International Journal of Scientific Research & Engineering Trends
Volume 6, Issue 2, Mar-Apr-2020, ISSN (Online): 2395-566X

Efficient Multipath Routing with Multichannel in WSN Network

M.Tech. Scholar Raghavendra Kumar, Assistant Professor Devkant Sen
Department of Electronics & Communication
Technocrats Institute of Technology & Science Bhopal(M.P), India
Raghvendrakumar513@gmail.com, Devkantsen1984@gmail.com

***Abstract* – In WSN due to the lack of resources of recharging or replacing of batteries will not be possible. The all nodes working in network is completely depend on the node energy in network by that the energy utilization is major issue in WSN. The efficiency of the network degrades and also responsible for the loss of packets. So routing in the sensor network is one of the important issue and many difficulties are faced during deployment of routing strategies.The dispute in sensor networks is that even if a host does not communicate on its own, it still normally forwards data and routing packets for others, which reduces its battery. Multi-path routing can avoid congestion and improve performance. In this technique the route is selected on the basis of higher energy capacity of nodes ,it means the multiple path are selected on the basis of higher battery capacity and the data ACK is received through the next alternative path that has next higher energy level but lower than the first preferred existing path in Grid WSN. The congestion is controlled by multipath routing. The proposed Enhanced AWMRP load balancing scheme is balance the load in network by selecting the path that has low mobility and higher energy value. The performance of proposed scheme is compare with the normal AWMRP and AWMRP with GECP (Group based Energy Conserving Protocol) routing protocol and provides the better outcome. Grid-based multi-path routing protocol intended to route packets fast, utilize and extend sensor nodes energy in addition to avoiding and handling network congestion when happens in the network.**

***Keywords* – WSN, Energy, AOMDV, AWMRP, Congestion, Load balancing, Routing.**

I. INTRODUCTION

The sensors with wireless radio equipment are supposed to communicate with each other, without the help of any other (fixed) devices. (Wireless Sensor Network) WSN play an important role in providing ubiquitous services and are envisioned to support future generation networks. Research in this area is becoming popular due to wide ranging applications supported. WSN are characterized by fast changing topology, limited battery power and constrained resources. WSN enable easy deployment as if they do not need any infrastructure like base stations but base station is exists in WSN [1].

All nodes in network are capable of movement and can be connected dynamically in random manner. The responsibilities for systematizing and controlling the network are distributed among the all nodes in network themselves. The entire network is mobile, and the individual node is allowed to move freely. In this kind of networks, some pairs of nodes may not be able to communicate directly with each other and have to required intermediate nodes within the sender and receiver so that the messages are delivered to their destinations. Such networks are often referred to as multi-hop or store-and forward networks. The nodes may be placed in or on airplanes, ships, trucks, cars, perhaps even on people or very small devices. WSNs are suitable for a large number of applications including battlefield monitoring, habitat monitoring, tracking of office equipment and environment surveillance. These sensor nodes have sensing component to collect the information, power supply unit, communication unit to transmit and receive data and processing unit.

As these sensing units are low battery-powered that's why it is very important to minimize the power consumption of wireless network. A great concern in WSNs is the distribution of networking load effectively as a sensor network scale up in size. Load balancing averages the energy consumption by spreading the workload across the sensor network. This helps in extending the expected lifespan of the whole sensor network by extending the time until the first node is out of energy. With the help of load balancing we can reduce the congestion hot spots by reducing wireless collision [2].

II. LOAD BALANCING IN WSN

Sensor nodes can use up their limited supply of energy performing computations and transmitting information in a wireless environment. As such, energy- conserving forms of communication and computation are essential. Sensor node lifetime shows a strong dependence on the battery lifetime [3]. In a multi-hop WSN, each node plays a dual role as data sender and data router.

The malfunctioning of some sensor nodes due to power failure can cause significant topological changes and might require rerouting of packets and reorganization of the network. In the network when load on a particular node exceeds than a threshold value, which is 50% of the initial Energy of that node, then that node is considered as overloaded node. Due to congestion on a single node results in the discharge of that node at a very high rate as compared to other nodes. Due to uneven load distribution in the network, holes are created [4]. Due to these holes efficiency of the network degrades and also responsible for the loss of packets. So routing in the sensor network is one of the important issue and many difficulties are faced during deployment of routing strategies. These routing strategies are affected by irregular topologies. In order to avoid this problem regular topologies are preferred over irregular one. An efficient routing approach should be developed which avoid the congestion on some nodes.and also prevents from the formation of holes [5].

