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Performance Evaluation of Underwater Routing Protocols for Underwater Wireless Sensor Network using OPNET

By

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Abstract

Underwater Wireless Sensor Networks are progress automation. This network includes sensor nodes (surface sink), mobile autonomous vehicles and AUVs that are submerged in water. These nodes are wireless nodes connected to the ocean via an acoustic link to perform various tasks. This paper compares routing protocols AODV and DSR reactive protocols for their performance under different vehicle conditions, nodes numbers and depths (20, 40, 60 and 80 respectively) at a constant speed of 1 m/s. The performance evaluation of DSR reactive routing protocols and AODV reactive routing protocols was done using v14.5 OPNET modeler. OPNET modeler v14.5 can be used for wired and wireless networks. The simulation results are compared between DSR and AODV routing protocols. Execution parameters include network load, throughput and end-to-end delay.

Keywords- Manet, Vanet & Underwater Wireless Sensor Network, Aodv And Dsr, V14.5 Opnet Modeler.

Introduction

Wireless networks are used today for communication. The network is self-organizing, self-healing and does not require interference from any centralized or pre-established infrastructure. Underwater wireless sensor networks are networks that do not have a centralized infrastructure. These networks include autonomous underwater vehicles, which work together using acoustics links over a specific area.

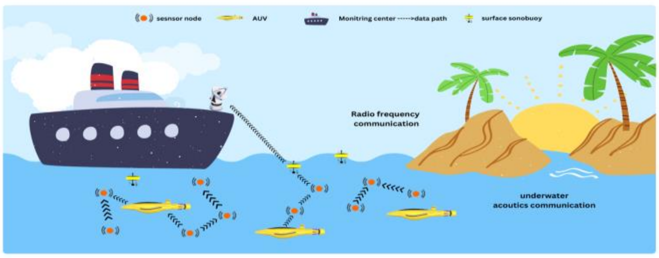

Fig. *Shows the UWSNs architecture*

UWSNs refer to wireless networks that use multi-hop acoustic links and radio relaying. Vehicular is a subclass of Mobile Adhoc Networks. UWSNs offer a wide range of applications. They can Be Used To Collect Data From The Underwater Domain,

Detect Oil Fields And Submerged Device And Monitor The Environment. The Sensor Node Also Sends Information In Case Of Emergency And Used For Pollution Detection Of Rivers And Sea, Monitor The Weather And Compile Sea Data.

The Following Is The Organization Of This Paper. The Following Sections Are Related Work: Section-Ii. Described Underwater Routing Protocols In Section-Iii And Result Of Simulation Is Described In Section-Iv. Finally, Performance Metrics Are Described And Measured In Section V. Section Vi Presents The Simulation Results And An Examination Of Our Observations. Section Vii Concludes With A Discussion Of Future Work And A Summary.

Related Work

To Solve for A Set Of Parameters, Such As Complete Delay [6], Packet Delivery Ration And Energy Use, Simulation & Analysis Aodv & Dsdv Routing Protocols In Uwsns By Using Aqua- Sim Network Simulator Was Proposed. [13] Proposes A Method "In Uwsns Enhancing The Reliability Of Head Nodes". In Case of A Head Node Fails, It Is Recombine Using This Scheme A Check-Pointing System. The New Scheme Will Better Reliability And Energy Efficiency. [5] Suggested An "Algorithm Anchor Free Localization", For Using Sensor Location Assistance in Underwater. This Method Used For Both Nodes The Mobile And Fixed Uwsns. It Depends on Data from Nearby Nodes To Create An Algorithm Structure. The Wireless Sensor Nodes Have A Limited Bandwidth And Propagation Delay. Due To Sensor Nodes Limited Battery Power, They Require A Lot Of Energy To Keep All Types Of Communications Going [18]. They Faced the Problem With Secure Connection Between Submerged Devices And Have Suggested A Crypto- Analytics Suite That Would Decrease The Message Overhead. They Have Developed A Secure Communication Suit To Ensure End-To-End Encryption. The Cryptographic Suit Provides Security For Vehicles, Including Key Management, Vehicle Validation, And Privacy [21]. This Approach Is Called "A Multimedia Cross Layer Protocol Which Is Used In Undersea Sensor-Net". It Will Enable Current Submerged Applications Such As Video Tactical Or Picture Monitoring Procurement, Multimedia Sea Monitoring, Undersea Observations And Protection Of Disaster Prevention. [7] Cluster Based Energy-Efficient Communication Techniques For Uwsns (Underwater Wireless Sensor Networks) Has Been Proposed. This Approach Is Intended To Improve Energy Efficiency, Reliability, Throughput, And Performance Of Uwsn Sensor Nodes.

