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RESEARCH ARTICLE

Frequency Hopping Based Performance Evaluation of TORA and OLSR Routing Protocols Using OPNET

Jonish[1], Kapil Chawla[2], Kuldeep Vats[3]

[1]M-Tech Department of CSE, SITM, Sonepat, Haryana, India

[2]Assistant Professor, Department of CSE, SITM, Sonepat, Haryana, India

[3]Department of CSE, Sonepat, Haryana, India

[1] sbit.cse08420@gmail.com; [2] life.kapil@gmail.com; [3] kuldeepvats@gmail.com

Abstract— In this paper analysis and performance of OLSR and TORA routing protocols is done. We used OPNET Simulation tool we created a network containing 50 mobile nodes with data rate 1 Mbps and 2 Mbps with transmission power 0.005 watts and buffer size 256000 bits each node moves randomly in the network and simulation time was 1500 sec. TORA and OLSR routing protocols were compared in terms of Traffic Received, Traffic Sent, Network Load, Retransmission Attempts and Throughput. According to the resulted performance OLSR performed better then TORA in both 1 Mbps and 2 Mbps

Keywords— TORA, OLSR, MANET, QOS, OPNET

I. INTRODUCTION

A Mobile Ad hoc Network is a dynamic self-configuring network formed by wireless nodes used as a temporary network without any intervention of centralized access points or base stations. MANET is a dynamic distributed network. Due to the dynamic nature the network topology keep changes randomly. The mobility of nodes in MANETs results in frequent changes of network topology making routing in MANETs a challenging task. Routing protocols in MANET helps node to send and receive packets. In this network, each node acts both as a router and as a host. These nodes like laptop, computers and wireless phones have a limited transmission range for direct transmission. The success of communication depends on cooperation of other nodes. [1]

One of the significant issues in data communication and performance of MANET is routing protocols. Hence, routing protocols required are to be effective and accurate so as to handle mobility of nodes and to give best utilization to MANET technology. MANET routing protocols are a standard that determines how

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nodes find the way to forward packets between devices in the network. In this paper performance of OLSR, TORA routing protocols is evaluated by using FTP application type of IEEE 802.11a/b/g WLAN Standard. [2]

TABLE I
IEEE 802.11 CLASSIFICATIONS

Standard	**IEEE 802.11a**	**IEEE 802.11b**	**IEEE802.11g**
Release	Sept 1999	Sept 1999	Jun 2003
Bandwidth(MHz)	20	20	20
Frequency(GHz)	0.5	2.4	2.4
Data Rate(Mbit/s)	6,9,12,18,24,36,48,54	5.5,11	6,9,12,18,24,36,48,54
Modulation	OFDM	DSSS	OFDM,DSSS

II. **RELATED WORK**

Anjali [1] analyzed the performance of AODV, OLSR and GRP routing protocols is evaluated for FTP based application traffic on IEEE 802.11 WLAN Standard and 48 Mbps data rate. The network performance is evaluated by using OPNET simulator based on various quantitative metrics- Network Load, Throughput, Retransmission Attempts and Media Access Delay by varying physical characteristics and number of nodes. A comparative performance analysis of these protocols have been carried out in this paper and in the last conclusion will be presented which demonstrate that performance of routing protocols differs by varying the network and selection of accurate routing protocol according to the network ultimately influences the efficiency of the network in a magnificent way.

Ravinder Ahuja [3] evaluated performance of three types of routing protocols (AODV, OLSR and ZRP) based on random waypoint mobility model. In this paper they analyze and compare the performance of protocols using Qualnet 4.5 from scalable network .These routing protocols were compared in terms of Packet delivery ratio, Average end-to end delay and Throughput when subjected to change in no. of nodes and pause time. Simulation results show that Reactive protocols better in terms of packet delivery ratio and throughput

Kuldeep vats [4] analyzed the performance of DSR, OLSR and GRP routing protocols. They used OPNET simulation tool. They created a network containing 150 mobile nodes with the data rate of 18 mbps and transmit power of 0.11 watts. Each node moves randomly within the network range 10,000 sq m and Simulation time was 1000 sec. According to their simulation result OLSR presented the best performance and GRP presented low to OLSR and high to DSR or finally DSR presented the low performance (DSR<GRP<OLSR) is analyzed.