III. WSN CHALLENGES AND ROUTING ISSUES

The design of routing protocols for WSN is difficult owing to many network constraints. WSN suffer from the restrictions of many network resources, as an example, energy, bandwidth, central process unit, and storage [6, 7]. The planning challenges in networks involve the subsequent main aspects:

1. **Limited Energy Capacity**

Since detector nodes area unit battery high-powered, they need restricted energy capability. Energy pretenses create an enormous challenge for network designers in hostile environments.

2. **Sensor locations**

Another challenge that faces the design of routing protocols is to manage the locations of the sensors. Most of the likely protocols assume that the sensors either are equipped with international positioning system (GPS) receivers or use some localization technique [8] to learn about their locations.

3. **Limited Hardware Resources**

Additionally to restricted energy capability, sensor nodes have conjointly restricted process and storage capacities, and thus will only perform restricted procedure functionalities.

4. **Massive and Random Node Readying**

Sensor node deployment in WSNs is application dependent and may be either manual or random that finally affects the performance of the routing protocol. In most applications, sensor nodes is scattered arbitrarily in an intended space or a massively over inaccessible or hostile region.

5. **Network Characteristics and Unreliable Ambiance**

A sensor network sometimes operates in a very dynamic and unreliable environment. The topology of a network, that is outlined by the sensors and therefore the communication links between the sensors, changes topology owing to detector addition, deletion, node failures, damages, or energy depletion.

6. **Data Aggregation**

Since in network nodes might generate important redundant knowledge, a similar packet from multiple nodes is collective in order that the quantity of transmissions is reduced. Data aggregation technique has been accustomed come through energy potency and data transfer improvement in a very range of routing protocols.

7. **Diverse sensing application requirements**

Sensor networks have a wide range of various applications. No network protocol will meet the necessities of all applications. Therefore, the routing protocols ought to assurance data delivery and its accuracy in order that the sink will gather the desired data concerning the physical phenomenon on time.

8. **Scalability**

Routing protocols ought to be able to scale with the network size. Also, sensors might not essentially have equivalent capabilities in terms of energy, processing, sensing, and significantly communication.

IV. ROUTING PROTOCOLS IN WSN

Routing in wireless sensor network (WSN) differs from conformist routing in fixed networks in various ways. The sensor node done routing without any fixed infrastructure, wireless links are unreliable, sensor nodes possibly will fail, and routing protocols have to congregate stringent resources requirements [9, 10]. Routing paths can be established in one of three ways, namely proactive, reactive or hybrid..

1. **Proactive (table-driven) Routing Protocol**

The proactive routing protocol is the table driven protocol to managing the table of route information in network. The proactive routing protocol are showing the better performance in fixed or stationary network because the routing table updation is not possible their but in dynamic sensor network the routing information is changes by that the overhead in network is more. The most well-known types of the proactive routing protocol are: - Destination sequenced distance vector (DSDV) routing protocol

2. Reactive (on-demand) Routing Protocol

The reactive routing protocols re maintaining the connection in a On demand manner means if required then established connection. The routing protocol are flooded the route request and if the destination found data delivery is started but after the completion of routing procedure including data sending route information is completely destroyed in from nodes that has participating in routing. The Ad hoc on-demand distance vector (AODV) and Dynamic source routing (DSR) protocol is the example of that kind of routing.

3. Hybrid Routing Protocol

The hybrid routing protocol as the name suggests have the combine advantages of proactive routing and reactive routing to overcome the defects generated from both the protocol when used separately. The familiar hybrid routing protocols are Zone routing protocol (ZRP) [11].

V. LITERATURE SURVEY

The Literature Survey has provides the information about the previous work that has done in this fileld.