Routing Protocol

Two Methods Can Be Used To Route Underwater Wireless Systems: Virtual Circuit Switch Or Packet Switch. First, Virtual

Circuit Are Used To Determine The Network's Path At The Beginning Of Network Operation. The Second Is For Symmetric Network Architecture, In Which Every Node Is Responsible For Routing Packets And Makes Their Own Decisions About How To Route Them. We Will Be Discussing Packet Switch Network To Determine Packet Delivery Ratio, Energy Utilization, And End- To-End Delay. There Are Two Types Of Routing Protocols For Packet Switch Mode: Proactive And Reactive.

Routing Is A Way To Create And Choose A Route To Send Information From One Source Node To Another. The Network Layer Includes Routing Algorithms. As Ad-Hoc

Networks, There Are Many Routing Algorithms. These Are The Protocols For Underwater Routing:

Proactive Routing Protocol (Prp)

These Protocols Use A Table. Every Node Manages A Table To Store And Transfer Information. Each Node Also Connects To The Other Via Linked Nodes. Table-Driven Protocols And Proactive Routing Protocols Are Other Names For These Systems. Dsdv And Olsr Are Two Table-Driven Routing Technologies. Dsdv (Destination Sequence Displace Vector Routing) Dsdv Is Based Upon The Bellman-Ford Algorithm. Dsdv Protocol Allows Users To Share Data Packets With Other Nodes. This Packet Stores Data Such As The Ip (Internet Protocol) Address, Number Of Sequence, And Hope Count. Each Of The Work's Nodes Changes Its Topology After Some Time, A Fixed Time, Or Immediately.

Lsr (Optimized Link State Routing)

To Collect Information About The Nearest Node In Olsr, Node Used "Hello" Message. Every Node In A Network Sends "Hello" Messages To Its Neighbour Nodes Immediately In Case Of A Problem. They Also Maintain A Table For Each Node. This Is Also Known As The Classical Link State Algorithm. This Is A Multipoint Relay Technique. This Technique Decreases The Cost Of Flooding To Sense Node During Flooding Message Is Very Costly Process.

Reactive Routing Protocols (Rrps)

Reactive Routing Protocol Allows You To Create And Choose A Route To Send Information From One Source Node To Another. This Types Of Protocols Another Name On-Demand Routing Protocols. Reactive Routing Protocol Decreased Network Traffic. This Protocol Is Used To Discover Routes And Search For Destinations In A Network.

Reactive Routing Protocols Types

1. DSR
2. AODV
3. TORA

We have used two UWSN reactive routing protocols in this paper. Nodes in UWSN have high mobility and move at high speeds. It is not recommended for proactive based routing. Due to the large amount of table information and bandwidth consumed, proactive-based routing protocols could fail in UWSN.

AODV

It is a reactive routing protocol that can achieve one to one models. AODV results implement efficient, automated, multi- hop routing within associate to moving nodes through root and manage wireless network. AODV gives permission to nodes to move fast to achieve new goals and doesn't need them to control routes to destinations. AODV explain three types of message: Route Requests, route replies and route errors. Nodes in AODV routing record the address of any query they receive upon receiving a broadcast query (RREQ). Backward learning is a technique of recording its previous hop. A reply packet which is sent to the desired location, contains a complete path from backward learning to its source. The node will make hop recording at each station along the path to establish the forward path from its source. A full duplex path is established by the flooding of queries and the sending of replies. Once the path is established, it will be maintained for as long as it is used by the source. Link failures will be reported recursively back to the source, which will then In order to find a different route, start a new query- response operation.

