PERFORMANCE ANALYSIS OF DIFFERENT ROUTING PROTOCOL USING WIRELESS SENSOR NETWORK IN NS3

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Abstract

A sensor network is a system contains a very small stations called sensor nodes. Through wireless fashion the nodes are communicate and WSN have variety of applications, nodes will communicate each other through different routing protocols. Based on the update mechanism they are classified as reactive, proactive and hybrid routing protocols. The performance of these protocols varies in simulation environment. The main of this paper is to compare the performance of four different routing protocols AODV, DSR, OLSR and DSDV respectively. The performance of these protocols were analyze in two ways such as by keeping number of nodes constant and movable. The evaluation is one by considering the different performance metrics such as throughput, end to end delay and jitter to analyze the lifetime of nodes. The simulation used is network simulator3.

Keywords: Energy Efficient, routing protocols, wireless sensor networks(WSN)

I. INTRODUCTION

Wireless sensor network(WSN) consists of several resource-constrained sensor nodes randomly deployed overall geographic region.These sensor nodes forward sensory data toward a resourceful base station. Depending on the application type, the base station is locate either far away sensor field or within the sensor field [1]. Such networks have a wide range of application in military and civil domains. The application of WSN are as follows: combat field surveillance, target tracking in battle fields, intrusion detection, post disaster rescue operations, smart home, monitoring and alarming systems for supermarkets, wildlife monitoring systems an many safety an security related applications [1]. In the aforementioned applications, the sensor nodes generate sensory data from the environment of interest. The sensed data are finally forwarded toward the base station for further processing and decision making with regard to the control for meeting the objective of the system in place. Depending on the application type, the sensor nodes and the base station can be static or mobile. In a typical WSN, the sensor nodes are inexpensive, disposable, and expected [1]. Therefore, energy is a very limited resource for a WSN system, and it needs to be managed in an optimal fashion.reliable and successful data delivery at the base station is desired. Energy efficient is an important aspect of any application of WSN. Routing of data in WSN is a critical task, and significant amount of energy can be saved if routing can be carried out tactfully. Routing is an issue linked to the network layer of the protocol stack of WSN
[1].

To identify an select best routing protocol for an application, it is required to understand the strict demands of that application first and then to select the appropriate protocol to be implemented and simulated. There are several routing protocols developed for WSNs. All these routing protocols have different competing features and qualities. Therefore, the selection of correct routing protocol is vital. Based on the route selection classification, WSN protocols can be categorized in three parts i.e. Proactive, reactive an hybrid. Many routing algorithms have been proposed for proactive an reactive approach and as well as for hybrid approach [2]. In proactive routing approach it continuously evaluates the path of the network, so whenever it needs to send the packets in the network the routes is already known and can send immediately. Reactive routing protocol invokes the route only when it is required. So route determination required more time as compared to proactive protocol. Because of larger delay and control traffic it is not applicable to the real time system. Hybrid routing is the combination of proactive and reactive approach an it make use of proactive to determine the early routes in its internal zone whereas uses the reactive approach in its intra-zone, that is communicating between inter-zone of the network [3].

The performance comparison is presented in this paper. Routing protocols DSDV and OLSR for proactive and AODV,DSR for reactive are well known approaches int heir respective domains. The parameters such as throughput, jitter and end to end delay are examined for each of the approaches. Finally, the simulation results of protocols are implemented on NS3 are concluded here.

The rest of this paper is organizes as follows, Section II gives brief description about the related works, followed by Section Ш gives brief description about problem definition, followed by Section IV gives simulation setup, followed by Section V gives proposed work and simulation results are discussed with an analysis. Finally, in Section VI, this paper is concluded with future scope of this work.

II. RELATED WORK

In the literature [1], describes the novel energy efficient routing protocol for WSNs. The protocol is reliable in terms of data delivery at the base station. The proposed protocol is hierarchical cluster based.