III. **MANET ROUTING PROTOCOLS**

MANET has a number of routing protocols created to be implemented on it categorized in three different types according to the functionality

A. Proactive Protocols

Table-driven methods are also called Proactive methods which keep routes to all other nodes in the network also consider those nodes which does not received packets sent. Thus, the route is already

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available when a path to a particular destination is needed at a node and there is no extra delay due to route discovery. An example of Proactive Protocol is OLSR.

1) OLSR

OLSR is a Proactive or table driven, link-state routing protocol. Link-state routing algorithms selects best route by finding various characteristics like link load, delay, bandwidth etc. Link-state routes are more accurate, stable and reliable in calculating best route. Conceptually, OLSR contain three generic elements: a mechanism for neighbor sensing, efficient flooding of control traffic, and a specification of how to select and diffuse sufficient topological information in the network in order to prove optimal routes [5][6].

B. Reactive Protocols

Reactive Protocols are bandwidth efficient. Route is determined when a path is required by a node to forward packets. Therefore, overhead routing is decreased because search for the route is not required on which packet is not sent. TORA is an example of Reactive Protocol.

1) TORA

TORA is scalable and adaptive routing algorithm based on link reversal. It finds multiple routes from source to destination in a dynamic mobile networking environment. An important design concept of TORA is that control messages are localized to a small set of nodes nearby a topological change. Other routing algorithms such as LMR use two-pass whereas both DSR and AODV use three pass procedure. TORA achieves its single-pass procedure with the assumption that all the nodes have synchronized clocks (via GPS) to create a temporal order of topological change of events.

C. Hybrid Protocols

It combine characteristics of both pro-active and re-active routing in order to find effective and reliable routes, without large control overhead, by locally using pro-active routing and inter-locally using re-active routing. In this method communication in MANET is possible when nodes are near to each other and the supposition that changes in topology are only important if they happen in the vicinity of a node.

IV. **SIMLATION SETUP**

This research is conducted using software known as OPNET Modeler, Which is just one of several tools provided by the OPNET Technologies suite in order to undertake the experimental evaluation; the version named OPNET Modeler 14.5 has been adopted in our study [7]. OPNET is one of the most extensively used commercial simulators based on Microsoft Windows platform, which incorporates most of the MANET routing parameters compared to other commercial simulators available. It simulates the network graphically and gives the graphical structure of actual networks and network components.

TABLE II
SIMULATION PARAMETERS

Simulation Parameter	**Value**
Simulator	OPNET Modular 14.5
Area	1000*1000
Network Size	50 Nodes
Data Rate	1, 2 Mbps

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Mobility Model	Random way point
Traffic Type	FTP
Simulation Time	1500 sec
Address Mode	IPV4
Standerd	IEEE 802.11 Frequency Hopping
Routing Protocols	OLSR , TORA

TABLE III
OLSR PARAMETERS

Attribute	**Value**
Willingness	Default
Hello Interval(sec)	2.0
TC Interval(sec)	5.0
Neighbor Hold Time(Sec)	6.0
Topology Hold Time(Sec)	15.0
Duplicate Message Hold Time(Sec)	30.0
Addressing Mode	IPV4

TABLE IV
TORA PARAMETERS

Attribute	**Value**
Mode of Operation	On-Demand
OPT Transmit Interval(seconds)	400
IP Packet Discard Timeout(seconds)	20

Fig. 1 shows the simulation environment of scenario containing 50 WLAN mobile nodes, one fixed WLAN Server, Application definition, Profile definition and RX Group Config. We configure the nodes in the scenario to work with 1 Mbps and 2 Mbps.

