International Journal of Engineering Research & Management Technology
ISSN: 2348-4039
July-2017 Volume 4, Issue-4
Email: editor@ijermt.org www.ijermt.org

A COMPARATIVE ANALYSIS OF VARIOUS ROUTING PROTOCOLS IN WSN ON THE BASIS OF DIFFERENT QUALITY OF SERVICE PARAMETERS

Dr. HIMANI GOYAL
Head & Professor
Dept of Electrical Engineering,
Poornima Institute of Engineering and Technology,
Sitapura, Jaipur, Rajasthan

RINA SHARMA
Research Scholar
Dept of Computer Application
I. K. Gujral Punjab Technical University
Jalandhar, Punjab

ABSTRACT:
Wireless Sensor Networks has achieved massive amount of attention of researchers. One thing which enhanced the use of WSN is its wide range of applications. As the name suggests is a wireless network making use of sensors for monitoring physical as well as environmental conditions. Energy efficiency is the main aim in the field of WSN. The main objective of this research paper is to compare the performance of various existing routing protocols like AODV, DSDV, DSR and ACO routing protocols with AODV- PSO Routing Protocol in terms of Energy Consumption, Packet Delivery Rate, Average Delay and Average Throughput. Simulation based results and data analysis shows that AODV-PSO is more efficient in terms of overall performance as compared to other existing routing protocols for Wireless Sensor Networks.

KEYWORDS: Wireless Sensor Networks, AODV, DSDV, Routing Protocol, Performance Comparison, Energy Consumption, Packet Delivery Rate, Average Delay and Average Throughput.

1. INTRODUCTION

In present scenario, Wireless Sensor Networks has gained enormous amount of attention of researchers across the world. Wireless sensor networks comprising of thousands of sensor nodes capable of sensing environmental information, processing it in efficient manner and transmitting the information back to base locations for further analysis [1].

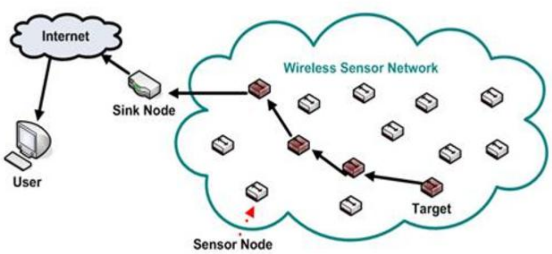

Figure 1. Wireless Sensor Network

Main components of a sensor node consists of sensing unit that senses any physical phenomenon, processing unit that performs different computations and communication subsystem that exchanges information between different nodes. [2]. The sensor nodes forming Wireless Sensor Networks have limitation in terms of low memory, less processing speeds. A radio is integrated on nodes to transmit the information back to sink node. The nodes are powered using battery to act as main power source. As the batteries are the only and primary power source, it becomes difficult to replace and charge the batteries once nodes are deployed which remains the foremost challenge in front of researchers to enhance the Energy Efficiency of sensor nodes [1].

Different applications have different network requirements and these applications play an important role in our day to day life. For example Health Monitoring System for the Elderly and Disabled has been developed in that monitors health activities remotely and in case of any emergency, immediate help can be provided.

Applications of WSN for Disaster Management is discussed in that throw a light on how WSN architecture can be used in handling disaster management situations [2].

As nodes are severely energy constrained, the battery must be used carefully by employing efficient power management techniques. In order to increase node lifespan, energy harvesting has been used as an alternative to supplement batteries. For energy harvesting Wireless Sensor Networks (WSN), the power manager plays the crucial role of balancing the energy harvested from the environment with the energy consumed by the node. This mode is usually called energy-neutral operation (ENO) in the literature. In order to respect the ENO condition, power managers typically adjust the wake-up period of the node (i.e. its duty cycle) to the environmental conditions. This method allows for optimizing the quality of service while ensuring the level of reliability required by industrial systems [3].

The main purpose of sensor networks is to gather regional/local information to participate in global decision about the physical environment. Different type of sensors like magnetic, visual, infrared, thermal, acoustic, seismic, and radar are available that encourage the use of these networks in wide range of applications like traffic control, environment monitoring, precision agriculture, weather forecasting, military surveillance, industrial sensing, etc. Despite of wide range of applications, wireless sensor networks face several design and architectural issues. Energy consumption by the sensor nodes while communicating is one of the prominent issues. Energy constrained sensors hamper the communication [4]

Each sensor node in the network consumes power, not only in sensing data, but also for processing the data and transmitting/receiving these processed information for further routing. Therefore, a routing protocol designed for these networks should definitely be such that the power consumption at each stage of the protocol's functionality is as low as possible. Secondly, the network lifetime has to be kept at its maximum by judiciously using the services of each sensor node for routing. In the case of WSN a routing protocol should be preferably simple – it should have less computational complexity, should be efficient in power consumption, should increase the network lifetime and should have less latency for data transmission from node to sink [5].

