Comparison of OLSR and DSDV Routing Protocols in Wireless Sensor Network by Using NS-2

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Abstract- The wireless sensor networks consist of large amount of small sensor nodes that can process, store and transmit data within limited range because of their small size and minimum cost these nodes with embedded sensors are widely used in the different type of applications such as the tracking and health monitoring. Data sent with a specific amount of average end-to-end delay, throughput, and latency in these networks. For routing, the data different protocols were used that can guarantee the communication and maintaining the paths in the network. I have compared the two routing protocols OLSR and DSDV in a wireless sensor network. I have compared the three-metrics throughput average end to end delay and the latency of these two protocols with a different packet size and make the three types of scenarios with respect to bandwidth in ns 2. The results show that the DSDV has high throughput, low latency and a low average end to end delay as compare to the OLSR that shows minimum throughput, a high average end to end delay and has high latency to transmit data in all the scenarios. In future we may extend our work to get some more interesting and useful results.

Keywords- Wireless Sensor Network, OLSR, DSDV, NS2

I. INTRODUCTION

In the1970s in the communication industry wireless networks are getting popular. These networks are grouped into two types: infrastructure less and the infrastructure networks. In infrastructure networks, movable nodes can move but the base stations remain to fix and when these nodes go outside from the range of that BS they come into the range of another BS during their communication. While within ad-hoc which are also known as infrastructure fewer networks nodes can move during communication but they do not have fixed base stations. In ad-hoc networks, mobile nodes can set up the routing with each other to build their own network 'on the fly' [i].

It is not possible to transmit the important information using wired sensor networks in the real-time environment. But in WSNs the data can be collected from inaccessible locations and processing is performing in real time. Here the WSNs play the main role in the delivery of data to the centralized destination from the outbound areas. That's way WSNs are deployed for a different purpose in different locations. The basic components for WSNs are the number of sensor nodes along with the base stations (BS). These small nodes with sensors are inexpensive and due to their small design, they have a limited amount of energy and storage capacity. These nodes may send the data directly to the destination with depends on the size of the network. In the environment, ambient conditions are measured by these wireless sensors after that these measurements are processed that can help to access the accurate situation of the areas around the sensors. To cover the large network coverage, it's important to make the use of the number of nodes that use sensors, because radio range of these small sensors is very limited so it can increase the network size. Therefore, the transmission of data especially in communication to the BS became possible by using intermediate nodes.

By means of the rapid development and increasing growth of WSNs, these networks can be used for many types of application health observations, military site environmental monitoring and event detection. Wireless sensor networks have very small or do not have the infrastructure. WSN consists of different network capacity of sensors node, which little has a small amount of energy and has batteries for the resources of power. Each node can sense, process the data and communicate with others. Depending on the usage the WSN is organized in a random or definitive manner. In the hazardous areas, these sensor nodes are put randomly however they are definitely placed in the areas that are safe.

The methods of routing in these kinds of networks are different from the commonly used methods of routing as they use a topology that is undetermined. If we utilize the only one link for routing among the two nodes for data transmission but if because of any problem it fails as result data may lose and communication will stop as it does not arrive at its destination. In order to reduce or get rid of this problem, we use the method of multi-path routing for the sensor network. If a connection in the network fails then because of the multiple routes between nodes the data can be transmitted from another link [ii].

Proactive routing protocols are the routing protocols which always maintain the route to every possible destination. But in on-demand protocols of routing paths are exposed and maintained just when these routes are wanted, hybrid routing protocols can work as both of these protocols [iii].

In this paper, we made an effort to compare the performance of two proactive routing protocols such as DSDV and OLSR routing protocols on the basis of three metrics throughput, average end to end delay and latency in wireless sensor networks.

II. Related Work

In [iv] the author discusses the optimized link state routing protocol which use the periodic exchange of messages to exchange the information between the nodes about their topological change. In [v] the author proposed a routing protocol EMBR to balance the energy associated with the multipath that can be used to enhance the life of the network. In [vi] we compare the routing protocols for MANET by using the VBR type traffic where simulation is performed by using ns2. In [vii] they compare the AODV with DSDV in dynamic WSNs and discuss the issues faced by both protocols. In [viii] a comparison between TORA and AODV is carried out on the bases of throughput and delay which shows AODV has high throughput but face more delay. In [ix] provide the study of hybrid proactive as well as reactive routing protocols using Qualnet simulator by using static as well as dynamic network. In [x] the author has performed the comparison by using network simulator 2 between the DSDV, DSR, TORA, and AODV by using a lifetime of the network, the overhead of routing as well as an end-to-end delay. In [xi] provide a routing protocol for the timeliness and reliability of sensor networks. In [xii] the author provides the S-OLSR routing protocol to overcome the problems associated with the breakage of links and the redundancy problem at the end compare them with other protocols. In [xiii] the comparison is performed on the basis of energy consumption between DSDV and AODV by using NS3. In [xiv] the author compares and review the working of different proactive and reactive routing protocols in VANET by using different parameters such as packet loss, throughput as well as an end to end delay.