In this paper [11] investigate the use of multiple paths so that a load repartition strategy can be used. Therefore, we propose a new multi-path routing protocol An Adaptive Weight based Multi Path Routing (AWMPR) which uses the topology obtained after running a topology control protocol to provide multiple paths from any node to a given sink. Thereafter, a load repartition is applied to distribute uniformly the traffic on all available paths according to the group sizes. AWMPR protocol is proposed which explores and establishes multiple paths from each node to the sink using information provided by the topology control protocol. Then, a load balancing mechanism is adopted using a new metric that defines a priority for each path. A priority is assigned to a path depending on the group cardinality.

In this paper [12]"Distributed Routing Algorithm to Perform Load Balancing in Grid Wireless Sensor Network" in this title we discuss a As Sensor area network is a vast network with thousands of nodes, the workload increases up to a great extent. This increased workload leads to increase in packet loss and decrease in network lifetime. Even the rate of message failure as well as node failure due to network congestion also increases.
In this paper [13]"Network Topologies in Wireless Sensor Networks: A Review" in this title we focus In Wireless Sensor Networks (WSNs), sensor nodes have limited battery power, so energy consumption is essential issue. Every sensor node can obtain its location information from GPS or other positioning system and send data to sink at any time.
In this paper [14] "Ad hoc on-demand multipath distance vector routing" in this we discuss a multipath extensions to a well-studied single path routing protocol known as ad hoc on- demand distance vector (AODV). The resulting protocol is referred to as ad hoc on-demand multipath distance vector (AOMDV).

In this paper [15] "Grid-based Coordinated Routing in Wireless Sensor Networks" This work explores grid-based coordinated routing in wireless sensor networks and compares the energy available in the network over time for different grid sizes. One node per grid is elected as the coordinator which does the actual routing. The source node starts flooding the network with every coordinator joining in the routing. Once the flooding reaches the sink node, information is sent back to the source by finding the back route to the source.

In this paper [16] "Brief Description of Routing Protocols in MANET And Performance And Analysis (AODV, AOMDV, TORA)" In this title , we compare and evaluate the performance of three types of On demand routing protocols- Ad-hoc On-demand Distance Vector (AODV) routing protocol, which is uni-path , Ad-hoc On-demand Multipath Distance Vector (AOMDV) routing protocol and Temporally Ordered Routing Algorithm (TORA).

In this paper [17] "Distributed Grid based Robust Clustering Protocol for Mobile Sensor Networks" This title presents a distributed grid based robust clustering protocol for mobile wireless sensor networks. An overwhelming majority of current research on sensor network routing protocols considers static networks only, while we consider mobile environment. Grid based robust clustering is a distributed location based, energy aware clustering protocol designed for mobile sensor networks.

In this paper [18] "effective load balancing algorithm for grid wireless sensor networks" In this title, we explore a load balancing algorithm for N x N grid sensor network. Here we assume an All too All communication mode. This routing algorithm balances the load on center node. In this title they mainly focus to develop the routing strategies in an all too all communication scenarios, which perform better load balancing using shortest paths.

VI. PROPOSED APPROACH

WSN has very attractive for collect or sending real time information from any place to other place. There are a lot of issues and challenges in designing a WSN network.The proposed higher energy capacity based Multipath load balancing mechanism can help in avoiding congestion and can increase the efficiency of the network resource utilization. The proposed energy efficient multipath routing protocol are reduces the workload of intermediate nodes by that the rate of packet reception has increased and the rate of packet loss has decreased as compared to existing AOMDV routing. The simulation results are represents the better performance of proposed scheme in Grid WSN, that has efficiently distribute the load as compare to normal AOMDV shortest path routing technique. This has lead to the decrease in node failure rate as well as in network congestion thereby increasing the network lifetime.

Input Parameter:

M:mobie nodes
S: sender node
R: receiver node
$L = \prod_{k=1}^{n} I_k$ Intermediate nodes Speed: node speed
Ch_i: i^{th} channel for communication ρ= end to end delay
e_i: initial energy of node in joule
e_x: energy discharge per packet transmission/ receiving in joule
Ψ= 550m^2 radio range AWMPR: Multipath routing

Output: Remaining Energy, Fraction of Survived Nodes, Routing Load, Packet Delivery Ratio, Data Receives Analysis, Delay

Procedure:

