A Simulated Analysis of AODV and DSDV Routing Protocols on Different Parameters

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Abstract: In modern era, wireless networks are gaining popularity especially in the domain of Ad-hoc networks and it is necessary to design a wireless network which gives the best performance by suitable protocol selection and path routing. In this network, a group of wireless mobile nodes cooperate with each other from source to destination with routing of packets. Data integrity and data delivery are the main parameters for the selection of protocol for communication in such Ad hoc networks, where it targets for efficient and timely delivery of message. Routing protocols are used to find the shortest path from source to sink in network for transmitting the packet and for efficient utilization of limited resources in sensor nodes, to extend the lifetime of the network. Sensor nodes are battery operated and will become redundant after the power consumption of the battery which makes it a challenging task to design a routing protocol. In this paper, a comparative analysis of two routing protocols (i.e. AODV and DSDV) has been presented by considering performance metrics such as end to end delay, loss packet ratio, and throughput on network simulator NS 2.35.

Index Term: *Ad-hoc On Demand Distance Vector (AODV), Destination-Sequenced Distance-Vector Routing Protocol (DSDV), Wireless Sensor Network (WSN)*

I. INTRODUCTION

Wireless Sensor Network (WSN) is a network of devices that can communicate the information gathered from monitored field through wireless links and the sensor nodes are connected with each other. In WSN the data is collected from the source node and is send to sink node through multi-hop routing algorithms. But the sensor nodes have some limitations regarding low memory, low power sources, and less processing speed [13]. Routing is important because the sensor nodes are battery-powered; will become redundant after the power consumption of the battery, which is also known as lifetime of WSN. In Ad-Hoc network routing, protocol should consider various functions like packet routing, transmission scheduling, maintaining network connectivity and determination of network topology. Primary goals behind the development of routing are minimum processing overhead, multi-hop routing capability, dynamic topology maintenance, loop prevention and minimum control overhead [18]. The advantage of such network is the deployment of nodes at any location and exchange of data via supportive intermediates nodes switch data from one to other node. To minimize energy consumption and enhancing the network life time researchers have designed various protocols for routing [9].

II. ROUTING IN WIRELESS SENSOR NETWORK

Routing is a process of establishing a path between sender and receiver node for transmitting the packet along the path. Routing protocol will find the shortest path for transmitting the packet. The objective of routing protocol is efficient utilization of limited resources of sensor nodes so that lifetime of the network is increased [14]. The routing protocol is capable of aggregating the data and the energy consumption [16].

A. Routing challenges and design issues in WSN

- **Fault Tolerance:** The routing protocol has the capability to form new links so that if any sensor node failure takes place, it will not affect the overall task of sensor node.
- **Energy Conservation:** The process of setting up the routes is influenced by energy consumption in which the nodes are deployed in random manner so that the multi-hop routing will consume less power than direct communication [17].
- **Data Aggregation:** Data aggregation is the combination of data from different sources and similar packets from the multiple nodes that can be combined to reduce the transmission.
- **Node Deployment:** There are two ways to deploy the nodes, one is to manually, where the data will route by the pre-determined paths and other is randomly, where the sensor nodes are scattered randomly and create a topology.
- **Transmission Media:** Transmission media is wireless and is not affected by any type of high rate error and fading.

- **Production Cost:** The cost for single node must be low.
- **Scalability:** Thousands of nodes will be deployed in the sensing area so that routing protocol scalable in the environment of event [16].

III. CLASSIFICATION OF ROUTING PROTOCOL

Routing protocol is classified into three categories, (i) Flat based routing, (ii) Hierarchical based routing, and (iii) Location based routing.

