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DELAY AWARE ENERGY ROUTING PROTOCOL FOR LOCATION CONSTRAINED NETWORK LIFETIME IMPROVEMENT BASED ON ADAPTIVE SINK-STARFISH ROUTING PROTOCOL

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Abstract

Wireless Sensor Networks (WSN) are expected to transform the way data is collected, processed, and disseminated in a variety of contexts and applications. Extending the life of wireless sensor networks requires the capacity to properly manage resources (WSNs). Clustering sensor nodes with the task of improving traffic demands in the networking is a sensible method for WSN's long-term energy use. For Wireless Sensor Networks, the current system established a Hierarchical Energy-Balancing Multipath routing protocol (HEBM). However, because the sensor nodes rely on energy for their operations, if one node fails or a link breaks owing to its limited battery life, it will have an impact on the entire network, necessitating cautious resource management. And also need efficient cluster head selection scheme to improve energy efficiency. To address this issue, the suggested system created a Fault Tolerance based Energy Efficient Routing (FTEER) mechanism that provides significant energy and network lifespan gains. At randomization, sensor nodes are dispersed in a capture zone. Then use neighbor discovery to locate the nodes that are closest to you. At least one neighborhood is performed by each node in the network. In this proposed work, distance-based clustering is performed. Then optimal CH selection is done by using Adaptive Adjustment step strategy-based Glowworm Swarm Optimization algorithm (AAGSO). The proximity seen between node and the base station, the based on residual energy of the node as well as its neighbors, and the quantity of node neighbors are all considerations to consider while choosing a CH. Finally, the cluster head creates a TDMA schedule, which gives a time window for data delivery to sensor nodes. When a defect (node or connection failure) occurs during packet delivery, communication is restarted by selecting backup routes or backup nodes. With respect to packet delivery ratio, end-to-end latency, energy consumption, and average remaining round, the experimental findings reveal that the suggested system outperforms the prior systems.

Keywords: Wireless Sensor Networks (WSN), routing, Fault Tolerance and Adaptive Adjustment step strategy based Glowworm Swarm Optimization algorithm (AAGSO).

1. Introduction

The MANET communication induced in several areas to exchange the data and communicate others with an emergency time. Ad-Hoc network is appropriate for

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employment in condition wherever there is no infrastructure or deployment of network is not cost effective. Without any fixed communication set up Ad-Hoc networks facilitates structuring of easy as well as adoptive communication. Mobile adhoc is always powered by limited battery power, creating a power storage network has always been an important task. By resolving the communication problem based on energy level, to propose a Delay aware energy efficient routing algorithm that calculates the energy of a node and separates the task accordingly to the sink. This improve the energy consumption of the node and extend the life time of the communication network.

Increasing the mobile nodes on specific location, the transmission medium get probable on communication medium. To increase the energy efficient based on routing optimization to improve the life time based on the location specific cluster control to mobile sink optimizer in adhoc network. Routing procedure of wireless networks should employ bandwidth in idealistic fashion. To accomplish this defending overhead, limited transmission range control is implemented over routing process which cares about topographical gathering. Mostly, in Ad-Hoc networks, due to regular variables in topology, saving topological information of all nodes believes to reserve overhead which effects in extra reduction of bandwidth to maintain the energy levels.