M deploy 1000*1000^2 range
S execute AWMPR for multipath based transmission S form (AWMPR, S, R, e_i, e_x) packet
Search route from S to R
While S search R && L in Ψ && L != R **Do**
L ← receives (AWMPR, S, R, e_i, e_x) packet
Calculate L_{ex}=L_{ei}
$(txp\ or\ rxp) * (txt\ or\ rxt)$ $L_{i\text{-}rtable}$ ← update-route
L forward (AWMPR, S, R, e_i, e_x) to next hop
If (L_i == R && paths>1) **then**

compare($path_i$, $path_j$)
If (l_{speed_i} < l_{speed_j} && $\rho_i < \rho_j$ && $e_{xi} < e_{xj}$) **then**
select(best 3 $path_i$) from S to R R generate reverse path to S
R Send Acknowledgment to S S Send(data, S, R, Ch_i
Else
Select($path_j$)
End if
End If

Send (data, S, R, Chi)
S create the Ch_i to send data by multipath
If $path_i$ > 1 && R found **Then**
S use sub channel of Ch_i send data to R by multipath
R acknowledge to S by selected path
A. *Else If*
path ==1 && R found **Then**
S send data by single path
R acknowledge to S by selected path Execute (AWMPR) for other route selection **Else**
Route not exit R not found
End if

Because dynamic topology structure and node change every second on its position, one of the measure challenges is congestion and energy efficiency in WSN if sender node want to send data into the some specific receiver so very first broadcast routing packet onto the network and get destination through the shortest path (if we apply AOMDV) or select route of minimum intermediate hop. After getting path sender sends actual data through uni-path link but at the same time more than one sender share common link so congestion occur onto the network that is measure issue for WSN is resolved by propose Enhance AWMRP scheme.

VII. SIMULATION TOOL OVERVIEW AND RESULT COMPARISON

The proposed method E-AOMDV was simulated in NS 2.31 (Network Simulator). NS2 is discrete event simulator developed by the University of California in Berkeley. The random mobility waypoint model [19] is used to generate a random waypoint for every intermediate node between the source node and the destination node. At network layer routing protocol used for simulation is AOMDV. Nodes send constant bit rate (CBR) traffic at varying rates over UDP connections. Each packet is of size 512 bytes. The simulation is done with 4000 simulation iterations in 1000m *1000m simulation area. NS is written not only in Otcl but in C++ also. For efficiency reason, NS separates the data path implementation from control path implementations. In order to reduce packet and event processing time (not simulation time), the event scheduler and the basic network component objects in the data path are written and compiled using C++.

The simulation results are represents the performance of previous AWMRP+GECP and proposed Enhanced-AWMRP enhancement scheme with AOMDV routing protocol.

1. Remaining Energy % Analysis

This graph represents the energy utilization of both the schemes. Here we clearly visualized the energy consumption in case of AWMRP+GECP routing and proposed Enhanced AWMRP routing scheme. In this

International Journal of Scientific Research & Engineering Trends
Volume 6, Issue 2, Mar-Apr-2020, ISSN (Online): 2395-566X

graph the X-axis represents the remaining energy percentage and the Y Axis is represents the number of iterations. The first blue line represents the remaining energy in case of proposed routing scheme and the second line represents AMWRP+GECP performance. Now the performances of proposed protocol in terms of energy consumption are much better. Then the energy utilization is also better.

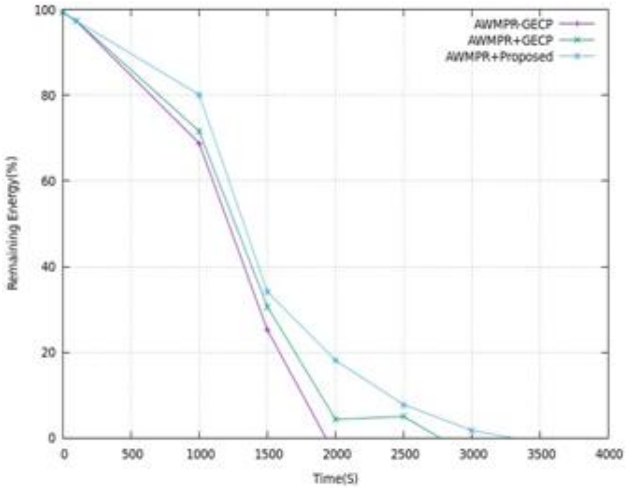

Fig.1. Remaining Energy % Analysis.

