Implementation & Performance Comparison of Various HYBRID Schemes in the Wireless Ad-hoc Network Using Network Simulator 2

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Abstract

In the wireless Ad-hoc Network, there is not a single protocol which can give the best performance in network. Performance of the protocol varies according to the variation in the network parameters. Security mechanism for the wireless network must be energy efficient and also requires some form of self-configuration and autonomic functionality as the sensor node has limited power. Presently, there are large numbers of networks so we require an energy efficiency protocol. In this paper two Hybrid Scheme comprising AODV & DSDV and AODV, WBAODV & DSDV protocol is proposed to minimize the delay, increase the throughput, increase the packet delivery Fraction (PDF) and decrease the energy.

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

1. Introduction

Ad-Hoc is Latin word which means "for this purpose". An ad hoc network is a wireless decentralized structure network comprised of nodes, which autonomously set up a network. It does not require central administration and external network infrastructure to transmit the data. Nodes can participate freely in network transmission and travel in network as time passes. Ad hoc network can consist of different types of multi-functional computation devices.

A mobile ad-hoc network (MANET) is a wireless and self-configuring infrastructure-less network. Each node is freely to move in any direction and make links to other nodes frequently. Each node acts as a router and maintains the information about the route traffic. Such networks may operate by themselves or may be connected to the larger Internet. MANETs are a kind of wireless ad-hoc network. [1] Wireless sensor networks (WSNs) consist of large number of sensor nodes. [2] Wireless sensor networks (WSNs) do not always have sensor nodes of same type. Sensor nodes of higher energy can be used to increase the lifetime and reliability of WSNs. A wireless sensor network (WSN) extends our capability to explore, monitor and useful in catastrophic or emergency scenario where human participation may be too dangerous. A sensor of todays encompasses self-organizing, flexible and scalable networks. Wireless sensor networks have at least one base station that works as a gateway between the sensor network and outside world. An ad hoc network is a set of networks where all devices have equal status on a network and are free to associate with any other ad hoc network device in link range. Wireless Ad hoc network is the known IEEE 802.11 Standard. Minimal configuration and quick configuring make ad hoc networks suitable for emergency situations like natural disasters or military conflicts. Ad hoc networks are formed quickly with the presence of dynamic and adaptive routing protocols. Both wireless ad-hoc and wireless sensor networks is distributed, battery powered and self management wireless network.

Performance of Hybrid Protocol Comprising WBAODV and DSDV is compared with AODV, WBAODV & DSDV Protocols on the basis of Pause time and concluded that Hybrid is less End to End Delay as compared to AODV, WBAODV & more than DSDV, more PDF, More Throughput and Less Energy Consumption as compared to AODV, WBAODV and DSDV Protocols (Deepak, Balraj, Darshan (2013)).

1.1 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.

1.1.1. On Demand (Reactive) Protocol. Ad-hoc On Demand Distance Vector (AODV) protocol is designed for Mobile Ad-hoc networks (MANET). It supports both unicast and multicast routing 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 establishing the route. If the route is not established between source and destination node, it broadcasts a route request (RREQ) packet across the network. Nodes receiving this packet in the network and update their information and set up backwards pointers to the source node in the route tables. The RREQ contains the information about source node's IP address, current sequence number, broadcast ID and update the sequence number. 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 starts to forward the 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. [4]

Weight-Based Ad-hoc On Demand Distance Vector (WBAODV) routing protocol is an enhancement of AODV. It is also an On Demand Routing Protocol. WBAODV 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. It is used in the network when Congestion is more. [3]

1.1.2. Table driven (Proactive) Protocol. Destination-Sequenced Distance-Vector (DSDV) Routing is a table-driven routing protocol for Mobile ad hoc networks (MANET) based on the Bellman–Ford algorithm. It was developed by C. Perkins and P.Bhagwat in 1994. The main emphasis was to solve the routing loop problem in the network. The link is present or absent is decided by the sequence number. The even numbers are used when the link is present otherwise odd number is used. These numbers are 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. [2]

1.1.3. Hybrid Protocol. On Demand Protocols (AODV, WBAODV) and Table Driven protocols (DSDV) have been used for the implementation of various hybrid schemes. There are three hybrid schemes are used in this proposed work.
1) AODV and DSDV Protocol
2) AODV, WBAODV and DSDV Protocol

Since both on demand and table driven protocols works best in different scenarios, hybrid uses both. Table driven (Proactive) are restricted to small domains and On Demand (Reactive) uses at outside this domain.