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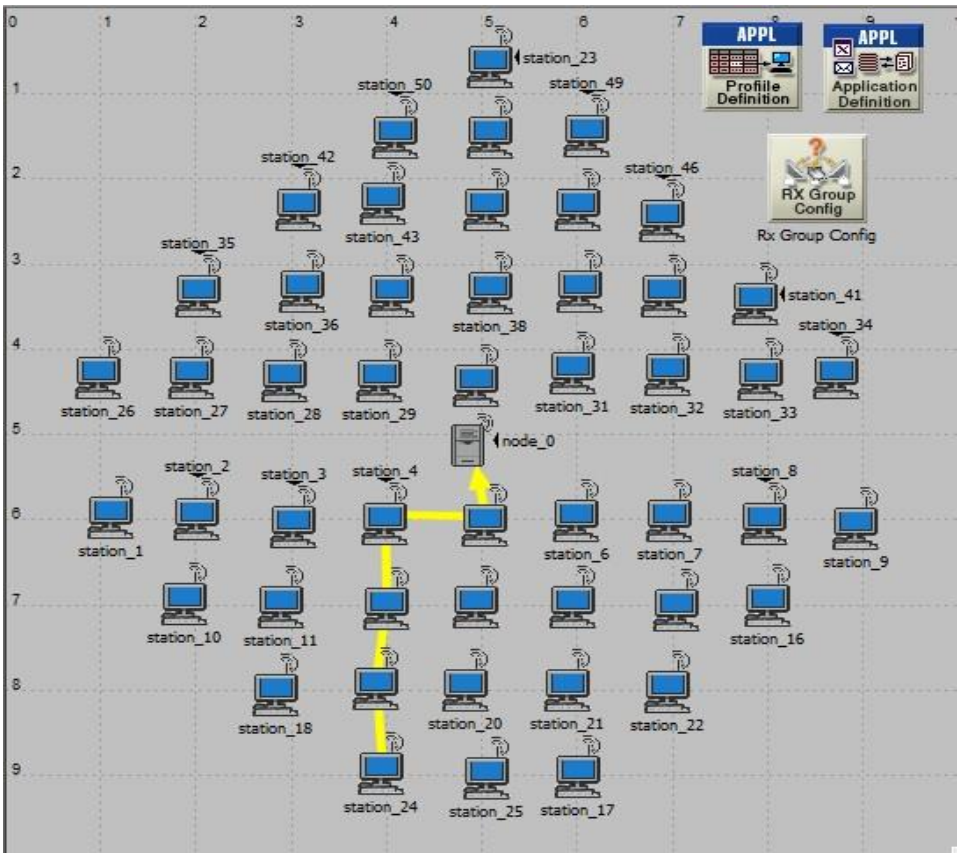

Fig. 1 Network Model for 50 Nodes scenario

V. **PERFORMANCE MERICS**

A. Traffic Received (bytes/sec)

Average bytes per second forwarded to all FTP applications by the transport layers in the network.

B. Traffic Sent (bytes/sec)

Average bytes per second submitted to the transport layers by all FTP applications in the network.

C. Network Load (bits/sec)

It represents the total load (in bits/sec) submitted to wireless LAN layers by all higher layers in all WLAN nodes of the network.

D. Retransmission Attempts (packets)

It is the total number of retransmission attempts by all WLAN MACs in the network until either packet is successfully transmitted or it is discarded as a result of reaching short or long retry limit.

E. Throughput (bits/sec)

It represents the total number of bits (in bits/sec) forwarded from wireless LAN layers to higher layers in all WLAN nodes of the network.

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VI. SIMULATION RESULTS AND ANALYSIS

Figure (2 - 6) below show Traffic Received, Traffic Sent, Network Load, Retransmission Attempts and throughput in 50 mobile nodes scenario for IEEE 802.11 standard at 1 Mbps and 2 MBPS data rate with TORA and OLSR respectively. The color scheme is showing the protocols behavior in different graphs which gives the average values. From these average values we will conclude the behavior of all these routing protocols.

A. Traffic Received (bytes/sec)

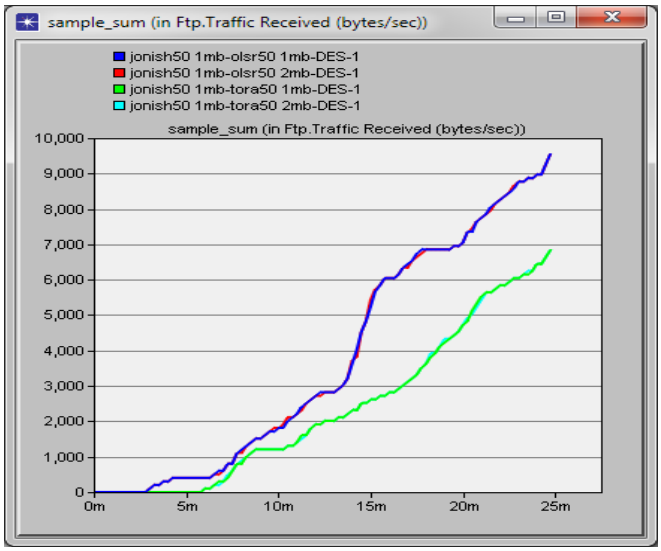

Fig. 2 Sample Sum for FTP Traffic Received in bytes/sec for OLSR and TORA in 1 and 2 Mbps

According to simulation, as we can see in Fig. 2, FTP Traffic Received in OLSR is higher than TORA in both the 1 Mbps and 2 Mbps and also OLSR don't have much difference in its 1 Mbps and 2 Mbps although TORA behaves exactly same for both 1 Mbps and 2 Mbps.

