Performance Analysis of DSR and OLSR Routing Protocols for Fixed Wireless Sensor Networks (WSN)

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***Abstract*—** Wireless Sensor Network (WSN) has been regarded as a distinguished Ad Hoc Network that can be used to fulfil multiple tasks and applications. Since a WSN consists hundreds of small size, low cost and battery powered sensor nodes. These nodes have the event sensing capabilities, data processing capabilities. Number of routing protocols has been implemented to perform routing in these networks. In this paper, an attempt have been made to evaluate the performance of OLSR and DSR routing protocol using Random Waypoint 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.

***Keywords*— Ad-hoc network, OLSR, DSR, MANET, OPNET Simulation, WSN**

• Introduction

Wireless sensors network (WSN) is the collection of homogenous, self organized nodes known as sensor nodes. These nodes have the event sensing capabilities, data processing capabilities. The components of sensor node are integrated on a single or multiple boards, and packaged in a few cubic inches. A wireless sensor network consists of few to thousands of nodes which communicate through wireless channels for information sharing and cooperative processing. A user can retrieve information of his/her interest from the wireless sensor network by putting queries and gathering results from the base stations or sink nodes. The base stations in wireless sensor networks behave as an interface between users and the network. Wireless sensor networks can also be considered as a distributed database as the sensor networks can be connected to the Internet, through which global information sharing becomes feasible. Wireless Sensor Networks consist of number of individual nodes that are able to interact with the environment by sensing physical parameter or controlling the physical parameters, these nodes have to collaborate in order to fulfill their tasks as usually, a single node is incapable of doing so and they use wireless communication to enable this collaboration.

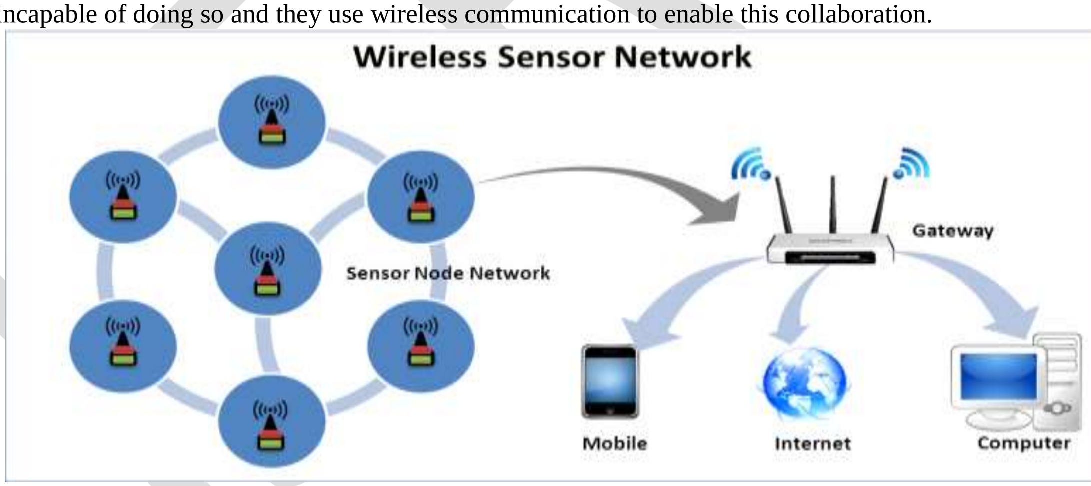

Figure 1. Wireless Sensor Network

• Literature Review

In recent years, several researchers have analyzed and compare various ad-hoc Routing Protocols taking into consideration different performance metrics as basis for performance evaluation. They have used different simulators and simulation models for the same.

Chowdhury, S.I et al [2]: evaluates the communication performance of the DSR and OLSR. The DSR protocol performs better with static traffic and limited number of source and destination pairs for each host. It requires fewer resources than OLSR as the control messages size and the route table is small reducing the computational power. In high density networks with highly sporadic traffic, OLSR performs better. But the best situation is when the between a large number of hosts. The quality metrics are easy to incorporate into current protocol. OLSR requires continuous bandwidth to receive the topology updates messages. In both protocols scalability is restricted due to their proactive or reactive characteristic.

