Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(TAKE HOME)
SEMESTER II
SESSION 2020/2021

COURSE NAME	:	WIRELESS SENSOR AND MOBILE AD HOC NETWORKS
COURSE CODE	:	BEJ 41503 / BEB 42003
PROGRAMME CODE	:	BEJ
EXAMINATION DATE	:	JULY 2021
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWERS ALL QUESTIONS **OPEN BOOK EXAMINATION**

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

Q1 Node lifetime and wireless sensor networks lifetime are fundamentally crucial in the implementation of wireless sensor networks for forest fire monitoring. These nodes and network lifetime are determined by the energy consumption, thus, the energy consumption is the main concern in a sensor node and the wireless sensor network system. Consider the wireless sensor networks which are organized as cluster.

(a) Differentiate the operation of cluster head and ordinary node for one round operation using flow diagram.

(8 marks)

(b) Consider a wireless sensor network shown in **Figure Q1(b).** It consists of two cluster headers, CH1 and CH2. Both CH1 and CH2 are connected to two different ordinary nodes. Assume that the sources of energy consumption are from the ordinary nodes and Cluster Head activities given by **Table Q1(b)(i)**.
Assume the free space fading as the propagation model with exponent 2, the number of sensing bit is ***b***, and the weighting factor for sensing, transmitting and receiving are given by $\{ h_2 , h_3 \} = \{1.4, 1.6\}$.

(i) Derive the total energy model for the network in terms of the variables concerned.

(12 marks)

(ii) Calculate the total energy consumed for the network. The variables are shown in **Table Q1(b)(ii).**

(5 marks)

Q2 Low Energy Adaptation Clustering Hierarchy (LEACH) algorithm is one of well known WSN routing algorithms. It is hierarchical based and need to select a leader in each round of data transmission.

(a) Distinguish the characteristics of LEACH algorithm.

(8 marks)

(b) Examine in detail the operation of LEACH, including all of its phases involved, the flow diagrams and **TWO (2)** mechanisms of cluster head selection.

(17 marks)

Q3 (a) Routing protocol is one of the very important elements in the management of mobile ad hoc network. State and explain briefly **THREE (3)** design objectives of routing protocols with regards to wireless mobile ad hoc network.

(6 marks)

(b) Ad Hoc On Demand Distance Vector (AODV) is a well-known protocol for mobile ad hoc network. It consists of a number of sub-protocols namely Route Discovery and Route Reply.

(i) Explain the operation of Route Discovery Protocol at the source, intermediate and destination.

(7 marks)

(ii) Analyze **FOUR (4)** optimization processes as applied to AODV protocol.

(12 marks)

Q4 (a) In the second model WSN/IoT Integration, it defines the adaptation layer of IPv6 over IEEE802.15.4 by a layer known as Low Power Wireless Personal Area Networks (6LoWPAN). One of the optimization processes is by IPv6 Header Compression.

(i) Describe the technique of IPv6 Header Compression.

(5 marks)

(ii) Calculate the percentage of improved protocol efficiency by the IPv6 Header compression.

(4 marks)

(b) For the WSN/IoT Integration one of the optimization processes is the IPv6 Header Compression as mentioned in **Q4(a)**. Evaluate **FOUR (4)** other optimization mechanisms in which 6LOWPAN protocol is utilized to adapt the integration of IPv6 to the 802.15.4 protocol.

(16 marks)

-END OF QUESTIONS -

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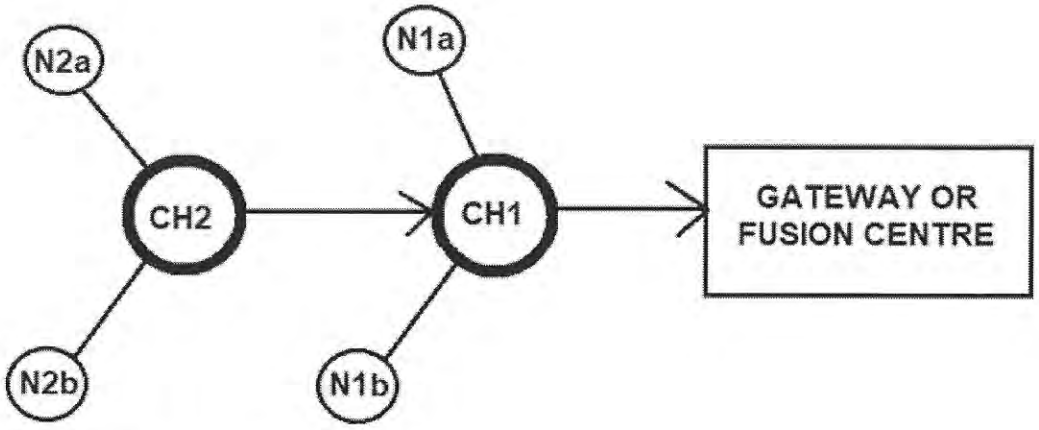

CH1, CH2 - cluster head
N1a, N1b - ordinary nodes connected to CH1
N2a, N2b - ordinary nodes connected to CH2

Figure Q1(b)

Table Q1(b)(i)

Types of Node	Cluster Head	Ordinary Nodes
Sources of Energy Consumption	Sensing, Receiving and Transmitting	Sensing and Transmitting

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Table Q1(b)(ii)

SYMBOL	DESCRIPTION	VALUE
N_{cyc}	Number of clock cycles per task	0.97 x 10^6
C_{avg}	Average capacitance switch per cycle	22pF
V_{sup}	Supply voltage to sensor	2.7 V
f	Sensor frequency	191.42 MHz
n_p	Constant depending on the processor	21.26
n	Path loss exponent	2 or 4
I_o	Leakage current	1.196 mA
V_t	Thermal voltage	0.2 V
b	Transmit packet size	2048 bits
E_{elec}	Energy dissipation: electronics	50 nJ/bit
E_{amp}	Energy dissipation: power amplifier	100 pJ/bit/m^2
T_{tranON}	Time duration: sleep -> idle	2450 µs
$T_{tranOFF}$	Time duration: idle -> sleep	250 µs
I_A	Current: wakeup mode	8 mA
I_S	Current: sleeping mode	1 µA
T_A	Active Time	1 ms
T_S	Sleeping Time	299 ms
T_{tr}	Time between consecutive packets	300 ms
T_{sens}	Time duration: sensor node sensing	0.5 mS
I_{sens}	Current: sensing activity	25 mA
I_{write}	Current: flash writing 1 byte data	18.4 mA
I_{read}	Current: flash reading 1 byte data	6.2 mA
T_{write}	Time duration: flash writing	12.9 mS
T_{read}	Time duration: flash reading	565 µs
E_{actu}	Energy dissipation: actuation	0.02 mJ
h_1	CH weight factor, for processing	1.2
h_2	CH weight factor, for transmission and receiving.	1.4
h_3	CH weight factor, for sensing	1.6
h_4	CH weight factor, for sensor logging	1.8
d	Transmission range	30 m