B. Traffic Sent (bytes/sec)

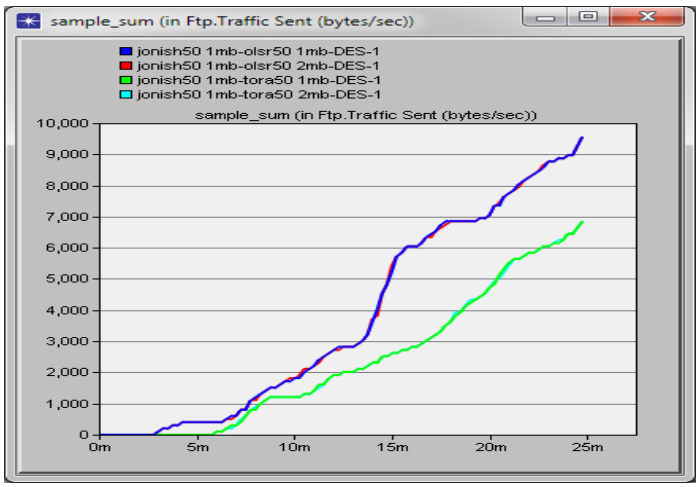

Fig. 3 Sample Sum for FTP Traffic Sent in bytes/sec for OLSR and TORA in 1 and 2 Mbps

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According to simulation, as we can see in Fig. 3, FTP Traffic Sent in OLSR is higher than TORA in both the 1 Mbps and 2 Mbps and also OLSR don't have much difference in its 1 Mbps and 2 Mbps although TORA behaves exactly same for both 1 Mbps and 2 Mbps.

And also we can see from Fig. 2 and Fig. 3 Traffic sent and Traffic Received don't have much difference for both OLSR and TORA in both 1 Mbps and 2 Mbps.

C. Network Load (bits/sec)

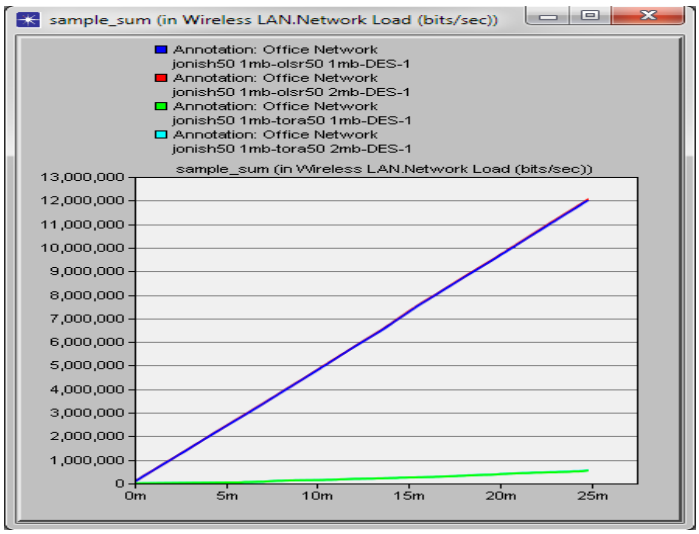

Fig. 4 Sample Sum for Wireless LAN Network Load in bits/sec for OLSR and TORA in 1 and 2 Mbps

According to simulation, as we can see in Fig. 4, Wireless LAN Network Load in OLSR is higher than TORA in both the 1 Mbps and 2 Mbps and also OLSR and TORA both behaves exactly same for 1 Mbps and 2 Mbps.