III. Material and Method

Here we have used two proactive routing protocols in this research paper for the purpose of their performance comparison on the bases of given metrics.

A. Optimized Link State Routing (OLSR)

The routs in OLSR protocol are available when required because it is a proactive protocol of routing. It is optimization in the link state (LSR) routing protocol. Thus, the change in topology may originate the flooding of information topology to all the hosts that are present in the network. In a network, it protocols use a multipoint relay to minimize the overhead. It can minimize flooding distribution of the same data in some areas of network and also provide the short path for data sending. The minimization of the time period for control messages broadcasting can have much reactivity to the changes in topology.

i) Basic Functions of OLSR Routing Protocol

This protocol can use two types of control messages which are the Hello as well as Topology control message. The first type of messages is used to search information on hosts neighbors and link status. Multipoint relay selector set is created through hello message it explains the node (neighbor) that is selected for acting as a multipoint relay with the help of this information that host computes the set of multipoint relays of its own. The hello message is sent to only one hop neighbors however TC message is sent to the whole network. These messages are used to send out the information of their own neighbors that are advertised that also have multipoint relay selector list. They are sent in periodic manners and only the hosts of MPR forward them [xv].

ii) Routing Neighbor Sensing

The host should know about the inks in these ad-hoc networks which are unidirectional as well as bidirectional messages of hello are send out periodically to be sensed by neighbors moreover these messages are only sent out to the one-hop neighbors. So, whenever this first host gets this message (HELLO) from the second host at that time it set its status of second host asymmetric in the table of routing. When the first host sends this message also include that it has an asymmetric link to the second host. Here the second host also set the status of the first host as symmetric in its own table of routing [x]. At last when the second host sends out the hello message again where the first host status is shown as symmetric, at that time this first host change its status to symmetric from asymmetric. Finally, both of these hosts know that the neighbors are alive and their links are bidirectional. In fig. 1 we have shown the flow of hello message in OLSR routing protocol.

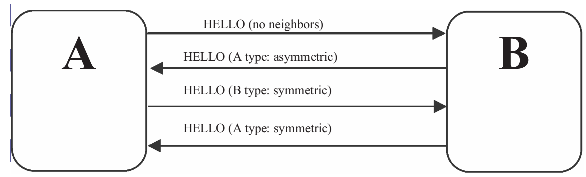

Fig.1. Hello Message Flow

The information about the neighbors and the local link is obtained from the hello messages. These messages are periodically broadcast to sense links, detecting neighbors as well as for the process of the selection of MPR. The hello message has the information about how frequently host sends these messages, its willingness to perform as MPR as well as the information of neighbors. The neighbor information may have the information about the neighbor type, link type, and interface address. Where the type of link shows links is asymmetric, simple lost or symmetric. Whereas neighbor type is symmetric, multipoint relay or else not a neighbor. Multipoint relay type points out that linkage to a neighbor is symmetric and this host has selected it as an MPR [xv].

iii) Multipoint Relays and Topology Information

MPR is the important idea at the back of OLSR to decrease the overhead of exchange of information. Rather than entire flooding, OLSR uses a multipoint relay to minimize the numbers of hosts that send out the information in the whole network. MPR is the host one-hop neighbor that forwards its messages. For exchanging the topological information as well as building the repository of topology host is chosen for the multipoint relay requirements to send out the topology control messages (TC). These messages are sent out in the complete network that are permitting just multipoint relays to forward the topology controlling messages. These messages are generating and transmit periodically in the network. The host sends these messages to issue their links in the network. The host should send out at least a link to its group of multipoint relay selector. The topology control messages contain the set of links of their own plus a serial number of every message. Here serial number may be used to avoid the looping of the message also to point out newness of the message if host finds a message that has small sequence number it should reject the message without any type of update. When the link is deleted or added from these messages the host add the sequence number. The sequence number is wrapped. Whenever host sends a set of links that becomes empty it still sends out the amount of time specified by the null TC message so that the previous TC message is invalid. It must stop to send topology control messages still it sends out some information again, Topology control message size may be large therefore these messages may have sent in part but receiver have to combine these parts within a specified time. The host can enhance its sending rate for sensing the failures of the link. As changing in selector set of multipoint relays is notice which specifies that link failure has taken place and the host should send new topology control message soon [xv].