The two important factors that lead to an efficient sensor network design are
1) Energy Consumption
2) Quality of Service (QoS)

Energy Consumption deals with the distribution of energy among all the nodes throughout the network and QoS depends upon high routing efficiency under multi hop transmission circumstances. Therefore, such types of network design put emphasis on both the routing efficiency and energy consumption [7].

Emerging applications usually involve challenging computations and the need for real-time requirements such as guaranteed Quality of Service (QoS) and bounded end-to-end delay. Existing WSN applications are mainly paying attention on low computational complexity and low-frequency data sampling and they rarely support real-time applications [8].

Moreover, according to the different types of application, the sensory data usually have different attributes, where it may contain delay sensitive and delay tolerant data. For example, the data created by a sensor network that examines the temperature in a normal weather, are not required to be received by the processing center or the sink node within certain time limits. However, a sensor network that used for fire detection in a forest, any sensed data that carries an indication of a fire should be reported to the processing center within certain time limits [9].

CHARACTERISTICS OF WIRELESS SENSOR NETWORK :-

- Deployment of sensor nodes
- Less power
- less computation capability
- Limited memory
- Unreliability

ROUTING PROTOCOLS CAN BE CLASSIFIED

Reactive Protocols: - Reactive protocols are also known as on demand routing protocols. They create a route only when the source node actually needs to send packets to the destination.

In proactive routing protocols, each node will be accessing set of tables, which contains routing information to every other node in the network. All the nodes update these tables to have a consistent and upto-date view of the network [6].

APPROACHES

New clustering approach that integrates load balancing by assigning less number of nodes to CH's near the BS and by distributing number of nodes in a cluster in an efficient manner. Load Balancing (LB) technique decreases energy consumption, if LB is included in cluster based networks [2]

Swarm Intelligence is the new branch of Artificial Intelligence. Swarm Intelligence concept was first introduced by Gerardo Beni and Jing Wang in 1989 with relation to cellular robotic systems. Inspired by social behavior of insects and other animals. The fundamental principle of Swarm Intelligence mainly focuses on **"Probabilistic-based Search Algorithms".** In Swam Intelligence, the most significant concept is "Swarm". Swarm is used to refer any restrained collection of interacting individuals or agents. Communication among these swarms in distributed manner without any requirement of centralized control mechanism makes these models highly reliable and robust to be implemented in diverse applications. The idea of Swarm Intelligence was initiated by two most important Algorithms: Particle Swarm Optimization (PSO) being developed by Kennedy and Eberhart in 2001 and Ant Colony Optimization (ACO) being developed by Stutzle and Dorigo in 2004 [1].

EA-FSR uses the energy as the basis for selecting a neighboring node rather than the shortest path length. The energy of all the neighboring nodes is compared to ﬁnd the node having maximum residual energy. Then this node is chosen to forward the packets. This process is performed for every node which has some packets to transmit. This mechanism ensures the energy balancing in the network as only one node is not constrained with the task of forwarding the data packets. Also, this ensures uniform energy consumption of all nodes in the network which decreases chances of the energy-hole formation [4].

LEO: Simple Least-Time Energy-Efﬁcient Routing Protocol with One-Level Data Aggregation. LEO is proactive, but the absolute route from each node to the BS is not necessary to be known by all the nodes in the network. Every node must have the information about its neighboring nodes only, in this way it reducing the memory requirement of each and every node. Two types of information of the neighbors is required in the neighbor table of each node ﬁrst, the total time required for a packet to reach the BS from that node and second, the residual node energy [5].

II. LITRATURE REVIEW

Anand Nayyar and Rajeshwar Singh [1] have analyzed and simulate to compare the performance of various existing routing protocols like AODV, DSDV and DSR routing protocols with ACO Based Routing Protocol in terms of End to End Delay, Packet Delivery Rate, Routing Overhead, Throughput and Energy Efficiency.

Simulation based results and data analysis shows that overall ACO is 150% more efficient in terms of overall performance as compared to other existing routing protocols for Wireless Sensor Networks.
Sukhkirandeep Kaur and Roohie Naaz Mir [2] introduced a new clustering approach for WSN that includes load balancing and improves energy efficiency by precise selection of CH's. Analysis and simulation results demonstrate the effectiveness of the proposed approach.

