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Analysis of OLSR, DSR, DYMO Routing Protocols in Mobile Ad-Hoc Networks using Omnet++ Simulation

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Abstract- In present scenario, choosing the routing protocol is vital task in mobile ad-hoc networks. These type of networks is collection of nodes which are connected dynamically and situated without using any infrastructure. There are various types of routing protocols have been implemented such as OLSR, DSR, DYMO, AODV, DSDV, BATMAN etc. These are implemented in specific simulation environments. In this research, an analysis has been done to choose the appropriate routing protocol. A comparison based on relative results is prepared for DYMO, OLSR and DSR protocol. A sample network is simulated to try these three routing protocols over a set of parameters. DYMO and DSR protocols found more difficult and OLSR protocol has better performance in comparison of both DYMO and DSR. This simulation has been carried out using OMNeT++ simulation framework.

Keywords: *AD-HOC network, DYMO, DSR, OLSR, OMNET++, INET.*

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Trapti Jain [α] & Savita Shiwani [σ]

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I. Introduction

Since 1970s, wireless networks have been liked by computer industry. Wireless networks are collection of nodes which provides communication without using any physical link. Mobile wireless networks have two types of variations i.e.

a) Infrastructure networks
b) Infrastructure-less networks

Infrastructure networks are known as collection of fixed nodes using wired gateways. In these networks a mobile node can communicate with nearest base station (which is called as bridge). Mobile node can also move in its geographical limit. If mobile node goes out of its range then it can reconnect using another base station, this process is called handoff.

Infrastructure-less networks are known as collection of nodes which are connected dynamically without any wired link. These types of networks communicate without any rules and laws. These networks have no fixed routers but nodes (work as router) themselves decide the route to transfer and maintain formation from one node to another node. These are also known as mobile Ad-hoc networks.

This research paper goes on to analyze the performance of routing protocols used in mobile ad-hoc networks. Section 2 describes various routing protocols. Section 3 describes OMNet++ simulation framework as well as its features. Section 4 describes network setup and performance analysis. Finally paper ends with significant conclusion.

II. Ad-Hoc Routing Protocols

According to topology information organization Ad-hoc routing protocols are categorized in two different ways:

a) Table-driven routing protocols (proactive)

This type of routing protocol maintains routing information from each node to every other node. Every node maintains one or more routing table to store routing information. When network topology changes then routing information has to be updated at every node. There are various types of protocols which fall in this category such as DSDV, WRP, OLSR, CGSR etc.

b) On-demand routing protocols (reactive)

This type of routing protocol creates routes when desired by source node that's why these are also known as source- initiated routing protocols. When a node wants to transfer information to another then a route discovery process is initiated. After route establishment a route maintenance procedure is called which maintain the route for particular node until route is no longer desired. Examples are AODV, ABR, SSR, TORA, DYMO etc.

Optimal Link State routing protocol

It is abbreviated as OLSR protocol and also known as proactive protocol. It is based on pure link state algorithm. It provides periodic exchange of information to maintain topology changes information at every node. OLSR works in purely distributed manner and suitable for large and dense networks. OLSR performs hop by hop routing technique which means each node uses its most recent information to route a packet in network. It also uses multipoint relaying technique to reduce retransmission of control messages. OLSR supports node mobility that can be traced through its own control messages depended upon frequency of these messages.

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Dynamic MANET on-demand routing protocol

It is reactive on demand (DYMO) protocol. It offers adaptation to change network topology and determines unicast routes between nodes within network. DYMO stores routes information for each intermediate hop. In DYMO, when a node wants to transmit information to another node then it transmits route request message (RREQ) to all other nodes in range. If an intermediate node receives this message then it appends information about itself and sends messages to all nearby nodes. Receiving node returns route reply (RREP) message unicast to sending node with appending information about itself. DYMO is also designed with future enhancements and uses generic MANET packet and message format and offers ways of dealing with unsupported elements in a sensible way.