iv) Routing Table Calculations

The host maintains a table of routing whose entries contains information like: address of the destination, the address of the local interface, next address and the number of hops toward the destination. The next address shows host of next hop. The information may get from a set of topologies (TC message) also from the information base on the local links (Hello message). Therefore, when some change takes place in that sets in that case routing table is again calculate. It is a proactive protocol so the routing tables should have routes for all the hosts that are available in the network. Information about links that are broken is not stored in these routing tables. The routing table changes when the change takes place in cases like neighbor link appeared or else disappeared, the neighbor with two hops is created or removed, the link of topology is appearing or vanished when multiple interface connection information change. The updates of that information do not guide to transmit the messages in the network. Shortest path algorithms are used to find the routes for routing table entry.

i) Advantages and Disadvantage

The OLSR does not require the central managerial system to manage the process of routing. Its proactive characteristics give the information it has provided complete information on routing to every host that participate in network and flooding is reduced with multipoint relays who forward topology messages. The reactivates to changes in topology is adjusted with the help of a change in a time interval for distribution of hello message. Proactive methods are not appropriate for wireless networks that are reconfigurable because they require much time to maintain the information routing in the network. If the movement of nodes is very fast than it requires computing the routs that may not be in use. It leads to the wastage of the capacity of the network. The OLSR protocol requires that every host periodically send out the topology information that is updated in the whole network it raises the usage of bandwidth [xv].

B. DSDV Protocol

This protocol is a modification in the RIP which we also call routing information protocol. This protocol can include the new sequence number to every entry in the routing table of that of usual routing information protocol. So, DSDV can avoid the routing loop formation by the use of a new sequence number by using these number nodes can differentiate between old information and the new one.

i) Packet Routing and Routing Table Management

Every node of network maintains the routing table in destination sequenced vector routing protocol that contains the list of available destinations the next hop address along with the sequence number which is created by the node of destination. The data packets are broadcast between nodes in the network by using the information which is present in the routing table of these nodes. With advertisement, all nodes periodically update their routing tables or when there is new information is presented for maintaining the reliability of these tables by dynamically change in the topology of the network of ad-hoc. Whenever the change in the topology of the network is detected periodically thus every node advertises the information of routing with the help of broadcasting the updated information of their routing tables. The packet which is updated starts with the metric of one of the directly linked nodes. It shows that every receiving neighbor is the one hop away from the node which is not similar to that of algorithms of conventional routing. The neighbors can update their tables by receiving the updated packet by an increase in the metric with one as well as they resend that updated packet to their related neighbors. Unless every node in the network receives the copy of that updated packet with that of the corresponding metric in the network the process will be repeated. This updated data can be kept for the time until node find out the best route for each specific destination node in all nodes previous to update their routing tables and resend these updated packets. But during the waiting time if anode gets more than one updated packets for that same destination than it always prefers the route that has the current sequence number for making the decisions to forward packet although if just sequence number has changed then information of routing is not essentially advertise instantaneously. If we receive the updated packet that has some sequence number and is by the same node then the packet that has small metric can be utilized and that of the existing route may be stored as a less preferred route or discard. Here that updated packet with the sequence number in the ad hoc network will be sent out to each and every moving node. The route advertisement may be a delay that is near to change unless they found the best routes which may dump the routing table fluctuations and minimize resending the entries of a possible route that came with a similar sequence number. Every node routing tables elements change with the change in the topology to maintain the reliability of network in order to achieve this consistency the advertisement of routing information should be quick enough to make it sure that every node in a dynamic network can always locate every other node. In the dynamically produced network, each node can send the packets to the others based on the updated information routing. Here the original nodes tag the packet that is updated with the sequence number to differentiate the new ones from the old ones. If the node gets information which is updated from another node the sequence number should be greater or equal from that of sequence number which is already present in its table of routing otherwise the information in this packet will be old so it is discarded. If the newly received sequence number is same as the sequence number that exists in routing table then both packets metrics are compared and the packet with small metric is used. The updated information route has the address of the next hop with the destination address. Here are two kinds of updated packets one of them is known as a full dump that carries all information of routing which is available and the other one is known as incremental which carry just changed information as of full dump which is available on last.