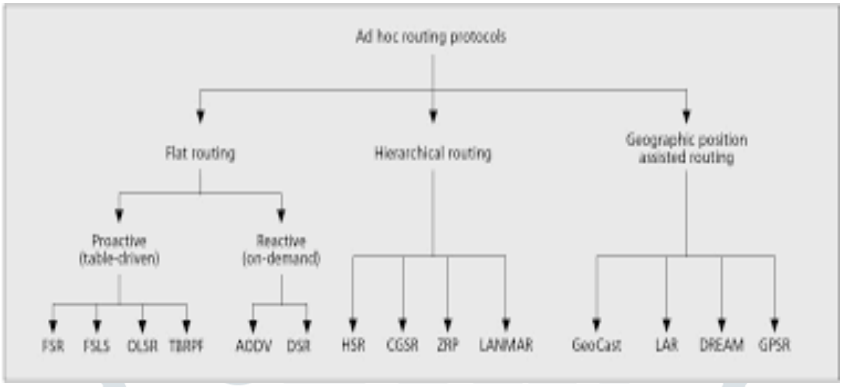

Fig1: Ad-hoc routing protocols [3]

Flat based routing protocols are classified according to routing strategy into two categories: proactive routing protocol and reactive routing protocol. Proactive routing protocol is also known as table driven routing protocol because when the route from source to destination is needed, a kind of global search procedure is started and each node make it to routing table so the table can be used to find the path of destination. They also respond to any changes in network topology and when it happens again the routing table is updated. Whenever the path to any destination is required to send the packet and route is already known then the further delays are omitted. Examples of proactive routing protocol are: DSDV, OLSR, FSR. Reactive routing protocol is also known as on-demand routing protocol as when the route is needed from source to destination then only the route for destination node is set up. But this process leads to delay since requested route is not available at that state. The examples of reactive routing protocol are: AODV, DSR [8].

The main objective of AODV and DSDV protocols is to send the packet from source to destination efficiently. This work includes two routing protocols, one is reactive protocol (AODV) and other is proactive routing protocol (DSDV), which has been discussed and analyzed on the basis of various parameters.

A. AODV (Ad-hoc On Demand Distance Vector) Routing Protocol: -It is reactive routing protocol and will discover the route when required. It supports multicast and unicast routing. It uses the sequence number for loop free routing and route maintenance. So all the routing packets carry their own routing number [12].

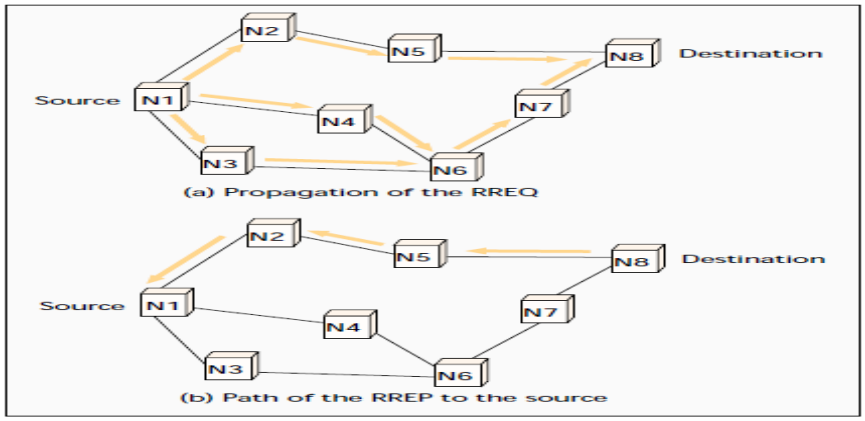

Fig2: AODV route discovery process [5]

When source node wants to send data to other node and there is no valid route located in the routing table, the source node broadcast the massage RREQ to discover the route for destination. After receiving the RREQ, protocol will check whether the routing table is valid or not. If the route found is valid then the route reply message will be sent but if the valid route is not located then the destination node has to send the Rebroadcast message to the source node. If there a break between the intermediate nodes then the Route Error message (RERR) will be initiated [12].

- **RREQ:** The route request sent by the source to destination. This contains the sequence number and request id in the route table.
- **RREP:** The route reply is sent by the destination to source through response to RREQ message set up by the route path.
- **RERR:** This is the route error which occurs when route data is lost during any broadcast [16].

B. DSDV(Destination-Sequenced Distance-Vector) Routing Protocol: It is proactive routing protocol which is based on time driven routing protocol, in which all the nodes can make their own table that can be used to locate the path for destination. It will produce the sequence number by the destination node in the network in which the routing table will be dynamically exchanged when route is updated so that every node utilizes the fresh list of nodes.

