

June 29th, 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 a rearrangeable switch of size 400×500 using only modules of size 10×10 , with the aim of minimizing the number of modules.

1. Draw the architecture.
2. Compute the total number of required modules.
3. What is the simplest routing algorithm that can be adopted?

Problem B

Consider a $N \times M$ input queued switch with Virtual Output Queueing and QoS support. For a generic (input- i , output- j) pair there exist two queues: VOQ_{ij}^H for high priority traffic (e.g. VoIP) and VOQ_{ij}^L for low priority traffic (e.g. web). An input traffic classifier sends the incoming packets to the correct queue.

1. Write in pseudocode a greedy algorithm to schedule the transmissions across the switching fabric, to maximize the number of high priority packets that are selected at each timeslot. Let $H[i][j]$ be the occupancy of VOQ_{ij}^H and let $L[i][j]$ be the occupancy of VOQ_{ij}^L .
2. Is it possible that low priority traffic will be starved indefinitely by high priority traffic? Motivate your answer with an example.

Problem C

Answer to the following questions related to cloud computing and data centers.

1. What are the key aspects of cloud computing, according to the NIST definition?
2. Define each cloud computing service model and provide at least two examples.
3. What does it mean that the cpu is virtualized in a data center?
4. What does it mean that the memory is virtualized in a data center?
5. What does it mean that the storage is virtualized in a data center?
6. What does it mean that the network is virtualized in a data center?
7. Describe the traffic within a data center, specifying the end-points and providing some examples.
8. What is the purpose of BGP within a data center?

Hints for the solution

Problem A

$$C_{400 \times 500} = 40 \times C_{10} + 10 \times C_{40 \times 50} + 50 \times C_{10}$$

Now the middle stage modules can be built as follows:

$$C_{40 \times 50} = 4 \times C_{10} + 10 \times C_{4 \times 5} + 5 \times C_{10} = 4 \times C_{10} + 5 \times C_{10} + 5 \times C_{10} = 14 \times C_{10}$$

Hence,

$$C_{400 \times 500} = 40 \times C_{10} + 10 \times 14 \times C_{10} + 50 \times C_{10} = 230 \times C_{10}$$