DSR

A DSR is a straightforward and multi-hop logical routing protocol and ad-hoc networks. In this protocol no need pre-established network infrastructure for configuration. It is also known as a self-organization network. It uses for sending packets between source nodes to destination in source routing. In source routing the source nodes understand the hop sequence to the destination. In this a route cache for storing information of nodes.

Simulation-Setup

In this work we used OPNET Modeler v14.5 to simulate. An area of 1km by 1km was used to model a campus network. All mobile nodes were located within this area. The simulation parameters employed in this simulation are described in Table I. They were used to compare and evaluate the performance of two different protocols AODV and DSR on MANET. There are different numbers of mobile devices in each scenario. For simulating AODV routing protocols, we need 20 mobile nodes operating at fixed speed of 1m/s. The second scenario has 20 mobile nodes operating at constant speed 1m/s to simulate DSR routing protocols.

Table 1.1 *Some parameters for simulation*

Simulation Parameters	
Examined protocol	AODV, DSR
Total Number of nodes	(20, 40, 60, 80, 100)
Nodes nature	Mobile nodes
Area for simulation	1km*1km
Time for Simulation	1000s
Mobility	1m/s
Pause time	100s
Performance parameter	Throughput, End to end delay, Network load
Type of traffic	FTP
Mobility model	Random waypoint
Data type	Constant Bit Rate(CBR)
Size of packet	512 Bytes

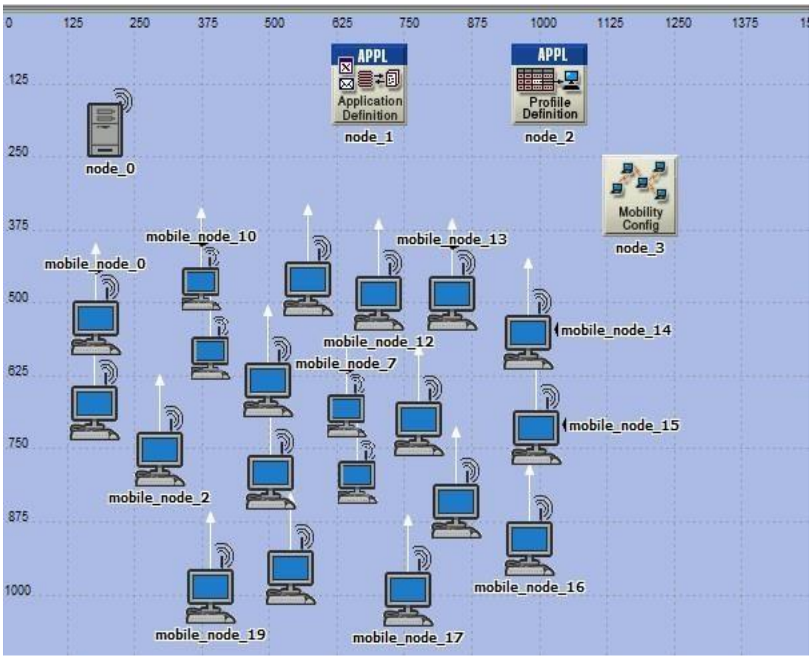

Table1.2 *List of scenarios*

Number of Network Scenarios	Number of Nodes	Routing Protocols
First Scenario	20	DSR
Second Scenario	20	AODV
Third Scenario	40	DSR
Fourth Scenario	40	AODV
Fifth Scenario	60	DSR
Sixth Scenario	60	AODV
Seventh Scenario	80	DSR
Eighth Scenario	80	AODV
Ninth Scenario	100	DSR
Tenth Scenario	100	AODV

We have 10 scenarios, each with a simulation time of 1000 seconds. Each scenario was run for 1000 second with constant mobility of 1 m/s. The constant pause time for each scenario is 100 seconds. This process was used to verify the behavior of DSR and AODV protocols. Ad-hoc routing protocol AODV, DSR to examine statistics of network load, throughput, delay and collect global discrete events statistics (DES). Then select Wireless LAN and define an application configuration in this FTP was set up with a lot of traffic(high load) to see how it affected the routing protocols. After creating application configuration, we can define profile configuration with FTP high-load and mobility configuration. This profile will include a default random waypoint and mobile nodes moving at constant speed of 1m/s with pause time of 100 seconds. The model and mobility pattern that the nodes will employ the simulation was running defined by the mobility configuration.