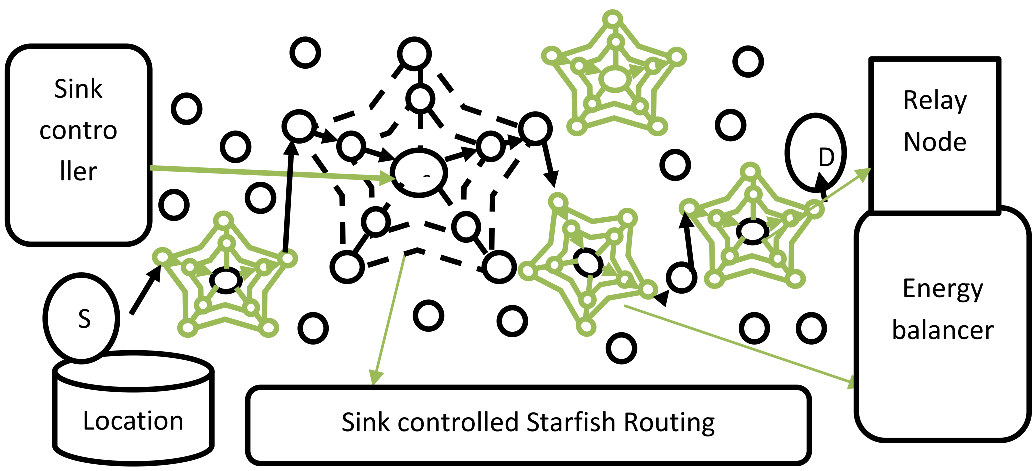

Figure 1: SINK controlled starfish routing protocol

The nodes are dynamic and can be connected in any way on clustered topology in dynamic network. The node acts as a router and is involved in finding and maintaining paths to other nodes in the network. Figure 1shows the SINK controlled starfish routing protocol. The goal of a routing algorithm is to send a packet from one end to the other. An important wiring challenge is choosing the best route based on a number of criteria. Routing protocols of traditional wired networks required for transmitting data from originator to target, are not directly used in Ad-Hoc networks as ad hoc networks are extremely dynamic nodes and are not stationery. Due to overhead of routing protocol, traffic is not permitted to restrict network or is allowed for a local change in link to cause an enormous control over traffic through network. To keep updated routing information,

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topology information must be exchanged between nodes on a regular basis. This is a relatively high network overhead. The advantage of this is that the paths are always available on demand. Every routing table of node catalogues reachable targets, next hop nodes and count of nodes to achieve. Every routing table marks sequence number to all entries which is allotted by destination node.

Mobile agents selectively select the appropriate layer agent by sharing terrain information between nodes for reliable data transfer. Using this method, the motion load and congestion-free traffic characteristics between zonal groups and different zonal groups are analyzed using the multimode gateway selection process. It can retain terminal power for a maximum period of time to extend battery life, and the gateway is selected based on the maximum load used by the various path data transfer mechanisms.

Path with fresh sequence number is employed and paths by way of elder sequence numbers are discarded. Paths have similar sequence number as existing path is selected if higher metric is identical at same time as lesser count of hops. Whenever a link to subsequent hop of path is out of order, transitory path to next node is instantly allotted with endless metric and a sequence number is modified. Pupations are straight away broadcasted in routing information packets.

The organisation of the paper section 2 describes the related work and its techniques, section 3 contain the prosed implementation Adaptive Sink-Starfish Routing protocol. Section 4 describes the result and discussion with testing performances and section concludes the performance of the proposed system.

2. Related work

Mobile adhoc in huge communication depends energy-efficient dynamic stochastic routing algorithm to improve communications [1]. This traditional flood mechanism produces a large number of duplicate packets that are sent across the network. It causes network conflicts, conflicts and redirects [2]. It uses a probability transmission method to improve the flood mechanism and avoid broadcast storm problems on the MANET. Data transfer capabilities and strategies are being considered [3]. The paths are set dynamically according to the limits. Network performance depends on the security of the data transfer.

Efficient cooperative multipath routing algorithm is discussed with network coding which maintains the coding for different nodes of network and according to the energy of the nodes, the method performs routing. Eenergy-efficient dynamic stochastic routing algorithms [4]. This traditional flood mechanism produces a large number of duplicate packets that are sent across the network. It exacerbates network conflicts, conflicts and exchanges [5]. The multiple routing protocol based on least approach for reliable routing is proposed which finds multiple routes to reach destination. The data packet from the source is directed and distributed in multiple paths.

Multipath Routing Protocol Using Genetic Algorithm (MRPGA) is presented which uses hybrid clustering and path selection [6,7]. The method performs clustering according to triangle optimization algorithm and the cluster head is designated conferring to trust

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degree of nodes where trust degree is calculated according to energy consumption and network lifetime [8], mobility and so on [9]. An efficient neural network based routing protocol is presented where the technique classifies the incline of routes available rendering to priority, distance, and mobility speed [10, 11]. In the sink location based rate adjustment on sending packet is presented. The method reduces the traffic issues by controlling the sending rate towards each node according to traffic volume.

Dependable starfish clustering based direction-finding algorithm is obtainable which identifies the route according to the ratio of sent and received packets [12]. The reliability of data transmission is assured by performing routing based on location detail in MANET to safeguard from replay attack [13]. An efficient multi path routing with stability is discussed which considers congestion of different routes. The method considers the bandwidth and delay with congestion to perform route selection [14].

