

Sub:	IoT&WSN				Sub Code: 18EC741
Date:	/12/2022	Duration:	90 Minutes	Max Marks:	50
					Sem / Sec: A,B,C,D

Answer any FIVE FULL Questions

1	<p>Explain the single node architecture with necessary hardware components. [10]</p> <p>The main architecture of sensor node includes following components:</p> <p>Controller module Memory module Communication module Sensing modules Power supply module</p> <p>Controller</p> <ul style="list-style-type: none"> ▪ <u>It is core of a wireless sensor network.</u> ▪ <u>It collects data from the sensors, processes this data, decides when and where to send it, receives data from other sensor nodes and decides on actuator's behavior.</u> ▪ It is CPU of sensor node as <u>it executes various programs</u> ranging from time critical signal processing and communication protocols to application protocols ▪ <p>Communication module</p> <ul style="list-style-type: none"> ➤ The communication module of a sensor node is called "Radio Transceiver". ➤ The essentially tasks of transceiver is to "transmit" and "receive" data between a pair of nodes. ➤ Depends upon the <ul style="list-style-type: none"> a) Choice of transmission medium b) Transceivers <p>Sensors</p> <p>Collect data from environment</p> <ul style="list-style-type: none"> • Main categories <ul style="list-style-type: none"> • Passive • Passive, narrow-beam • Active sensors <p>Actuator</p> <p>A device or mechanism capable of performing a physical action for example motor, light bulb, LEDs etc</p> <p><u>Memory:</u></p> <ul style="list-style-type: none"> ✓ Memory is required to store programs and intermediate data; usually, different types of memory are used in WSN for programs and data. ✓ <u>Random Access Memory (RAM)</u> to store intermediate sensor readings, packets from other nodes, and so on. ✓ RAM is fast, its main disadvantage is that it loses its content if power supply is interrupted. ✓ <u>Read-Only Memory (ROM)</u> Program code can be stored in Read-Only Memory (ROM) or in Electrically Erasable Programmable Read-Only Memory (EEPROM) or flash memory. <p><u>Flash memory</u> is similar to EEPROM but data can be erased or written in blocks instead of only a byte at a time. It can also serve as intermediate storage of data in case RAM is insufficient or the power supply of RAM should be shut down</p>
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Explain crucial points influencing the physical layer of WSN. [10]

- Both wired and wireless communication can be used.

- Wired communication:

It can be carried out by using field buses like LON, CAN etc.

- Wireless communication

- ✓ It can be radio frequencies, light, ultrasound etc
- ✓ It provides relatively high data rate and does not require the line of sight between sender and receiver.
- ✓ It uses communication frequency between 433 MHz to 2.4 GHz.

- Transceivers is the combination of transmitter and receiver.
- The main task is convert the bit stream coming from microcontroller to the radio waves.

They can also perform modulation , demodulation, amplification and so on.

- Radio performance
- **Carrier frequency and multiple channels**
- Transceiver can operate at different carrier frequencies and must support multiple channels like FDMA, TDMA, CSMA, ALOHA etc
- **State change times and energy**
- Transceiver can operate in different modes sending and receiving using different channels.
- In such cases the time and energy required to change the between two states is an important figure of merit.
- **Data rates:**
- Typical values are few tens kilobits/sec.
- **Modulation**
- Transceiver supports on/off keying, ASK, FSK etc.
- **Noise figure**
- $NF = SNR_I / SNR_O$
- **Gain**
- Ratio of output signal power to input signal power.
- **Receiver sensitivity**
- It defines the minimum signal power at the receiver needed to achieve minimum E_b/N_0 .

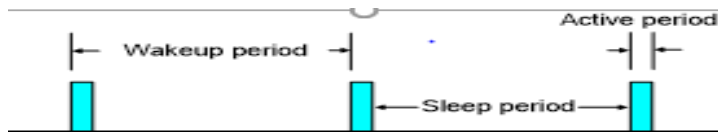
3.

3 Write a short note on low duty cycle protocols and wake up concepts and explain the S-MAC protocol with necessary figure. [10]

Low duty cycle protocols and wakeup protocols

Wake up channel time 'T': (sleep period + active period)

It is divided into sleep period and listen period 'Trx' ($T \gg \gg Trx$) and these together are called wake up period.



Duty cycle: Ratio of active and wakeup period. As the active period is very less as compared to wakeup period hence called as Low duty cycle.

- **Periodic wakeup scheme:** The Node uses periodic wakeup scheme. Here the node spend most of time in sleeping state and wakeup periodically in 'listen period' to receive packets from other nodes. The sleep state is left only when node is about to transmit and receive packets. All the nodes must be synchronized to this wakeup period.

3 b S-MAC protocol

- Stands for Sensors Medium Access Control
- Also called as S-MAC or Scheduled MAC.
- Specifically designed for Ad hoc wireless sensor networks
- Primary goal: Energy Efficiency

Main features of SMAC include

- Periodic Listen and sleep
- Collision Avoidance
- Overhearing Avoidance
- Message Passing

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- Nodes exchange their schedule by periodically broadcasting SYNC packet in active period.
- Nodes Listen for SYNC packets for a fixed amount of time.