ii) Responding to Topology Changes

When the nodes that are mobile shut down or move to another place than links can break, these broken links may detect with the help of communication hardware or by not receiving the broadcasts from that previous neighbor from a long time. The metric is assigned as infinity for that broken link. If the link of next hop break then the route for that hop is instantly assigned the metric as infinity also update the sequence number. Any node other to the destination produces the sequence number to explain broken link which must be greater than the previous one. The new sequence number along with the infinity metric is pack in updated message plus is flush over the network. In order to avoid any type of conflict between the node itself and its neighbors whenever the topology of network change the node generate for itself even number of sequence, it generates the odd number only if the link change.

iii) Damping Fluctuation

Fluctuation is the common problem that arises in the DSDV with the following criterion of the routes update:

- If the new sequence number is used than routes are prefer always with these numbers moreover old sequence number routes are discarded.
- The route which contains the sequence number that is equal to the existing one it is only preferred if it contains the better metric then the existing route will be discarded. The sending of the information about routing with the help of moving nodes are the asynchronous events although some reliability is expected. When many nodes are independently sending the updated message, and have different intervals of sending it to turn out a specific moving node get new packets of updates, which may cause that node to change the route forth and back between the different next hops even if there is no topology change. This type of fluctuation takes place due to the above two routes are chosen criteria. Possibly a node has gotten the two route which has the same sequence number or new number one after other to the same destination from different neighbors but moving node every time get route which has a worse metric. It leads to fluctuation by the ongoing bursts of the newly updated packets. It will take place if there are a number of nodes that are movable that are sending their updates in irregular manners. On the other hand, if the nodes act independently with different intervals of transmission this situation may take place with some movable nodes. Here fig. 2 shows the working of DSDV routing protocol.

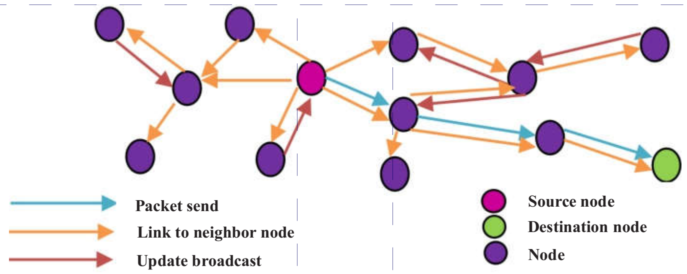

Fig . 2. Network structure and working procedure of DSDV

iv) Performance

The DSDV need every node to keep the two tables. The volume of complexity may generate plus maintain these kinds of tables. The updates can be sent out to the neighbors in periodic manners. By increase in the number of nodes in the network the bandwidth size with tables of routing need to update these tables to grow at the same time. The overhead to maintain as well as update those tables may increase in the same way. It is ordinary that intense overhead of routing may decrease networks performance.

v) Advantages and Disadvantage

The DSDV is one of the early algorithms presented. It is appropriate to create the ad-hoc network with the fewer number of nodes [xiv]. The DSDV needs the updating of its tables of routing regularly that use battery power along with a little bandwidth even if the network is inactive. Every time, network topology changes a new sequence number is essential prior to re-coverage of the network. So DSDV is not appropriate for the networks that are highly dynamic [xvi].

C. Performance Matrices

We have so many quantitative matrices that we use to analyze the performance of different routing protocols. I used the matrices of performance in my thesis in support of proactive routing protocols are given below.

I) Throughput

It is the average amount of message that is successfully delivers on per unit time like the average amount of the bits that are delivered for each second [xvii].

ii) Average End to End Delay

This is the ratio of the difference in time that every packet of CBR sends as well as receive a total difference of time over a total number of packets of CBR received [xviii].

iii. Latency

It is described as an average quantity of time between the start of disseminating a data as well as the arrival of information on the node which has an interest in receiving that information [xix]. Therefore, latency calculates the time performance for every message [xx].

