Performance Comparison of AODV, WBAODV, DSDV & HYBRID in the WSN using Network Simulator 2

Deepak Kumar Garg
Deptt. of Electronics Engg.
GZS PTU Campus, Bathinda

Balraj Singh
Deptt. of Electronics Engg.
GZS PTU Campus, Bathinda

Darshan Singh Sidhu
Deptt. of Electronics Engg.
GZS PTU Campus, Bathinda

Abstract

Wireless ad-hoc networks of sensor nodes are commonly deployed to monitor numbers of real-world phenomena. Their applications are immensely used in monitoring, surveillance and many other military and civilians needs. As Sensors have limited power, so security mechanism for the sensor network must be energy efficient. It also requires some form of self-configuration and autonomic functionality. Now a day, there is large number of networks so we require an energy efficiency protocol. In this paper Hybrid Scheme comprising WBAODV and DSDV protocol is proposed to minimize the delay, increase the throughput, increase the packet delivery Fraction (PDF) and decrease the energy as compared to AODV, WBAODV and DSDV protocol.

Keywords: Wireless sensor network, WBAODV, DSDV, AODV, PDF.

1. Introduction

1.1. Background

The increase in computing devices increases the computing capacity and complexity of the network. With this increasing system complexity, network management issues and communication protocols are reaching a level beyond human ability to manage and secure, the stability of current infrastructure, systems and data is at an increasingly greater risk. A future network algorithm needs to be adaptive, robust, and scalable with fully distributed and self-organizing architectures. To have good result there is need for a approach to have energy efficient protocols. [6]

1.2. Wireless Sensor Network

Wireless ad-hoc network is a collection of mobile nodes that communicate with each other over wireless links. These devices are monitoring physical and environmental conditions, such as temperature, vibration, motion, sound, pressure, or pollutants, at different locations. A wireless sensor network is a collection of nodes organized into a cooperative network. Each node consists of processing capability (one or more microcontrollers, CPUs or DSP chips). It also contain multiple types of memory (program, data and flash memories), RF transceiver, power source (e.g., batteries and solar cells), and accommodate various sensors and actuators. There are two types of wireless sensor networks.

1) Structured
2) Unstructured

The structured wireless sensor networks are those in which the sensor nodes deployment is in a planned manner. The unstructured wireless sensor networks are the one in which sensor nodes deployment is in an ad-hoc manner. The routing becomes an issue in large number of sensor nodes deployed in wireless sensor networks for communication with no fixed infrastructure and along with other challenges of manufacturing, design and management of these networks. [3]

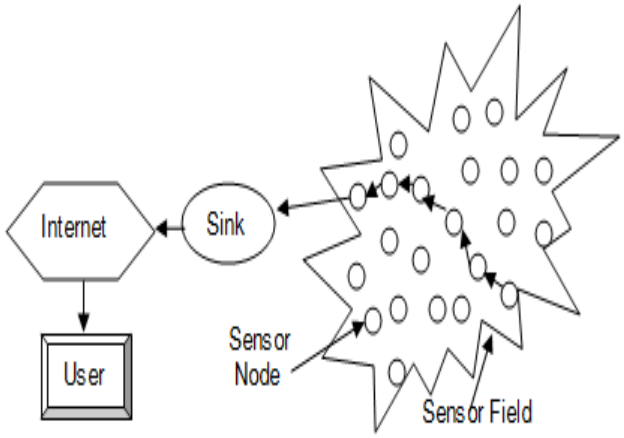

Figure 1. Basic architecture of Wireless Sensor Network. [4]

Sometimes, Mobilize is needed to move sensor node from current position and carry out the assigned tasks. Since the sensor may be mobile, the base station may require accurate location of the node which is done by location finding system. The size of a single sensor node can vary from shoebox-sized nodes down to devices the size of grain of dust. AODV protocol uses more metrics in addition to the number of hopes to increases the throughput and decreases the number of packets with collisions over the paths (David and Zoubir (2006)). Route in WBAODV Protocol is decided by four factors: the speed of nodes, the power level of battery, Bandwidth and Hope Count to get high throughput, minimum numbers of hopes for routing, low memory overhead and less amount of energy consumption as compared to AODV Protocol (D.P.S. Edvinoe and Christina (2011)). Performance of AODV and DSDV is compared on the basis of speed & time and concluded that AODV is higher End to End Delay, more PDF and Less Packet Loss as compared to DSDV Protocol (Ajay, Rasvihari, Vineet, Rashmi and Rinkoo (2013)).