The procedure uses a genetic procedure to forecast the path a communication will take if it is sent to a neighboring node [15]. An exercise activity is defined to evaluate the effectiveness of this predicted path by considering the energy levels [16]. The message will only be sent to the nearest node if the predicted benefit-fit value of the path exceeds the limit intended by applying the idea of stochastic routing [17]. The method uses location of the nodes in performing routing according to GPS. The security in data transmission is approached with nodes energy in MANET [18]. The method distributes the nodes according to poison point process and selects the next relay based on the location and knowledge of nodes to support data transmission [19, 20] . In the security in routing is enforced using fuzzy rule analysis scheme which maintains set of rules for different class of people and measures the trust value according to the feature values and the rule available?

3. Proposed implementation

Towards the Delay aware energy routing protocol for location constrained improving network lifetime is implemented based on Adaptive Sink-Starfish Routing protocol. This focus to improve the location based constraints on improve the routing standards by considering level optimization**.** This paper proposes a Delay aware energy routing protocol and Adaptive SINK-STARFISH Routing protocol that combines the benefits of cluster control routing and energy consistent routing. It takes advantage of all above principles to improve the path of messages from source to destination to consume energy level optimization.

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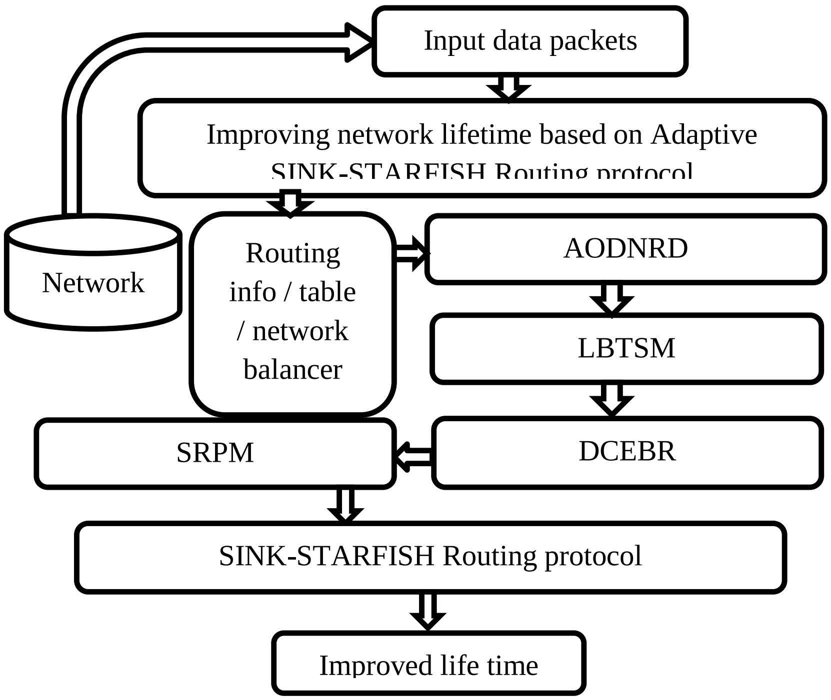

Figure 2: Architecture diagram AS^{2}RP

The proposed Delay aware energy routing protocol improves the energy constraints which is for analyzing the energy level support carrying best transmission with higher performance. The location constrained improving network lifetime based on Adaptive SINK-STARFISH Routing protocol. Figure 2 shows the Architecture diagram AS2RP. The formation of cluster creates star head support by controlling the transmission nodes to improve the communication medium. The following processing approach defines the implementation principle of energy efficient management in mobile network performance.

3.1 Adaptive on demand neighbor route discovery (AODNRD) algorithm

Initially, the routes available between the source and destination is discovered similar to the AODV routing protocol. The source node broadcast a packets to the network which has been received by the neighbors. On receiving the packet of route based on demand, the perform lookup in their neighbor table to identify the presence of destination node id. If there exist a presence, then it is concluded as it has a route to the destination. Otherwise, the same packet has been multicast to the neighbors. If there is a route, then the node attaches the node id to the route in reverse path, and tags the energy, speed, direction with the route.