Dynamic source routing protocol

It is on-demand routing protocol which is source initiated. DSR protocol has two phases, route discovery and route maintenance. Every node maintains a route cache which stores route information. When a node wants to transmit a packet to another node then firstly it checks in route cache for available path to send packet. If route is still available then message is transmitted otherwise route request packet is broadcasted in route discovery phase. A route reply is generated when the route request reaches the destination node or an intermediate node which contains in its route cache an available route to the destination node. Route maintenance phase is used when an error in route packets occurs. Route error packets are sent by node. When this packet is received by other node then error hop is removed from route cache.

III. Omnet++ Simulation Framework

Sample network has been simulated using OMNet++ 4.2.2. which is available freely for academic use. Scenarios in OMNeT++ are represented by a hierarchy of reusable modules written in C++. Modules relationships and communication links are stored as Network Description (NED) files and can be modeled graphically. Simulations are either run interactively in a graphical environment or are executed as command-line applications.

The INET Framework provides a set of OMNeT++ modules that represent various layers of the Internet protocol suite, e.g. the TCP, UDP, IPv4, and ARP protocols. It also provides modules that allow the modeling of spatial relations of mobile nodes and IEEE 802.11 transmissions between them.

IV. Network Setup

This simulation has been done in windows7. The overall simulation is based on networking simulation framework OMNeT++ (version 4.2.2). In this simulation IEEE 802.11g specifications are preferred. Simulation is run in command-line environment using cmdenv. Nodes are spread randomly over the network without using any mobility model. Message length has been used as only 512 bytes. The playground configuration is used: 1000 m X 800 m with 10, 20 and 30 nodes. The simulation time is decided as 100 seconds. Packets have been transmitted randomly with uniformly distributed speed (0 to 25 seconds). When packet is reached to its destination node then another packet is ready to transmit to destination node which is again randomly chosen.

Fig 1 shows network design in simulation progress of network in tcl/tkenv graphical environment with 30 nodes.

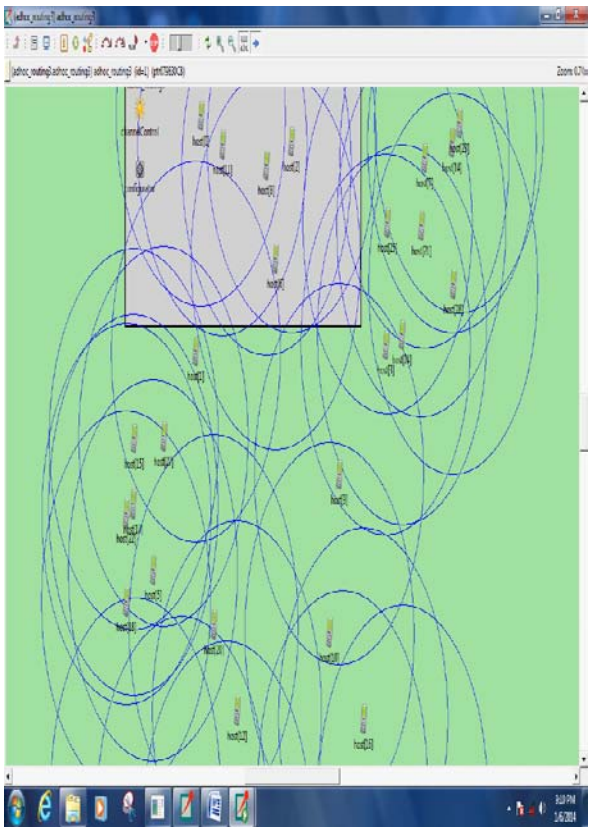

Figure 1 : network design with nodes =30

a) Performance analysis

There are following parameters that have been analyzed as explained below:

Throughput - Throughput is a parameter, which is measured in either bits/sec or data packets per sec. Throughput is rate of successfully delivered packets over the networks. In ad-hoc networks data packets are delivered using nodes.

