Φροντιστήριο Κεφαλαίων 5 & 6

Βαρδάκης Γιώργος

Πρόβλημα 1

In section 5.3, we provided an outline of the derivation of the efficiency of slotted ALOHA. In this problem we'll complete the derivation.

a. Recall that when there are N active nodes, the efficiency of slotted ALOHA is $N * p * (1 - p)^{N-1}$. Find the value of p that maximizes this expression.

b. Using the value of p found in (a), find the efficiency of slotted ALOHA by letting N approach infinity. Hint: $(1 - 1/n)$ N approaches 1/e as N approaches infinity.

Πρόβλημα 1 - Απάντηση

a) Ισχύει E(p) = $N * p * (1-p)^{N-1}$. Για να βρούμε που μεγιστοποιείται υπολογίζουμε την πρώτη παράγωγο. Έτσι έχουμε:

E’(p) = $N(1-p)^{N-1}$ $-\mathrm{N} * \mathrm{p} * (\mathrm{N}-1) * (1-p)^{N-2}$

Θέλουμε E’[p]=0 => $N*(1-p)^{N-1} - N*p*(N-1)*(1-p)^{N-2}=0$=>

$N*(1-p)^{N} *(1-p)^{-1}- N*p*(N-1)*(1-p)^{N} *(1-p)^{-2}=0$=> $\frac{N}{1-p}$ - $\frac{N*p*(N-1)}{(1-p)^2}$ =0 =>

$N*(1-p)^2=(1-p)*N*p*(N-1)$ => 1-p = p*N-p => p’ = $\frac{1}{N}$

Πρόβλημα 1 - Απάντηση

b

$$E(p^*) = N * \left(\frac{1}{N}\right) * \left(1 - \frac{1}{N}\right)^{N-1} = \left(1 - \left(\frac{1}{N}\right)\right)^{N} / \left(1 - \left(\frac{1}{N}\right)\right)$$

$$\lim_{N\to\infty}\left(1 - \frac{1}{N}\right) = 1 \qquad \lim_{N\to\infty}\left(1 - \frac{1}{N}\right)^{N} = \frac{1}{e}$$

lim N->∞ E(p *) = 1/e = 0.37 = 37%

Πρόβλημα 2

Suppose there are two ISPs providing WiFi access in a particular café, with each ISP operating its own AP and having its own IP address block.

a. Further suppose that by accident, each ISP has configured its AP to operate over channel 11. Will the 802.11 protocol completely break down in this situation? Discuss what happens when two stations, each associated with a different ISP, attempt to transmit at the same time.

b. Now suppose that one AP operates over channel 1 and the other over channel 11. How do your answers change?

Πρόβλημα 2 - Απάντηση

a) The two APs will typically have different SSIDs and MAC addresses. A wireless station arriving to the café will associate with one of the SSIDs (that is, one ofthe APs). After association, there is a virtual link between the new station and the AP. Label the APs AP1 and AP2. Suppose the new station associates with AP1. When the new station sends a frame, it will be addressed to AP1. Although AP2 will also receive the frame, it will not process the frame because the frame is not addressed to it. Thus, the two ISPs can work in parallel over the same channel. However, the two ISPs will be sharing the same wireless bandwidth. If wireless stations in different ISPs transmit at the same time, there will be a collision. For 802.11b, the maximum aggregate transmission rate for the two ISPs is 11 Mbps.

Πρόβλημα 2 - Απάντηση

b) Now if two wireless stations in different ISPs (and hence different channels) transmit at the same time, there will not be a collision. Thus, the maximum aggregate transmission rate for the two ISPs is 22 Mbps for 802.11b.

Πρόβλημα 3

In step 4 of the CSMA/CA protocol, a station that successfully transmits a frame begins the CSMA/CA protocol for a second frame at step 2, rather than at step 1. What rationale might the designers of CSMA/CA have had in mind by having such a station not transmit the second frame immediately (if the channel is sensed idle)?

Πρόβλημα 3 - Απάντηση

Suppose that wireless station H1 has 1000 long frames to transmit. (H1 may be an AP that is forwarding an MP3 to some other wireless station.) Suppose initially H1 is the only station that wants to transmit, but that while half-way through transmitting its first frame, H2 wants to transmit a frame. For simplicity, also suppose every station can hear every other station's signal (that is, no hidden terminals). Before transmitting, H2 will sense that the channel is busy, and therefore choose a random backoff value.

(next slide...)

Πρόβλημα 3 - Απάντηση (συνέχεια)

Now suppose that after sending its first frame, H1 returns to step 1; that is, it waits a short period of times (DIFS) and then starts to transmit the second frame. H1's second frame will then be transmitted while H2 is stuck in backoff, waiting for an idle channel. behind this design choice. Thus, H1 should get to transmit all of its 1000 frames before H2 has a chance to access the channel. On the other hand, if H1 goes to step 2 after transmitting a frame, then it too chooses a random backoff value, thereby giving a fair chance to H2. Thus, fairness was the rationale