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Light Weight Concurrent Scheduling of Mobile Sink routing protocol towards Minimization of Propagation Delay against Spatial and Temporal Uncertainties of Cluster based Wireless Sensor Network

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Abstract

Wireless Sensor Network highly exposed to certain security attacks due to various uncertainties of the network which lead to node compromise. Hence considerable attention has been made by researcher during scheduling of the mobile sink to data collection of sensed information from the sensor nodes. Many secure data aggregation mechanism has been proposed to withstand the network against these kind of attack. Despite of many advantageous, those architectures will lead to several limitations such as large propagation delay and high energy consumption and spatial and temporal uncertainties. In order to mitigate those challenges, Light Weight Concurrent Scheduling of Mobile Sink routing protocol towards Minimization of Propagation Delay against Spatial and Temporal Uncertainties of Wireless Sensor Network is designed. It should be capable achieving energy efficiency and collision avoidance due to uncertainty in transmission and reception. Proposed model eliminates the packet collision and poor channel utilization challenges. Initially, node is partitioned and cluster head is selected based on the highest energy density of the node in the particular location. Employing Full duplex channel easily examines the spatial and temporal characteristic of the node through utilization cache information of routing table. It further helps to build the light weight scheme with behavioral strategies of the nodes for secure propagation of the sensed data to the mobile sink. Light weight scheme deployed in mobile sinks estimate the node trustworthiness and simultaneously collects the secure aggregated data packets of the sensor node through cluster head against dynamic time slots concurrently .Comparing with traditional secure routing architecture, simulation results demonstrates that proposed architecture can reduce the propagation delay against various uncertainties and maximizes the

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life time of the network on increasing the networking performances with respect to packet delivery ratio, throughput and propagation delay. Finally proposed model obtains the cooperative communication of sensor node information to the base station through mobile sink on heterogeneous wireless sensor network environment.

Keyword: Wireless sensor network, Lifetime maximization, Concurrent Scheduling of Mobile Sink, Routing technique, Node Clustering

1. INTRODUCTION

Wireless sensor network have attracted significant research interest as it is employed in the board range of applications such as patient monitoring in healthcare [1], crop monitoring in agriculture [2] and device monitoring in industries[3]. Especially Wireless Sensor Network are characterized by bit rate, propagation delay, bandwidth, node density as node transmit the sensed information packets to base station at various period of time through wifi channel using media access protocol [4]. Moreover, wireless sensor network leads to high propagation delay and high energy consumption. It also leads to poor channel utilization and low network throughput on packet transmission at various periods of time. Hence it becomes mandatory to design a routing protocol to manage all those challenges.

In this paper, a new Light Weight Concurrent Scheduling of Mobile Sink routing protocol towards Minimization of Propagation Delay against Spatial and Temporal Uncertainties of Wireless Sensor Network has been proposed. It capable achieving energy efficiency and collision avoidance under uncertainty in transmission and reception [5]. In this Protocol, communication among the nodes is fixed and its control packets has been shared. Multiple Accesses with collision avoidance is incorporated along the protocol[6]. Specifically all nodes utilizes the allocated time slots with time to achieve collision elimination for communication which minimizes the channel utilization and increase the throughput of network greatly.

Sensor node energy consumption is strongly associated with the node working state. On changing each node working state into different states, the energy consumption of each node can be minimized and the lifetime of the network lifetime can be increased. On consideration of the state conversion of idle state of sleep state during non transmission increase the energy consumption. Medium Access Control protocol is employed for concurrent scheduling of sensor nodes or cluster head to sink node avoid the spatial temporal uncertainty. Further mobile sink and different cluster head has been scheduled effectively according to propagating-delay-difference[7]. On enabling scheduling concurrency among the different cluster head to mobile sink, data collision is avoided completely as mobile sink schedule the receiving time effectively and map the receiving time of mobile sink into the sending time of cluster head.

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Node scheduling approach[8] to mobile sink reduces the spatial-temporal uncertainty and the idle-interval among two successive packets, increase the network throughput and enhances the channel utilization. Node scheduling approach utilizes the sleep schedule to mobile sink to transmit node state between wake up and sleep state effectively to receive the data collected from cluster head to transmit those data to base station. Sleep schedule adopted to mobile sink results in energy saving. Collision of the control packet between the multiple cluster head to the mobile sink during communication of data packets utilizes the channel reservation phase and relay selection scheme. Further it select the best relay node for transmission of the data packets using a shortest propagation delay-based relay selection approach for data transmission phase [9].

Rest of the paper is organized as follows; section 2 provides review of literatures on the existing energy efficient routing protocol of the wireless sensor network and section 3 defines proposed routing protocol considered as Light Weight Concurrent Scheduling of Mobile Sink routing protocol towards Minimization of Propagation Delay against Spatial and Temporal Uncertainties of Wireless Sensor Network. Section 4 presents the simulation results and performance of the current framework against the traditional models on basis of the multiple performance measures. Finally section 5 summarizes the research work .