Andrea Castagnetti et.al [3], presented a global power management approach for energy harvesting sensor nodes. However, this approach is based on a joint duty-cycle optimization and transmission power control. By concurrently adapting both parameters, the node can maximize the number of transmitted packets while respecting the limited and time-varying amount of available energy. Obtaining a high-packet delivery by using original predictive transmission power controls that can efficiently adapt the transmission power to the wireless channel conditions. Simulation results show improvement in energy efficiency and a packet reception ratio.

Harish Kumar et. al [4] have proposed a routing scheme based upon the fisheye state routing with a difference in route selection mechanism to make sure the decrease in the overall energy consumption of the network. This scheme is named as Energy-Aware Fisheye State Routing (EA-FSR). It is simulated bearing in mind various parameters using QualNet5.0. EA-FSR performance has been compared with the original fisheye state routing algorithm which is also simulated in the same environmental situation. Comparison of various parameters like end-to-end delay average energy consumption and throughput have been conducted
Sudip Misra and P. Dias Thomasinous [5] introduced a simple, least-time, energy-efficient routing protocol with one-level data aggregation that ensures increased life time for the network. Comparison of protocol with popular ad hoc and sensor network routing protocols AODV, DSDV, DD and MCF. According to the observation the proposed protocol outperformed them in throughput, average energy consumption, latency and average network lifetime. The proposed protocol uses node energy and absolute time as the condition for routing this confirms the reliability and congestion avoidance

Jerrin Sebastian et. al [6] An algorithm is presented which can be used for overcoming the congestion, thereby increasing the total network utilization.

Piyush Charan et. al [7] compared two analytical models which demonstrate and forecast the QoS in terms of throughput, average end-to-end delay, jitter, and energy consumption. Different network models are grid-based and cluster-based. Both are simulated using QualNet v 6.1 Simulator.

Goran Horvat et. al [8] presented a cross layered handover algorithm in order to improve declined performance and the QoS by means of multi-channel redundancy. Measurement results show that the proposed algorithm enhances the delivery ratio by 25% and the RTT by 40% in the worst-case situation. However, it under performs upon the heavy traffic load where the trade-off is shown accordingly.

Jalel Ben et. al [9] presented Energy Efficient and Quality of service, multipath routing protocol (EQSR) which optimized the network lifetime by balancing energy consumption among several nodes, with the attention of service segregation to give permission to delay important traffic to reach the sink node with in an acceptable delay, reduces the end to end delay through distributing the traffic across multiple paths, and enhances the throughput by introducing data repetition. EQSR uses the residual energy, available buffer size of node and Signal-to-Noise Ratio (SNR) to forecast the best next hop by means of paths construction phase. EQSR simulated results illustrated that the above protocol is more energy efficient, having higher packet delivery ratio and lowering average delay.

III. PROPOSED WORK

This research paper is to compare the performance of various existing routing protocols like AODV, DSDV, DSR and ACO routing protocols with AODV- PSO Routing Protocol in terms of Energy Consumption, Packet Delivery Rate, Average Delay and Average Throughput. Simulation based results and data analysis shows that AODV-PSO is more efficient in terms of overall performance as compared to other existing routing protocols for Wireless Sensor Networks.

IV. RESULT AND DISCUSSION

Protocol	Energy Consumption
LEO	2.43
MCE	2.53
EA-FSR	3.13
FSR	3.55
PSCH 25%	2.24
PSCH 33%	2.54
AODV-PSO	1.61

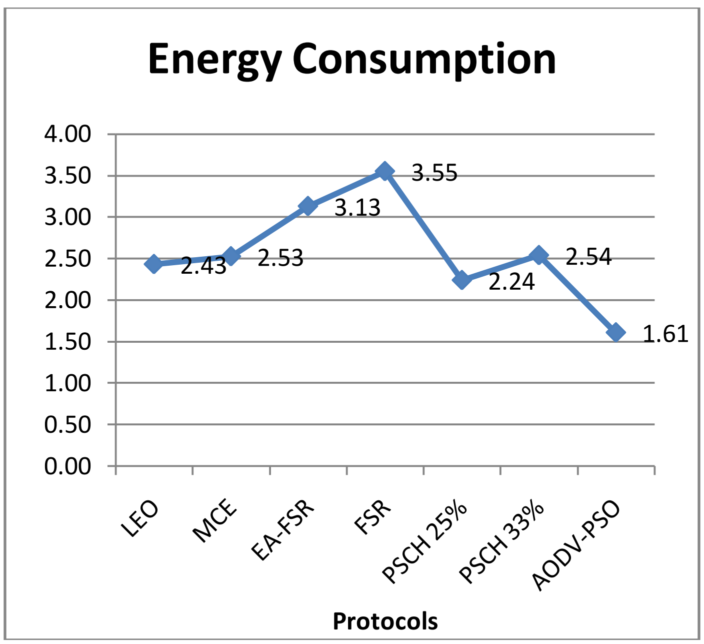

Figure 4.1 Total Energy Consumed according to various protocols

Figure 4.1 shows the Energy Consumption according to various protocols. X-axis is used for protocols and Y-axis is used for Energy Consumption. It is shown in the form of line graph.