Many researchers have been working in this direction to evaluate the performance of these protocols in different simulation environments. The main aim of this paper is to compare the performance of three different protocols- AODV (Ad-hoc on demand distance vector routing), DSDV (Destination-Sequenced Distance-Vector Routing) and ZRP (Zone Routing Protocol) which constitutes a good combination of on-demand (reactive), table-driven (proactive) and hybrid protocols respectively.It is taken into account that these protocols are the best protocols in their respective domains due to their low overhead. The performance of these protocols will be analyzed in two ways. Firstly, by keeping no. of CBRs constant and varying nodes from 10 to 50. Another way is by keeping no. of nodes constant and varying no. of CBRs from 1 to 7. The evaluation is done by considering the performance metrics - throughput, jitter and average end to end delay. The simulator used is Qualnet 7.3 [3].

In this paper, the performance analysis is carried out on Ad-hoc On-demand Distance Vector (AODV), Dynamic Source Routing (DSR), Optimized Link State Routing (OLSR) and Destination Sequenced Distance Vector (DSDV) protocols using NS2 simulator. The delay, throughput, control overhead and packet delivery ratio are the four common measures used for the comparison of the performance of above protocols [4].

In this paper, a routing algorithm termed Energy-efficient Routing Algorithm to Prolong Lifetime (ERAPL) is proposed, which is able to dramatically prolong network lifetime while efficiently expends energy [5].

Ad-hoc and sensor networks are becoming an increasingly popular wireless networking concepts lately.This paper analyzes and compares prominent routing schemes in these networking environments. The knowledge obtained can serve users to better understand short range wireless network solutions thus leading to options for implementation in various scenarios. In addition, it should aid researchers develop protocol improvements reliable for the technologies of interest
[6].

MANET is a mobile ad hoc network in which nodes are move freely and perform the communication. In mobile ad hoc network, directional antenna plays a vital role. Directional antenna has many advantages such as increased transmission range, higher gain and reduced interference. Directional antenna uses a set of elements which has fixed beam nature and radiate the frequency in all directions and also at a specific angle. In this paper we analyze the performance of different directional antennas for different routing protocol such as AODV, LANMAR and RIP. The performance analysis is based on different metrics of the application layer such as average jitter, average end to end delay and the basis of physical layer metrics such as power consumed in transmit, receive and idle mode using QualNet 6.1 [7].

In this paper [8], an attempt have been made to evaluate the performance of OLSR and DSR routing protocol using Random Way point model, and also investigate how well these selected protocols performs on WSNs, in static environments, using OPNET 16.0 Simulation tool. The performance analysis of these protocols will focus on the impact of the network size and the number of nodes. The performance metrics used in this work are throughput, average end-to-end delay and network load.

Sensor nodes in Wireless Sensor Networks are connected via wireless links. The function of these nodes are Reactive /on demand routing protocol like Ad-hoc sensing the events when placed in the environment and Distance Vector(AODV) and Dynamic Source sending those sensed data to the base station.Many routing,.power management, and data dissemination protocols have been used for WSN. The nature of WSN is similar to MANET (Mobile Ad-hoc Network) where nodes are mobile and communicate directly to base station. Proactive protocols like DSDV (Destination Sequenced Distance Vector) and Reactive Protocols like AODV (Ad-hoc On Demand) and DSR (Dynamic Source Routing) are Used during packet transmission and data forwarding. In this paper AODV protocol is used and analyzed in different terrain areas by using NS2 simulator tools[9].