2. RELATED WORK

This section focuses on the traditional protocols and methods with their inherent challenges of the wireless sensor network to achieve shortest propagation delay aware energy efficient data communication in long communication range through clustering, node positioning, collision avoidance and security mechanism of the network. The existing protocol is reviewed and examined with crucial factor of WSN such as node deployment, energy, end to end delay and coverage in order to enhance the network lifetime.

2.1. Detecting Reactive Jamming using Channel Access Model

Wireless sensor networks are exploited to multiple type of wireless jamming attacks such as reactive, optimal, proactive, and hybrid jammer to deny effective channel utilization. Among multiple jamming attack, reactive jammer has been a increased security consideration for wireless sensor network. Cross layer design has been employed to Efficient Channel Access (ECA) Approach for mitigating reactive jammer and to enhance the channel utilization of the network. Proposed model jointly optimizes the channel accessibility probabilities and cooperative hopping probabilities of authenticated sensor nodes **.**

Mutual functional computation among physical and MAC layers is used to design a cooperative jamming detection model. In MAC layer, sensor node controls its channel accessible probability to reach increased chances to communicate to other nodes. Contention may increase as there may be many contender sensor device to determine the particular channel.

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2.2. Delay-Aware Probability-based MAC protocol

Delay aware probability protocol avoids the handshaking process and incorporates the concurrent transmissions to significantly enhance the network throughput. Compatibility association among sensor node to mobile sink is based on their distances is determined at run-time. A utility-optimization architecture incorporates the compatibility association to compute the optimal transmission strategies for sensor node. It increase the sensor node average waiting time for acquiring channel and it leads to hidden terminal issue.

Particular architecture will formulate the MAC protocol to a incorporate the optimization challenges on assuming the increased transmission capability of sensor node in long-delay of wireless sensor networks. Such increased transmission capability incorporates the feasibility of de-synchronizing packet arrivals at the mobile sink under long propagation delay. De-synchronizing packet receptions of the mobile sink has been mentioned in WSN.

3. PROPOSED MODEL

In this part, detailed architecture of the present model entitled as “Light Weight Concurrent Scheduling of Mobile Sink routing protocol towards Minimization of Propagation Delay against Spatial and Temporal Uncertainties of Wireless Sensor Network is designed to increase energy efficiency and reduce the propagation delay.

3.1. Network Model –Dynamic Multihop wireless Sensor Network

Dynamic Multihop wireless Sensor Network composed of the network elements using the specific topology in the acoustic medium. It deployed as 3D model. Modems are built into wireless sensor nodes so that data can be transmitted wirelessly. Sensor nodes transmit data in a certain direction to the mobile sink. Numerous sensor nodes and a mobile sink make up the proposed network. A hop-count from the sensor node to the mobile sink is configured for each node connected to the mobile sink. A network is made up of several source nodes, each of which has a significant number of packets that need to be transmitted [8].

- **Mobile Sink**

The task of gathering felt data from other sensor nodes or cluster heads within sensor node clusters falls to Mobile Sink. In the network structure, the mobile sink serves as the transmitter to the base station and is constantly in the wake-up mode. It has radio modems installed [9].

- **Source node:** The node which sends the sensed data or forwarding sensed packets to base station through mobile sink.
- **Intermediate node:** The node which receives the packet of sending node is considered as intermediate node to receive packets.

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3.2. Issues related to Collision

Occurrence of Collision on the packet transmission of sensed information by network node simultaneously leads to type of collision situation

- **Receive-Receive Collision:** Two or more packets from different sensor node or cluster heads reaches a mobile sink simultaneously. In this situation, no packets can be received successfully to the mobile sink due to collision occur in the channel transmit the data packets [10].
- **Send Receive Collision:** Another packet from a different sensor node arrives at the same cluster node or mobile sink while the sensor node is delivering its packet through the cluster head to the mobile sink. Since the modem is operating in half duplex mode in this instance, the arrived packet cannot be effectively accepted by the mobile sink [11].

Packet Crosstalk: It is referred to as when other packets delivered to different nodes impede the packet receipt at the mobile sink, making it more difficult for the sensor node to transmit data to the mobile sink.

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3.3. Spatio Temporal Uncertainty issues

The propagation speed of a mobile sink causes a significant propagation delay in a wireless sensor network because it alters the transmission distance, and wireless sensor networks use routing protocols to transfer sensed data to the mobile sink [12]. However, even if the packet's transmission time is known, its arrival time at the mobile sink is unknown. As a result, even though the packets are sent at different times, several packets from multiple sensor nodes can interfere with each sensor node at the mobile sink. Significant factors of the spatial-temporal uncertainty is

- Transmission distance
- Sending time of the packet

3.4. Energy Consumption

Energy consumption of the sensor nodes and mobile sink is computed to carry out the effective data transmission on eliminating data losses and node failure. Computation of energy of sensor node in acoustic medium is given as follows