Performance parameters

Three performance parameters were chosen to measure the effectiveness of AODV routing protocols and DSR routing protocols.

End to End Delay

The average time it takes for a packet to travel throughout the network is known as the packet delay from end to end. Delay is the length of time it takes for packets to transit from the source to the destination. It's counted in seconds. The term "packet end- to-end delay" refers to all network delays. All network delays, such as propagation delay, processing delay, transmission delay , and queuing delay , are included.

Network load

It is the total data traffic carried by the network. The volume of traffic on a network is referred to as network load that is added to the network. This is the traffic overload. The VANET routing packets are affected by high network load. This reduces the speed of reaching the channel.

Throughput

The ratio of total data to destination can be described as throughput. Throughput is the time taken by the destination for the last message to be received. It can be expressed in bits or bytes per second (byte/sec, bit/sec).

Analysis and Result

Simulation outcomes show the performance of the protocols under consideration in terms of network traffic (load) and complete delay. Figure 1.1-1.5 DSR shows the more throughput as AODV. Figure 1.6-1.10 shows the network load performance. DSR has a lower network load than AODV in all scenarios that are based on different numbers of nodes. Figure 1.11-1.15 shows the higher end-to-end delay performance of DSR in all scenarios.

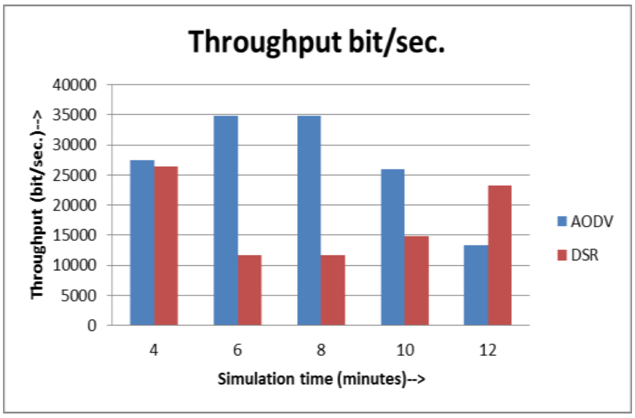

Figure 1.1 *AODV and DSR throughput for 20 nodes*

In figure 1.1 we take 20 nodes for checking performance of AODV and DSR. After result AODV throughput is lower than DSR. DSR shows the more throughput as AODV it means AODV is better than DSR.

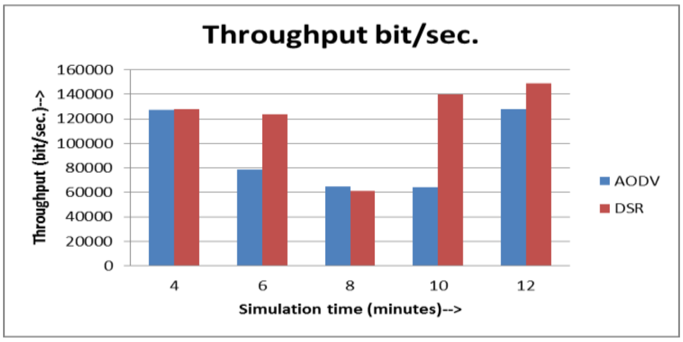

Figure 1.2 *AODV and DSR throughput for 40 nodes*

In figure 1.2 we take 40 nodes for checking performance of AODV and DSR. After result AODV throughput is lower than DSR. DSR shows the more throughput as AODV it means AODV is better than DSR.

