BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE AND ENGINERRING

DEPARTMENT OF COMPUTER SCIENCE

BSc HONS DEGREE IN NETWORK ENGINEERING

NWE405: INTERNET OF THINGS

DURATION: 2HRS 30 MINS TOTAL MARKS: 100

INSTRUCTIONS TO CANDIDATES

Answer all questions.

- OCT 2024

Question 1

a. Explain the main advantage of the virtual carrier sensing technique over the physical carrier sensing technique, which are used in the IEEE802. Wireless Local Area Network (WLAN). [5 marks]

b. List **three** main design requirements of an IoT network. [3 marks]

c. Evaluate **two** techniques that can be used to minimise energy consumption of a sensor node. [6 marks]

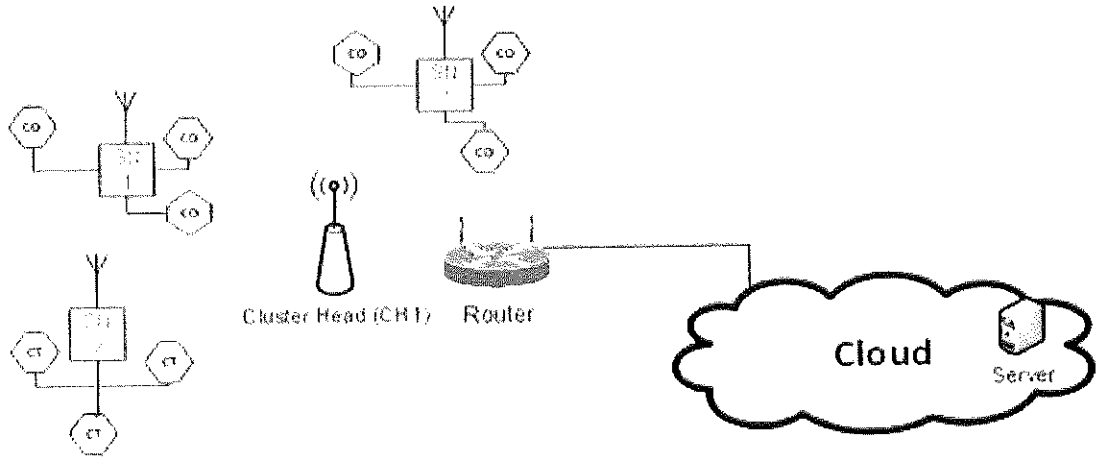
d. Explain how the slotted CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance) protocol is used by the IEEE802.15.4 standard to transmit packets from a sensor node. Use the superframe structure to explain the operation of this protocol. [6 marks]

Question 2

a. Explain the **two** main advantage of the edge computing architecture over the cloud computing architecture for IoT applications? [4 marks]

b. Consider the IoT network where sensor data are stored in a cloud storage server. The sensor network uses 6LoWPAN/IEEE802.15.4 protocols. The cluster head (CH) also uses 6LoWPAN/IEEE802.15.4 protocols to transmit data to the router. The router is connected to the cloud via an Ethernet link of 40 Mbits/sec. The router-to-cloud

distance is 10 km. The sensor nodes use the CoAP (Constrained Application Protocol) whereas the cloud server uses the http protocol.



Draw the protocol stacks of the Cluster Head, Router, and Cloud Server. [5 marks]

c. Assume that each cluster head is allowed to send 20 data packets per minute. The router is allowed to send one data packet per minute to the cloud server.

Calculate:

i. The maximum possible payload size of the sensor nodes. [3 marks]

ii. The transmitted Ethernet packet size. [3 marks]

iii. The Ethernet packet transfer delay [3 marks]

Question 3

a. Draw the IoT reference model. Explain how the model can be used to design a smart city IoT system. [7 marks]

b. Illustrate the main differences between the CoAP (Constrained Application Protocol) and the MQTT (Message Queue Telemetry Transport) protocols. [6 marks]

c. Demonstrate how the MQTT protocol can be used to distribute data to a large number of application servers. [5 marks]

Question 4

a. Explain the concept of Edge Computing in IoT. Discuss the advantages and disadvantages of Edge Computing in IoT systems. [10 marks]

b. Discuss the applications of IoT in various industries, such as healthcare, manufacturing, and transportation highlighting or showing the benefits and challenges of IoT adoption in these industries. [14 marks]

Question 5

a. Discuss the importance of device management in IoT. [8 marks]

b. Explain the device lifecycle management process and the challenges of managing large-scale IoT deployments. [12 marks]

END OF PAPER