D. Network Simulator 2

We select this simulator tool because it provides the support for the networking researchers. It is appropriate to compare the protocols, design the new protocols and also to evaluate the traffic [xxi, xxii]. It is developed as a collaborative environment and is open source as well as distributed freely. Many peoples and institutes in research and development maintain and develop and use it. This may raise confidence in its usage. Its version for Solaris, Linux, and windows are available [xxiii]. It also gives the extensive support for the simulation of UDP, TCP routing over the wireless and wired networks [xxiv]. In Fig. 3 we have shown the test bed model that is used to perform the simulation that is used in this paper to perform the simulation of OLSR And DSDV in a wireless sensor network to

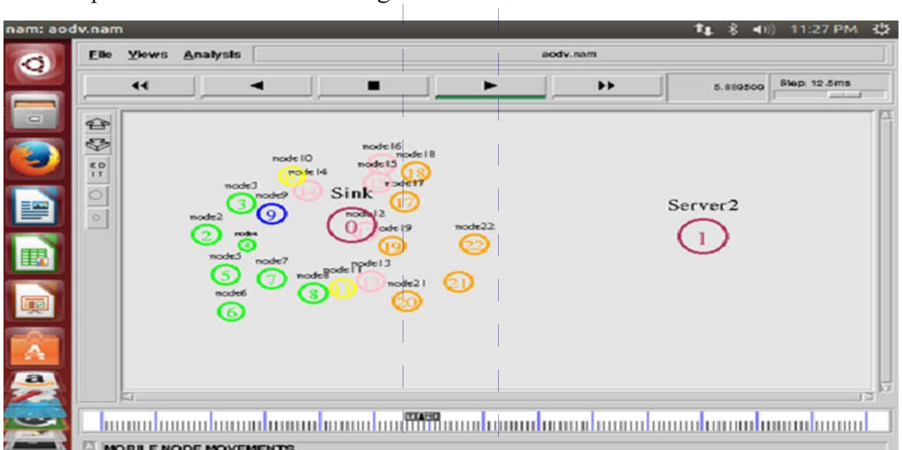

Fig. 3. Testbed Model

compares their three-metrics performance by using different packet size as well as bandwidth [xxv].

IV. Simulations and Results

In this experiment, I have used different scenarios and then make the analysis for comparison by using the ns 2. In experiment simulation I have used the DSDV and OLSR routing protocols in WSN and make the scenarios depending on 54, 108 and 300 Mbps bandwidth and 1000, 1500, 2000, 2500, 3000, 3500, 4000, 4500, 5000 and 5500 packet sizes to compare the throughput, average end to end delay and latency of these routing protocols by using the CBR traffic and make the line and bar graphs to show the results.

A. Simulation Model

TABLE I
The Environment of Simulation

Parameter	Details
Simulator	NS-2.35
Area of simulation	1800 m * 840 m
MAC protocol	802.11
Radio Propagation model	Two Ray Ground
Routing Protocol	DSDV, OLSR
Traffic Type	CBR
Number of nodes	22
Network interface Type	Phy/wirelessly
Channel type	Channel/Wireless channel
Interface queue type	Queuel Drop Tail
Antenna	Antenna/Omni antenna
Maximum packet in ifq	50
Packet Size	1000 to 5500
Bandwidths	54,108,300 Mb

In table I we show the network parameters that we use to carry out our simulation by using the network simulator 2 for the two proactive routing protocols OLSR and DSDV.

Fig. 4 shows the latency with 54 Mb bandwidth by using CBR traffic for DSDV and OLSR routing protocols. The DSDV has taken the low latency as compare to OLSR. The OLSR has high latency with 1500 packet size but when the packet size becomes 2000 it again starts to increase it at 2500 packet size it decreases again at 3000 but increases again at 4000. Overall OLSR takes more latency to start the process for data transfer.

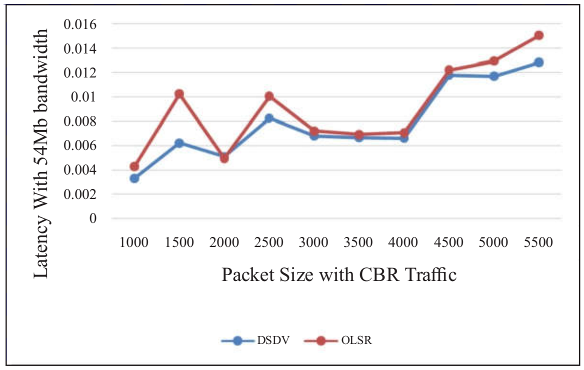

Fig. 4. Packet Size Vs Latency

In Fig. 5 the latency rate of OLSR with 108MB is more than that of DSDV. OLSR latency increases at 1500 packet size then it starts decreasing continuously but at 4500 it again starts increasing. This shows that OLSR takes more latency to transfer the data.