$E_{aggregate} = E_{Send} + E_{Receive} + E_{idle}$ Eq.1

$E_{send} = l\, p_o\, A\,(d)$ ....Eq. 2

$E_{Receive} = \lambda_r l$ Eq.3

$E_{idle} = T_{idle} E_{aver\text{-}idle}$ Eq.4

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Where E_{send} is the transmission energy consumption of clusterhead, $E_{Receive}$ is the energy consumption of the mobile sink, E_{idle} is the energy consumption for idle waiting of mobile sink, *l* is the length of a packet, P_0 is the receiving power of receiving packets on the mobile sink, λ_r is the receiving energy consumption coefficient of the mobile sink[13], $E_{aver\text{-}idle}$ is the average energy consumption of mobile sink in idle waiting state, and A(d) represents the energy consumption of the channel as the propagation distance of the node is *d* in the radio waves.

$$A(d)= d^{\eta}a^{d} \text{ ....Eq.5}$$

$$a= 10^{\alpha(f)/10} \text{ .....Eq.6}$$

$$\alpha(f)= 0.11\frac{f^2}{1+f^2}+44\frac{f^2}{4100+f^2}+2.75*10^{-4} f^2 +3*10^{-3} \text{...Eq.7}$$

Where η is the energy consumption factor of the packet, α(f) is the energy coefficient and *f* is the modem carrier frequency of the mobile sink. The total energy consumption of mobile sink can be minimized by decreasing the idle time of mobile sink assuming that other parameters remain non -varied through above equation.

3.5. Network Delay Model

Network Delay model is due to medium of node deployment and its transmission with speed. In this part, various causes of the network delay of the wireless sensor network communication is computed as

- **Processing delay of Mobile Sink**
- **Queue Delay of Cluster head**
- **Propagation delay of mobile sink**
- **Transmission Delay of cluster head**

$$T_{aggregate} = T_{processing} + T_{propagation} + T_{Transmission} + T_{queue} \text{....Eq.8}$$

$$T_{processing} = \sum_{i=1}^{N}\frac{D_i}{V_P} \text{ ....Eq. 9}$$

$T_{Transmission} = \frac{N}{l/R_{bit}}$ Where N is the Hop Count of the cluster head

The handling delay of portable sink and line delay of the versatile sink are less than the proliferation delay of remote sensor organize. Subsequently Preparing and Transmission delay as it were considered. Encourage the operation of each hub shifts among the wake-up state and rest state of the portable sink intermittently [80]. Particularly wake hubs composed of two states such as working state and sit still state. One cycle of resting state and waking state may be a steady esteem.

$$T= T_{wake} + T_{sleep} \text{ ....Eq. 10}$$

$$T_{wake} = T_{work} + T_{idle} \text{ ......Eq.11}$$

It is determined that when T_{work} is fixed, the sleep time of the mobile sink can be increased by minimizing the idle time of sensor node which simultaneously decreases the total energy consumption of the mobile sink As a outcome, decreasing the idle time of sensor nodes

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sensibly plays an significant part in enhancing network performance, especially on basis of network throughput and energy saving.

3.6 Concurrent Scheduling of Cluster Head with Spatial Temporal Uncertainties

It is considered as scheduling protocol as it is capable of scheduling the working time and idle time of receiving node to eliminate the spatial temporal uncertainties of the network on incorporating the concurrent transmission strategies [13]**.** Concurrent Planning kills the diverse engendering delay caused by the versatile sink hub and numerous sending hubs. In this planning, thought portable sink plan the accepting time successfully and outline the accepting time of portable sink into the sending time of cluster head agreeing engendering delay distinction and it transmit the sensor hub.

The concurrent transmission will be carried out on the suspicion to dodge collisions. It handle on sending a information parcel from a sensor hub at the time planned by its cluster head. The cluster heads plans its no overlapping accepting time in progress at that point it plans and dole out the sending time to each sensor hub agreeing to their particular delay.

- **Scheduling Scheme**

Further, the scheduling scheme based on mobile sink and cluster head nodes to avoid spatial-temporal uncertainties will reduce the idle-time interval among two successive packets at mobile sink towards their data transmission to base station and it concurrently enhances the network throughput and channel utilization effectively.

- **Sleeping Scheme**

Scheduling scheme employed to cluster head node and mobile sink will automatically wake up according to collect from the sensor node an d transmit data to the mobile sink. The remaining time of the mobile sink and cluster is transformed to sleep state in order to result in network energy saving.

3.6.1. Initialization Phase

Amid initialization stage, the cluster head begin to broadcast hi bundles with ID, area and no of handling sensor hub as transmission ask. On gathering of hi bundle from cluster head, portable sink extricates no of preparing sensor hub and number of the hi message taken care of by it and it broadcasts the overhauled hi message [14] .

A hi bundle is planned with limitation as less no of handling sensor hub to higher no of preparing hubs by cluster head. Through hi bundles, an portable sink gets its data of the sensor hubs and cluster head . At that point, the cluster head and versatile hub upgrades its directing table Nt and after that versatile sink computes the separations among cluster head and

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oversee the neighbor cluster head concurring to their areas. The cycle period T of mobile sink is additionally computed within the initialization stage of the organize.