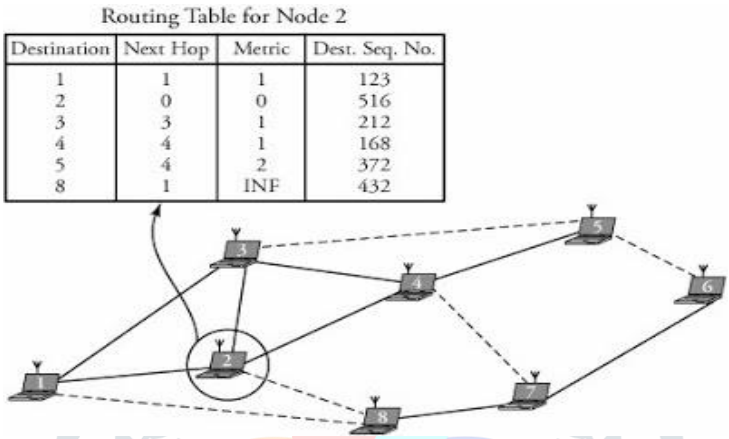

Fig3: DSDV routing protocol [4]

When any changes are detected in the topology then updates are transmitted periodically and immediately. The routing updates of two types:

a) *Fully dump:* Where the node transmits the whole routing table.
b) *Incremental updates:* Where the node only sends that entries which have changed since last update [7]. DSDV is used for freedom from the loops.

IV. RELATED WORK

A wireless sensor network consists of large number of nodes. Each node is capable to measure physical quantities of the surrounding environment and transmitting them by using a radio link. The energy efficient cluster oriented method has been used to overcome the basic difficulty of coverage hole and energy hole and the problem has been controlled by introducing the density controlled distribution nodes, the fixed optimum number of the cluster heads in each round [16]. The routing protocol AODV gives the better performance for both MANETs and WSNs. The results indicate that AODV and LEACH both perform well, but AODV is less reliable than LEACH because the results of AODV varies drastically as compared to LEACH protocol [6]. The single routing protocol cannot perform at optimum in all circumstances. So, the routing protocol should be done attentively according to the requirements of the specific routing tasks [8]. AODV performs better in a network with greater number of nodes, whereas DSR performs better when the number of nodes are in scarce. Average End-to-End Delay is the least for DSDV and it does not change when the number of nodes is increased [9]. Presented simulation study to DSR routing protocol and simulate a number of mobile nodes. The results and their recommendation shows that the AODV and DSR routing protocol perform almost same when the mobile node are in movement [20]. Two routing protocols has been compared i.e. AODV and DSR based on performance metrics and concluded that AODV exhibits a better performance in terms of packet delivery fraction and throughput with increasing number of mobile nodes due to its on demand, and proved that AODV has slightly higher average end-to-end delay than DSR. The number of nodes in the network increases AODV and DSR gives nearly constant throughput [21].

IV. PERFORMANCE ANALYSIS

To compare and analyzed the performance of AODV and DSDV protocol, simulation of these two protocols has been carried out using networking simulation tool NS2. In this section simulation environment, performance metrics and results have been discussed.

A. Simulation Environment: The network simulation has been done by using network simulator NS2.35. It is an open source simulator tool and the simulation is performed under Linux (Ubuntu 18.0.1) environment. This environment supports research in networking. It is an event driven simulation tool which is written using two languages: (i) Object Oriented Tool Command Language (OTCL), (ii) C++ Language. NS2 simulator performs simulation using different traffics i.e. Transmission Control Protocol (TCP) and User Datagram Protocol (UDP).

B. Performance parameters used:

- **Average Throughput:** Average throughput is defined as the total number of packets delivered over the total simulation time. It is also defined as rate of successful message transmission over the communication channel.

  Average Throughput = (No of received packets/ (Finish time-Start time))(8/1000) kbps*

- **End to End Delay:** End to End delay is defined as the time taken by the packet to travel from application layer of source node to application layer of destination node.

  End to End Delay = (Time at reception of packet-Time at generation of packet)

- **Packet Loss:** Packet loss is defined as the packets that are not received at the destination which are send by the source across the network.

  Packet Loss= (Number of packet send)-(Number of packet received)

C. Simulation parameters: Simulation is performed using NS2.35 Network Simulator. And the simulation scenario consists of 100 nodes in a rectangular area. There are different parameters used for the simulation.