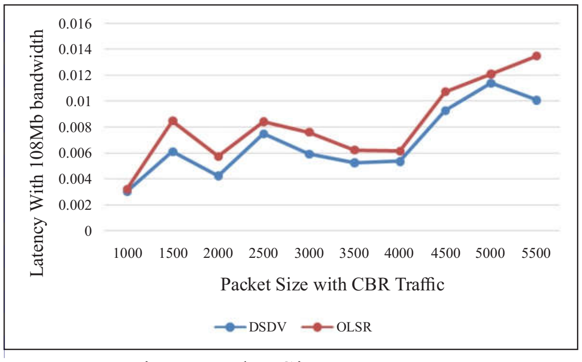

Fig. 5. Packet Size Vs Latency

Fig. 6 shows latency with 300Mb bandwidth in CBR traffic of the DSDV and OLSR routing protocols where DSDV has taken low latency as compared to OLSR. OLSR take more latency to start the process for data transfer. OLSR starts to decrease the latency with respect to increases in the packet size. On the packet size of 3000 but at 5500 both faces almost the same latency rate of OLSR is more than DSDV.

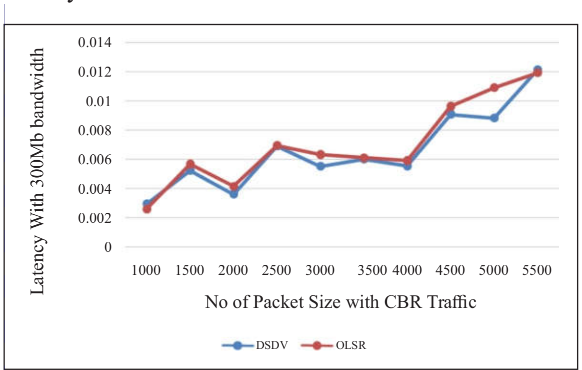

Fig. 6. Packet Size Vs Latency

i) Comparative Bar Graph of Latency

In Fig. 7 comparison bar graph of latency on 54, 108 and 300 Mbps bandwidth shows that in all the three cases of bandwidth, the DSDV has the minimum latency to transmit data as compare to OLSR which shows that DSDV is better than OLSR in the case of latency.

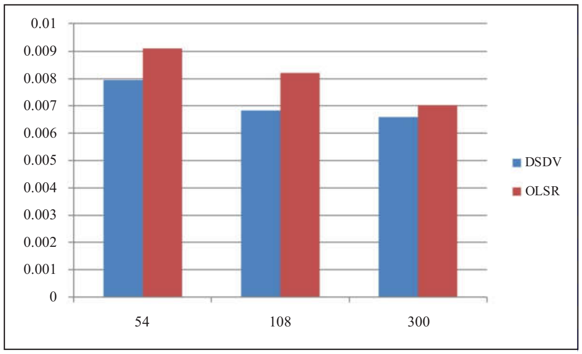

Fig. 7. Comparison of Latency on 54, 108, 300 MB

Fig. 8 shows graph below where the difference in throughput of DSDV and OLSR routing protocol was considered for a packet size of 1000, 1500, 2000, 2500, 3000, 3500, 4000, 4500, 5000 and 5500 respectively. The throughput of OLSR start to increase at the packet size of 1500 but when we increase the packet size to 2000 it starts to decrease the graph shows that the throughput of DSDV is more as compared to OLSR.

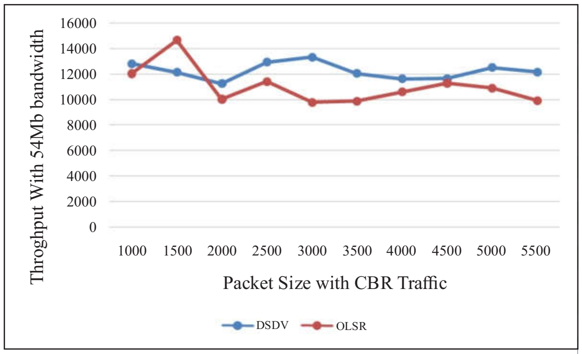

Fig. 8. Packet Size Vs Throughput

Fig. 9 shows graph below where the difference in throughput of DSDV and OLSR routing protocol was considered for packet size1000, 1500, 2000, 2500, 3000, 3500, 4000, 4500, 5000 and 5500 respectively. Throughput for DSDV protocol is greater as compared to OLSR but at the point of packet size 2000 throughput of DSDV decrease. When increasing the more packet size the throughput again changed for DSDV protocol.