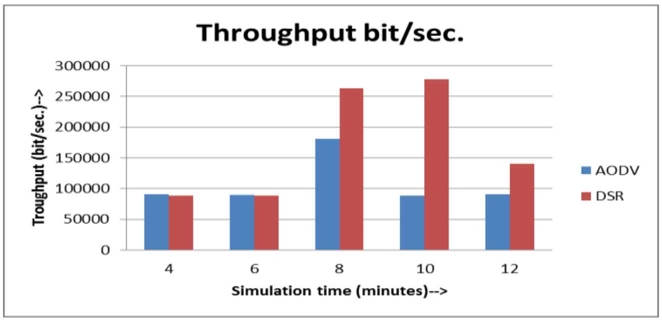

Figure 1.3, *AODV and DSR throughput for 60 nodes*

In figure 1.3 we take 60 nodes for checking performance of AODV and DSR. After result AODV throughput is lower than DSR. DSR shows the more throughput as AODV it means AODV is better than DSR.

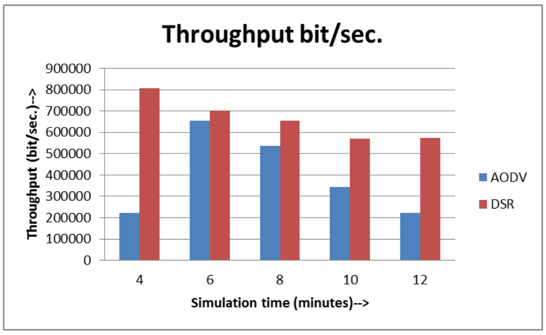

Figure 1.4, *AODV and DSR throughput for 80 nodes*

In figure 1.4 we take 80 nodes for checking performance of AODV and DSR. After result AODV throughput is lower than DSR. DSR shows the more throughput as AODV it means AODV is better than DSR.

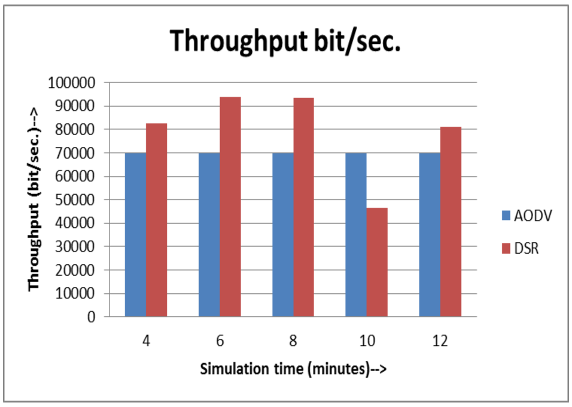

Figure 1.5 *AODV and DSR throughput for 100 nodes*

In figure 1.5 we take 100 nodes for checking performance of AODV and DSR. After result AODV throughput is lower than DSR. DSR shows the more throughput as AODV it means AODV is better than DSR

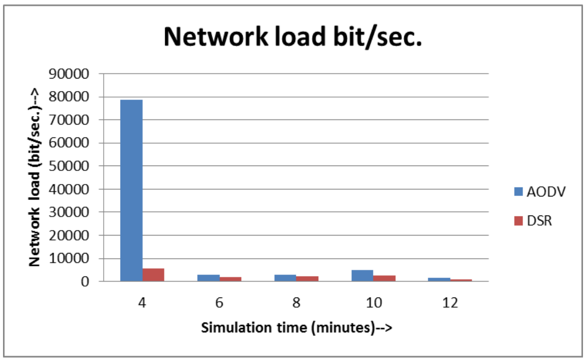

Figure 1.6 *AODV and DSR network load for 20 nodes*

In figure 1.6 we take 20 nodes for checking performance of AODV and DSR. After result AODV Network load is longer than DSR. DSR shows the lower network load as AODV it means DSR is better than AODV.

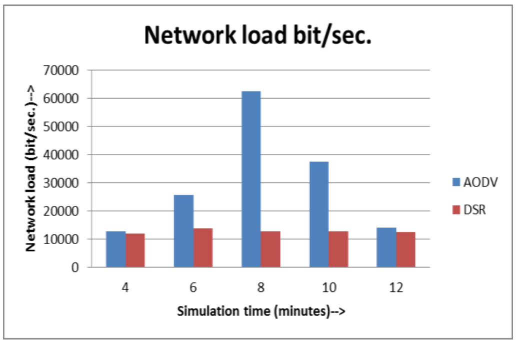

Figure 1.7 *AODV and DSR network load for 40 nodes*

In figure 1.7 we take 40 nodes for checking performance of AODV and DSR. After result AODV Network load is higher than DSR. DSR shows the lower network load as AODV it means DSR is better than AODV.