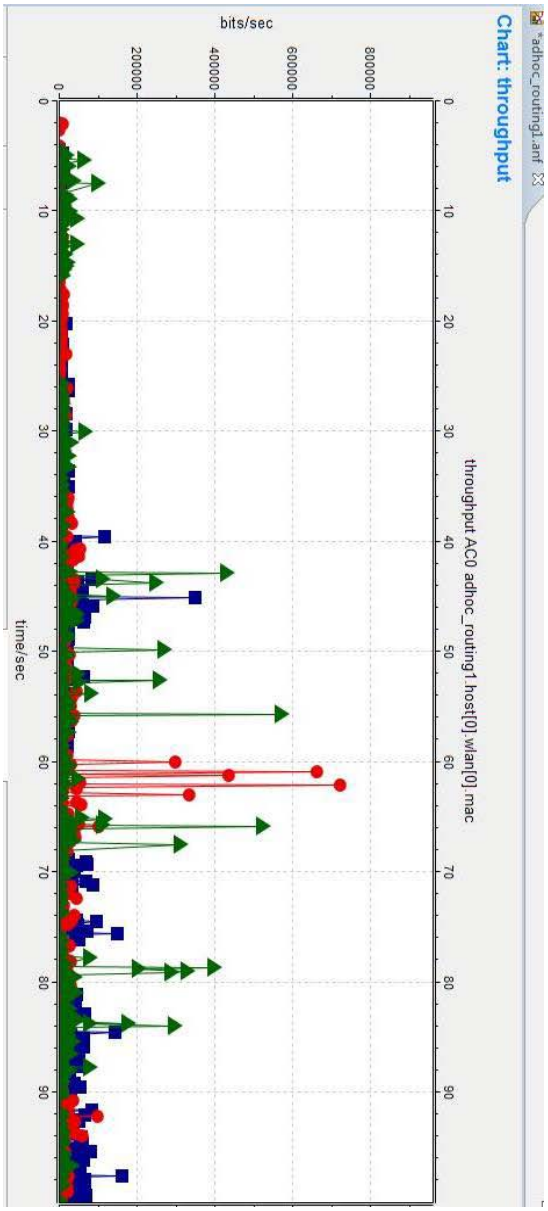

Figure 2 : (a) throughput at host #0 when nodes=10

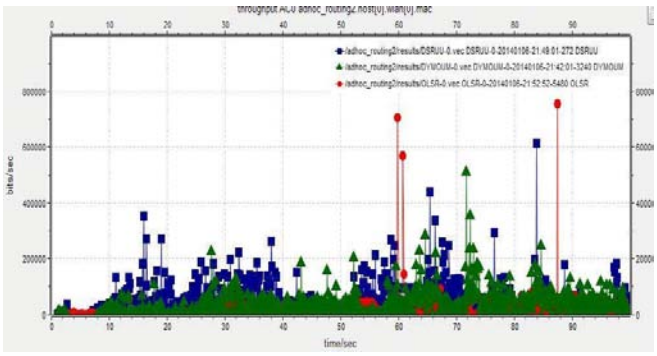

Figure 2 : (b) throughput at host #0 when nodes =20

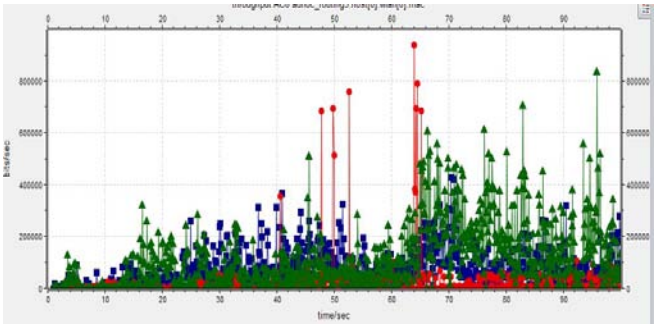

Figure 2 : (c) throughput at host #0 when nodes =30

Figure 2 (a,b,c) shows the graphs generated from the vector data for three protocols during simulation time period. There is comparative analysis of three protocols but conclusion cannot be made clear according to this parameter.

Jitter

Jitter is a parameter which is known as variation in latency. It is measured as variability over the time of packet latency across the network. Its standard term is packet delay variation (PDV). In this simulation it has been measured as mean value for three protocols using window size=10. When packet delay variation is zero then value of jitter will be zero.

