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# Comparison of Multihop Routing Protocols Based on Packet Interval Time in Wireless Sensor Networks

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***Abstract*.- In this paper, comparative analysis of changing the packet interval time on the energy consumption, throughput of the proposed multihop routing protocol and Assisted LEACH protocol is analyzed. Simulation substantiate that varied causes throughput to change alternately and energy consumed is constant for both the protocols.**

**Keywords- Assisted LEACH, multihop routing, packet interval, energy consumption.**

## I. Introduction

The main features of WSNs are scalability with respect to the number of nodes in the network, self-organization, self-healing, energy efficiency, a sufficient degree of connectivity among nodes, low-complexity, low cost and size of nodes WSN can contain hundreds or thousands of sensing nodes deployed randomly. As the batteries of the sensor nodes are not chargeable, the need is to make the methods of data transmission so effective that the maximum data should be able to be routed to the intended base station as quickly as possible thus minimizing delays and negating all kinds of the packet drops, routing overheads etc along with make the design of the routing protocol energy efficient. If the protocol is able to conserve energy in the nodes for a substantial amount of time than this indicated clearly that such protocol would definitely be able to extend the lifetime of the wireless sensor networks.

Once data has been made available to the CHs, the next task is to route that data either using single hop manner or in multihop manner so that it could reach Base station. Small periodic packet intervals are a cause of concern for the wireless sensor network as repeatedly to transmit those data packets a lot of energy is consumed by all the nodes in the network[1]. After sending each data packet, there is a set time in which channel is sensed as to check whether it is free or not to again transmit other data packets and route them to the base station round by round.

The packet interval variation needs to be analyzed so that the impact on changing the time intervals at which the packets are to be sent to the base station can be understood in relation to the energy efficiency and latency of the network. If the packet interval time is less then the throughput of the network would be increased but on the other hand packet drops or traffic congestion occurs and if it is more then energy consumption of the network would increase, packet delays will also increase which would lower the energy efficiency as well as the throughput of the network.Many multihop routing protocols have been developed by the researchers over the years some have focused on residual energy like HEED[2] while others have focused on different routing techniques Multihop Leach[3] ,C LEACH[4] some others have worked on increase the levels of hierarchy such as LEACH[5], Assisted Leach[6] of nodes so that network lifetime could be considerably extended. The second section discusses material and methodology third discusses results fourth describes conclusion .

## II Material and Methodology

To guarantee the real time performance of the nodes, each data packet is constrained in a time interval in which it must be sent to the destination node. If time expires, the data packet has to be discarded. Once node failure or congestion occurs, large amounts of data packets will be discarded, which may cause disastrous consequences. Consequently, it is more significant and challenging to provide both real-time and fault tolerance characteristics in WSN routing protocol[7]. Channel utilization is a traditional metric for MAC protocols that illustrates protocol efficiency. High channel utilization is critical for delivering a large number of packets in a short amount of time .In sensor networks, quickly transferring bulk data typically occurs in network reprogramming or extracting logged sensor data. By minimizing the time to send packets, we can also reduce the network contention[8]. In a wireless sensor network packet size has the direct effect on reliability and performance of communication between wireless nodes, so there is need to have an optimal packet size for wireless sensor networks. In fact, if a packet transmission fails, the sender has to wait for a random back off period before resuming the packet transmission. However, this period is computed independently from the channel coherence time. Therefore if the channel conditions during retries are still the same or worse, successive failures occur and latency is increased. Network performance would improve if the packet interval depends on the time coherence of the channel. If the interval is too small compared to the coherence time, packet error rate will be high when channel conditions are bad and vice-versa. The packet interval management may also involve the application layer. There is an impact of changing the packet interval on the network performance. The packet transmission time can be tuned in order to optimize the packet delivery ratio.[9]

In thus module the main concept of both the hierarchical multihop routing protocol would be discussed in brief starting with Assisted LEACH Protocol. Both the protocols work on radio dissipation model as their base which can be understood as For both the protocols the first order radio model[10] is used for energy dissipation in communication, where radio dissipates Eelec = 50 nano Joule / bit to drive the transmitter and the transmit- amplifier dissipates $\varepsilon_{elec}$ =100 pico Joule/ bit/m2. To save energy, when required the radio can be turned on or off.