4.

Explain 6LoWPAN and TRAMA protocol [10]

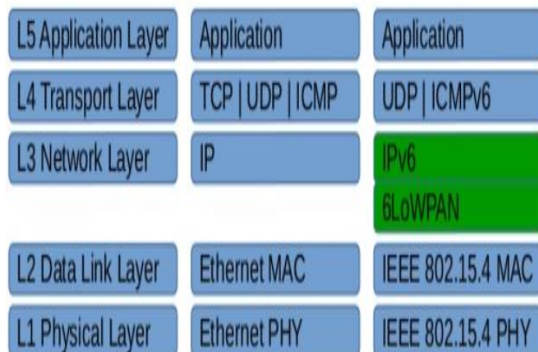
- TRAMA protocol creates schedules allowing nodes to access a single channel in collision free manner.
- Schedules are created in the distributed manner and on demand.
Nodes are time synchronized and divide the time into
 - Random access periods
 - Scheduled access periodsCycle: Random access period followed by a scheduled access period is called as cycle.

TRAMA Working

- Nodes broadcast their schedules and periodically provide their neighbors with updated list of receivers for the packets stored in queue.
- Nodes exchange neighborhood information by capturing the respective packets from neighbor.
- They learn about their two-hop neighborhood.
- Hence nodes execute distributed scheduling algorithm to determine for each time slot of the scheduled access period of transmitting nodes and receiving nodes.

6LoWPAN

- **6LoWPAN** is an acronym of IPv6 over Low -Power Wireless Personal Area Networks (WPAN).
- 6LoWPAN concept originated from the idea that “even the smallest and the low-power devices (operating in LR-WPAN) with limited processing capabilities can participate in the Internet of Things
- 6LoWPAN sits between network layer and data link layer hence called as **adaptation-layer protocol** for the IEEE 802.15.4 network devices.
- Features of 6LoWPAN are **header compression, fragmentation and reassembly.**
- The devices are the **WPAN** nodes having low power and low speed and forms a mesh network.



5. Write a short note on Optimization goals and figure of merit [10]

- The main challenge for a network is how to optimize a network.
- Optimization and figures of merit depend upon certain parameters like:
 - ❖ Quality of service
 - ❖ Energy efficiency
 - ❖ Scalability
 - ❖ Robustness

Quality of service involves:

A) Low level networking device observable attributes like: Bandwidth, delay, jitter, packet loss rate
B) High level, user observable also called as subjective attributes like: Quality of voice communication or video transmission

Energy efficiency:

The Energy efficiency of the WSN can be increased by considering various aspects.

- **Energy per correctly received bit:**
It defines the average energy consumed in transporting and receiving one bit of information, after considering all possible intermediate hops from source to destination.
- **Energy per reported event:**
It defines the average energy consumed in reporting one event. Since same event can be reported from various sources. Hence redundant information can be reduced.

Scalability:

With WSN potentially consisting of thousands of nodes, the ability to maintain performance characteristics irrespective of the size of the network is referred to as scalability.

The need for extreme scalability has direct consequences for the protocol design as the complexity will increase and can effect the performance.

Robustness:

Wireless sensor networks should also exhibit an appropriate robustness

They should not fail just because a limited number of nodes run out of energy, or because their environment changes and severs existing radio links between two nodes

If possible, these failures have to be compensated by finding other routes.

6. Write a short note on 1) Network gateway 2) Event based programming 3) Process based programming. [10].

PAMAS: Power Aware Multi-Access with Signaling

- a) **Signaling channel/control channel:** For sending RTS/CTS messages and busy tone messages and it enables the nodes to determine that for how long they can power off themselves.
- b) **Data channel:** Actual data transmission happens.

Network gateway

A gateway is a network node used in **telecommunications that connects two networks with different transmission protocols together**. Gateways serve as an entry and exit point for a network as all data must pass through or communicate with the gateway prior to being routed.

But here occurs some issues like

- How to handle the several gateways.
- Choose “best” gateway (integrates routing & service discovery)
- Finding the host IP address to which it has to be forwarded.

Event-based programming:

- ✓ In **Event-driven programming** the flow of the program is determined by events such as
 - User actions (mouse clicks, key presses)
 - Sensor outputs
 - Arrival of packets
 - Expiration of a timer or messages from other programs/threads.
- ✓
- ✓ **Event handler:** These events are handled by a set of instructions that store the necessary information about the occurrence of event are called Event handler.

Process-based concurrency:

- ✓ It is concurrent (parallel) execution of multiple processes at the same time on a single CPU.
- ✓ Processes communicate using messages
- ✓ Disadvantage:
Equating individual protocol or layer to individual process leads to high overhead.