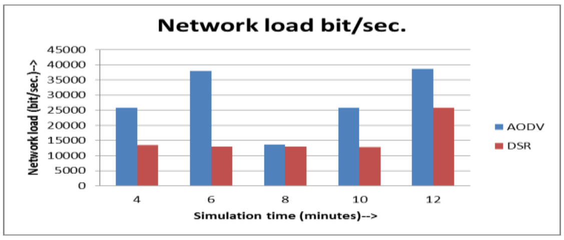

Figure 1.8 *AODV and DSR network load for 60 nodes In figure 1.8 we take 60 nodes for checking performance*

of AODV and DSR. After result AODV Network load is higher than DSR. DSR shows the lower network load as AODV it means DSR is better than AODV.

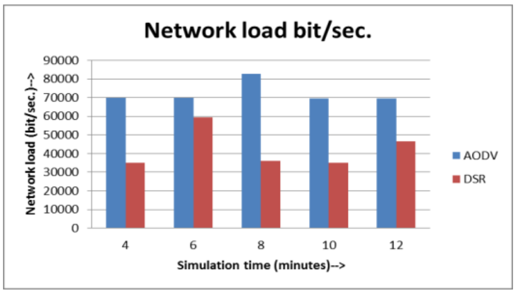

Figure 1.9 *AODV and DSR network load for 80 nodes*

In figure 1.9 we take 80 nodes for checking performance of AODV and DSR. After result AODV Network load is higher than DSR. DSR shows the lower network load as AODV it means DSR is better than AODV.

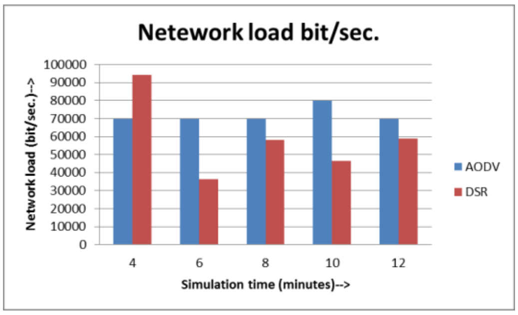

Figure 1.10 *AODV and DSR network load for 100 nodes*

In figure 1.10 we take 100 nodes for checking performance of AODV and DSR. After result AODV Network load is higher than DSR. DSR shows the lower network load as AODV it means DSR is better than AODV.

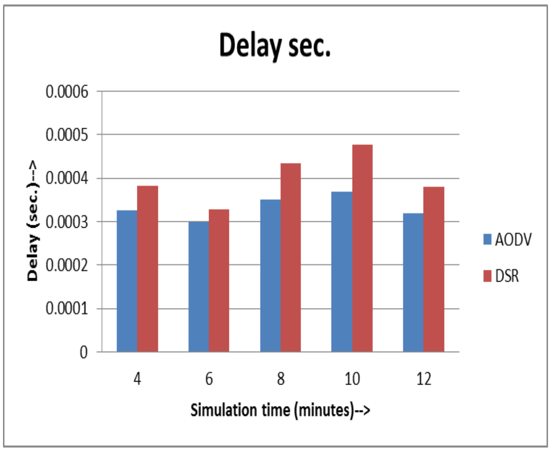

Figure 1.11 *AODV and DSR delay for 20 nodes*

In figure 1.11 we take 20 nodes for checking performance of AODV and DSR. After result DSR the end- to-end latency is longer than the AODV. AODV showing the lower end to end delay as DSR it means AODV is better than DSR.

