2022

COMPUTER SCIENCE AND ENGINEERING

Paper : CSEL-843

(Elective IV : Wireless Sensor Networks)

Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer ***question nos.*** **1, 2** and ***any four*** questions from the rest.

1. Answer ***any five*** from the following : 2×5

(a) State the principal advantages and disadvantages of multi-hop communication.

(b) Why the sensor nodes in WSN must be self-configurable?

(c) State examples of delay sensitive and delay tolerant WSN based applications.

(d) The key idea behind CSMA/CD is that the sender detects collisions, allowing it to react correspondingly. Why is this approach not practical in wireless networks?

(e) In a CSMA/CA network, nodes use a random delay before accessing the medium. Why is this being done?

(f) Is overhearing a problem in a wireless sensor network? Give reasons.

(g) Why DSDV uses 'immediate advertisement' instead of periodic advertisement for any change in network?

2. Answer ***any five*** from the following : 4×5

(a) How does the S-MAC protocol reduce the duty cycles of sensor nodes?

(b) State Hidden Station problem. How is it addressed in MACA?

(c) What is data-centric routing? Why is data-centric routing feasible (or even necessary) compared to routing based on identities (addresses)?

(d) Asymmetric (or unidirectional) links occur when node A can hear node B, but B cannot hear node A. Is it a problem for the AODV protocol? If so, how this can be addressed?

(e) In AODV, is it possible that route discovery packets travel in the network forever? Why or why not?

(f) Discuss the role of PCF; even if DCF exists in the same layer for medium access.

(g) Consider an application where WSN is used to measure humidity in a field. Low-power sensors report measurements only when certain thresholds are exceeded. What type of routing will be effective for this scenario? Justify your answer.

3. Comment with justification for using a schedule based protocol in WSN. State the motivations behind proposing TRAMA (Traffic Adaptive Medium Access Protocol) compared to TDMA. Describe, in brief, each of the phases of the TRAMA protocol highlighting the contribution of the said protocol. 2+2+6

4. (a) Energy efficiency, Scalability, Adaptability and Low latency are the four important requirements of WSN. Describe concrete WSN applications where a specific requirement would be more important than the others.

   (b) "Knowledge about location of the node(s) helps to improve performance of routing protocol in Ad-hoc network." —comment on this statement with justification. 6+4

5. (a) In general, the large sensor networks are clustered. State the reasons.

   (b) Explain Query driven routing in WSN through an example.

   (c) Discuss a receiver-initiated MAC scheme (used in WSN) highlighting the advantages over sender-initiated approaches. 3+3+4

6. Flooding is a simple strategy for distributing data to all sensor nodes in a network with limitations. Answer the following questions:

   (a) State the limitations (Challenges) of flooding.

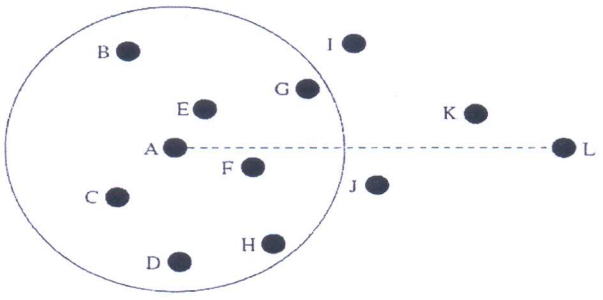
   (b) Which of these can be addressed by gossiping and how can they be addressed?

   (c) How do sequence numbers contribute to reducing unnecessary transmissions? Are sequence numbers alone sufficient and, if not, what other information is needed to use them correctly?

   (d) How does the SPIN family of protocols address the said challenges?

   (e) Comment about the addressing of the said challenges by Directed Diffusion compared to the strategies used by SPIN. 2+2+2+2+2

7. (a)



   Consider the above topology. Node A wishes to forward a packet toward destination L via one of its neighbours (its communication range is indicated with the circle). Which neighbour will A choose for each of the following forwarding strategies?

   Greedy forwarding, Most forwarding progress, Nearest with forwarding progress, Compass routing

   (b) Discuss the cluster head election policy in the LEACH protocol and explain how LEACH can consider the available energy on each node in this election process. State your opinion, with necessary justifications, regarding the choice of TDMA within a cluster by LEACH. 4+(4+2)

8. (a) Define the usefulness of the terms 'Coverage' and 'Connectivity' in context of WSN design.

(b) Distinguish between point coverage and barrier coverage problem through an example.

(c) Discuss an algorithm to ensure area coverage with minimum number of sensor nodes. 2+3+5

9. (a) Through a concrete example, state the need of time synchronization in a WSN.

(b) Discuss two new challenge(s) for designing time synchronization protocol for WSN.

(c) Node A sends a synchronization request to node B at 3150 (on node A's clock). At 3250, node A receives the reply from node B with a time stamp of 3120.

- What is node A's clock offset with respect to the time at node B (you can ignore any processing delays at either node)?
- Is node A's clock going too slow or too fast?
- How should node A adjust the clock?

(d) Discuss the differences in the design of the TPSN and the LTS synchronization protocols.

3+2+2+3