Vidhale et. al. [6] evaluates three routing protocols which are DSDV, AODV and DSR. DSDV has low throughput but also has high routing load compared to AODV and DSR. Both AODV and DSR protocols perform very well. Although in some situations AODV outperforms DSR, DSR has the best performance especially when evaluated based on the average end to end delay. Moreover, changing the packet size doesn't affect the performance of DSDV but affects the performance of AODV and DSR. All protocols perform well when they are evaluated based
on the mobility of the nodes.

Ding Y et al. [8] evaluate and improve the performance of the AODV and OLSR routing protocols under two realistic mobility models for VANET. OMNET++ simulator is used for performance evaluation. The main objective of this work is improves the communication performance of routing protocols by increasing the density around the receiver. In their work, authors also analyze the properties of the two mobility models in high density urban areas. Finally after the simulation result, authors concluded that the performance of AODV is better than OLSR and OLSR routing protocol seem more affected by the density than AODV, the reason behind is that proactive routing protocol maintains the entire network topology while reactive routing protocol create routes when they need.

• WSN Routing Protocols

Routing is a mechanism to establish and to select a specific path in order to send data from source to destination. There are various routing algorithm designed for ad-hoc networks. The protocols for WSN routing can be classified as:

• Proactive Routing Protocols:

Proactive (table-driven) protocols allow a network node to maintain the routing table to store topology information about all other nodes, each entry in the table contains the next forwarding hop node used in the path to the destination irrespective of the fact that whether they are presently participating in the communication or not. The table is updated periodically to reflect the changes in the network topology and should be broadcast to the neighbours. After analysing all routes, the shortest route will be chosen through shortest path algorithm to each possible destination in the table. Examples are FSR (Fisheye State Routing Protocol), DSDV (Destination Sequenced Distance Vector Routing Protocol), and *Optimized Link State Routing (OLSR)*

B. Reactive Routing Protocols:

Reactive (On-Demand) protocols do not continuously exchange routing information with the neighbor nodes, instead a route is determined on a demand and maintain only those routes that are needed in current communication. When a source node needs to find a route to the destination node, it starts a route discovery process in which the query packets are flooded into the network for the path search. The destination node responds for establishing a route and this phase completes when route is found. Examples are AODV, DSR, TORA.

• Simulation Setup

In this work we employed OPNET Modeler 16.0 for simulation. A campus network was modelled within an area of 50*50 KM. The all mobile nodes were spread within the area. In Table I describe the simulation parameters that are used in this simulation in order to evaluate and compare the performance of two selected routing protocols (OLSR, DSR) over a MANET network. Each scenario was run for 1800 seconds (simulation time). Under each simulation we check the behavior of OLSR and DSR routing protocol with constant pause time. For examining average statistics of the network load, delay and throughput for the OLSR and DSR routing protocol of WSN we collected DES (global discrete event statistics) on each protocol and Wireless LAN. We take the FTP traffic in the application configuration object this sets the application to model the high load FTP traffic for analyse the effects on routing protocols.