1.3 Protocol used in Wireless Ad-hoc Network

These three protocol are being used; On Demand (Reactive), Table Driven (Proactive), Hybrid (Mixture of Reactive & Proactive). The Brief details are discussed below.

1.3.1. On Demand (Reactive) Protocol. Ad-Hoc on-demand distance vector (AODV) and Weight Based AODV (which is enhancement of AODV). The Ad hoc On Demand Distance Vector (AODV) routing algorithm is a routing protocol designed for ad hoc mobile networks. Unicast and multicast routing both are supported by AODV. It is an on demand algorithm and maintains a route whenever source wants to be. These routes are maintained as long as they are needed by the sources. AODV is loop-free, self-starting and uses sequence numbers to ensure the freshness of routes.

It uses a route request / route reply query cycle for established the route when a route is not established between Source and Destination Node. It broadcasts a route request (RREQ) packet across the network. Nodes receiving this packet, update their information and set up backwards pointers to the source node in the route tables. The RREQ contains the source node's IP address, current sequence number, broadcast ID and update sequence number for the destination. On receiving the RREQ node may send a route reply (RREP) if it is either the destination or if it has a route to the destination. In this case, it unicast a RREP back to the source Otherwise it rebroadcasts the RREQ. RREP propagates back to the source and set up the route. Once the source node receives the RREP, it start to forward data packets to the destination. As long as the packet is transmitting from source to destination, the route is active otherwise route is deleted and nodes propagates the error message (RERR). If the source node still want the route, whole process start again.

Weight-Based AODV (WBAODV) routing protocol which is efficient and superior of the standard AODV routing protocol in performance. It is an efficient and also immune against the most commonly possible routing attacks.

1.3.2. Table driven (Proactive) Protocol. Destination-Sequenced Distance-Vector Routing (DSDV) is a table-driven routing scheme for ad hoc mobile networks based on the Bellman–Ford algorithm. It was developed by C. Perkins and P.Bhagwat in 1994. The emphasis was to solve the routing loop problem. Sequence number is used to decide whether the link is present or not. The even numbers are used when link is presented otherwise odd sequence number is used. These numbers is generated by the destination and send out the next update with this number. Routing information is distributed between nodes by sending full dumps infrequently and smaller incremental updates more frequently.

1.3.3. Hybrid Protocol. On Demand and Table Driven Protocols have been used for the implementation of hybrid protocol which comprising Weight Based Ad-Hoc on demand Distance Vector (WBAODV) and Destination Sequence Distance Vector (DSDV) protocol. Since both on demand and table driven protocols work best in different scenarios, hybrid uses both. Table Driven are restricted to small domains and On Demand uses at outside this domain.

2. Proposed Algorithm

The AODV Routing protocol uses an on-demand approach for finding routes, that is, a route is established only when it is required by a source node for transmitting data packet. (DSDV) stems out from the fact that DSDV uses source routing in which a data packet carries the complete path to be traversed. The WBAODV is weight based AODV protocol to enhance the stability of a network. The Weight Based Ad-Hoc on demand Distance Vector (WBAODV) and Destination Sequence Distance Vector (DSDV) combines to form a hybrid (WBAODVDSDV) .It is hybrid Mechanism that act as better efficiency in wireless sensor Ad-hoc network. Then look up table declares that which protocol may act as better and uses it to record the values.