Protocol	Packet Delivery Ratio
CLPM-FIXED	95.0
CLPM-PTPC	89.0
PSCH 25%	78.0
PSCH 33%	85.5
DSDV	86.8
AODV	84.4
DSR	89.6
ACO	92.9
AODV-PSO	99.9

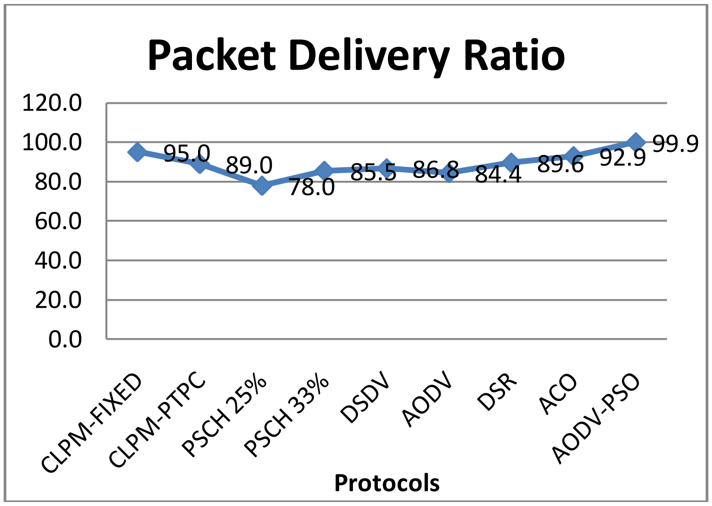

Figure 4.2 Packet Delivery Ratio according to various protocols

In the above Figure 4.2, this shows the Packet Delivery ratio according to various protocols. X-axis is used for protocols and Y-axis is used for PDR. It is also shown in the form of line graph.

Protocol	Average Delay
PSCH 25%	1.12
PSCH 33%	0.94
DSDV	7.28
AODV	5.95
DSR	7.21
ACO	2.13
AODV-PSO	0.0082

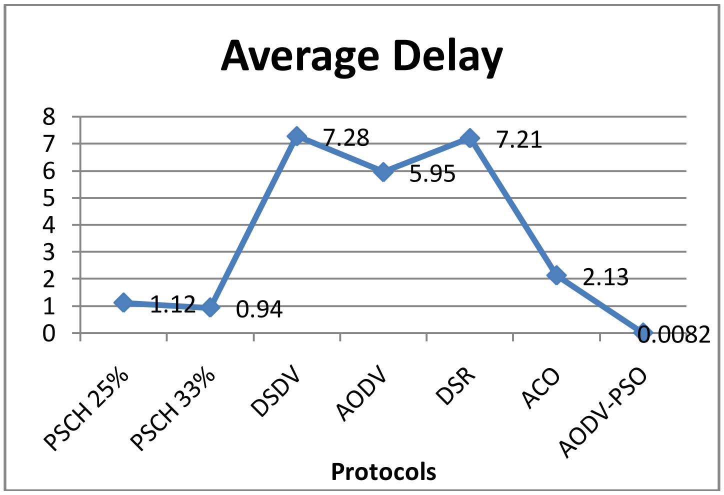

Figure 4.3 Average Delay taken according to various protocols

In Figure 4.3, this shows the Average Delay according to various protocols. X-axis is used for protocols and Y-axis is used for Average Delay rate. It is shown in the form of line graph.