Also the radio spends the minimum energy required to reach the destination. The energy consumed for data transmission of k bits packet is calculated from the Eq. (1).

$$E_{TX}(k,d) = E_{elec} * k + \varepsilon_{elec} * k*d^2 \quad (1) \quad [10]$$

and to receive this message, the radio expends energy is shown in Eq. (2):

$$E_{Rx}(k) = E_{RX\text{-}elec}(k) \quad (2) \quad [10]$$

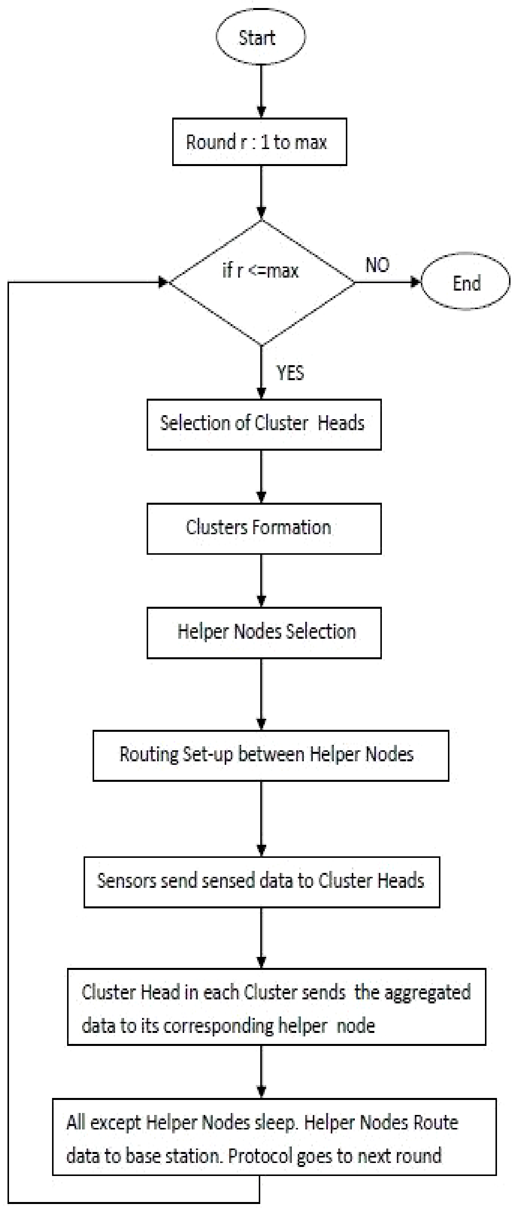


Fig 1: Flowchart of Assisted LEACH Protocol[6]