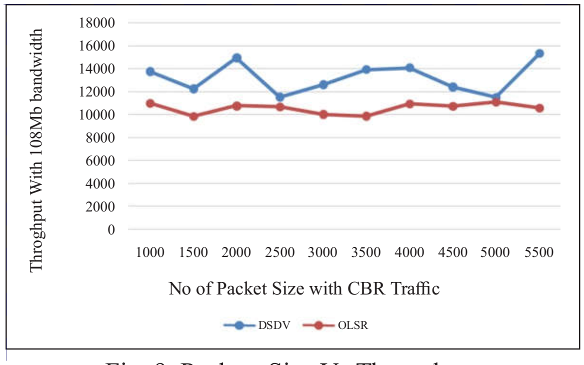

Fig. 9. Packets Size Vs Throughput

Fig.10 shows graph below where the difference in throughput of DSDV and OLSR routing protocol was considered for packet size1000, 1500, 2000, 2500, 3000, 3500, 4000, 4500, 5000 and 5500 respectively. Throughput for DSDV and OLSR are the same as the packet size of 1500 but as we increase the packet size the throughput of DSDV increase as compare to OLSR.

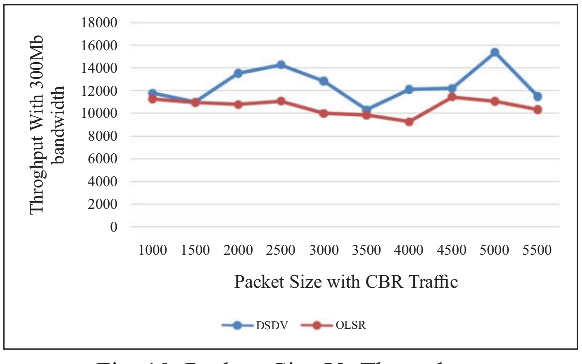

Fig. 10. Packets Size Vs Throughput

ii) Comparative Bar Graph of Throughput

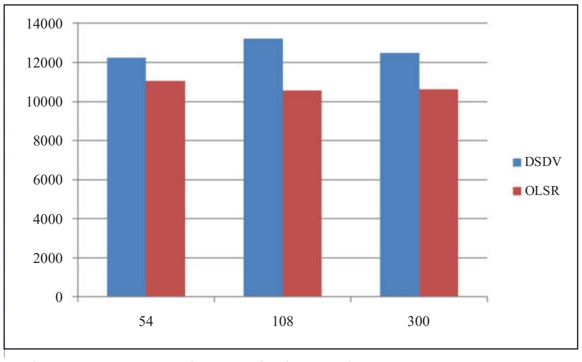

Fig. 11. Comparison of Throughput on 54, 108, 300 MB

Fig. 11 shows the comparison bar graph of an average end to end delay on 54, 108 and 300 Mbps bandwidth shows that in all the three cases of bandwidth the DSDV shows the high throughput as compared to OLSR which shows that DSDV is better than OLSR in the case of throughput.

Fig. 12 shows the average end to end delay graph below for OLSR and DSDV protocol with CBR traffic and 54 Mb bandwidth. The DSDV has less delay as compared to OLSR and at the packet size of 2000, they almost face the same delay. But overall OLSR protocol has more end to end delay as compare to DSDV.

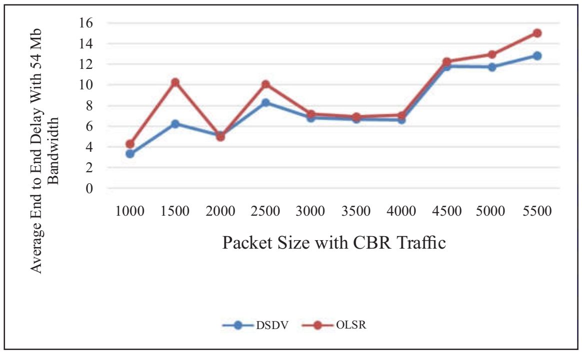

Fig. 12. Packet Size Vs Average end to end delay

The graph in Fig. 13 shows the average end to end delay graph below for OLSR and DSDV protocol with CBR traffic and 108 Mb bandwidth. The DSDV has less delay as compared to OLSR and at the packet size of 2000 and 4000 the delay of OLSR decrease but after increasing the packet size it again starts to increase. OLSR protocol has more end to end delay as compare to DSDV

