July 18th 2011

Exam of Switching architectures

Rules for the exam. It is forbidden to use notes, books or calculators. When needed, use approximations. Report the solution of each problem on a different paper sheet.

Time available: 70 minutes.

PROBLEM A
Consider a $4 \times 4$ input queued switch, with each port running at 8 Gbps. Assume that the internal timeslot corresponds to a 64 bytes packet. The following rate matrix must be guaranteed:

$$
\hat{R} = \begin{bmatrix}
1 & 1 & 1 & 1 \\
2 & 2 & 0 & 0 \\
0 & 2 & 1 & 1 \\
1 & 0 & 0 & 2
\end{bmatrix} \text{ Gbps}
$$

1. Draw the simplest Clos network which allows to use Paul algorithm to decompose the matrix.
2. Find the possible frame sequence, named $F_1$, according to Paul algorithm.
3. Use the Birkhoff-von Neumann decomposition to find the possible frame sequence, named $F_2$.
4. Are $F_1$ and $F_2$ the same? Why?
5. Under which admissibility conditions, the two frame sequences $F_1$ and $F_2$ allow to obtain the maximum throughput?

PROBLEM B
Consider a bufferless switch of size $N \times M$, running on a slotted fashion. At each timeslot, a broadcast packet (i.e., directed to all the $M$ outputs) arrives at each input with probability $p$.

1. compute the throughput in function of $p$
2. compute the admissibility condition for $p$
3. compute the maximum throughput under admissible traffic

PROBLEM C
Consider a non-interruptible, rearrangeable (NIR) switching network built with three stages.

1. Define the NIR property.
2. How can the switching network be designed?
3. Describe the control algorithm to configure the network.