2. Proposed Algorithm

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. [2] We know that AODV protocol uses an on-demand approach and established the route only when it is required by a source node for transmitting data packet to the destination. WBAODV protocol is also an on demand protocol and used to enhance the stability of a network. DSDV is a table driven protocol and complete path must be traversed before sending the packets. Every protocol has its own advantages and disadvantages in the network. The Connection Setup time is lower in AODV but it faces a problem of stale entries due to intermediate node can lead to inconsistent routes, multiple route reply packets can leads to heavy control overhead and unnecessary bandwidth consumption due to periodic beaconing. DSDV faces the problem of small amount of bandwidth and battery uses even when the network is idle due to regular update of its routing tables. The problems of Reactive and Proactive protocols can be solved by combining both of them to make a hybrid protocol. The various different hybrid schemes are proposed to get better results.

3. Simulations and Results

We have simulated the various Hybrid scheme which comprising different on demand and table driven protocols by Network Simulator Version 2 (NS2) and performance analysis is done on the basis of the following parameters:

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

The network simulator NS2 is a discrete event network simulator developed at UC Berkeley that focuses on the simulation of IP networks on the packet level. NS2 is based on two languages: C++ and TCL and it is using TCL/OTCL (Tool Command Language/ Object Oriented tcl) as a command & configuration interface. Ns-2 is an object-oriented simulator written in C++ and OTcl.

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

3.2. End to End delay performance Comparison

The average time taken to route the 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. [5]

Lower the value of end to end delay, better the performance of the protocol. The proposed hybrid comprising AODV and DSDV protocol shows the significant improvement in end to end delay as compared to other hybrid protocol shown in the figure 1. using network simulator 2.

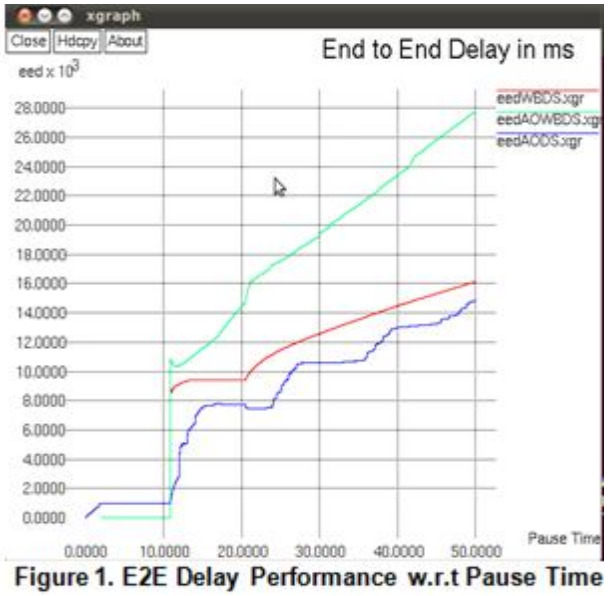

Figure 1. E2E Delay Performance w.r.t Pause Time

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. [2]

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

The proposed hybrid comprising AODV and DSDV shows the higher throughput as compared to hybrid comprising AODV, WBAODV and DSDV but less than hybrid using WBAODV and DSDV protocols as shown in figure 2.

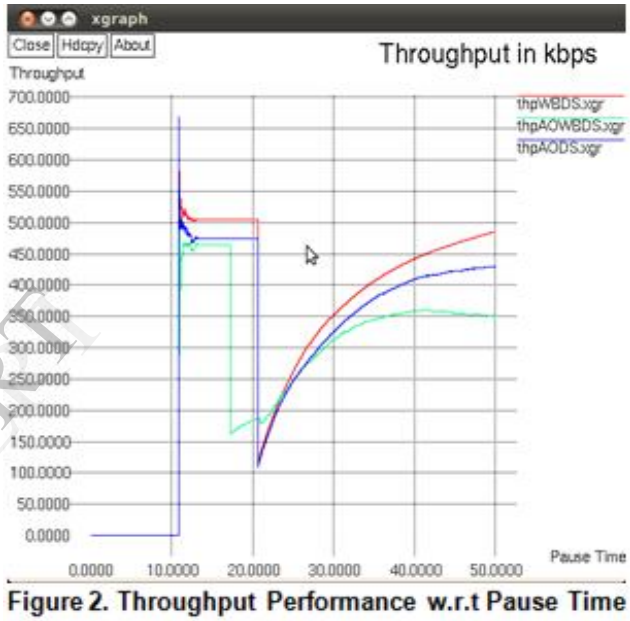

Figure 2. Throughput Performance w.r.t Pause Time

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. [5]

Greater the value of PDF, better the performance of the network. The proposed hybrid comprising AODV and DSDV shows the higher PDF as compared to hybrid comprising AODV, WBAODV and DSDV but less than hybrid using WBAODV and DSDV protocols as shown in figure 3.