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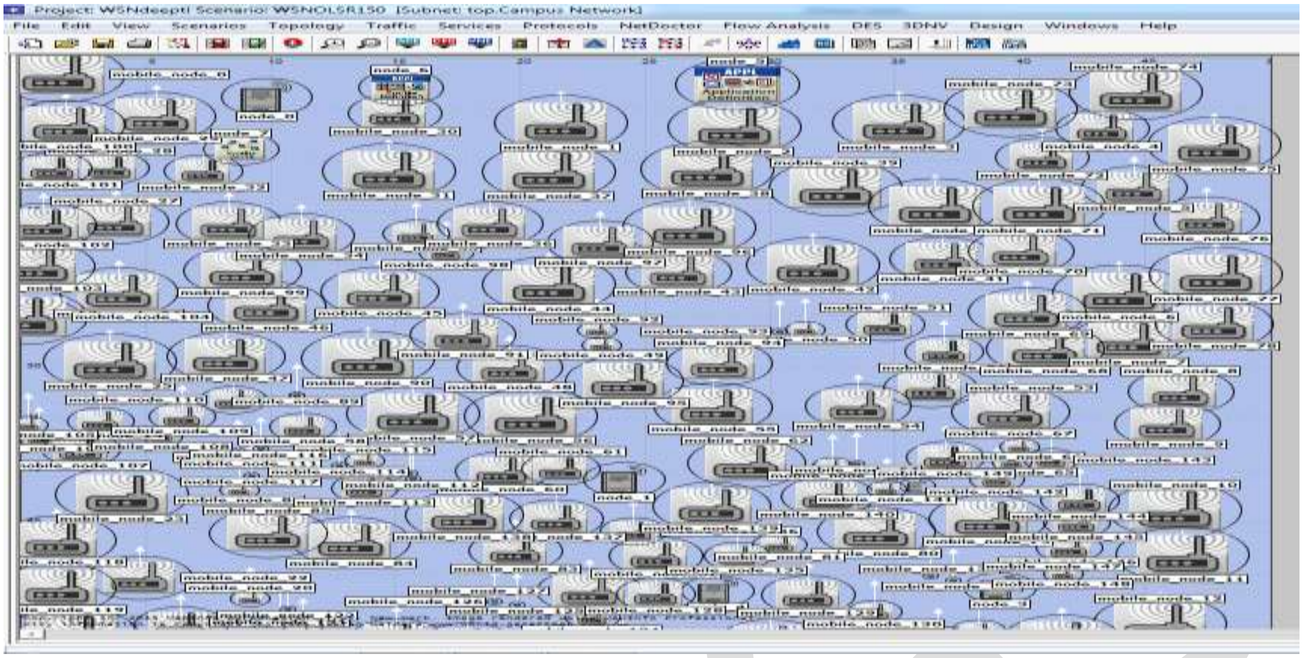

Figure 2: WSN Scenario

Table I Simulation Parameters

Simulation Parameters	
Examined Protocols	OLSR and DSR
Number of Nodes	100,150,200, 250 and 300
Types of Nodes	Static
Simulation Area	50*50 KM
Simulation Time	1800 seconds
Pause Time	200 s
Performance Parameters	Throughput, Delay, Network load
Traffic type	FTP
Mobility model used	Random waypoint
Data Type	Constant Bit Rate (CBR)
Packet Size	512 bytes
Trajectory	VECTOR
Long Retry Limit	4
Max Receive Lifetime	0.5 seconds
Buffer Size(bits)	25600
Physical Characteristics	IEEE 802.11g (OFDM)
Data Rates(bps)	54 Mbps
Transmit Power	0.005
RTS Threshold	1024
Packet-Reception Threshold	-95

Table II Scenario used

Scenarios	Nodes and Its Types	Protocol
Scenario 1	100 Static Nodes	OLSR
Scenario 2	100 Static Nodes	DSR
Scenario 3	150 Static Nodes	OLSR
Scenario 4	150 Static Nodes	DSR
Scenario 5	200 Static Nodes	OLSR
Scenario 6	200 Static Nodes	DSR
Scenario 7	250 Static Nodes	OLSR
Scenario 8	250 Static Nodes	DSR

In profile configuration object we configured the profile with high load FTP application. The default random waypoint mobility model was used in this simulation. Mobile nodes in all scenarios moving with pause time are 200 seconds.

• Performance Metrics:

We have primarily selected the following three performance metrics in order to study the performance comparison of OLSR and DSR.

End to End Delay

The packet end to end delay is the average time that packets take to traverse in the network. Delay is the total time taken by the packets to reach from the source to destination. It is expressed in seconds. Hence all the delays in the network are called packet end-to-end delay. It includes all the delays in the network such as propagation delay (PD), processing delay (PD), transmission delay (TD), queuing delay (QD).

$$AED = \frac{\sum_{i=0}^{n} \text{Time Packet Received}_i - \text{Time packet sent}_i}{\text{Total Numbe of Packets Received}}$$

Network Load

Network load can be define as the total amount of data traffic being carried by the network .When there is more traffic coming on the network, and it is difficult for the network to handle all this traffic so it is called the network load. High network load affects the WSN routing packets that reduce the delivery of packets for reaching to the channel.

