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Due until 12 Dez 2006

Exercises of lecture
Wireless Sensor Networks
Winter 2006/2007

Sheet 6

SECTION 1:
Preamble Sampling, TRAMA

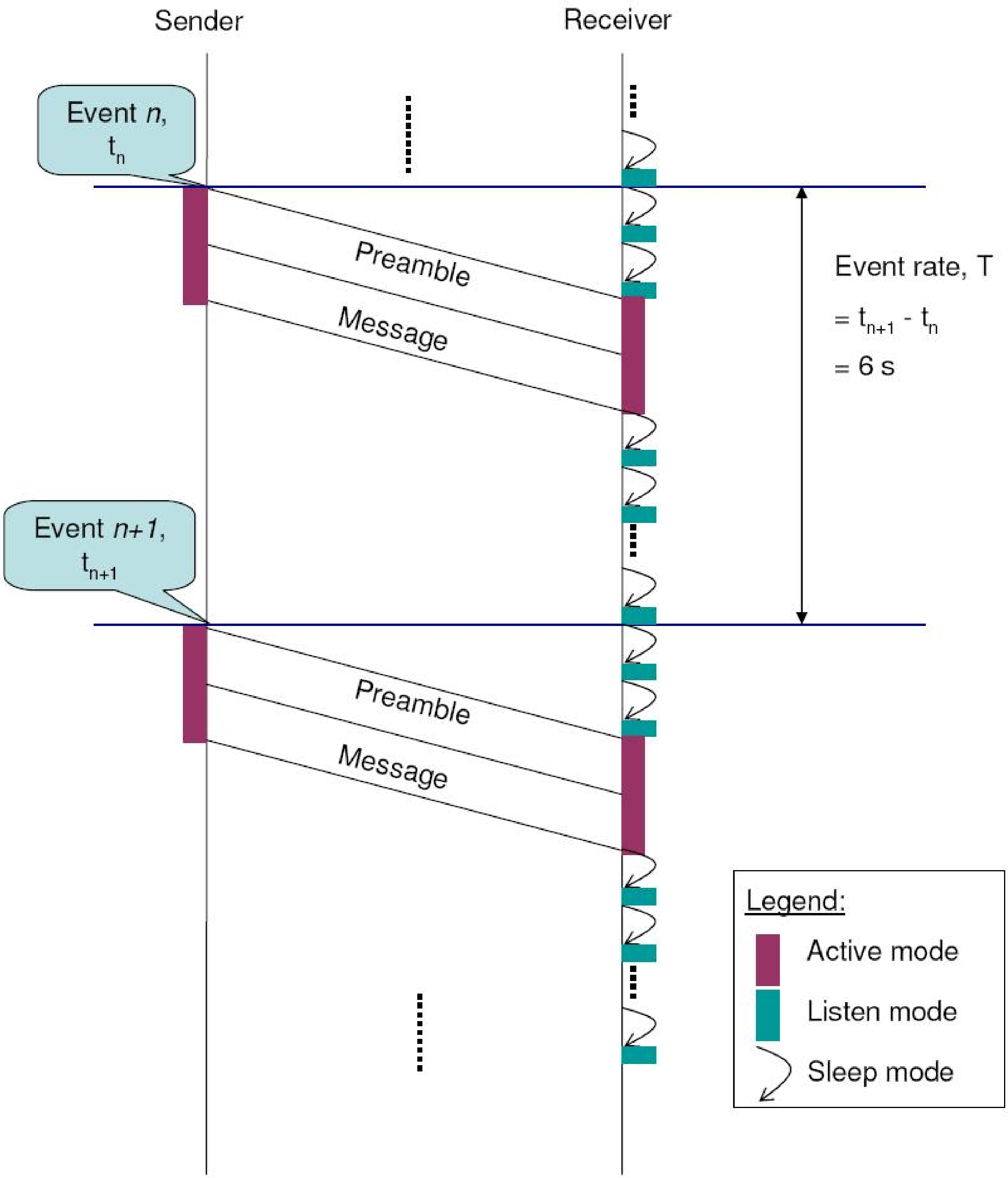
1. Based on the diagram that represents the worst case scenario on the next page, the following data is given for each sensor node in a wireless sensor network to collect the temperature and moisture level of a forest:

   Average number of data collection event: 10 events per minute
   Number of message(s) per event, m: 1 message per event
   Preamble interval = Listening interval + Sleeping interval
   Listening interval = 0.05 s
   Power needed for Listening mode, P_{Listen}= 0.8 W
   Power needed for Receiving mode, $P_{Receiving}$ = 0.9 W
   Power needed for Transmitting mode, $P_{Transmitting}$ = 2 W
   Preamble interval and message interval are always the same, which is equal d.

   (a) Find the the optimum value for the preamble signal, d for this particular application? [Hint: Refer to slide 61 of 64 on Lecture 8 at *http://download.informatik.uni-freiburg.de/lectures/WirelessSensorNetworks/2006-2007WS/LectureRecordings/Flash/WSN-08/WSN-08.html*]

   (b) Similarly, find out the optimum value for the preamble signal if the message interval is always the double of that of the preamble interval.

   (c) With the preamble, the transmission and reception length are increased. Will it have impact on collision?



Solution:

(a) Considering the total energy consumption for the WSN per event (energy unit used is Joule):

Energy consumption at Sender, E_s
$= 2 \times d \times P_{Transmitting}$
$= 2 \times d \times 2$
= 4d

Energy consumption at Receiver, E_r
$= 2d \times P_{Receiving} + ((T - 2d)/d) \times listeninginterval \times P_{Listen}$
$= 2d \times 0.9 + ((6 - 2d)/d) \times 0.05s \times 0.8$
= 1.8d + 0.24/d - 0.08

Total energy consumption, E
$= c \times d + c'/d + c$"
$= E_s + E_r$
c = 5.8
c' = 0.24
c" = -0.08

Differentiate E:
$c - c'/d^2 = 0$
$d^2 = c'/c = 0.24/5.8$
$d = \sqrt{0.24/5.8}$

(b) Based on same steps used for previous question. Considering the total energy consumption for the WSN per event:

Energy consumption at Sender, E_s
$= 3 \times d \times P_{Transmitting}$
$= 3 \times d \times 2$
= 6d

Energy consumption at Receiver, E_r
$= 3d \times P_{Receiving} + ((T - 3d)/d) \times listeninginterval \times P_{Listen}$
$= 3d \times 0.9 + ((6 - 3d)/d) \times 0.05s \times 0.8$
= 2.7d + 0.24/d - 0.12

Total energy consumption, E
$= c \times d + c'/d + c$"
$= E_s + E_r$
c = 8.7
c' = 0.24
c" = -0.12

Differentiate E:
$c - c'/d^2 = 0$
$d^2 = c'/c = 0.24/8.7$
$d = \sqrt{0.24/8.7}$

(c) Probability of collision due to longer transmission is increased too.

2. TRAMA is a MAC protocol which is based on TDMA. In TRAMA each node knows schedule and priority of its two hops neighbors within a given time slot. Hence in a given time slot, a node with highest priority among nodes with data, is given chance to transmit. A PhD student claims to improve design where a node now knows schedule of more than two hop neighbors then will this new protocol will further improves the performance of TRAMA? Explain.

   Answer: No! The PhD student has not improve any thing. Recall at MAC layer we only transmit one hop neighbors. Hence we have to see that maximum of what hop nodes, of a sender, can interfere a transmission at MAC layer. **One hop nodes:** a node which is one hop away from the sender and also one hop from the receiver can send data to receiver, in case no carrier sense is used. **Two hop nodes:** a node which is two hop away from sender and one hop away from receiver can send data to receiver, even if carrier sense is used. This situation can create hidden-terminal-problem (at the receiver) hence knowing schedule of such nodes is useful. Similarly when a possible receiver is overhearing data from a two hope neighbor then sending data is useless. It is because it cannot receive (hear) the data transmission. **Three or more hop nodes:** There are no situation where receiving or sending data schedules of three or more hop neighbor might be useful. Hence the PhD student work might end up wasting resources (like memory and CPU cycles) for nothing.