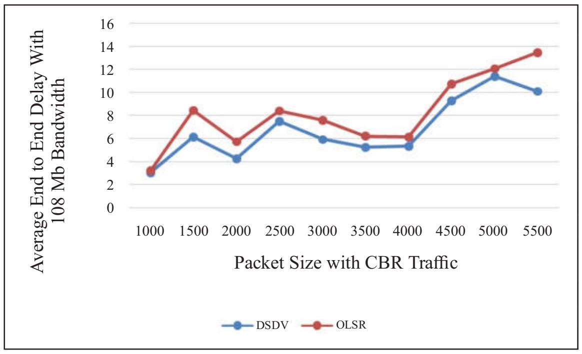

Fig.13. Packet Size Vs Average end to end delay

Fig. 14 shows the average end to end delay with the use of 300 bandwidth on the different packet size of DSDV and OLSR on the 2500 packet size both protocols have the same delay but when we increase the packet size to 3000 the delay of DSDV increase.

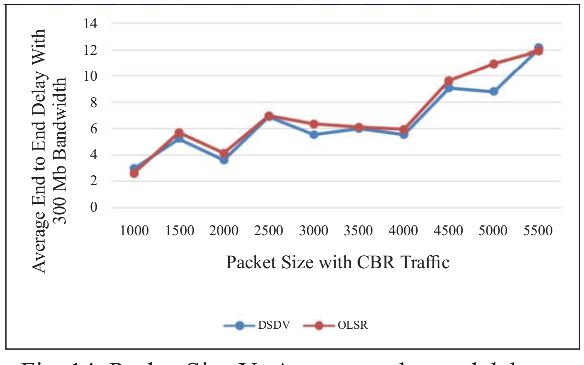

Fig. 14. Packet Size Vs Average end to end delay

iii) Comparative Bar Graph of Average End to End Delay

In Fig. 15 the comparison bar graph of an average end to end delay on 54, 108 and 300 Mbps bandwidth shows that in all the three cases of bandwidth the DSDV shows the minimum Average end to end delay as compare to OLSR which shows that DSDV is better than OLSR in the case of an average end to end delay.

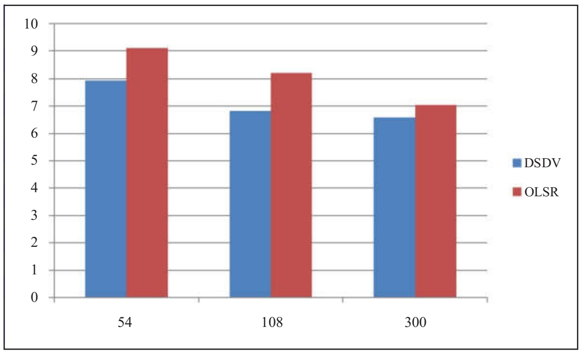

Fig. 15. Comparison of Average End To End Delay on 54, 108, 300 MB

V. Conclusion

I have made the simulation in ns2 by using different scenarios in which I have used Tcl file that generates the tr file and by using this tr file I have generated the results. I have to use awk and pearl files to calculate the performance metrics. I have made different experiments where I have compared two routing protocols OLSR and DSDV in wireless sensor network on the basis of three metrics throughput, latency and average end to end delay with different packet size of 1000, 1500, 2000, 2500, 3000, 3500, 4000, 4500, 5000 and 5500 along with the bandwidth of 54, 108 and 300 Mbps with CBR traffic in ns 2. We have made the line graphs as well as the bar graphs for all the scenarios separately. first I have made the line graphs of all the metrics separately with the 54, 108 and 300 Mbps bandwidth and also made their bar graphs by taking the mean of their values and then I made the comparison graphs of all the metrics with respect to bandwidths to know their comparative results with all the three bandwidths. The results show that the DSDV has high throughput and low latency and low end to end delay. OLSR has a more average end to end delay, low throughput and has high latency as compare to DSDV in all the scenarios which show that DSDV with these performance metrics is better than that of OLSR in WSN.

VI. FUTURE WORK

In future, by using our results of both protocols that we have gain by performing simulation we may study which of these protocols will be selected as an energy efficient routing protocol in disaster situations.

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