Throughput

Throughput can be defined as the ratio of the total amount of data reaches a destination from the source. The time it takes by the destination to receive the last message is called as throughput. It is expressed as bytes or bits per seconds (byte/sec or bit/sec). It can expressed as

• Result and Analysis

The simulation result shows the performance behavior of the considered protocols in terms of network load, end to end delay and throughput. Figure 3–6 depicts the performance on the basis of network load with varying number of nodes. From graph results it is observed that DSR has less average network load as compared to the OLSR routing protocol. DSR has less average network load because of its on demand routing characteristics so there is no need to update the routing table. Figure 7–10 depicts the performance on the basis of end to end delay with varying number of nodes. From graph results it is observed that DSR shows higher end to end delay as compared to OLSR due to the reason that when a RREQ is sent, the destination replies to all RREQ it received, which make it slower to determine the least congested route. In OLSR, every destination replies to only first RREQ. Figure 11–14 depicts the performance on the basis of throughput with varying number of nodes. Here we see that OLSR shows very high average throughput as compared to DSR that shown in figure 6.12.Because OLSR is highly reliable in terms of large-scale environment and high-speed. The reason for high throughput of OLSR in comparison with other protocols is that, for OLSR routing paths are easily available due to the characteristic of proactive routing protocols.

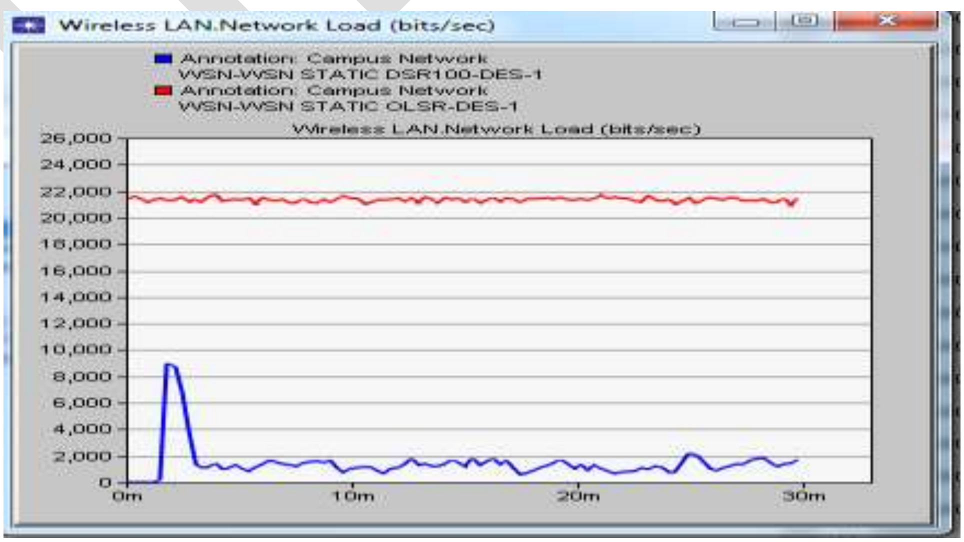

Figure 3: Network load of OLSR and DSR for 100 Static nodes.

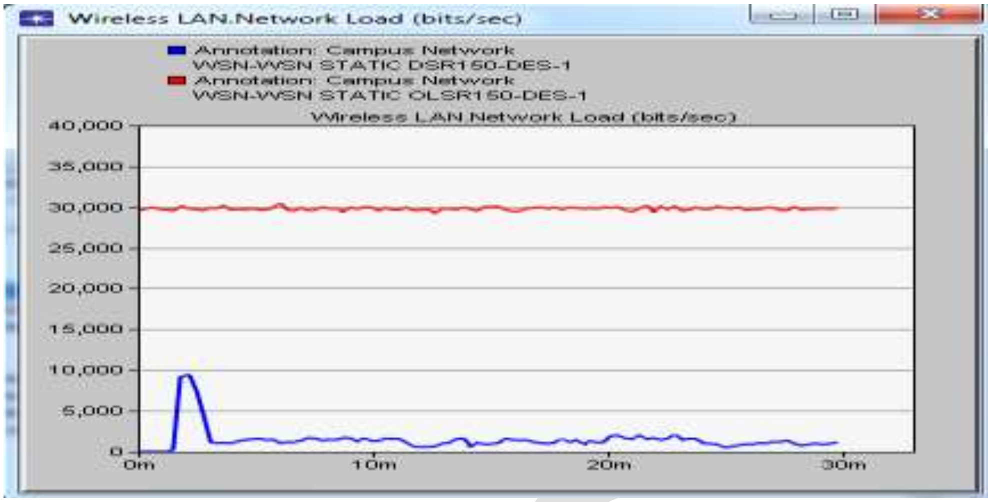

Figure 4: Network load of OLSR and DSR for 150 Static nodes.

