Spring Term 2017



## ADVANCED COMPUTER NETWORKS

### Assignment 5: Software Defined Networking

Assigned on: **23 March 2017**

Due by: **30 March 2017**

## Question 1

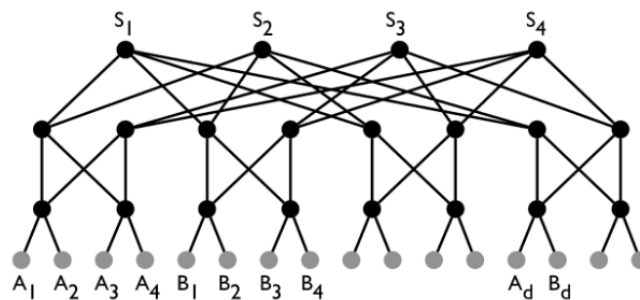
What is the problem if all nodes use the same hashing function for ECMP?

## Question 2

Let's say a flowlet is defined using the flowlet gap  $\Delta$ . What are the drawback of having very large or small values of  $\Delta$ ?

## Question 3

Consider the network below, where all links are 10Gbps. Assume the data center is using shortest path routing with ECMP. Four of tenant A's VMs  $\{A_1, A_2, A_3, A_4\}$  each have a long-running TCP flow sending to  $A_d$ ; likewise, four of tenant B's VMs  $\{B_1, B_2, B_3, B_4\}$  are sending to  $B_d$ . The paths taken by each flow depend on ECMP hashing. What is the worst possible hashing, assuming TCP makes optimal use of the available bandwidth, approximately what average data rate will flow  $A_1 \rightarrow A_d$  receive?



## Question 4

- a) What are key characteristics of software-defined networks? How are they different from traditional networks?
- b) What are areas of application of SDNs? Are they suitable for all settings (Data Centers, ISPs, the Internet...)?

## Question 5

- a) In traditional data centers with non-virtualized network, moving services (or VMs or tenants) between machines can be difficult. Why?
- b) What are the possible solutions?

## Question 6

Suppose an NVP data center has one tenant with 10 VMs and one with 100 VMs. Each tenant allows any communication within its virtual network and no external communication. How many total unidirectional tunnels will be constructed in the data center?