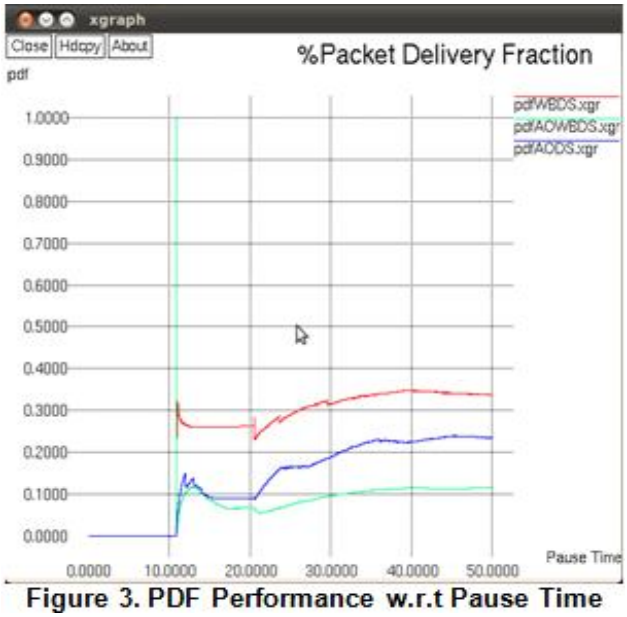

Figure 3. PDF Performance w.r.t Pause Time

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. [3] It must be low as possible The proposed hybrid comprising AODV and DSDV shows the less energy consumption as compared to hybrid comprising AODV, WBAODV and DSDV but less than hybrid using WBAODV and DSDV protocols as shown in figure 4.

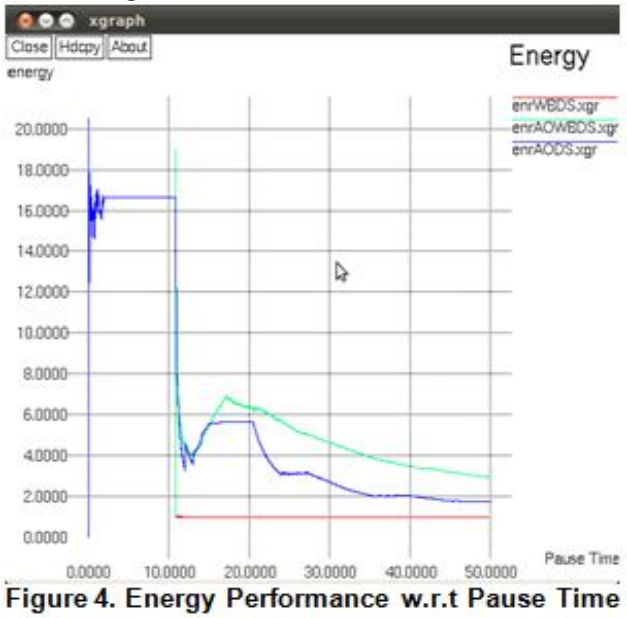

Figure 4. Energy Performance w.r.t Pause Time

4. Discussion & Results

In this paper, we have simulated the three hybrid scheme. Hybrid comprising AODV &DSDV, Hybrid comprising AODV, WBAODV & DSDV and hybrid using WBAODV and DSDV are simulated using NS2. In this proposed work, the results in terms of end to end delay of hybrid comprising AODV & DSDV is lower than other hybrid, throughput is higher than hybrid comprising AODV, WBAODV & DSDV but lower than hybrid using WBAODV &DSDV, Packet Delivery Fraction is greater than hybrid comprising AODV, WBAODV & DSDV but less than hybrid using WBAODV &DSDV and Less Energy is required as compared with hybrid comprising AODV, WBAODV & DSDV but higher than hybrid using WBAODV &DSDV. It is concluded that results of proposed protocol are better or comparable with other hybrid.

5. References

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