2.1. Flowchart

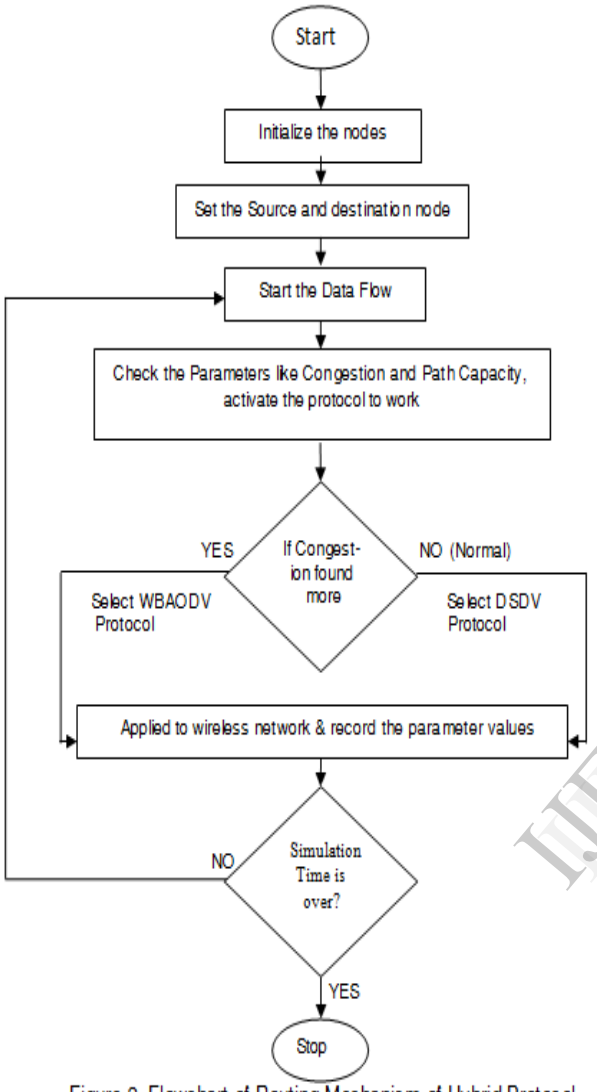

Figure 2. Flowchart of Routing Mechanism of Hybrid Protocol

3. Simulations and Results

We have simulated the various parameters by Network Simulator 2 (NS2) and compared with two on demand (reactive) routing protocol AODV and WBAODV and one table driven (proactive). The main objective of our simulations is to show that hybrid protocol has significant improvement as compare to individual Reactive and Proactive Protocol.

3.1. Simulation Environment

Table 1. Parameter value of Simulation Environment

Simulator	Network Simulator 2.34
Network Size	1000m x 1000m
No. of nodes	50
Simulation Time	50Sec
MAC Type	802.11
Bandwidth	4Mz
Traffic Sources	CBR, FTP
Traffic Agents	UDP, TCP
Interface Queue Length	50
Packet Size	512 Byte data
Max speed	10
Interval time b/w Packets	0.05
Max. Packets to be send	10000

The Performance analysis of proposed Hybrid Protocol comprising WBAODV and DSDV is done by comparing with existing two on demand protocol AODV & WBAODV and one table driven DSDV on the basis of the following parameters:

1. End to End delay
2. Throughput
3. Packet Delivery Fraction(PDF)
4. Energy

3.2. End to End delay performance Comparison

The average time taken by a data packet to arrive at the destination. It also includes the delay caused by route discovery process and the queue in data packet transmission.

$$Delay = Tr - Ts$$

Whereas Tr is arrive time & Ts is send time

The lower value of end to end delay means the better performance of the protocol. The proposed work shows the significant improvement in end to end delay as compared to individual Reactive and comparable with Proactive protocol. The graph show the delay v/s pause time using the Network Simulator 2 in figure 3.

3.3. Throughput performance Comparison

Throughput refers to the ratio of the amount of packets received at the Destination to the amount of packets transmitted at the Source. It must be higher for the better performance of the network.

$$\text{Throughput} = \frac{\text{(Total Data Bits Received)}}{\text{(Simulation Runtime)}}$$

The proposed work shows the higher throughput in hybrid as compared to other on demand & Table driven protocol in figure 4.