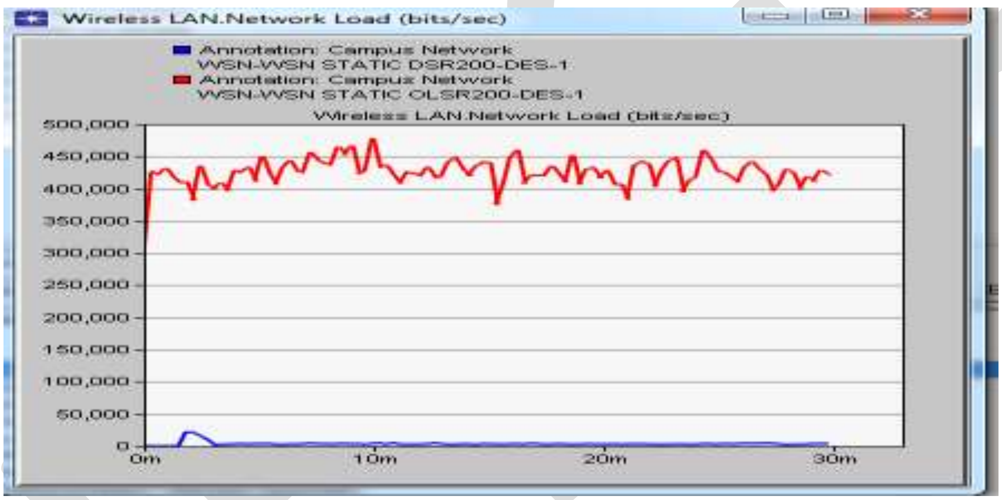

Figure 5: Network load of OLSR and DSR for 200 Static nodes.