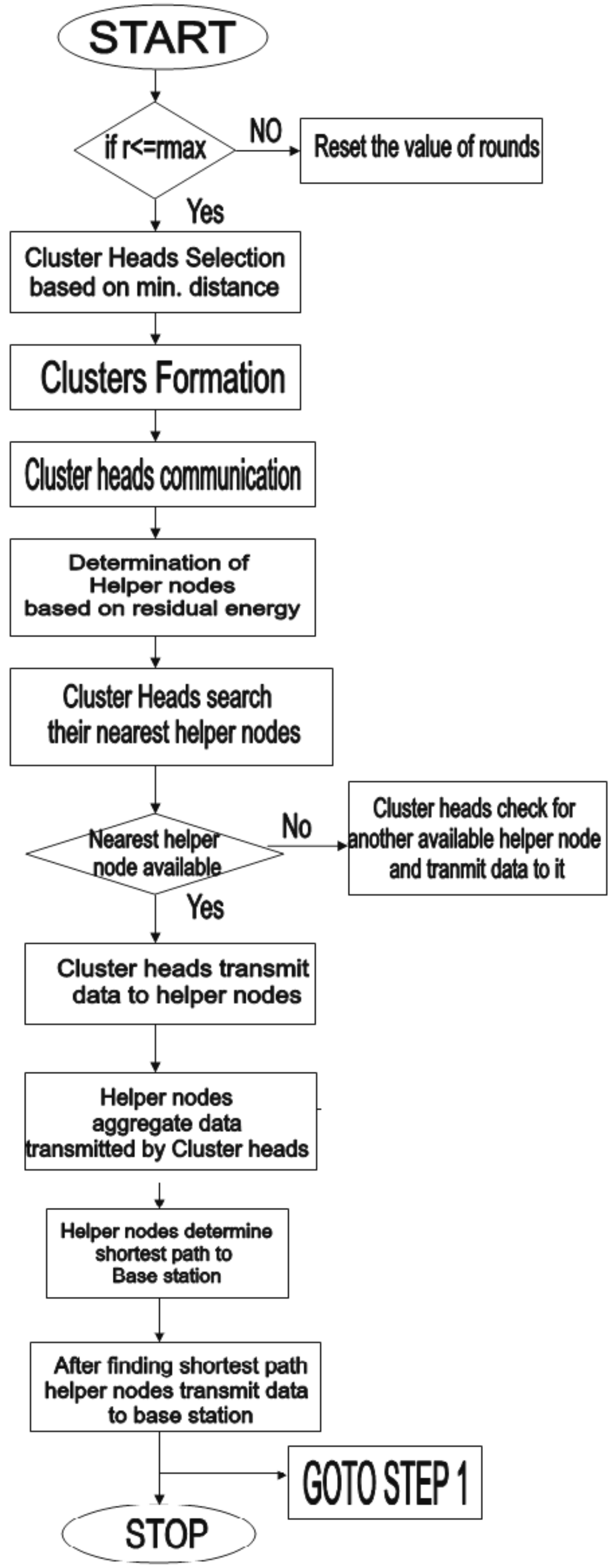


Fig 2: Flowchart of Proposed Protocol[10]

## III RESULTS AND TABLES

The simulation scenario consists of 50 sensor nodes deployed in the network field of size 1300m*1000 m in the wireless sensor network. All the simulations have been performed using NS2.The results have been obtained at the end of seven rounds of the network at simulation time = 30 sec for both the protocols.

The graphs show two lines one in blue color and other in pink color .The pink line shows the results of the Assisted LEACH protocol and the blue line shows results of the proposed multihop LEACH protocol. The main objective of simulation is to analyze the effect on performance on the two multihop routing protocols by varying packet interval time.

TABLE 1
SIMULATION PARAMETERS

| | |
|---|---|
| Simulator : | Ns-2.35 |
| Simulation time : | 30 sec |
| Channel Type: | Wireless |
| No of nodes: | 50 |
| Topology: | 1300m *1000m |
| Radio Propagation model: | Two way ground |
| Communication Model : | Bi direction |
| Transmission Range: | 250m |
| Initial energy: | 100 Joules |
| Antenna Type: | Omni Antenna |
| Traffic Type: | CBR |
| Packet Size: | 256 bytes |

The analysis of the both the protocols is done by analyzing them on some of the performance metrics such as:

1)Throughput[10]: It is the measure of the number of bits of data packets that are transmitted from source to destination in given time. It is always less than 1. The formula of measuring throughput is

$$\frac{Number\ of\ bytes\ received}{Time\ in\ milliseconds} \quad (3) \quad [10]$$

Generally it is measured in Kb/sec or Bytes/sec.

2)Average Energy Consumption ( Ea ) [10]

The average energy consumption is calculated across the entire topology. It measures the average difference between the initial level of energy and the final level of energy that is left in each node.