Protocol	**Average Throughput**
DSDV	6.24
AODV	8.21
DSR	8.02
ACO	9.58
AODV-PSO	3

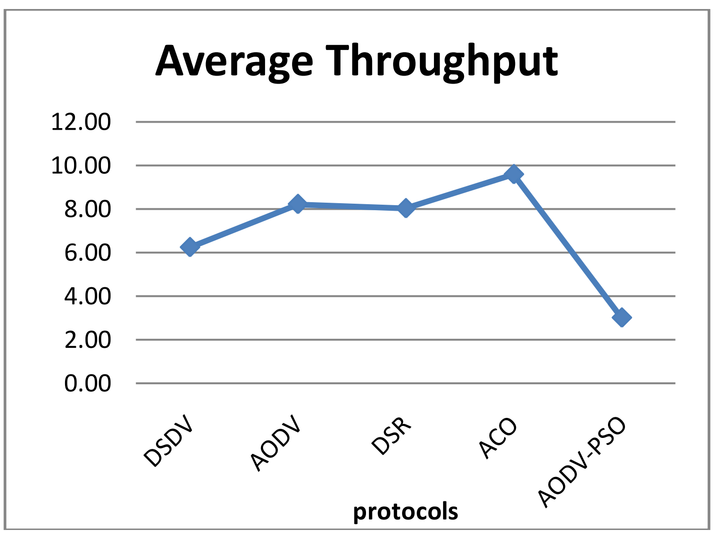

Figure 4.4 Average Throughput according to various protocols

Figure 4.4 shows the Average Throughput according to different protocols. X-axis is used for protocols and Y-axis is used for Average Throughput. It is also shown in the form of line graph.

V. CONCLUSION

Quality of service parameters like Energy Consumption, Packet Delivery Ratio, Average Delay and Average Throughput plays significant role in network performance. Various protocols like DSDV, AODV, DSR, ACO and CLMP are compared with AODV-PSO. Performance evaluation is done on the following performance metrics like Energy Consumption, Packet Delivery Ratio, Average Delay and Average Throughput. Simulation results show that Energy Consumption, Packet Delivery Ratio, Average Delay are improved

Analysis of the above data shows that overall energy consumption is reduced by 54.6%. It is 3.55 for FSR and 1.61 for AODV-PSO. Another factor which is affected by it is the reduction of average delay by 99.9%. It was 7.28 for DSDV and 0.0082 for AODV-PSO. Packet delivery ratio (PDR) is improved by 28.1% from 78 (PSCH25%) to 99.9 (AODV-PSO). However, Average throughput was also reduced from 9.58 to 3 but the other three factors improved their performance.

VI. REFERENCE

1. Nayyar and Singh, “Simulation and Performance Comparison of Ant Colony Optimization (ACO) Routing Protocol with AODV, DSDV, DSR Routing Protocols of Wireless Sensor Networks using NS-2 Simulator”, American Journal of Intelligent Systems 2017, 7(1): 19-30
2. Sukhkirandeep Kaur and Roohie Naaz Mir, “Energy Efficiency Optimization in Wireless Sensor Network Using Proposed Load Balancing Approach”, International Journal of Computer Networks and Applications (IJCNA) Volume 3, Issue 5, September – October (2016)
3. Andrea Castagnetti, Alain Pegatoquet, Trong Nhan LE, and Michel Auguin, “A joint duty-cycle and transmission power management for energy harvesting WSN”, IEEE Transactions on Industrial Informatics 10 (2), 2014, 928-936
4. Harish Kumar, Harneet Arora and R.K. Singla [ ], “Energy-Aware Fisheye Routing (EA-FSR) algorithm for wireless mobile sensor networks”, Cairo University, Egyptian Informatics Journal (2013) 14, 235–238
5. Sudip Misra and Dias Thomasinous, “A simple, least-time, and energy-effi cient routing protocol with one-level data aggregation for wireless sensor networks”, The Journal of Systems and Software 83 (2010) 852–860
6. Jerrin Sebastian, Smitha Jacob and Deepu Job “QoS Based Congestion Control Algorithm for Video Traffic in Wireless Mesh Network” International Research Journal of Engineering and Technology (IRJET), Volume: 03 Issue: 08 Aug-2016 Page 363-368.
7. Piyush Charan, Rajeev Paulus, Tahsin Usmani, and Syed Hasan Saeed, “Performance Evaluation of AODV Protocol for Energy Consumption and QoS in IEEE 802.15.4 Based Wireless Sensor Network Using QualNet Simulator”, Scientific Research Publishing, Wireless Sensor Network, 2016, 8, 166-175
8. Goran Horvat, Jelena Vlaovic and Drago Zagar, “Budva, Montenegro Improving QoS in Query-Driven WSN Using a Cross-Layered Handover Algorithm”, 4th Mediterranean Conference on Embedded Computing MECO – 2015
9. Jalel Ben, Othman and Bashir Yahya, “Energy efficient and QoS based routing protocol for wireless sensor networks”, J. Parallel Distrib. Comput. 70(2010)849–857