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Algorithm steps:

Input: Neighbor Table Nt, Route Table Rt, Packet P

Output: Route Table Nt, Neighbor Table Nt

Start

Read Packet P, neighbor table NT, Route Table Rt.

Generate packet's on sequence message.

RMA-RREQ = {SourceID, Dest.ID.}

Initialize Broadcast Timer BrT.

Broadcast RMA-RREQ and start BrT.

While BrT runs

Receive packets.

Extract route R = $\int Route \in packet$

Add to route table RT = $\sum(Route \in RT) \cup R$

End

Neighbor receives the support node packets

If neighbor found a route or entry in neighbor table then

Generate packet P = {NodeId, Energy, Mobility, Direction}

Send in reverse path.

Else

Forward to neighbors and wait for the reply.

End

Stop

The procedure of route discovery has been presented in the above algorithm which discovers the available routes based on the broadcast mechanism. The algorithm also collects the traffic, speed, and direction of each hop available in the route. Identified and indexed values are used to perform route selection further.

3.2 Location based Transmission support measure (LBTSM)

In this stage the nodes of the network communication are estimated based on the region approximation algorithm uses the routes being discovered. For each route identified, the method approximate various features. The traffic, hop count, mobility, and energy are being approximated. Each approximation returns a support measure on specific parameter. Using the support measure of various parameter, the method estimates the multi factor QoS support value. Based on the value of LBSTM the method choose a single route to perform data forwarding.

Algorithm Steps:

Input: Route Table RT, Packet P

Output: Route R

Start

RT = Route Discovery (Source, Destination)

For each route R from RT

Tsm = Traffic-Approximation®

Esm = Energy-Approximation®

Msm = Mobility-Approximation®

Hsm = Hop-Approximation®

Compute LBSTM = $\frac{Tsm}{Hsm} \times \frac{Esm}{Msm}$

End

Route R = $\int_{i=1}^{size(RT)} Max(RT(i).MFQoS)$

Forward data packet through route selected.

Stop

Consider the route R, which has k number of hops which are moving in different direction and speed. Among the nodes of route R, consider there are N-m number of nodes which are located in geographic region r, then it should be considered for its suitability to get selected for better data transmission. So the mobility support of any route should be measured and has been measured as follows:

Mobility support Ms = $\int_{i=1}^{size(R)} \frac{\sum R(i).Mobility \rightarrow OtherRegion}{\sum R(i).Mobility \leftarrow Region}$ .... (1)

Now the cumulative mobility support Ms can be measured as follows:

Transmission support measure (TSM) = $\frac{\sum_{i=1}^{size(R)} Nl(i).Ms}{size(Nl)}$ .... (2)

The above equation 1, 2 shows how the mobility transmission support has been estimated. According to the value of TSM, a small set of routes can be performed.

3.3 Delay constrained Energy balancing rate (DCEBR)

The data transmission in any network takes certain amount of network cost. In MANET, the mobile nodes involve in transmission lose their energy. By involving in continuous

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transmission leads to the death of mobile nodes by estimating through DCEBR. So the energy parameter has been considered. It is necessary to consider the energy support of the route before getting into the data transmission. Consider the route r has n number of nodes. Among them, each has certain amount of energy according to their initial energy Ie and number of transmission involved. The support of energy provided by the route r has been measured as follows:

First it is necessary to monitor the traffic condition of any route because the nodes of selected route should be capable of sustaining for the traffic condition. So, first the amount of traffic at each hop or node should be measured. It has been performed as follows:

$$\text{Node list Nl} = \sum Nodes \in r \quad \ldots\ldots\ldots\ldots\ldots.(3)$$

From the route table Rt, the value of traffic at each node n present in Node list Nl can be obtained. According to that, with the energy constant µ which represent the power in joules required for any node to perform data transmission. According to this, amount of traffic present and the energy value at the node can be used to estimate the traffic support of any specific hop node H. It is measured as follows:

$$\text{Energy support Es} = \int_{i=1}^{size(Nl)} \frac{Nl(i).Energy}{Nl(i).Traffic \times \mu} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots..(4)$$

If the value of Es is greater than a specific threshold, the hop is suitable to involve in data transmission further. Otherwise, the node will dead after sometime which lead to route rediscovery and retransmission.

$$\text{Cumulative Energy support CES} = \frac{\sum_{i=1}^{size(Nl)} Nl(i).Es}{size(Nl)} \quad \ldots\ldots\ldots.(5)$$

The energy support of any route represents the suitability of any route to perform data transmission.