In this paper[10] we examined LEACH protocol in simulated environment to analyses its energy consumption. In addition, we have also analyzed network performance with different traffic loads, node densities and sizes of WSN in terms of area. The results present significant insights into the working of LEACH protocol and the trade-offs between different parameters. The results depict that LEACH protocol consumes significant energy even when the nodes send no data. Also, the optimum CH percentage values for LEACH at different packet rates are between 5 to 10 percent.[11] This paper proposes S-MAC, a medium-access control (MAC) protocol designed for wireless sensor networks. Wireless sensor networks use battery-operated computing and sensing devices. A network of these devices will collaborate for a common application such as environmental monitoring. We expect sensor networks to be deployed in an adhoc fashion,with individual nodes remaining largely inactive for long periods of time,but then becoming suddenly active when something is detected. These characteristics of sensor networks and applications motivate a MAC that is different from traditional wireless MAC such as IEEE 802.11 in almost every way: energy conservation and self-configuration are primary goals, while per-node fairness and latency are less important. S-MAC uses three novel techniques to reduce energy consumption and support self-configuration. To reduce energy consumption in listening to an idle channel, nodes periodically sleep. Neighboring nodes form virtual clusters to auto-synchronize on sleep schedules. Inspired by PAMAS, SMAC also sets the radio to sleep during transmissions of other nodes. Unlike PAMAS, it only uses in-channel signaling. Finally, S-MAC applies message passing to reduce contention latency for sensor-network applications that require store-andforward processing as data move through the network. We evaluate our implementation of S-MAC over a sample sensor node, the Mote, developed at University of California, Berkeley. The experiment results show that, on a source node, an 802.11-like MAC consumes 2–6 times more energy than SMAC for traffic load with messages sent every 1–10s.

In this paper[12], we discuss several routing protocols such as Ad Hoc On Demand Distance Vector (AODV),Ad hoc On-demand Multipath Distance Vector (AOMDV),Dynamic Source Routing (DSR),Destination-Sequenced DistanceVector Routing (DSDV)and different connection types such as TCP, Constant Bit Rate (CBR) for WSN. In this research, we analyzed performance of routing protocols by considering different scenarios and metrics. We compare protocols performance by using several metrics such as Packet Delivery Ratio (PDR), Loss Packet Ratio (LPR) and Average End to End Delay (E2E) with varying pause time and speed time. We use network simulator NS2.35 for compare and analyze WSN protocol performance.

In this paper[13], with the help of the concept of potential in physics, we design an Energy-Balanced Routing Protocol (EBRP) by constructing a mixed virtual potential field in terms of depth, energy density, and residual energy. The goal of this basic approach is to force packets to move toward the sink through the dense energy area so as to protect the nodes with relatively low residual energy. To address the routing loop problem emerging in this basic algorithm, enhanced mechanisms are proposed to detect and eliminate loops. The basic algorithm and loop elimination mechanism are first validated through extensive simulation experiments. Finally, the integrated performance of the full potential-based energybalanced routing algorithm is evaluated through numerous simulations in a random deployed network running eventdriven applications, the impact of the parameters on the performance is examined and guidelines for parameter settings are summarized. Our experimental results show that there are significant improvements in energy balance, network lifetime, coverage ratio, and throughput as compare to the commonly used energy-efficient routing algorithm.

This paper[14] overviews research efforts of our research team conducted during the last year to contribute on the design of UWSN by means of modeling and simulations. The first contribution was the adaptation of an energy-efficient and robust architecture for WSN to the subaquatic acoustic medium by means of an ns-3 simulator model. Then, a low power underwater wake-up model for the ns-3 simulator was developed to test and improve wake-up systems. Finally, as a result of all acquired knowledge, a complete underwater wireless sensor network ecosystem of models for the ns-3 simulator was researched.In this paper[15], we present Bee Swarm, an energy-efficient hierarchical routing protocol for WSNs. Our protocol integrate three phases for clustering, data routing and transmission, which is the key aspect of this proposed protocol, thus ultimately contributes to its robustness.
Evaluation of simulation results show that Bee Swarm perform better in terms of packet delivery and energy consumption compared to other hierarchical routing protocols for WSNs

III. PROBLEM DEFINITION

- Increasing energy efficiency and network lifetime is the biggest challenge of an MANET and WSN.
- There is no implementation of WSN Routing protocols in ns3.
- Comparison of routing protocol is one in different network simulators.But not in ns3.
- NS3 doesn't have energy efficient routing protocol.