7. Explain the LEACH protocol in WSN with necessary figures. [10]

LEACH (Low-Energy Adaptive Clustering Hierarchy)

- **It is self-organizing, adaptive clustering protocol that uses dynamic clustering method.**
- Base station (sink) is fixed and away from sensors.
- LEACH conserves energy

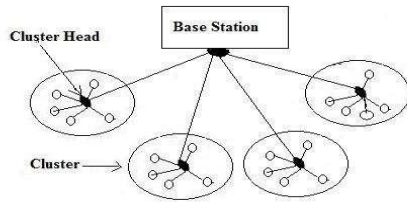
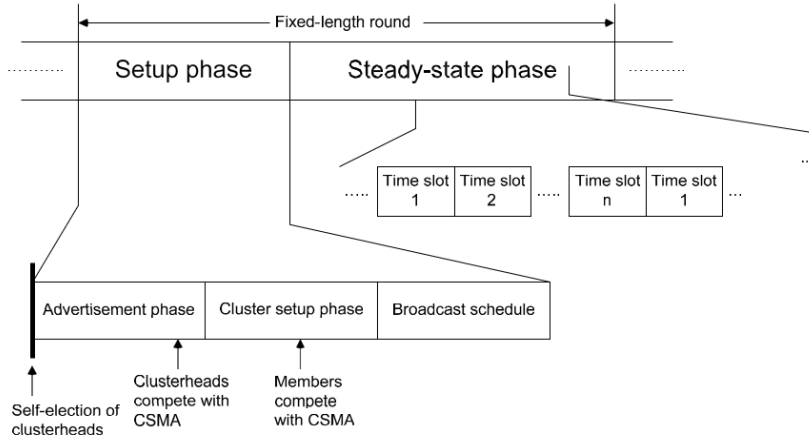
through:

Aggregation

Adaptive Clustering

Setup phase

Steady- state phase.



8. Explain CSMA protocol with flow diagram. [10]

CSMA protocols are contention-based, where neighbors try their luck to transmit their packet.

- The node sense the channel before transmitting.
- If the channel is busy then the node selects other random channel, repeats the carrier sensing and after a number of unsuccessful trials it just backoff.

And if the channel is idle then it start transmitting

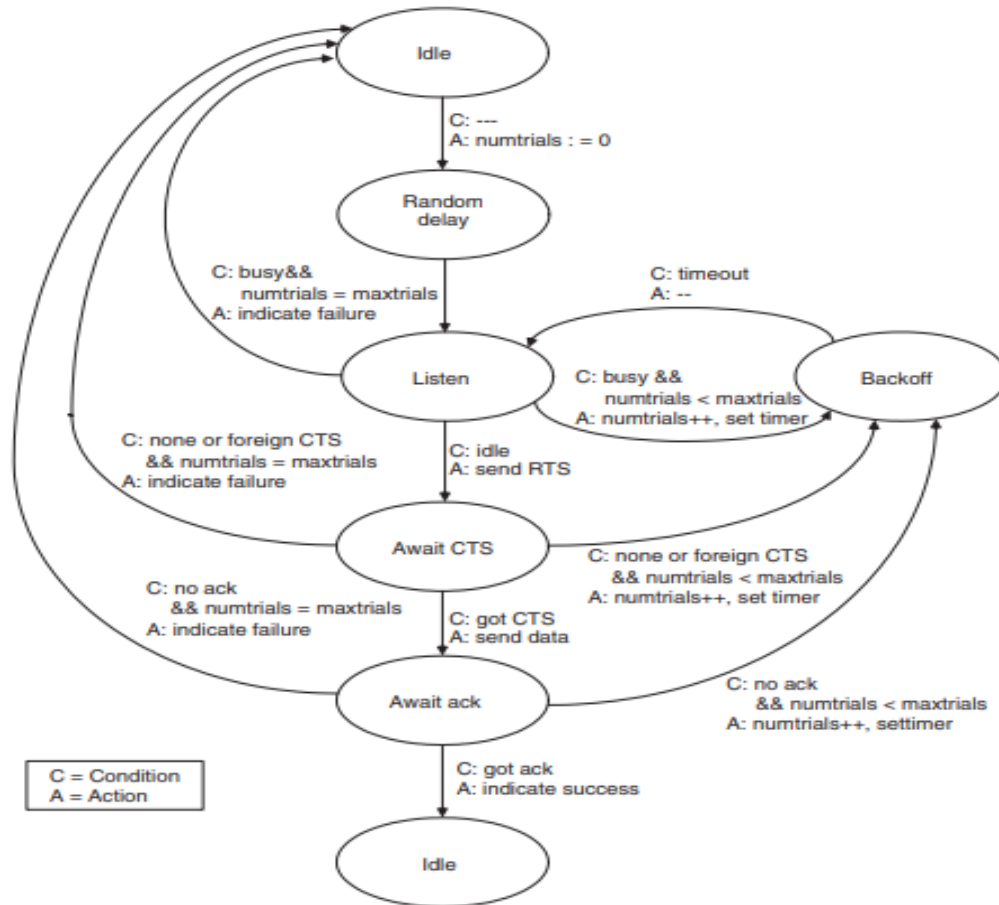


Figure 5.9 Schematic of the CSMA protocol presented in reference [888]