3.4 Substitutive relay path modularization algorithm (SRPM)

In the broadcasting, power consumption classical is used to predict the values that shows the performance of the method. Energy consumption to the receiver to the H bits level expressed, transmitting from the transmitter,

$$e_T\ (H, r) = \{H^* e_c + H^* \varepsilon_s {}^* r^2 \text{ if } r <= r_0\} \text{ and}$$

$$e_T\ (H, r) = \{H^* e_c + H^* \varepsilon_s {}^* r^4 \text{ if } r >= r_0\} \quad \ldots\ldots\ldots.(6)$$

Where r is the source and receiver as well as e_c, which is the time between the amounts of energy consumed to transmit and receive data interval. Balancing two expressions to 0 r = r_0

$$\text{Obtain } r_0 = \sqrt{\varepsilon i / \varepsilon m} \quad \ldots\ldots\ldots\ldots\ldots.(7)$$

Parameters εi and εm is mean value of multipath fading channel model have been based on the space among the transmitter and the receiver that are different. If the distance is smaller than the threshold value 0 r and the amount of free space model is larger than 0 r, the multipath model is used. The basic cost of obtaining data can be expressed as:

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$$e_g = H \times e \qquad \text{.............(8)}$$

In this way, the transmission area consider LXL square meters. The base station in the center of the system for effortlessness inch to head node for the selected transmission channels to all non-head node, 'R' is channel bits. Thus, the energy channel of the head node indicated consumption.

$$e_{ch} = (T/k-1)*H*e_c + T/K * H* e_d + H* e_c + \varepsilon_s * r^2_d \qquad \text{...............(9)}$$

Where, T is distributed uniformly in a square region of number of nodes.

e_d the cost of processing bits reported to the base station.

R_d the normal distance among the base station and the channel header.

CH's unused energy is expressed as:

$$E_{non\text{-}ch} = H* e_c + H*e_s*r^2_h \qquad \text{.........(10)}$$

$$\text{Where,} \quad r^2_h = L^2/2\pi K \qquad \text{....(11)}$$

r_h the average distance between the channel and the cluster.

At the present addition, the calculations (11) and (10) become to be the whole energy dissipated through an overweight is assumed by

$$e_{total} = R*(2*T* e_c + T* e_d + \varepsilon s*(K* r^2_d + T* r^2_h)) \qquad \text{......(12)}$$

The e_{total} is separated by detail to K and associating to zero, the ideal total of group can be predictable and is assumed by

$$K_o = \sqrt{\frac{T}{2\pi}}\sqrt{\frac{\varepsilon sL}{\varepsilon m r2d}} \qquad \text{......(13)}$$

Where, $r_d = 0.765*L/2$

The best probability of a node becomes CH, G_{opt} is given by

$$G_{opt} = 1/0.765*\sqrt{\frac{2}{L\pi}}\sqrt{\frac{\varepsilon s}{\varepsilon m}} \qquad \text{......(14)}$$

G_{opt} this is a very important parameter because it increases exponentially due to the formation of energy spent in the entire cluster during processing.

3.5 Adaptive SINK-STARFISH Routing protocol (AS^{2}RP)

However, towards maximization, the energy is the factor which must be considered as star fish routing. Number of methods is available in the route selection which consider the energy of different hops of the route to form start point cluster. However, they suffer to achieve the lifetime maximization performance as they consider only the energy parameter to form cluster point. It is necessary to consider various other parameters in route selection like traffic and latency which is permitted by cluster head to form route. By combining such factors in route selection, the lifetime of the network can be improved.

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1. Cluster member sends a data packet to the cluster head to form star cluster
2. Group head collects a packet from the cluster members to joint cluster head
3. Select from each cluster and select the base station transmitted distance value head
4 Sort transmission distance value for each cluster head
5. If d (CH1) or d (CH 2) or d (CH 3) are the same, it sends a data packet to the base station.
6. If anyone by binding CH transmission range as SCH, and larger than the other means CH
7. SCH transmits packet data to a base station
8. Stop

Data transmission and selected SCH are based on the data packets to send the cluster head and transmitting the data by estimating the distance from the cluster head and the cluster member. Cluster head sends the data packets by transmitting the range in to the base station.