Table1: Simulation environment table

Simulation Parameters	Value	Value
Protocol	AODV	DSDV
Channel Type	Wireless	Wireless
Propagation Type	Two ray Ground	Two Ray Ground
Antenna Type	Omni Antenna	Omni Antenna
Mac layer	802_11	802_11
Traffic Type	UDP	UDP
No. of Nodes	100	100
Packet size	5000,10000,15000,20000-------48000bytes	5000,10000,15000,20000------48000 bytes
Simulation Area	500m x 500m	500m x 500m
Simulation Time	400sec	400sec

D. Simulation Results

Network simulator version NS2.35 has been used for simulation. The analysis of AODV and DSDV protocols has been focused on four performance metrics for analysis, (i) Packet Loss, (ii) Average End-to-End Delay, (iii) Normalized Routing Load (NRL) and (iv) Average Throughput.

Table2: Result analysis of AODV and DSDV

Parameter measured	100 nodes AODV	100 nodes DSDV
No. of packets send	2500	750
No. of packets received	2310	596
No. of packets dropped	190	154
Packet delivery ratio	92.40	79.47
Normalized routing Overhead	0.148	0.073
Average throughput	105.02	99.61
End to End Delay	3095.71	3186.06

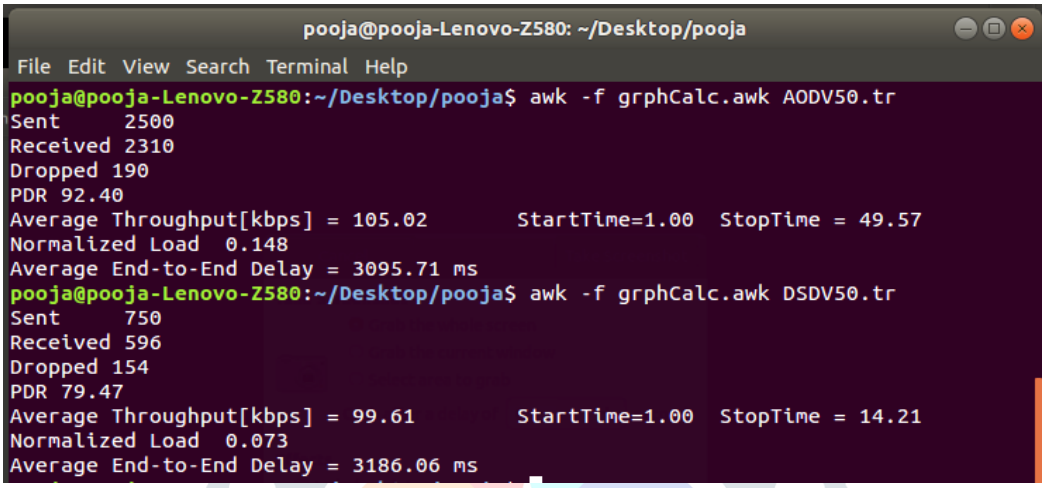

Fig4: The results of performance metrics for AODV and DSDV simulation

- **Average Throughput:** Fig 4, shows that Throughput of AODV is higher than DSDV at high mobility simulation period. Which clarifies that simulation and the expected throughput can be obtained in AODV routing protocol. It signifies that the AODV protocol is better than DSDV. The result shows that the throughput of DSDV is less than AODV.

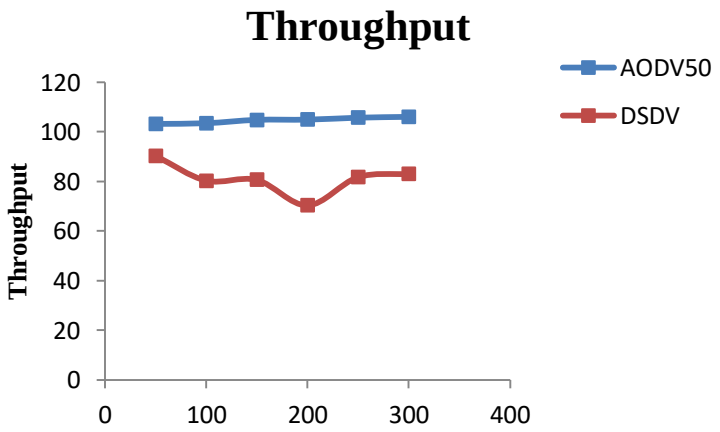

Fig5: Two protocol of WSN with respect to Throughput

• **End-to-End Delay:** Fig 5, shows that the end to end delay of AODV protocol becomes lesser than DSDV protocol. With increase in the number of nodes, DSDV end to end delay become very high than AODV so, AODV shows better results than DSDV.

