Massachusetts Institute of Technology
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6.02 Fall 2011 **Solutions to Chapter 16** Written: November 13, 2011

Please send information about errors or omissions to hari; questions best asked on piazza.

1. (a) To prevent unfairness caused by some nodes being starved.
   (b) To prevent the capture effect, in which one node dominates the medium for several packets in a row.
   (c) The utilization will be (much) lower than the theoretical maximum (e.g., much lower than $1/e$ for slotted Aloha). The reason is that the collision rate will be very high.
2. See PSet.
3. See PSet.
4. (a) True; e.g., if one node is backlogged and the others aren't, Aloha's utilization will be 1, while TDMA will be $1/N$.
   (b) False; p will change dynamically with successes and collisions, and will not converge to any particular value in general.
   (c) False; $U = 3 \cdot (1/3) \cdot (1 - 1/3)^2 = 4/9 \neq 1/e$.
   (d) False; TDMA can achieve 100% uilization, but slotted Aloha will converge to an expected value of $1/e$.
   (e) False; contention windows guarantee a transmission *attempt* within a bounded time, but there's no guarantee of success.
5. (a) $U = p(1-2p)^2 + 2(2p)(1-p)(1-2p) = 0.384$.
   (b) Note that $p < 0.5$ because p_B and p_C must be smaller than 1.

   $$U = p(1-2p)^2 + 2(2p)(1-p(1-2p) = 5p - 16p^2 + 12p^3.$$

   The maximum value of U is 0.456, occurring when $p = 0.202$ (the other extremum of 0.687 is not valid because $p < 0.5$.
6. See PSet.
7. See PSet.
8. (a) All four nodes positioned so they can hear each other perfectly.
   (b) A and B can hear each other well; A and C can hear each other well; B and D can hear each other well. But D can't hear A and C can't hear B. A now sends to C and B to D. This is also called an "exposed terminal" situation.
9. See PSet.
10. See PSet.
11. See PSet.
12. See PSet.

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