Let $E_i$ = the initial energy level of a node, $E_f$ = the final energy level of a node and N = number of nodes in the simulation. Then

$$E_a = \sum_{k=1}^{n} \frac{(E_{ik} - E_{fk})}{N} \quad (4) \quad [10]$$

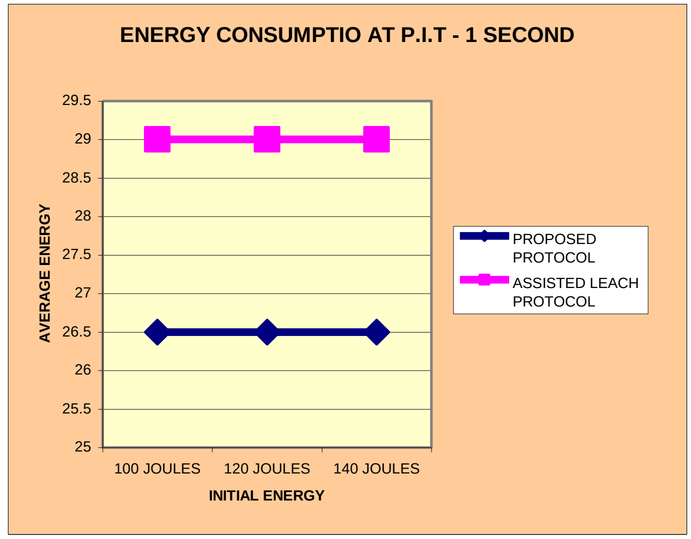


Fig 3: Energy consumption of both protocols at packet interval time of 1 second

The graph clearly shows that on running the simulation for seven rounds, when packet size is kept at 256 bytes and the initial energy is varied from 100 Joules to 140 Joules, the average energy consumed by the proposed protocol remains constant at value of 26 Joules. This clearly indicates that with the increase in the packet interval time (transmission), the protocol remains unaffected on the grounds of energy consumption while routing packet from source to sink round by round. whereas the energy consumption remains constant for Assisted LEACH

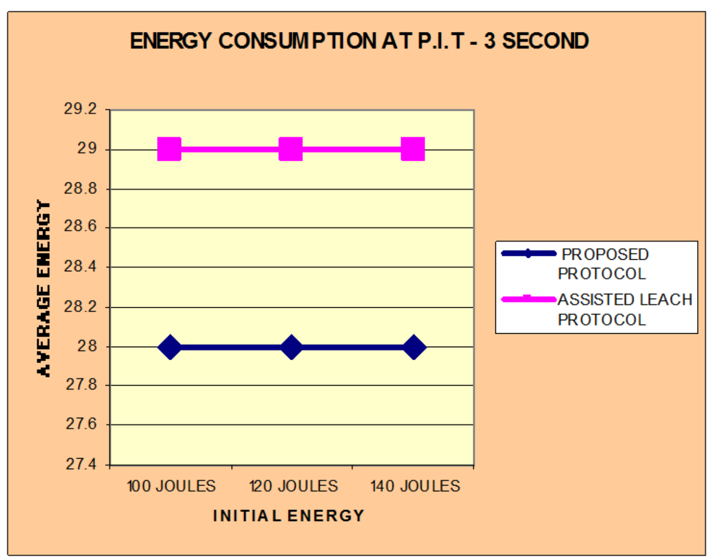


Fig 4: Energy consumption of both protocols at packet interval time of 3 second.

The graph clearly shows that on running the simulation for seven rounds, when packet size is kept at 256 bytes and the initial energy is varied from 100 Joules to 140 Joules, the average energy consumed by the proposed protocol remains constant at value of 26 Joules. This clearly indicates that with the increase in the packet interval time (transmission), the protocol remains unaffected on the grounds of energy consumption while routing packet from source to sink round by round whereas the energy consumption remains constant for Assisted LEACH.