SOLUTION

- A Routing Protocol should try to minimize the total energy consumption of the network.
- The performance of certain routing protocol is analyse & selected as energy-efficient.

IV.SIMULATION SETUP

The analysis and comparison of protocols can be evaluated by real world experiments or simulation. Since simulation is cheaper or flexible more research work of wireless sensor network s conducted using simulation software. It reduces the need for time consuming and costly real world experiments. The simulation used in my analysis is Network Simulator-3. The reason for choosing this software is live visualizer, connected to real world, portability.

The main aim of this paper is to compare the performance of AODV, DSDV, OLSR and DSR in different simulation environments. The comparison was made by varying the node density and the simulation environment one at a time and keeping all the nodes as constant and movable. The simulation was carried on an area of size 7*7. Each simulation was carried out for 500 seconds. The performance metrics used for comparison were throughput, end to end delay and jitter. Various parameters and their description is summarized below in the table given:

TABLE 1 -SIMULATION PARAMETERS

PARAMETERS	**PARAMETER VALUE**
Simulation	**NS3**
Simulation Area	**7*7**
Nodes	**49**
Simulation Time	**500 sec**
MAC Protocol	**IEEE 802.11**
Routing Protocol	**AODV, DSDV, DSR, OLSR**
Channel	**Wireless**
Model	**Mobile/Static**
PHY	**DSSS rate 1Mbps**

V.PROPOSED WORK

Here we propose a routing protocol in a WSN in which the sensor nodes are placed in both static as well as mobile. The main objective of this paper is to extend the lifetime of the sensor nodes in a network. The protocol offers some suitable alternate routes for packet forwarding in presence of node or link failure in the current route. The protocol takes care of energy efficiency an reliability of a routes.

A.PERFORMANCE METRICS

The required parameters to analyse a four routing protocols AODV, DSDV, DSR and OLSR are:

AVERAGE END TO END DELAY

Average time delay for send data packet from the source node to destination. When average delay is less, then the performance is better.

THROUGHPUT

It is the ratio between the actual number of packets transmitted by the nodes in the system to the number of successfully delivered packets at the base station. Higher throughput is desirable.

JITTER

It is the variation in delay by different data packets that reached the destination. Smaller jitter should make performance better.

PACKET DELIVERY RATIO

It is the ratio of deliver packet which is send by the source node and received by the destination node. When packet delivery ratio is high then performance is better.

RESIDUAL ENERGY

It is the current value of energy in a node after receiving or transmitting routing packets.

B.SIMULATION RESULTS

OVERALL ANALYSIS OF STATIC NODES

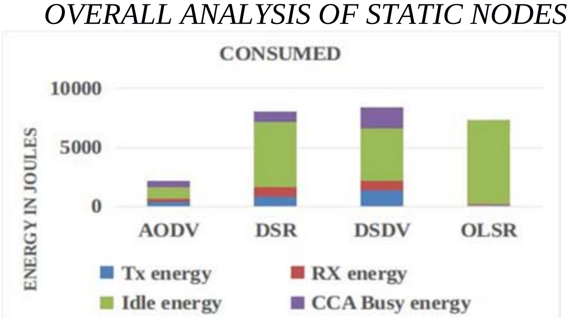

Fig 1 Average energy consumption

Fig.1 depicts the behavior of the proposed protocol in terms of average energy consumption. It is observed that, AODV have better performance in all performance metrics.