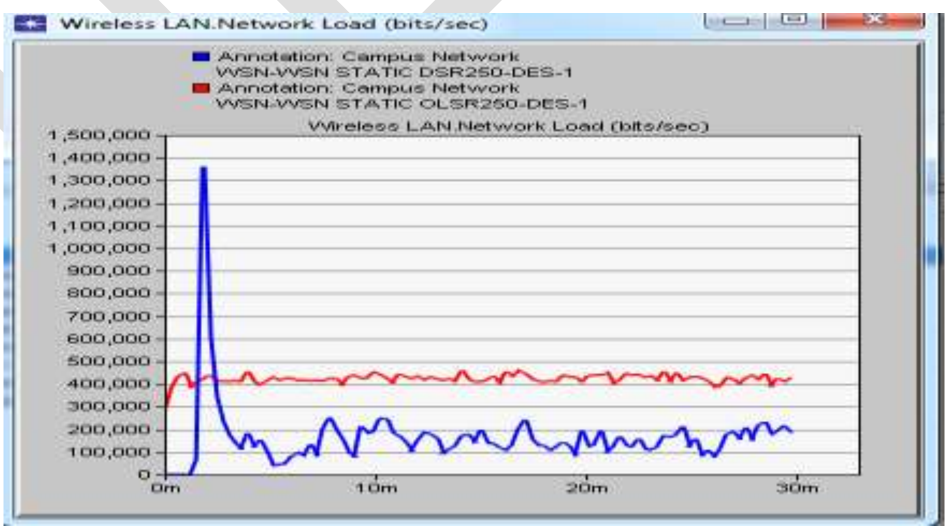

Figure 6: Network load of OLSR and DSR for 250 Static nodes

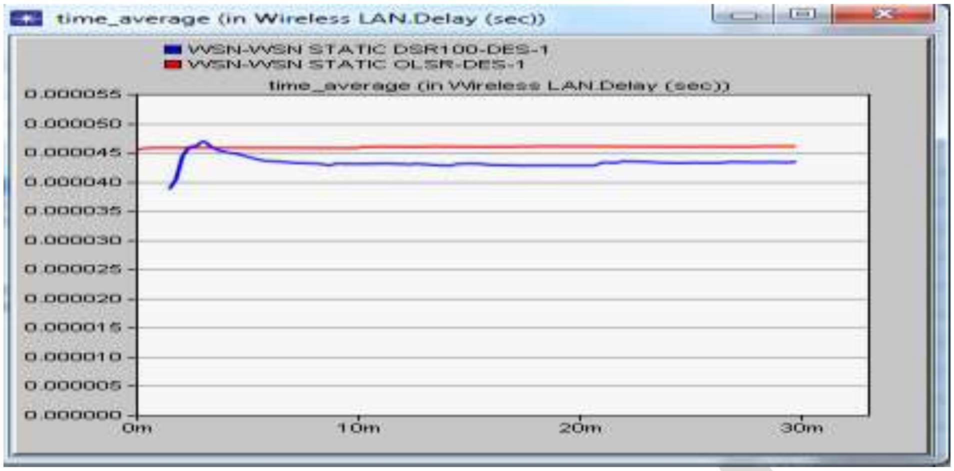

Figure 7: End to End Delay of OLSR and DSR for 100 Static nodes

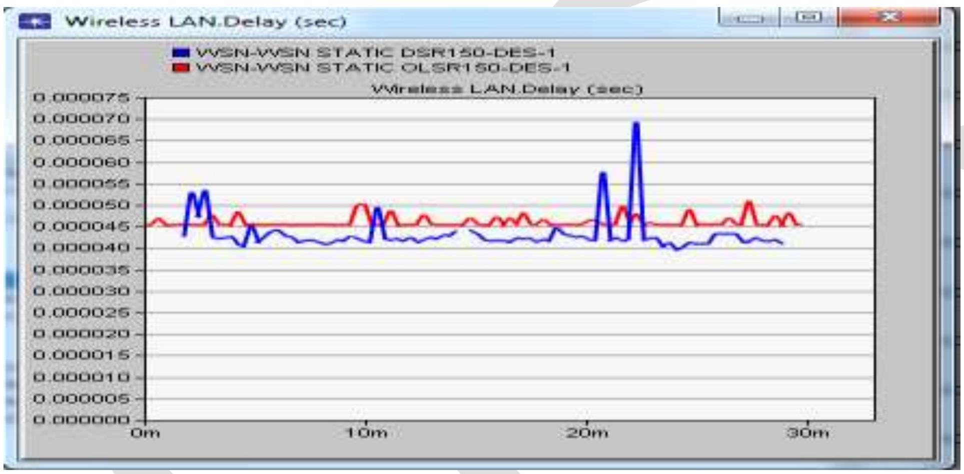

Figure 8: End to End Delay of OLSR and DSR for 150 Static nodes