3.6.2. Allocation Phase

Allotment stage is to apportion the sensor hub bundle to cluster head or versatile sink on killing the different parcels coming to the versatile sink at same time. When a bundle comes to the versatile sink and it isn't as it were related to the sending time of the parcel but too related to the separate among the versatile sink and cluster head hubs, as well as the bundle estimate. On completion of the initialization stage, each cluster heads gets a neighbor table Nt , recording the sensor hub and other data of its neighbor node to set up a nearby topology[15].

An information parcel planned to portable sink on premise of the higher hub thickness cluster heads to lower hub thickness cluster heads. Consequently, portable sink transfers the information parcels from its sensor hub through its cluster head hub in arrange to dodge parcel collision. Assist sending times of sensor hubs are decided and distributed individual cluster head. The cluster head computes the tansmission arrange of its sensor hubs concurring to the need of the sensor hubs, particularly little esteem of p(s), the higher the need.

Propagation Delay Difference Computation

Receiving Node utilizes the propagation delay difference computation to schedule the receiving time schedule to sending time of sensor nodes to achieve concurrency on avoiding packet collision.

$$P(si) = \begin{cases} \frac{D_i}{D_{max}} \\ \frac{D_i}{D_{max}} \end{cases} + Ni*lmax ....Eq.12$$

Priority of the Sensor nodes

Case 1: the sensor node is closer to the cluster head , particular node will have highest priority

Case 2: If the distance is equal or the smaller the value of N_i , the highest priority of the cluster head will be allocated to node with smallest distance by preset the time to start receiving packets from sensor node and it calculates the sending time while the first sensor node starts to send packets.

Algorithm 1: Concurrent Scheduling protocol

Input: Sending Nodes and Receiving Nodes

Output: Schedule time of the receiving nodes to sending nodes

Process:

P(r) = Parent Node which acts sink node to collect the packet of sending node

S(r) = Child Node or Sending Node which acts as sensor node

X is the Processing Node

Compute Distance using Hello Packet

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Distance = Time taken to reach the receiving node * Speed of transmission node
Node Deviation ΔD= $T_{r(i+1)}$-T_{ri}
While (x ε S(r) and x.attribute = True)
Calculate the Threshold on basis of the Propagation Delay
If (Distance > Threshold)
Send Schedule time to the Sender Nodes with idle waiting time as Config Packet C_p
Else
Allocate the sending node for data transmission without collision on conditions
Condition 1: ΔD>=0
$L_i = l+(l*N_i^l)$
Condition 2: ΔD= Infinite
$L_i = l+(l*N_{i\,max}^l)$
Else if
Schedule the mobile sink to sleep state to improve energy consumption

The sending time of each sensor hub to cluster head has been calculated independently. At that point, the cluster head and portable sink broadcasts as Config parcel which carries sending time of each sensor hub. When each sensor hub gets the Config bundle from the cluster head or portable sink, it computes the sending time on its config bundle. After computing the sending time, the cluster head hub with less no of hub thickness and separate begin to transmit the information parcel on computing the accepting times of itself and the sending times of its sensor hubs without send-receive struggle, cluster head broadcast Config bundles to their sensor hubs.

3.7. Node Interference Elimination

Obstructions is taken care of by Hub Collision Evasion and selecting the ideal transfer hub. It accomplishes clock synchronization through trading synchronization bundles among sensor hubs. Concurring to the gotten synchronization bundles, each cluster heads knows the resting and waking timeline of neighbor hubs, hence it can computes its transmission period. In any case, in arrange to improve vitality effectiveness and minimize the parcel collision, the hubs with the less proliferation delay contrast will utilizes little obligation cycles because it moo transfer speed utilization [16] .

Time-division component is to oversee channel in which different hubs transmit information parcels at different time period. The spatial-temporal instabilities issue can be taken care of by computing the sending time and the engendering remove among the sensor hub and cluster head hub. Transfer hub determination and collision evasion accomplished at the same time by orchestrating non-overlapping arriving times of parcels from different senders by planning the sending times of distinctive senders concurring to the proliferation delay contrast and bundle arriving

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Channel leads to path loss due to the time-varying and frequency-varying propagation of a transmitted packet. Path loss is computed using distance of the sending and receiving node

Path Loss is mentioned as

$$A(d,f) = A_o\, d^m\, \alpha(f)^t \text{ ....Eq.13}$$

where *m*, *A*0 and $\alpha(f)^t$ are the spreading factor, a unit normalizing constant, and the absorption coefficient, respectively.

Transmission Loss is given by

$$T_D = {}_{10} \log \frac{A(d,f)}{A_o} = m*10 \log d + d.10\log \alpha(f)\text{....Eq.14}$$

The data packet needs to be relayed somewhere between the cluster head and the mobile sink in order for it to be transmitted successfully. The number of successfully received data packets at the mobile sink decreases as route loss grows with distance. The temporary cluster head must transfer the data packet to the mobile sink when it receives data packets transmitted during the fixed cluster head's energy outage. It is the most effective method for transferring the data packet in the event that the node fails. The suggested model's architecture is shown in Figure 1.