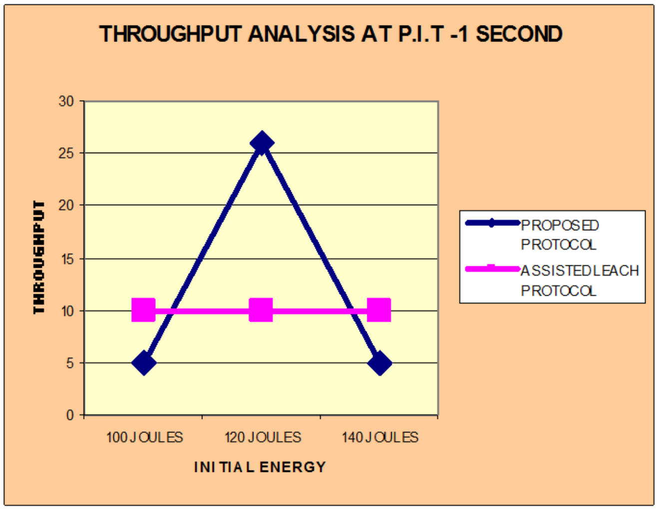


Fig 5: Throughput anlaysis of both protocols at packet interval time of 1 second

The graph clearly shows that on running the simulation for seven rounds, when packet size is kept at 256 bytes and the initial energy is varied from 100 Joules to 140 Joules, the throughput of the proposed protocol attains peak value at 120 Joules initial energy and declines for 140 Joules which means that on increasing the value of packet interval the proposed protocol starts consuming more energy although at certain point of time the throughput of the protocol increases and decreases alternately whereas the throughput remains constant for Assisted LEACH.

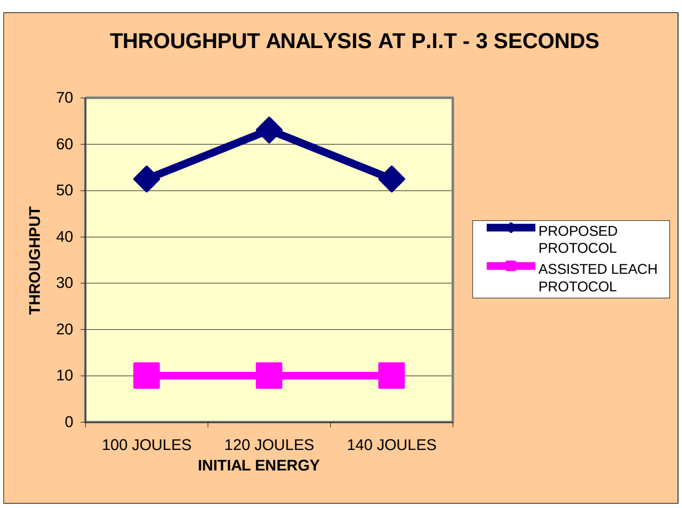


Fig 6: Throughput anlaysis of both protocols at packet interval time of 3 second

The graph clearly shows that on running the simulation for seven rounds, when packet size is kept at 256 bytes and the initial energy is varied from 100 Joules to 140 Joules, the throughput of the proposed protocol attains peak value at 120 Joules initial energy and declines for 140 Joules which means that on increasing the value of packet interval the proposed protocol starts consuming more energy although at certain point of time the throughput of the protocol increases and decreases alternately whereas the throughput remains constant for Assisted LEACH.

TABLE 2
PACKET INTERVAL = 1 second

| **Initial Energy** | **Assisted LEACH** | | **Proposed Scheme** | |
|---|---|---|---|---|
| | Throughput | Average Energy | Through put | Average Energy |
| 100 Joules | 10 Kb/s | 29 J | 26.5 Kb/s | 26.5 J |
| 120 Joules | 10 Kb/s | 29 J | 26.5 Kb/s | 26.5 J |
| 140 Joules | 10 Kb/s | 29 J | 26.5 Kb/s | 26.5 J |

TABLE 3
PACKET INTERVAL = 3 second

| **Initial Energy** | **Assisted LEACH** | | **Proposed Scheme** | |
|---|---|---|---|---|
| | Throughput | Average Energy | Through put | Average Energy |
| 100 Joules | 10 Kb/s | 29 J | 52.5 Kb/s | 28 J |
| 120 Joules | 10 Kb/s | 29 J | 63 Kb/s | 28 J |
| 140 Joules | 10 Kb/s | 29 J | 52.5 Kb/s | 28 J |

## IV. CONCLUSION

The above results prove that by keeping the packet size constant and varying initial energy along with varying the packet interval, both the protocols expend constant energy in a particular time interval but the value of throughput increases and decreases for the protocol but remains same for Assisted LEACH Protocol.

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