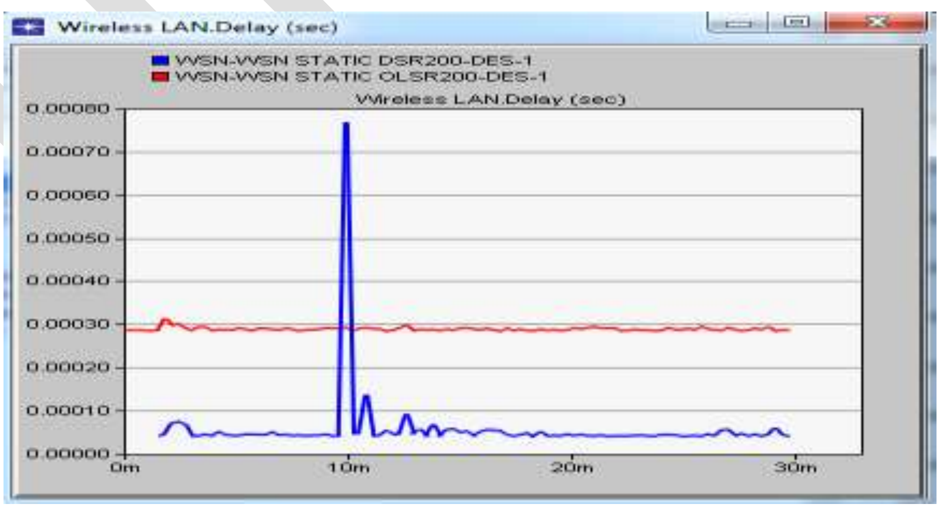

Figure 9: End to End Delay of OLSR and DSR for 200 Static nodes

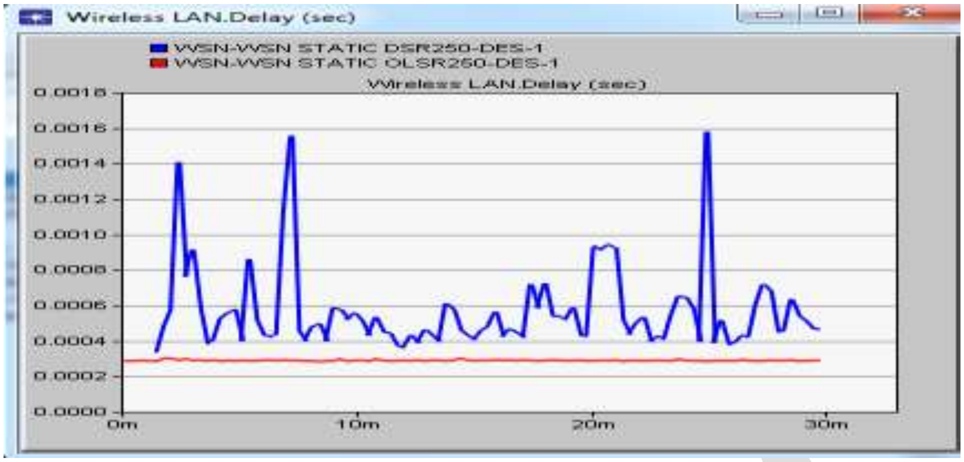

Figure 10: End to End Delay of OLSR and DSR for 250 Static nodes

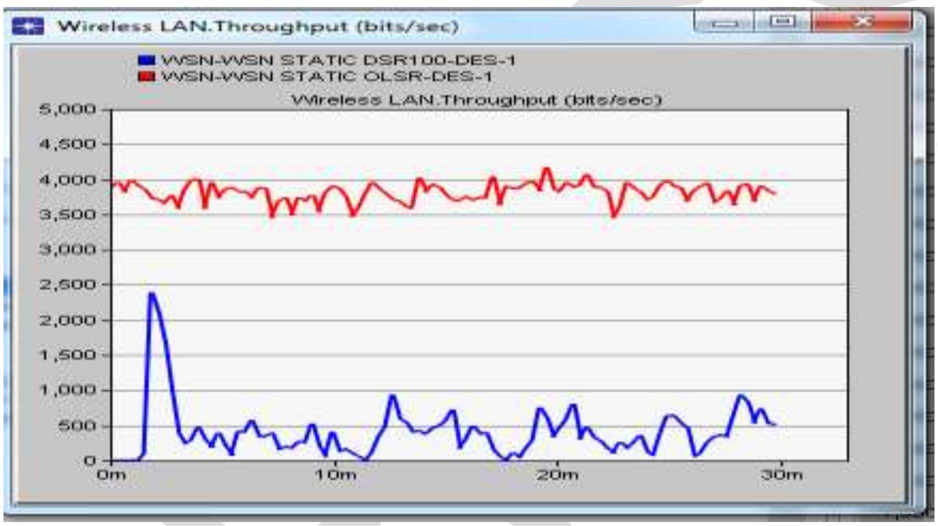

Figure 11: Throughput of OLSR and DSR for 100 Static nodes.