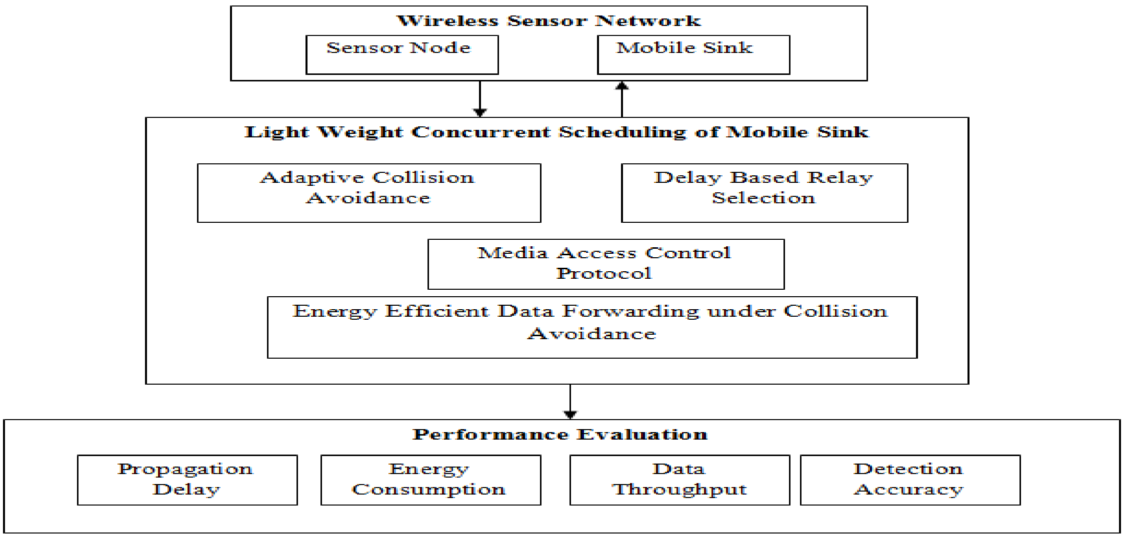

Figure 1: Architecture of the Adaptive Control Packet Collision Avoidance Concurrent Scheduling MAC protocol

3.8. Relay Node Selection

3.8.1. Relay nodes (Rs) located between sending Node and receiving node can listen the transmission of neighboring nodes as routing relay and cooperating relay. In this relay node selection is carried out in two phases such as Communication channel reservation phase and Data transmission phase.

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3.8.2. Communication channel reservation phase

By exchanging control packets, a channel is reserved. The Adaptive Control Packet Collision Avoidance technique is then used to prevent collisions between these packets. During this stage, every relay node makes an adaptive calculation to determine whether or not a back-off timeout is required. The relay node sends a control packet without a back-off timer if it cannot calculate the surrounding nodes that are causing the collision.