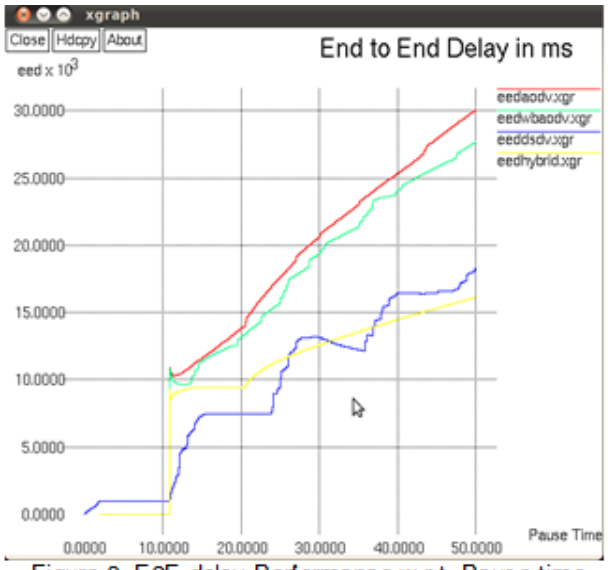

Figure 3. E2E delay Performance w.r.t. Pause time

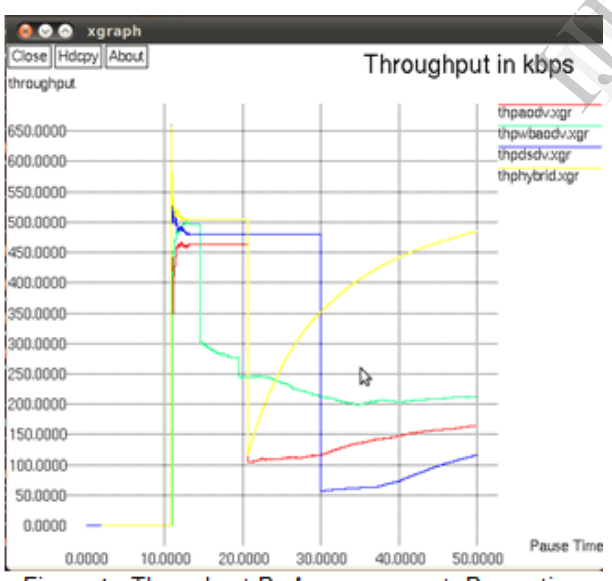

Figure 4. Throughput Performance w.r.t. Pause time

3.4. Packet Delivery fraction (PDF) Performance Comparison

It is defined as percentage of packets delivered to the destination to those generated at the source.

PDF= (Pr/Ps)*100

Whereas Pr is total packet received and Ps is total packet send.

Greater the value of PDF, better is the performance of the network. The proposed work has better PDF as compared to other protocol is shown in the figure 5.

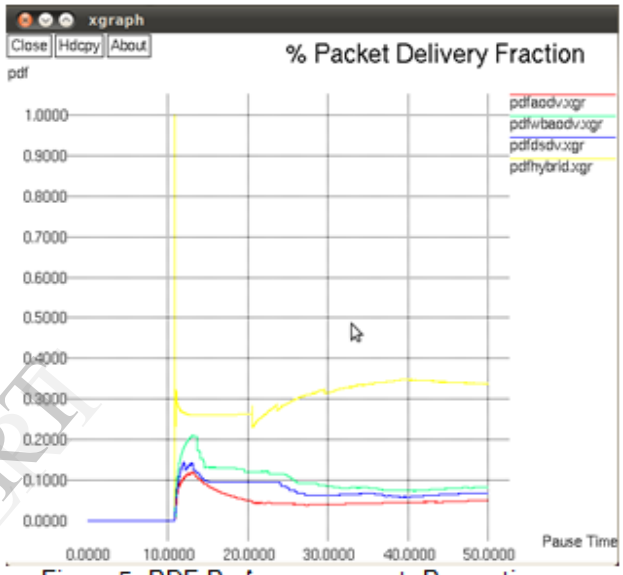

Figure 5. PDF Performance w.r.t. Pause time

3.5. Energy Performance Comparison

Energy is needed for sending a file or data, with the consideration of the size of packages. Practically it is not possible to replace the batteries of large number of deployed sensor in the hostile environment. Therefore there is a need to reduce the Energy consumption of the network. [5] It must be low as possible. By using Hybrid Scheme, energy consumption is less as compared to Ad-hoc on demand distance vector (AODV), Weight Based Ad-hoc on demand distance vector (WBAODV) and Destination Sequence Distance Vector (DSDV).