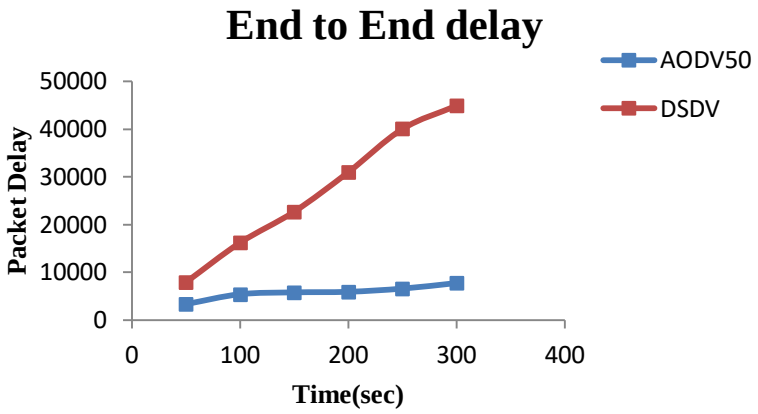

Fig6: Two protocol of WSN with respect to End-to-End delay

- **Packet Loss:** Fig 6, shows that the packet size of DSDV is not capable of handling large packets, resulting packets will not be properly delivered to the destination, showing AODV will handle the large packets thus, is better than DSDV.

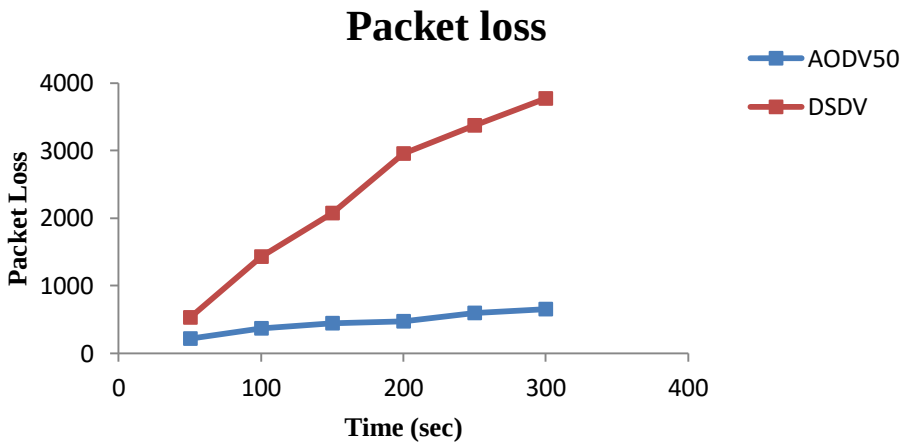

Fig7: Two protocol of WSN with respect to Packet loss

CONCLUSION AND FUTURE WORK

A comparative analysis of AODV and DSDV routing protocols has been done using four performance metrics (i) packet Loss, (ii) end-to-end delay, (iii) average throughput and (iv) normalized routing load. It has been concluded that with increased number of nodes up to 100, a single routing protocol can't perform best in all circumstances. And the small network size of DSDV protocol is very effective and simple but when the network become larger, then performance of DSDV protocol degrades, AODV is good for medium size network. The packet size of DSDV is not capable of handling large packets; the packet will not be properly delivered to the destination. Considering the overall performance, AODV is best routing protocol in terms of all parameters which have been selected for simulation. In this paper, a comparison simulation of proactive (DSDV) and Reactive (AODV) Routing Protocol of MANET has been done. Basically, the routing protocols have been designed for MANET, whereas these protocols have been modified and used for Wireless Sensor Network. So in future the work may be carried out in the direction of security attacks in MANET protocol in terms of end to end delay, routing overhead and network load and further enhanced to support more energy efficient.

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