2. Fraction of Survival Nodes

The energy saving analysis of network in case of previous AWMRP-GECP, AWMRP+GECP and proposed E-AWMRP

is a measure that shows the survival capacity in proposed approach is more. The performance of proposed scheme is showing the more energy after the end of simulation time. The more end energy of nodes is showing the better energy utilization as compare to normal energy routing it means that energy completely waste in normal energy routing for retransmission because of link breakage.

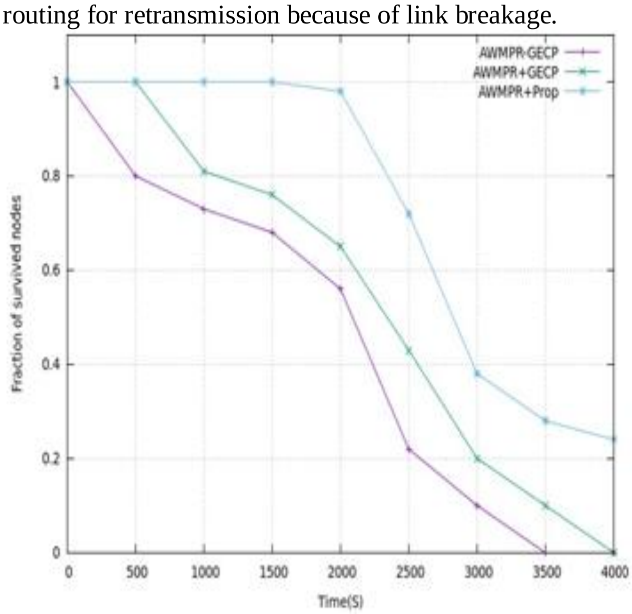

Fig.2. Survival Nodes Analysis.

3. Routing Load Analysis

This graph represents the analysis of number of connection establishment or routing packets are delivered in network. The routing packets are delivered in network for established connection in between sender to destination after that the delivery of data packets started to deliver in between sender and receiver. Here in case of previous work the routing overhead is more than 5.7 up to the end of simulation time but in proposed low mobility based and higher energy based node selection scheme maximum load is nearest to 2.1 up to the end of simulation. In proposed scheme also the successful packet delivery in case of proposed Enhanced AWMRP routing scheme is more as compare to previous scheme. It means that in less number of routing packets the performance of proposed scheme is better and it also takes the advantage of energy saving from routing packets delivery in network.

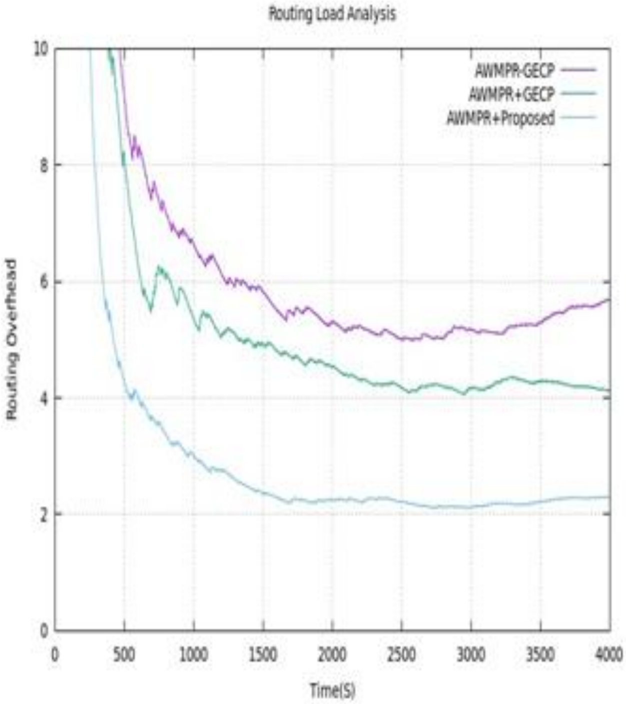

Fig.3. Routing Load Analysis.

