Solution to Exam in TSIN02 Internetworking

Department of Electrical Engineering,
Linköping University

Exam date: August 28, 2014, 14:00–18:00

1. **Switches:** See lecture 2 and 3 on switches and DHCP. Only host A, B, and the DHCP server D have transmitted, so the switch table is A: 1; B: 2; , D: 4, OTHER: broadcast, except on interface where the frame arrived.

2. **CSMA:**

   a) See lecture 1 (the part on CSMA-CD and CSMA-CA method 1)!

   b) See lecture 1 (the part on CSMA-CA method 1 and 2)!

3. **Source coding for packet networks:**

   a) Performing the same calculations as in lectures 9 and 10, the stationary receive and loss probabilities are

$$\pi_r = \frac{P_{r|l}}{P_{l|r} + P_{r|l}} \approx 0.97, \quad (1)$$

$$\pi_l = 1 - \pi_r \approx 0.03. \quad (2)$$

   b) The number of reconstruction levels per description is $M = 10$, so $\Delta = \frac{1}{M}$. According to application layer lectures 3, 4, the distortion if the packet arrives is $\frac{\Delta^2}{12} \approx 8.3 \cdot 10^{-4}$.

   c) The stationary overall mean distortion is $D = \pi_r \frac{1}{12M^2} + \pi_l \approx 3.3 \cdot 10^{-2}$.

4. **IPv4 subnetting:** Calculating as in lesson 2, we have:

   Subnet C: 187.53.4.0-187.53.7.255/22

   Subnet B: 187.53.8.0-187.53.15.255/21

   Subnet A: 187.53.16.0-187.53.31.255/20

   256 addresses are left unused.

5. Following the whiteboard notes of lecture 5, or Section 11.2.3 of 20Q, we have that the net user utility before service upgrade is 200 SEK, and after service upgrade is -800 SEK. The service upgrade should thus not be done while applying this new pricing scheme.

6. a) The cost of exceeding capacity at day is

$$c_{day} = \max[100(d_{A,day}(1 - q_A(p)) + d_{B,day}(1 - q_B(p)) - 12), 0], \tag{3}$$

The cost of exceeding capacity at night is

$$c_{night} = \max[100(d_{A,night} + d_{A,day}q_A(p) + d_{B,night} + d_{B,day}q_B(p) - 12), 0]. \tag{4}$$

The rewards given out is

$$c_{reward} = p(d_{A,day}q_A(p) + d_{B,day}q_B(p)). \tag{5}$$

Therefore the objective function to minimize is $c_{day} + c_{night} + c_{reward}$ with the constraint $p \in [0, 100]$.

b) The optimal p can be found by a numerical search over p. The search over one variable p does not require much computational complexity.