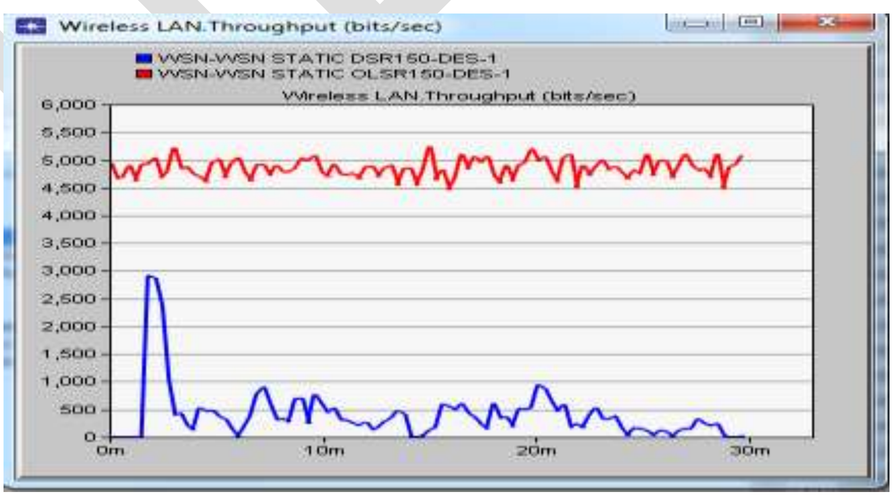

Figure 12: Throughput of OLSR and DSR for 150 Static nodes

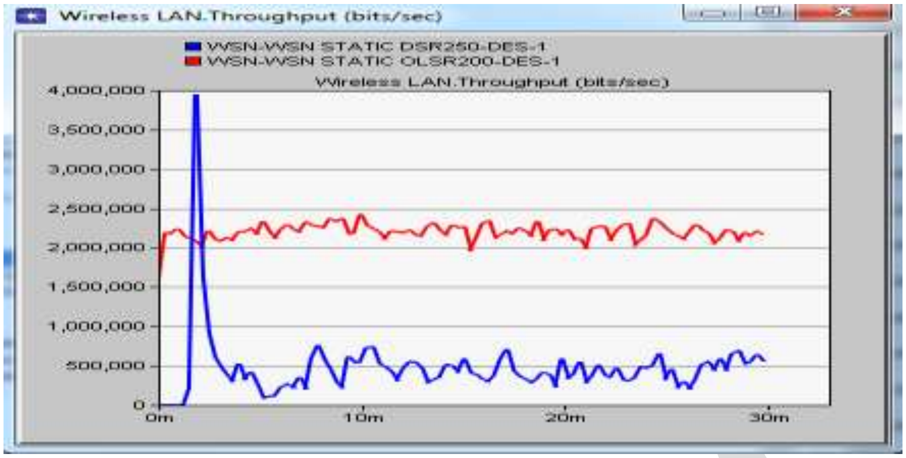

Figure 13: Throughput of OLSR and DSR for 200 Static nodes.

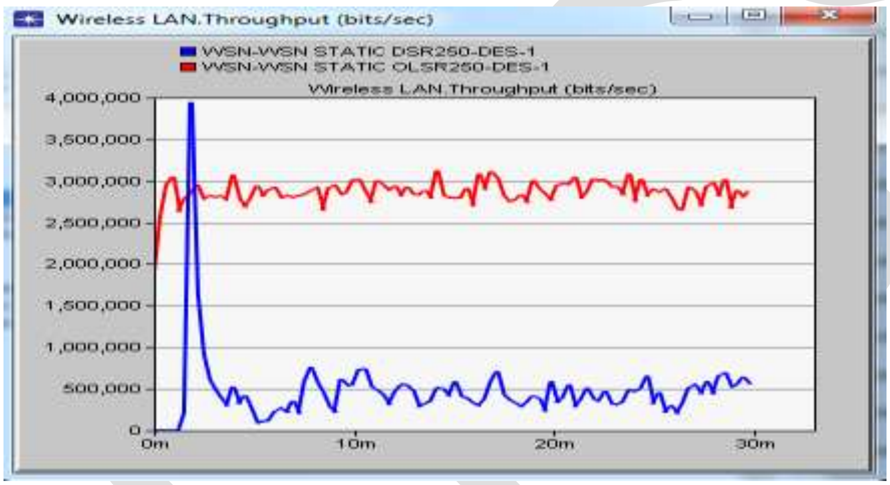

Figure 14: Throughput of OLSR and DSR for 250 Static nodes.

• Conclusion:

This paper described a performance evaluation and comparison between two routing protocols (OLSR, DSR) for Wireless Sensor Networks. Both protocols were simulated using OPNET 16.0 and were compared in terms of end to end delay , throughput and network load with varying number of nodes (100, 150, 200, 250, 300). From the simulation result in section we can conclude that average throughput of OLSR in all scenarios is much better than DSR and average end to end delay of DSR is much higher than OLSR and in terms of network load DSR shows less average network load as compared to OLSR routing protocol.

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