4. PDR Analysis

This graph represents the performance of both the schemes in term of PDR. Packet Delivery Ratio (PDR) is one of the important performance parameter to measure the performance of network. The performance of previous AWMPR-GECP, AWMRP+GECP and proposed Enhanced-AWMRP enhancement scheme with AOMDV routing protocol is measures. Due to the loss of packets in network the performance of normal energy based routing is not calculated at the end of simulation. Here the PDR is about 89% but in case of proposed schemes we include the factor of packet loss on the bases low mobility and high energy, that is not include in previous scheme by that proposed mobility based energy efficient scheme gives

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Volume 6, Issue 2, Mar-Apr-2020, ISSN (Online): 2395-566X

the PDF more than 95%. It means the performance of network is increases as compare to previous scheme.

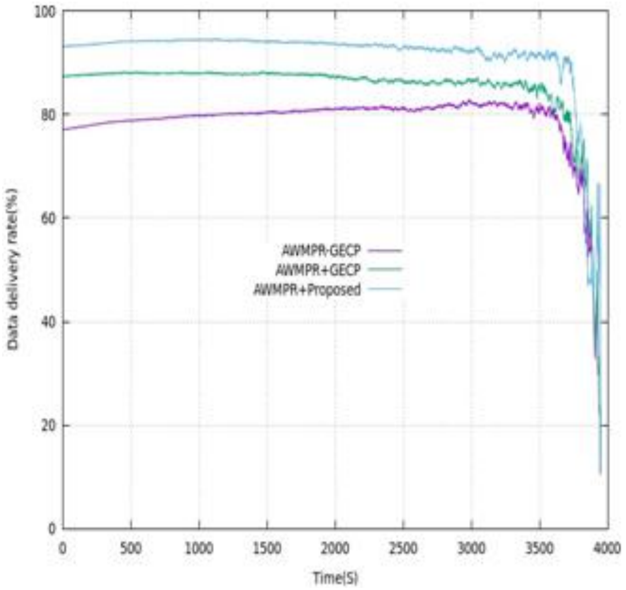

Fig.4. PDR Analysis.

5. Delay Performance Analysis

Delay is the important factor to measure extra time in network is consumes by sensor nodes for sending receiving. This graph represents the delay performance analysis of proposed Enhanced AWMRP, AWMRP and AWMRP+GECP. In case of proposed scheme the nodes in network are utilizes their energy in communication not for waste in retransmission and AOMDV control the congestion. It means that the nodes are utilizes their energy properly in proposed scheme. In case of AWMRP the delay is reaches to 0.25 milliseconds (ms) but in case of proposed scheme the delay is minimum about .18 ms It means the life of network and packets sending in network are more in proposed scheme.

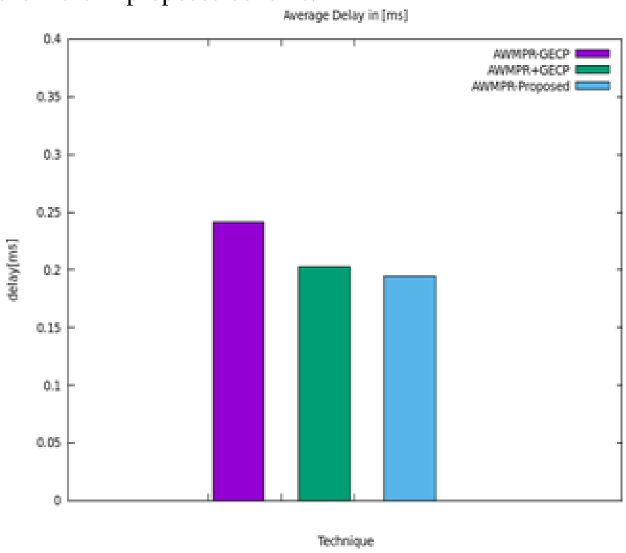

Fig.5. Delay Analysis.

6. Data Receiving Analysis

This graph represents the analysis of packets receiving in all three protocols. The behaviour of proposed Enhanced AWMRP receiving data successfully and data dropping is minimum. Here the energy efficient routing with low mobility higher energy based scheme is proposed to increases the network life and energy utilization of nodes. Now in case of AWMRP and AWMRP+GECP the packets receiving are not more than 6000 packets but in proposed Enhanced AWMRP the performance is improved and packets receiving is reaches to nearby 10000 packets and this is possible because of selecting reliable route but the packet loss in case of previous is more as compare to proposed scheme.