4. Result and discussion

The proposed simulation was carried out through network simulator having NS@ tool command language to construct MANET topology based on dynam9c network communication. The Constant bit rate 10 packet per mill seconds was processed through UDP. The testing performance carried out by considering different stages as tested below progress.

Table 1 Details of simulation parameter and values

Key	Value
Simulator	NS2
Total Nodes	200
Energy	100 joules
Battery Voltage	50 volts
Control Packet Size	10 Bytes
Transmission range	100 meters
Simulation area	1000 meters

The simulation details considered for the performance evaluation of proposed scheme is presented in Table 1. The simulation is performed using the network simulator NS2 and the evaluation is carried out by varying the number of nodes in the simulation. In each

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simulation condition, the performance of the methods are measured and compared with the results of other methods.

Table 2: Comparison of throughput performance

Performance on Throughput in %			
Number of Nodes	**EEMPR**	**MRPGA**	**AS^{2}RP**
10	13	58	62
20	26	64	66
30	42	68	69
40	68	76	84
50	82	89	97

The performance on throughput has been measured and presented in Table 2, where the proposed AS^{2}RP algorithm have produced higher throughput performance than other methods.

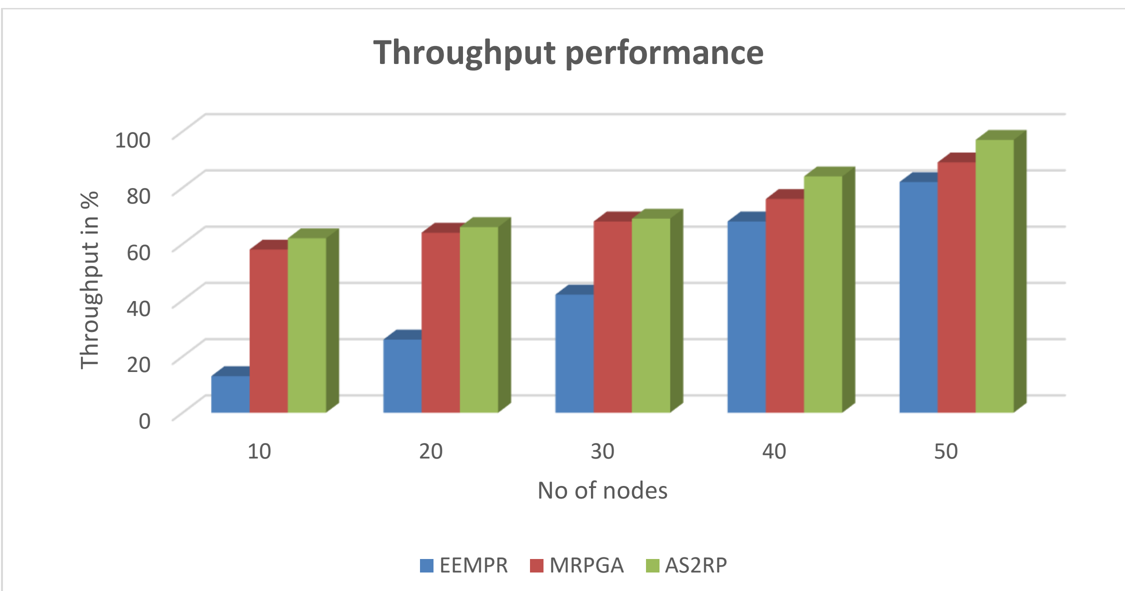

Figure 3: Analysis throughput performance

Analysis of throughput performance comparison results shown in figure 3. In this analysis result the proposed AS^{2}RP method has 89%. Likewise the existing Multipath Routing Protocol Using Genetic Algorithm (MRPGA) algorithm has 80%.

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Table 3: Comparison of PDR performance

Performance on PDR in %			
Number of Nodes	**EEMPR**	**MRPGA**	**AS²RP**
10	19	31	35
20	36	39	58
30	49	65	74
40	58	80	87
50	73	83	98

Table 3 shows the comparison of PDR performance the proposed and existing results. The proposed algorithm provide better performance compared with previous algorithm.