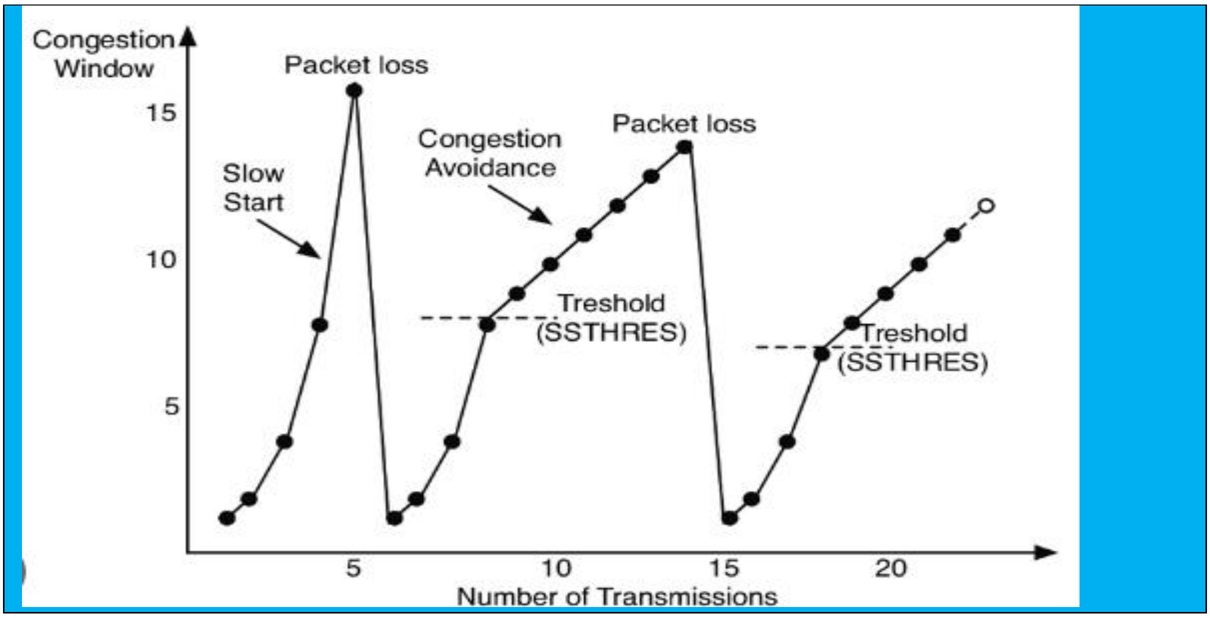

Figure 2 Congestion Avoidance in Packet Scheduling using Time Slot

Otherwise, Contention Window for back-off timer is computed by considering the available number of neighboring cluster head nodes. Eligibility of cluster head Node selected on basis of cooperation of the sensor nodes

$T_{SR} < T_{SR}$....Eq.15

$T_{RR} < T_{SR}$

Where *TSD* shows the propagation delay of a direct path among sensor node and cluster head. If the cluster head and sensor node are apart from one another, cooperation is permitted between them. A request-to-send (RTS) control packet is sent to the cluster head upon implementing the half-duplex limitation during the first transmission phase, and additional adjacent nodes also receive RTS control packets. The only sensor nodes that will cooperate for data packet transfer are those that meet an index of merit based on the difference in propagation delays from end to end.

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Every sensor node collects propagation delay to/from neighboring sensor nodes that are one hop away during initialization. Upon receiving the RTS, the ith cluster head makes sure that the propagation delay between the cluster head and sensor is smaller than the propagation delay between the cluster head and another sensor node. The cluster head sends the sensor node a ready-to-cooperate (RTC) control packet after confirming eligibility. Following the cluster head's availability check, the mobile device additionally sends clear-to-send data (CTS). Currently, both cluster heads and sensor nodes will be sending a lot of control packets to the mobile sink. There is a correlation between the number of control packets and their likelihood of collision. The cluster head employs an adaptive control mechanism to manage packet collisions by measuring inequality based on the difference in delay between sensor nodes.
It is given by

$\Delta d=|D_{R_x}-D_{R_y}|$.....Eq.16

$\Delta d = |(T_{SR_x}-T_{SR_y})*c|>\frac{N_{pkt}}{DR}*c$....Eq.17

Where D_{R_x} and D_{R_y} are the distances and $T_{SR_x}-T_{SR_y}$ are propagation delay of the two relay node. N_{pkt} is length of the sensed packet and data rate. If the distances of two cluster head assure the inequality, the two packets transmit by *sensor node of cluster head 1*and *sensor node of cluster head 2* at the same time reach at mobile sink without collision. In such case, cluster head transmits control packet immediately without using any back-off timer.

On computation of Contention window CW, channel-state probabilities need to be estimated as it is considered as significant performance metrics such as, success probability P_s collision probability P_c and transmission probability P_t.

$P_c = 1-(1-P_{CP})^{k-1}$....Eq.18

Where P_{cp} is a probability that cluster head tries to transmit a control packet which can be computed as

$P_{cp}=\frac{2}{c_{win}-1}$....Eq.19

Where C_{win} is the contention window when cluster head tries to transmit control packet. Pt is computed by considering at least one cluster head planning to transmit a control packet

$Pr_{tran=}1-(1-P_{CP})^k$...20

If there is no packet transmission to mobile sink and channel is idle, P_I can be computed as

$Pr_{idle} = 1- pr_{tran}$ Eq.21

The *Pr is* computed when there is only one cluster head transmitting with the similar distance in a specified time. It can be estimated as

$Pr_{suc} =\frac{K\, p_{cp}(1-p_{cp}}{1-(1-P_{Cp}})$

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The mobile sink does not send the ACK for control packets because of the lengthy propagation delays. Therefore, the timing of the control packet and the propagation delay determine the time for collision and success.

Algorithm 2: Cluster Head Concurrent Scheduling protocol

Spatial Information of the node = S_I
Temporal Information of the Node = T_i
Distance between (x_{i-1} y_{i-1}) and (x_i y_i) = D_t
If (D_t > Specified limit)
Commit Data Transaction
Set status of the node as 1
Else
Choose best path for data Transmission
Set status of the nodes as 2
Interference = N
Network Inference (Speed of the Node 1 at T_i - Speed of Node 1 at T_{i+1})
Reduce the traffic to the Node

- **Data transmission phase**

Using the propagation delay of two pathways, the cluster head node is found during the retransmission process. The selected cluster head's name is sent by the cluster head to the mobile sink together with the data packet during the second data transmission phase. In the event that a data packet reception fault occurs, the mobile sink requests the best path to be used for retransmission. A cluster head transmits ACK/NACK in response to a single cluster head transferring the data packet.