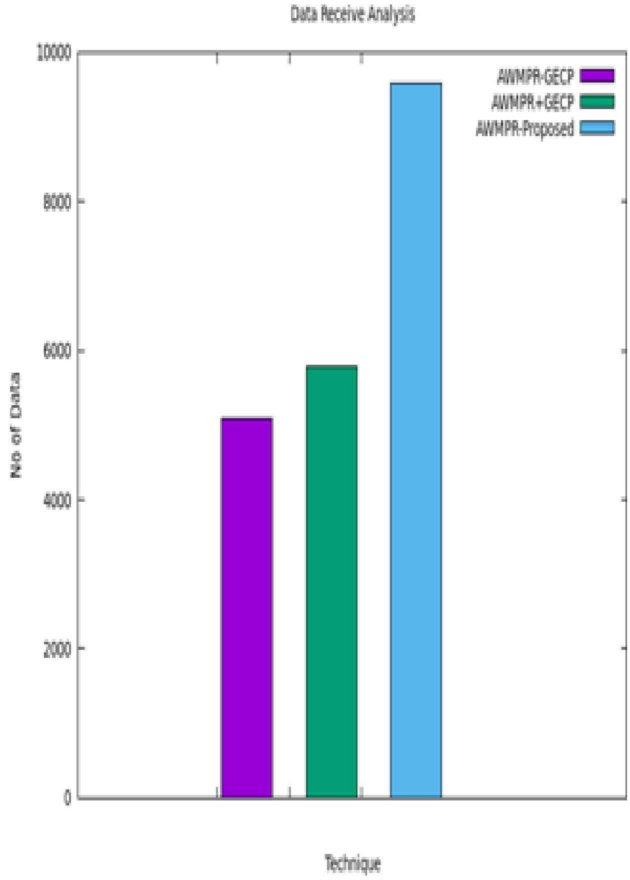

Fig.6. Data Receiving Analysis.

7. Overall Analysis

The complete summarized performance of previous AWMRP, AWMRP+GECP and proposed Enhanced AWMRP are mentioned in table 1. The total energy consumption is important factor to measure the performance of energy based protocol. This table 1 represents the different performance like PDR, NRL etc. The energy is remaining after end of simulation and the remaining energy of all the 100 nodes is max in proposed scheme. These kinds of analysis are done with all the schemes and find that the proposed scheme is saving highest amount of energy and also minimizes congestion.

Table I: Summarized Analysis.

Parameters	AWMPR - GECP	AWMPR +GECP	AWMPR-Proposed
Total Data Sends	6267	6633	10287
Total Data Receives	5082	5791	9578
Normal Routing Load	4.87	4.12	2.29
Data Receives %	81.09	87.31	93.11
Avg Delay	0.24	0.2	0.19
Avg Throughput(Mbps)	2.8	3.19	5.27
Avg Energy Consume	58.05	55.01	51.87
Avg Residual Energy	24.4	27.48	30.57

VIII. CONCLUSION AND FUTURE OUTCOME

The interconnection of these nodes forming a network called wireless sensor network (WSN). At present in Grid WSN devices are considerably constrained in terms of computational power, memory, efficiency and communication capabilities due to economic and technology reasons. Due to the workload extension on number of nodes in network leads to increase in packet loss and decrease in network lifetime. The AOMDV protocol is reduces possibility of retransmission by providing alternative path instantly in network.

Even the rate of message failure as well as node failure in network congestion is occurs also increases by that energy consumption of nodes are enhanced. WSN nodes are battery powered which are deployed to perform a specific task for a long period of time. The proposed EAWMRP load provides a higher energy path as compare to previous AWMRP-GECP that spending among nodes which therefore maximizes the network lifetime. The higher energy spending will reduce the amount of energy consumption which is usually given to other nodes that follow the routing procedure to establish the route on the basis of higher energy selection basis. The performance is enhancement is shown by performance metrics that proves that the performances of proposed scheme are better than compared scheme. In future the work is done on location based routing with Location Aware Routing (LAR) protocol to minimize overhead and delay. The LAR is used to identify the current location on malicious node that doing the routing misbehavior in network

REFERENCES

[1]. WU Shu-Ci and NIAN Xiao-Hong, “The Architecture and Characteristics of Wireless Sensor network”, International Conference on Computer Technology and Development – vol2. No1., pp.561-565, Dec 2010.