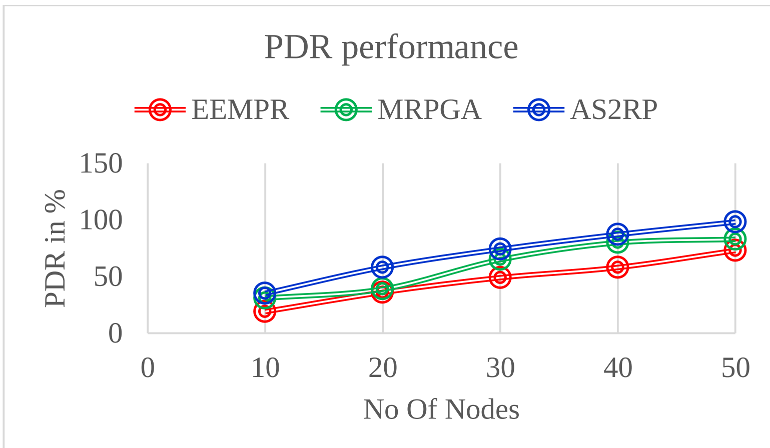

Figure 4: Comparison of PDR performance

Figure 4 describes the comparison of PDF performance results. The proposed **AS²RP** algorithm PDR performance has 83%, and the existing algorithm PDR performance has 46%.

Table 4: Analysis of energy consumption performance

Performance on energy consumption in %			
Number of Nodes	**EEMPR**	**MRPGA**	**AS²RP**
10	45	39	35
20	51	42	39
30	64	55	46
40	72	65	59
50	78	75	63

Analysis of energy consumption performance results presents in Table 4. The proposed algorithm gives low energy consumption compared than previous algorithm.

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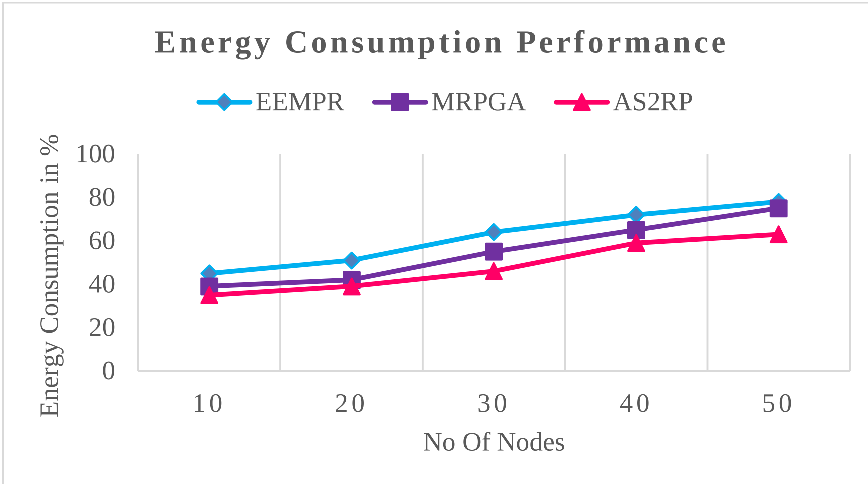

Figure 5: Analysis of energy consumption performance

The analysis of energy consumption performance has been measured and presented in figure 5. The proposed AS^{2}RP algorithm has 63%, and the existing system EEMPR algorithm has 75% and MRPGA algorithm has 78%.

Table 5 analysis of network lifetime performance

Performance on Network lifetime in ms			
Number of Nodes	**EEMPR**	**MRPGA**	**AS^{2}RP**
10	21	53	62
20	25	62	68
30	36	80	84
40	42	87	98
50	56	122	134

Table 5 presents the network lifetime in milliseconds. The proposed algorithm provide better result performance compared than existing algorithm.