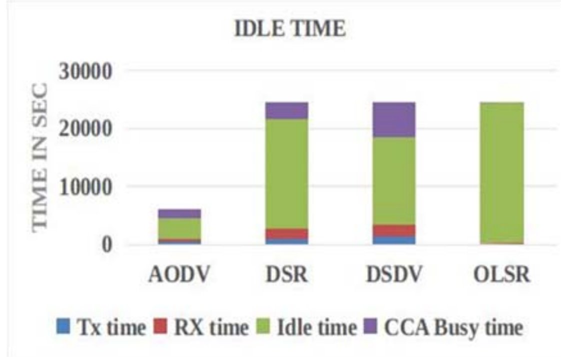

Fig 2 Average Idle Time

Fig.2 depicts the behavior of the proposed protocol in terms of average idle time consumption. It is observed that, AODV have better performance in all performance metrics.

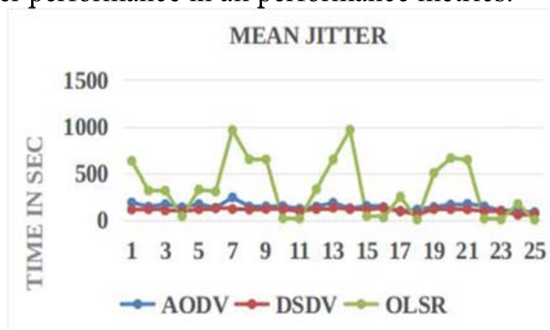

Fig 3 Overall analysis of jitter

Fig 3 Here we notice that as the no. of nodes increases, the value of jitter for AODV, DSDV goes decreasing but in case of OLSR, this parameters increases as the no. of nodes increases. So, overall we can say that AODV is the most preferred routing protocol for larger networks.

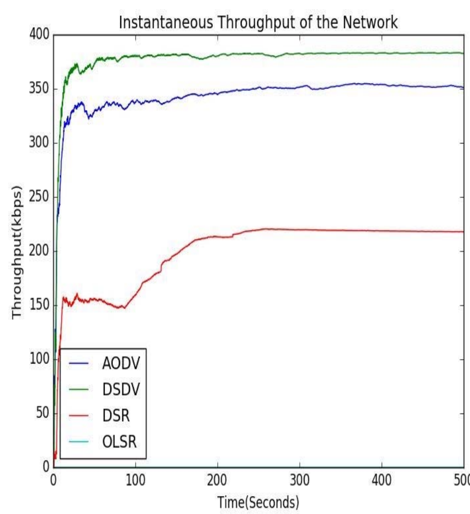

Fig 4 Instantaneous throughput

Fig 4 Here we notice that the value of throughput for AODV remains constant as DSDV and OLSR shows many variations . So, overall we can say that AODV is the most best routing protocol for larger networks in terms of throughput.

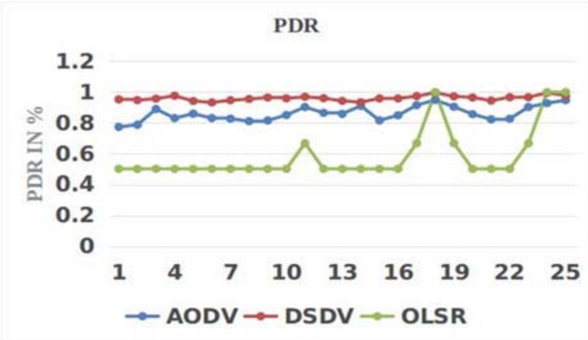

Fig 5 Packet delivery ratio

OVERALL ANALYSIS OF MOBILE NODES

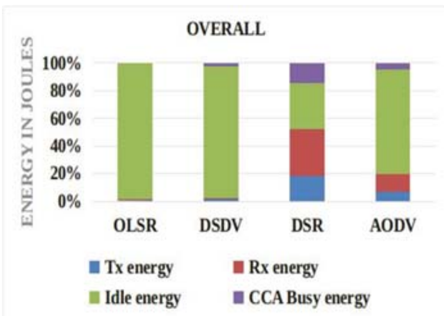

Fig 6 Average consumption

Fig 6 depicts the behavior of the proposed protocol in terms of average energy consumption. It is observed that, AODV have better performance in all performance metrics.