[2]. Fie Chang and Qing Wang, “A New Strategy for WSN Routing”, Global Journal of Computer Science and Technology, Vol. 10 Issue 15 (Ver. 1.0), pp. 15-22, December 2010.

[3]. W. Heinzelman, A. Chandrakasan and H. Balakrishnan, "Energy-Efficient Communication Protocol for Wireless Mi- crosensor Networks," Proceedings of the 33rd Hawaii International Conference on System Sciences (HICSS '00), January 2000.

[4]. Qiu Ying and Gao Ming “Energy Aware Routing Algorithm in WSN”, International Conference on Communications, circuits and Systems (ICCCAS), pp.103-107, June- 2010.

[5]. Fie Chang and Qing Wang, “A New Strategy for WSN Routing”, Global Journal of Computer Science and Technology, Vol. 10 Issue 15 (Ver. 1.0), pp. 15-22, December 2010.

[6]. Jamal Al-Karaki, and Ahmed E. Kamal, “Routing Techniques in Wireless Sensor Networks: A Survey“, IEEE Communications Magazine, vol 11, no. 6, pp. 6-28, Dec. 2004.

[7]. 13. Kemal Akkaya and Mohamed Younis, “A Survey on Routing Protocols for Wireless Sensor Networks”, Ad hoc Networks, vol. 3, no. 3, pp. 325-349, May 2005.

[8]. AODV Protocols in wireless sensor network” IEEE, International Conference on Education and e-Learning Innovations, 2012.

[9]. Nasrin Hakim Mithila, “Performance analysis of DSDV, AODV and DSR in Wireless Sensor Network” International Journal of Advanced Research in Computer Science and Electronics Engineering (IJARCSEE) Volume 2, Issue 4, pp.395-404, April 2013.

[10]. Bahia Zebbane and Manel Chenait, "Integrate Topology Control with Multi Path Routing to Enhance the Sensor Network Lifetime," IEEE 15th International Symposium on Wireless Communication Systems (ISWCS), 2018.

[11]. Ashima and Sanjeev Thakur “Distributed Routing Algorithm to Perform Load Balancing in Grid Wireless Sensor Network” VSRD-IJCSIT, Vol. 2 (7), pp. 582-589, 2012.

[12]. Divya Sharma,Sandeep Verma, Kanika Sharma “Network Topologies in Wireless Sensor Networks: A Review” NITTTR, Chandigarh, UT, India, IJECT Vol. 4, Issue Spl - 3, April - June 2013.

[13]. Mahesh K. Marina, and Samir R. Das “Ad hoc on-demand multipath distance vector routing” Wireless Communications And Mobile Computing Wireless

Communication. Mobile Computing, pp. 969–988 2006;

[14]. Robert Akl, Uttara Sawant, "Grid-based Coordinated Routing in Wireless Sensor Networks" IEEE 1-4244-0667-6/07/ 2007.

[15]. Er.Punardeep Singh, Er.Harpal Kaur, Er. Satinder Pal Ahuja, "Brief Description of Routing Protocols in MANETS And Performance And Analysis (AODV, AOMDV, TORA)" Volume 2, Issue 1, January 2012.

[16]. Shahzad Ali and Sajjad Madani "Distributed Grid based Robust Clustering Protocol for Mobile Sensor Networks" The International Arab Journal of Information Technology, Vol. 8, No. 4, October 2011.

[17]. Sonia Chawla, Sukhvir Singh, "effective load balancing algorithm for grid wireless sensor networks," International Journal of Engineering Science and Technology (IJEST) pp 5769-5771, Vol. 3 No. 7 July 2011.

[18]. Issariyakul, T. and Hossain, E. "Introduction to Network Simulator NS-2" pp.197-230, Springer 2011.-the-rise-and-fall-of-jet-airways-39555d6911b5.