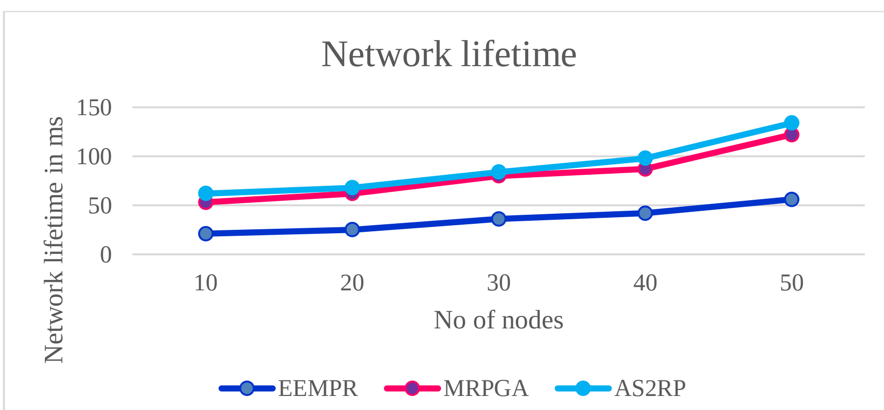

Figure 6 Analysis of network lifetime performance

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Figure 6 presents the analysis of network lifetime comparison graph results. In this result analysis, the proposed AS^{2}RP method has 134ms and the existing algorithm is MRPGA algorithm has 56ms.

Table 6: Analysis of end to end delay performance

Performance on End to end delay in ms			
Number of Nodes	**EEMPR**	**MRPGA**	**AS^{2}RP**
10	4.5	3.6	1.7
20	6.8	5	2.8
30	7.2	7	4.4
40	8.9	8.6	5.8
50	9.4	9.2	6.5

Table 6 describes analysis of end to end delay performance for proposed and existing methods comparison result. The proposed algorithm provide low time latency performance than previous algorithm.

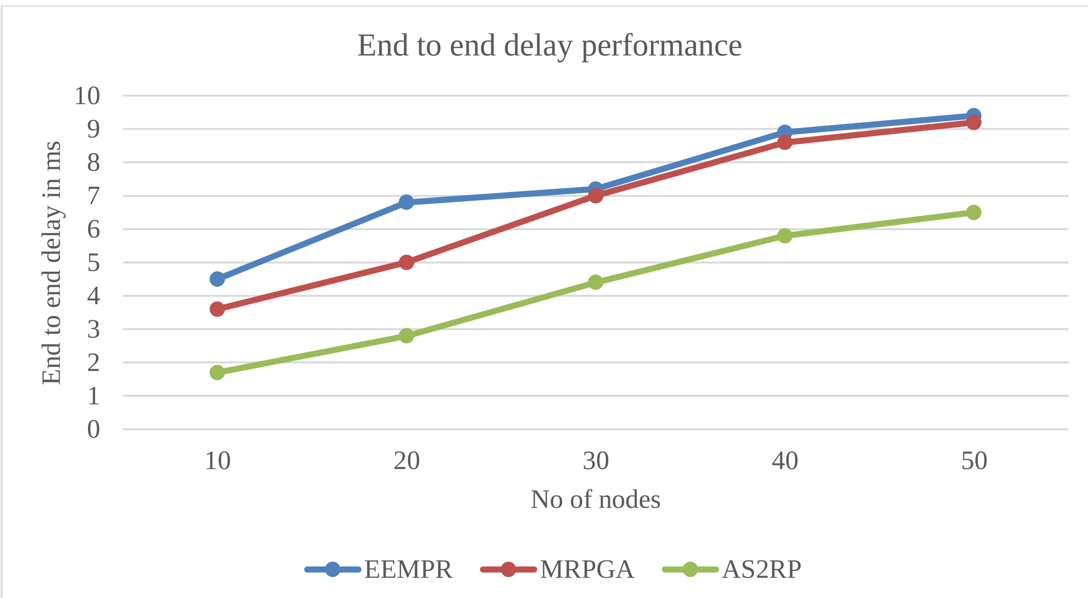

Figure 7: Analysis of End to end delay performance

Analysis of end to end delay performance comparison graph result shown in Figure 7. The proposed algorithm AS^{2}RP algorithm latency has 9.2ms and the existing algorithm latency has 10ms.

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Conclusion

To conclude presented the detailed explanation on the experimental analysis and the results produced by various approaches. The performance of the methods are measured on different parameters and compared with the result of other methods. The operating principle of the regional-based multi-factor approximation based routing algorithm was presented. This method detects available routes and calculates traffic, energy, movement and hop count support for each route. Based on these values, the support values are measured to select the best path for data transfer. The result section analyses different parameters such as a PDR achieves 98 % high, throughput achieves 97 %, end to end delay, network lifetime, and energy consumption as well than other methods. The proposed method produce higher performance compared than previous algorithm. The next chapter presents the conclusion of the research.

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