D. Retransmission Attempts (packets)

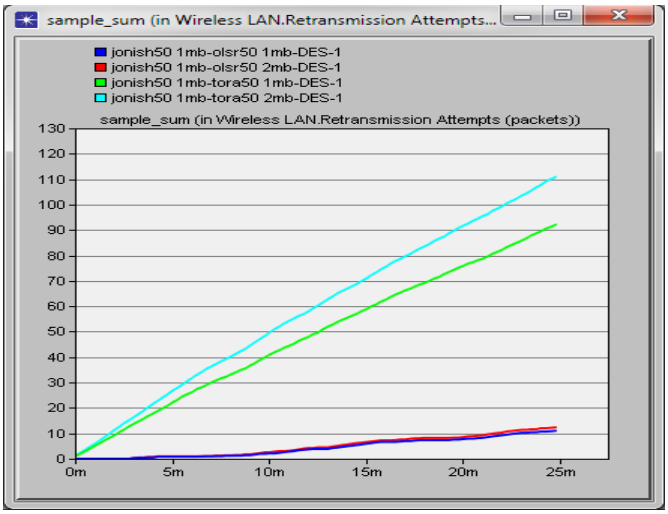

Fig. 5 Sample Sum for Wireless LAN Retransmission Attempts in packets for OLSR and TORA in 1 and 2 Mbps

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According to simulation, as we can see in Fig. 5, Wireless LAN Retransmission Attempts in TORA for 2 Mbps is highest of all it can be easily understood by the order which is TORA (2 MBPS) > TORA (1 Mbps) > OLSR (2 Mbps) >OLSR (1 Mbps) .

E. Throughput (bits/sec)

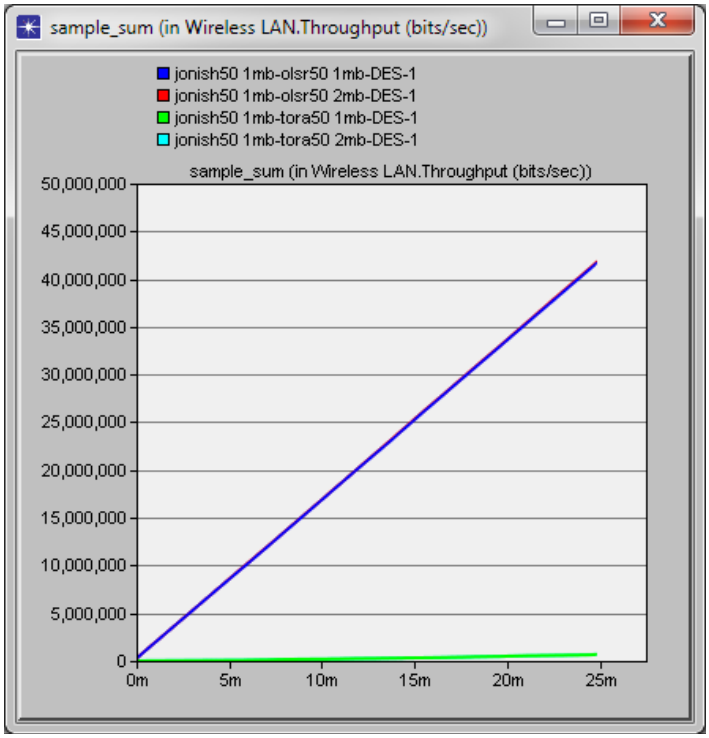

Fig. 6 Sample Sum for Wireless LAN Throughput in bytes/sec for OLSR and TORA in 1 and 2 Mbps

According to simulation, as we can see in Fig. 6, Wireless LAN Throughput in OLSR is higher than TORA and also OLSR and TORA both behaves exactly same in 1 Mbps and 2 Mbps.

VII. CONCLUSION

In this paper performance of OLSR and TORA is evaluated for metrics like Traffic Received, Traffic Sent, Network Load, Retransmission Attempts and Throughput by using 50 nodes scenario with IEEE 802.11 Frequency Hopping WLAN Standard in 1 Mbps and 2 Mbps. From the above discussion we find out that OLSR performs best in each case in terms of **Traffic Received, Traffic Sent, Network Load** and **Throughput**. In terms of **Retransmission Attempts** TORA is showing better results than OLSR for 50 nodes with both 1 Mbps and 2 Mbps.

TABLE 5
RESULTING VALUES

S. No.	Performance Metrics	OLSR (1 Mbps)	OLSR (2 Mbps)	TORA (1 Mbps)	TORA (2 Mbps)
1	Traffic Received	High	High	Low	Low
2	Traffic Sent	High	High	Low	Low

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3	NETWORK LOAD	HIGH	HIGH	LOW	LOW
4	RETRANSMISSION ATTEMPTS	LOWEST	LOW	HIGH	HIGHEST
5	THROUGHPUT	HIGH	HIGH	LOW	LOW

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