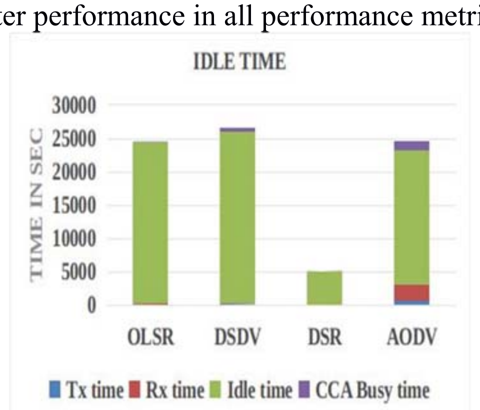

Fig 7 Average idle time

Fig.7 depicts the behavior of the proposed protocol in terms of average idle time consumption. It is observed that, AODV have better performance in all performance metrics.

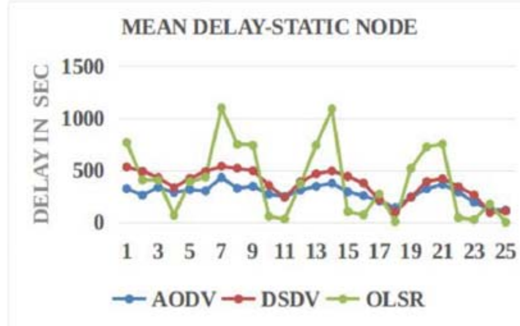

Fig 8 Mean delay

Here we notice that as the no. of nodes increases, the value of mean delayfor AODV, DSDV goes decreasing but in case of OLSR, this parameters increases as the no. of nodes increases. So, overall we can say that AODV is the most preferred routing protocol for larger networks.

FINAL ENERGY ANALYSIS

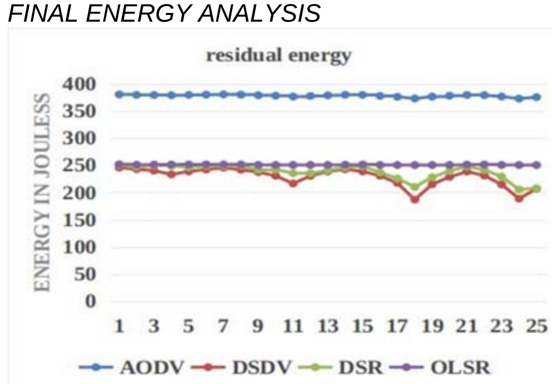

Fig 9 Residual energy

In residual energy graph, AODV remains stable after the data transmitting. Hence AODV has energy efficient. By comparing the data collected from the four routing protocol we considered, AODV is the best in all analysis. Hence AODV is the energy efficient routing protocol. This analysis is based on the comparison of transmission time, receive time, CCA busy time and idle time of the static nodes.

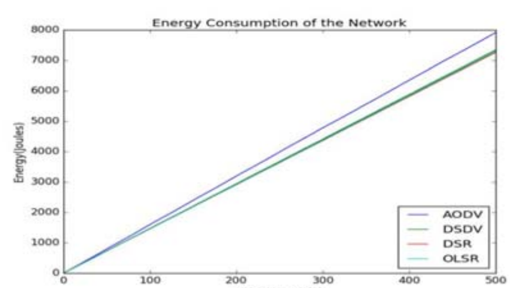

FIG 10 Energy consumption of mobile nodes

By comparing the data collected from the four routing protocol we considered, DSR is the best in all analysis. Hence DSR is the energy efficient routing protocol. This analysis is based on the comparison of transmission time, receive time, CCA busy time and idle time of the static nodes.

VI.CONCLUSION

Four protocols AODV, DSR, DSDV and OLSR are compared based on energy consumption, throughtput, jitter, end to end delay with the simulation and graphical results.AODV is the best solution for static nodes and DSR is the best solution for mobile nodes.This results will help the designers and engineers for implement in real life of wireless sensor network and also for future research and development of these protocols.

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