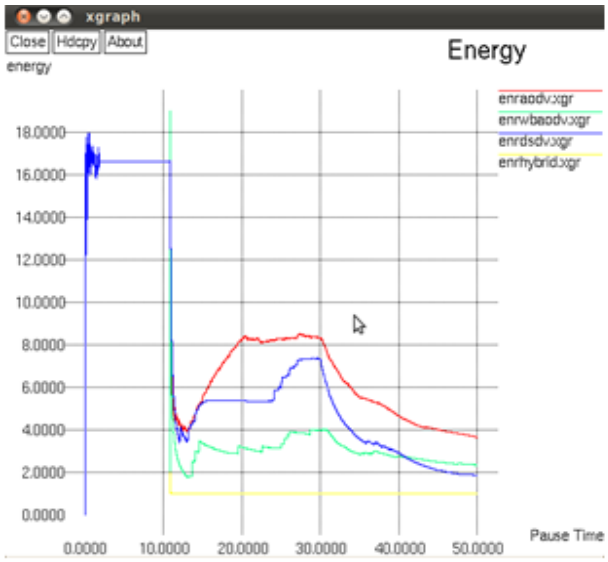

Figure 6. Energy Performance w.r.t. Pause time

Table 2. Average values of all parameters

Protocol / Parameters	AODV	WBAODV	DSDV	HYBRID
End to End Delay	20.91	18.86	11.94	13.20
Throughput	187.22	244.41	220.88	393.49
PDF	0.049	0.099	0.075	0.319
Energy	6.074	3.115	4.108	1.000096

4. Discussion & Results

This paper concludes that there is not a single protocol which can give the best performance in wireless Ad-hoc network. Performance of the protocol varies according to the variation in the network parameters. In this proposed work, the results in terms of end to end delay is lower than AODV & WBAODV but higher than DSDV, throughput is higher than AODV, WBAODV and DSDV, Packet Delivery Fraction is greater than AODV, WBAODV and DSDV and Less Energy is required as compared with two on demand protocol i.e. AODV and WBAODV and one table driven protocol i.e. DSDV. It is concluded that results of proposed protocol are better or comparable with AODV, WBAODV and DSDV protocol.

5. References

[I]. David Espe, Zoubir Mammeri, "Routing Algorithm to Increase Throughput in Ad hoc Networks", International Conference on Networking, International Conference on Systems and International Conference on Mobile Communications and Learning Technologies, 2006.

[2]. D.P.S Edvinoe Christina, Mrs R. Jothi Chitra, "Energy Efficient Secure Routing in Wireless Sensor Networks", International Conference on Emergying Trends in Electrical and Computer Technology, 2011, pp. 982-985.

[3]. V. Kanakaris, D. Ndzi and D. Azzi, "Ad-hoc Networks Energy Consumption: A review of the Ad-Hoc Routing Protocols", Journal of Engineering, Science and Technology Review 3 (1), 2010, pp. 162-167.

[4]. I. Akyildiz, W. Su, Y. Sankarasubramaniam, E. Cayirci, "A survey on Sensor Networks", IEEE Communications Magazine, vol. 40, Issue: 8, 2002, pp. 102-114.

[5]. Ajay, P, R., Rasvihari Sharma, Vineet Srivastava, Rashmi Tikkar, Rinkoo Bhatia, " Performance Comparison of AODV & DSDV Ad-Hoc Networking Routing Protocol on the basis of Variable Speed and Pause Time", International Journal of engineering and innovative Technology, Vol. 2,Issue: 10, 2013, pp. 58-61.

[6]. Shah Sheetel , "Autonomic Wireless Sensor Networks" http://arri.uta.edu/acs/networks/WirelessSensorNetChap04.pdf