Exercises of lecture

Wireless Sensor Networks

Winter 2006/2007

Sheet 5

SECTION 1:
MAC protocols

1. The design of energy-efficient strategies to prolong the lifetime of sensor node is of utmost importance. To date, many evergy-efficient protocols have been proposed for WSN. One of them is S-MAC. It was proven in the experiment conducted on the Mote sensor node by WeiYe and et. al. [1] that the S-MAC protocol is capable of reducing the energy consumption to 2-6 times than that of an 802.11-like MAC protocol. What are the energy-saving methods being adopted by S-MAC protocol? Identify the drawback(s) of S-MAC if any.
   answer:
   1) Its periodic sleep and wakeup mechanisum saves energy.
   2) Furthermore when a node cannot transmit and recieve because it overhears transmission of some other node then it goes to sleep too.
   3) The node send data in big brust of fragments. That decreases the control over head associated with RTS/CTS.

2. Consider a protocol which is based on RTS/CTS messages. Furthermore in this protocol nodes not use CSMA and never sleep. In this protocol, any node that overhears CTS (with or without hearing RTC) defer it transmission for the time-period data will take to transfer (for example node-E). Furthermore, when any node overhears RTS (from a Node-B), it defers its transmission until CTS should have been received. *However, a node (consider node-C) resumes transmission when CTS is not heard after RTS within a specified time period, because it is out of range from reciever (or because of collision).*

   (a) The protocol creator claims that he has solved hidden terminal problem (hint: also consider node-C start sending data to node-B). Explain if his claim is right or wrong?
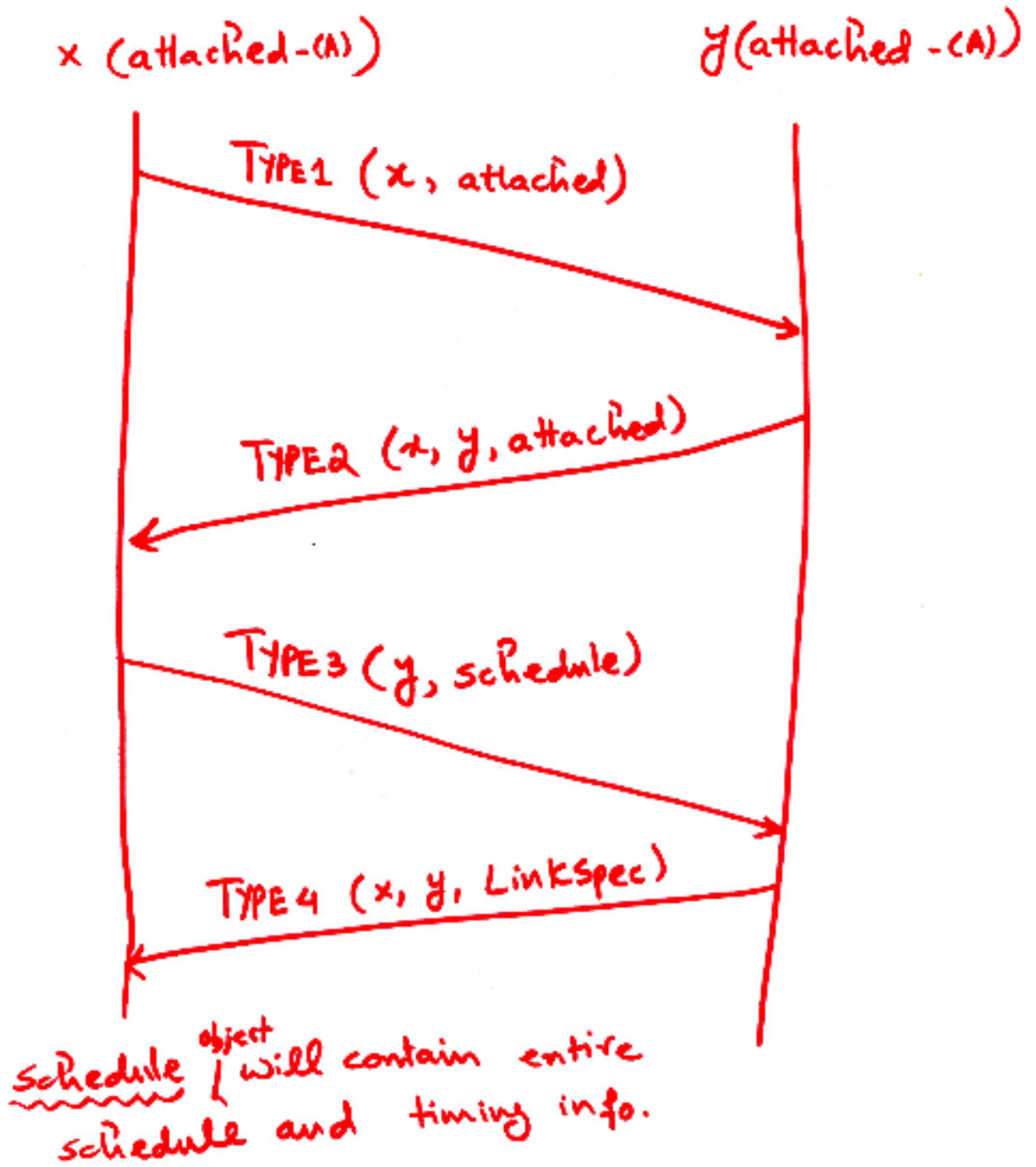   **answer:** Yes it solves the hidden terminal problem. Recall, we have collision at reciever and not at the sender. Hence when node-C start sending data to node-B there is not conjestion/collision given that it data range cannot reach the reciever.

   (b) Furthermore, the protocol creator claims that he has also solved exposed terminal problem. Explain if his claim is right or wrong?
       answer: No! It does not solve exposed terminal problem. It is because even though now node-C can now send packet but it cannot listen. Hence without listening it

cannot intiate RTS/CTS messaging. One possible answer could be that node-C should send data without RTS/CTS however such action can create hidden terminal problem.

3. **SMACS protocol**: Both node x and node y have already few "links" attached with other nodes. Draw the messaging diagram (similar to one drawn in class) to establish a new link between node x and y.

x (attached-(A))   y (attached-(A))

TYPE1 (x, attached)

TYPE2 (x, y, attached)

TYPE3 (y, schedule)

TYPE4 (x, y, LinkSpec)

schedule object will contain entire schedule and timing info.

4. **IEEE 802.15.4**:

   (a) State **three** reasons that why a device has to wake up to listen beacon transmission when it has already a guaranteed time slot reserved and can be used to send/receive information to/from it.
   1) It slot might be de-listed by the coordinator due to lack of activity.
   2) Coordinator might have data to send that it cannot fit in number of time-slot reserved for the device.
   3) The beacon has the length of the superframe, furthermore it gives length of "Guranteed time slots (GTS)" and "Contention access period" in it. A change on these lenght decide the time period a device can sleep.

   (b) State **two** reasons that why a guaranteed time slot reserved for a device can be de-listed by coordinator?

   1) Coordinator might have de-listed it because of lack of activitiy.
   2) Device request to delist it might be fulfilled by the coordinator.

References

1. Wei Ye, John Heidemann and Deborah Estrin, *An Energy-Efficient MAC Protocol for Wireless Sensor Networks*, In Proceedings of the 21st International Annual Joint Conference of the IEEE Computer and Communications Societies (INFOCOM), Vol.3, pp. 1567-1576, New York, NY, USA, June, 2002.