4. SIMULATION ANALYSIS

Simulation analysis of the Light Weight Concurrent Scheduling of Mobile Sink routing protocol towards Minimization of Propagation Delay against Spatial and Temporal Uncertainties of Wireless Sensor Network has been simulated with Sensor Node and Sink Nodes. In particular, the spatial uncertainty of the environment due to dynamic deployment conditions of the network is evaluated. In this sensor node deployment and its various configuration of the network on basis of multihop clustering model with parameter setting is mentioned in the table 1

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Table 1 : Network Configuration Setting

Parameter	Configuration Value
Area of Network Coverage	1000*1000m^2
Number of Sensor Nodes	100
Initial Sensor Node Energy	1000 Joules
Signal Frequency	12khz

On the analysis of the Light weight concurrent scheduling of spatial and temporal uncertainty of mobile sink protocol on end to end delay versus traffic of nodes to receiving nodes is plotted with the existing schemes represented as Concurrent scheduling of spatial and temporal uncertainty of media access protocol and energy density based Media access protocol. It is obvious that the end to end delay of the proposed scheme is low due to effective management of relay node and receiving node on eliminating the interference and collision in the network. Figure 3 represents the performance of the proposed architecture with end to end delay on basis of various environment parameters is compared with existing architectures.

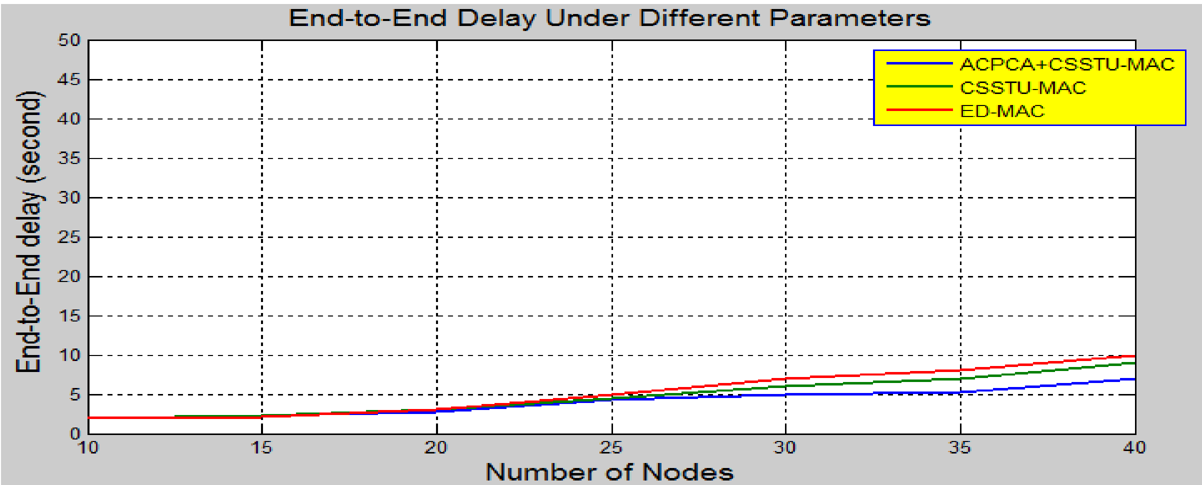

Figure 3: Performance of end to end delay

On the analysis of the Light weight concurrent scheduling of spatial and temporal uncertainty of mobile sink protocol on network throughput versus traffic of nodes to receiving nodes is plotted with the existing schemes represented as Concurrent scheduling of spatial and temporal uncertainty of media access protocol and energy density based Media access protocol. It is obvious that the network throughput of the proposed scheme is high due to effective management of relay node and receiving node on eliminating the interference and collision in

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the network. Figure 4 represents the performance of the proposed architecture with network throughput on basis of various environment parameters is compared with existing architectures