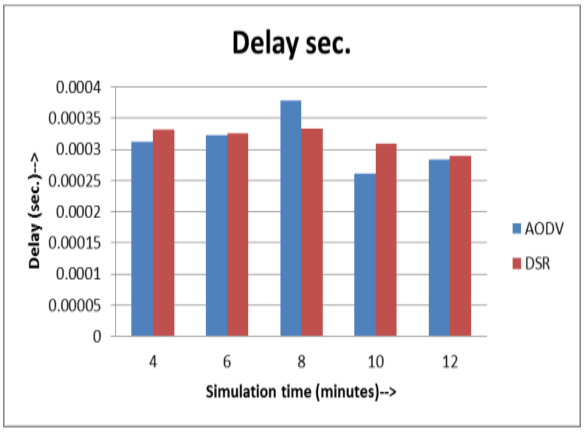

Figure 1.12 *AODV and DSR delay for 40 nodes*

In figure 1.12 we take 40 nodes for checking performance of AODV and DSR. After result DSR The end- to-end latency is longer than the AODV. AODV showing the lower end to end delay as DSR it means AODV is better than DSR.

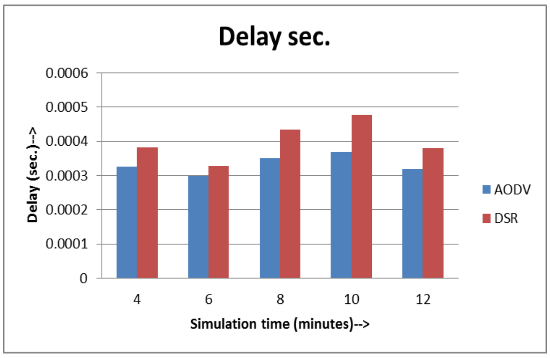

Figure 1.13 *AODV and DSR delay for 60 nodes*

In figure 1.13 we take 60 nodes for checking performance of AODV and DSR. After result DSR The end- to-end latency is longer than the AODV. AODV showing the lower end to end delay as DSR it means AODV is better than DSR.

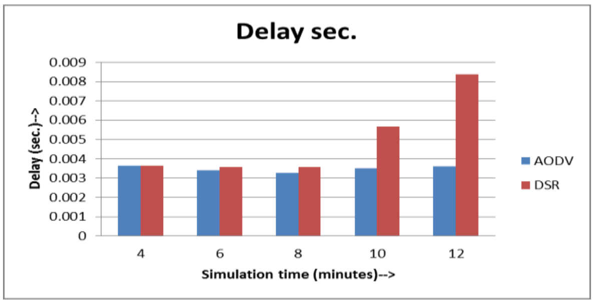

Figure 1.14 *AODV and DSR delay for 80 nodes*

In figure 1.14 we take 80 nodes for checking performance of AODV and DSR. After result DSR end to end delay is higher than AODV. AODV showing the lower end to end delay as DSR it means AODV is better than DSR.

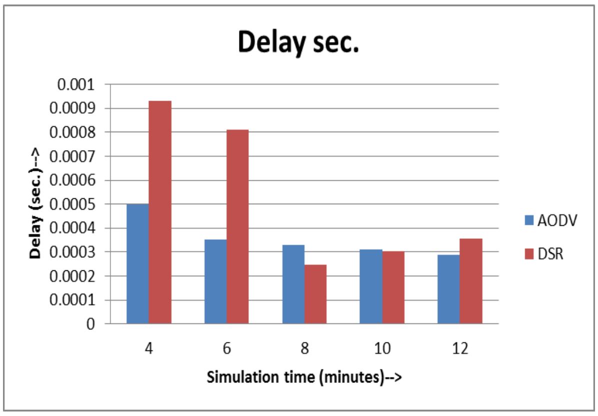

Figure 1.15 *AODV & DSR delay for 100 nodes*

In figure 1.15 we take 20 nodes for checking performance of AODV and DSR. After result DSR The end- to-end latency is longer than the AODV. AODV showing the lower end to end delay as DSR it means AODV is better than DSR.

Conclusion

This paper compares two different reactive routing protocols (DSR and AODV) with different nodes (20, 40,60, 80,100). These protocols are compared in terms three performance parameters throughput, delay, and network load with constant mobility of 1m/s. Using OPNET 14, we compared these protocols and verified their performance. After performing performance evaluation and comparison, we found that AODV end to end delay and throughput is lower than DSR in all scenarios. This is superior than DSR. AODV is more than DSR in terms of network load, but in this case DSR better in all cases and my future work I will take others protocol to simulate data using OPNET 14.5 and other simulation tool

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