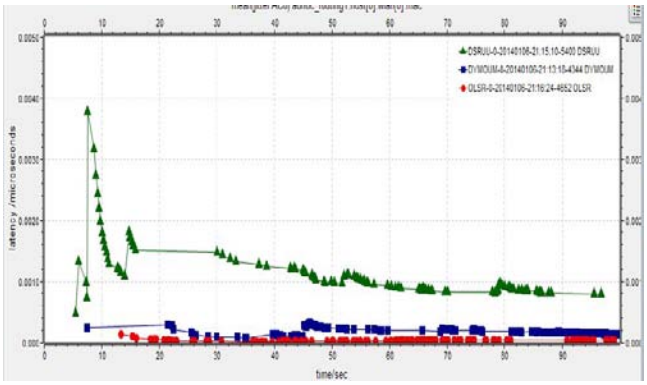

Figure 3 : (a) jitter at host #0 when nodes=10

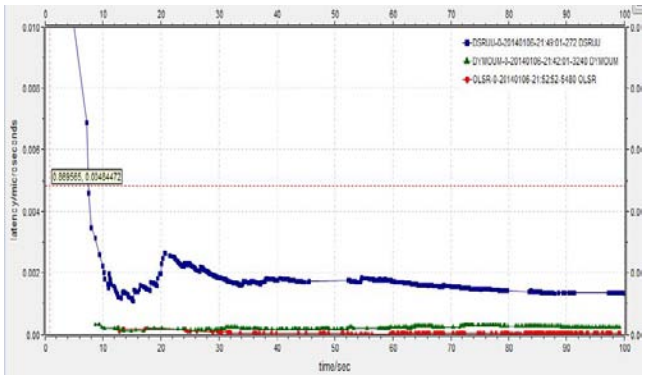

Figure 3 : (b) jitter at host #0 when nodes=20

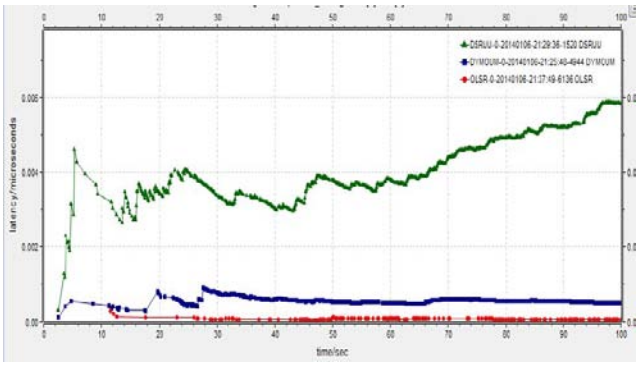

Figure 3 : (c) jitter at host #0 when nodes=30

Figure 3 (a,b,c) shows the graph generated from vector data during simulation. Initially it is shown that when no of nodes 10 then DSR protocol has value of jitter larger then OLSR and DYMO protocol. OLSR has minimum value of jitter approximately zero in comparison of others regardless no of nodes. OLSR is better in this case.

Now there has been made a comparison table for various parameters as shown below:

NO of nodes	Parameters	OLSR	DSR	DYMO
10	End to end delay	Low	high	Very high
	Throughput	Very high	high	high
	Jitter	Very low	high	low
	No of collisions	Low	high	high
	SNIR	Low	high	low
	Dropped packets by queue	Zero	high	zero

NO of nodes	Parameters	OLSR	DSR	DYMO
30	End to end delay	low	high	Very high
	Throughput	Very high	high	low
	Jitter	Very low	high	low
	No of collisions	low	Very high	high
	SNIR	Very low	Very high	high
	Dropped packets by queue	zero	high	zero

V. Conclusion

In this research paper, three protocols are evaluated such as OLSR, DYMO, DSR. The comparison has been made over a set of parameters increasing the no of nodes during each simulation. In conclusion, it has been shown that OLSR is better than DYMO and DSR routing protocol.

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