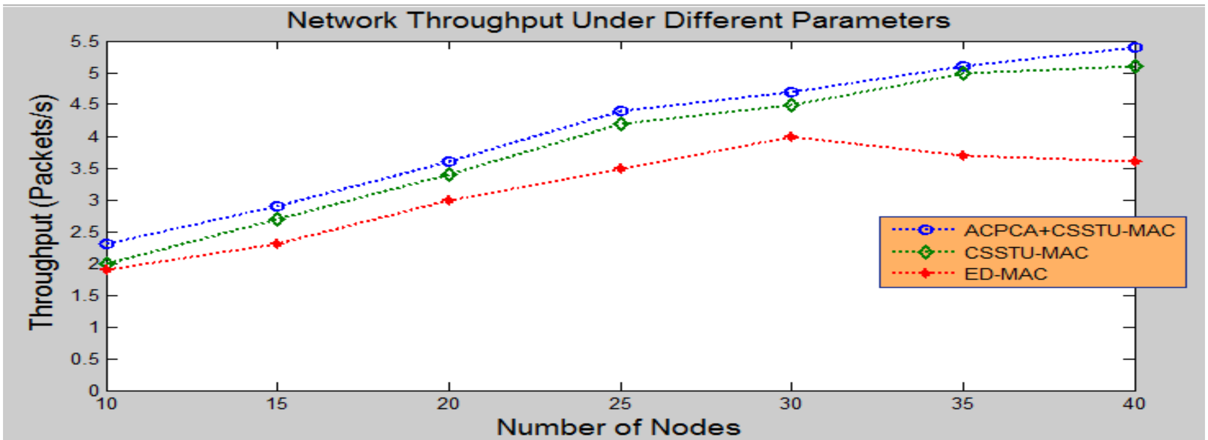

Figure 4: Performance of Network Throughput

On the analysis of the Light weight concurrent scheduling of spatial and temporal uncertainty of mobile sink protocol on energy consumption versus traffic of nodes to receiving nodes is plotted with the existing schemes represented as Concurrent scheduling of spatial and temporal uncertainty of media access protocol and energy density based Media access protocol. It is obvious that the energy consumption of the proposed scheme is high due to effective management of relay node and receiving node on eliminating the interference and collision in the network.

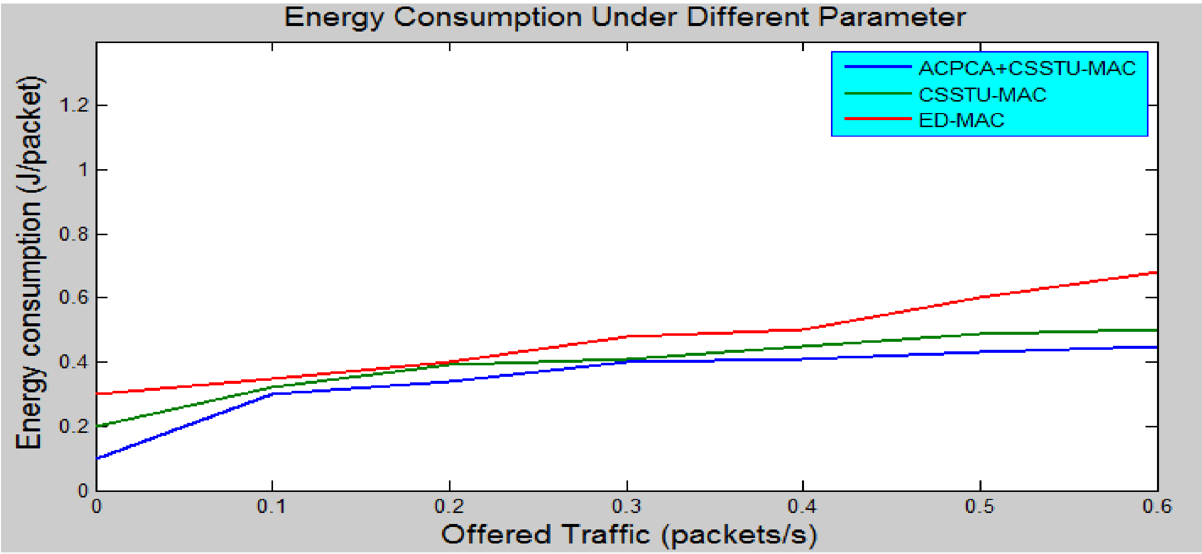

Figure 5: Performance of Energy Consumption

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Figure 5 represents the performance of the proposed architecture with energy consumption on basis of various environment parameters is compared with existing architectures Table 2 provides the simulation results of the proposed protocol and existing techniques with respect to various performance metrics

Table 2: Performance evaluation

Technique	Energy Consumption	Network Throughput	End to End Delay or Propagation delay
Light weight concurrent scheduling of spatial and temporal uncertainty of mobile sink protocol -Proposed	286joules	610kbps	10ms
Cluster Head scheduling of spatial and temporal uncertainty of media access control Existing 1	245 joules	531kbps	18ms
Energy efficient media access control-Existing 2	187joules	421kbps	24ms

Collision avoidance and concurrency scheduling protocol towards handling temporal-spatial Uncertainty as well as long propagation delay in WSN has been designed and simulated in this chapter. Concurrent transmission and collision avoidance using concurrent scheduling of the working state of the node improves the channel utilization and network lifetime for data transmission in high packet propagation period.

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CONCLUSION

In this work, Light Weight Concurrent Scheduling of Mobile Sink routing protocol towards Minimization of Propagation Delay against Spatial and Temporal Uncertainties of Wireless Sensor Network is designed and simulated. It is capable of achieving energy efficiency and collision avoidance. Design initiates with node partitioning to select the cluster head based on the highest energy density of the node in the particular location. On selecting cluster head , it examines the spatial and temporal characteristic of the member node through utilization cache information of routing table. On examination, data aggregation of sensed information of member node is collected and transmitted to base station through mobile sink. In particular model sink utilizes the light weight scheme with behavioral strategies to evaluate the trustworthiness of the nodes for secure data communication to base station concurrently

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using dynamic time slots. Finally, simulation and performance analysis of the proposed model outperforms the traditional secure routing architecture on packet delivery ratio, throughput and propagation delay along maximizes the life time of the network and reducing the propagation delay against various uncertainties to achieve the cooperative communication of sensor node information to the base station through mobile sink on heterogeneous wireless sensor network environment.

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