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PERFORMANCE COMPARISON OF OLSR AND STAR ROUTING PROTOCOLS IN MANETS USING RANDOM WAYPOINT MOBILITY MODEL

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ABSTRACT

The Mobile Ad-hoc Network (MANETs) is a dynamic network in which collection of mobile nodes forming a temporary network without any infrastructure, centralized access point, or central administration. It allows wireless nodes to communicate with each other in the absence of any centralized support. In this kind of scenario any node can move from place to another in an arbitrary manner and hence topology gets change very frequently. Because of this dynamic geographical arrangement the link instability and node mobility make routing a core issue in MANETs. Some appropriate routing mechanism is required to manage the successful deployment of MANETs. This paper presents the performance analysis of two proactive routing protocols OLSR and STAR. This simulation study was conducted by using the QualNet 5.0.2 simulator. Performance analysis of OLSR and AODV is evaluated on the basis of three performance metrics Average Jitter(s), Average-End-To-End Delay (s), and Throughput (bits/s). The simulation results clearly indicate that the OLSR routing protocol is clearly outperforms STAR routing protocol.

INTRODUCTION

A Mobile Ad Hoc Network (MANET) (Jun-Zhao Sun, 2001) consists of independent mobile nodes which communicate with each other. In MANETs all nodes are mobile and can be connected dynamically in an arbitrary manner with each other. Generally in this type of environment every participating node generates their own data packets and forwards to others i.e. every node act as terminal as well as router. With the latest technological advancement one can form small ad-hoc networks on campuses, during conferences, and even in our own home. However, the main applications of ad-hoc networks in rescue missions and in situations located in rough or underdeveloped territories. The availability of mobile nodes at an instant can increase or decrease due to mobility. The mobility is main cause of availability of paths at a particular moment which may vary in an Ad-hoc network time to time. So, the important thing is the connection between two nodes during communication or in another words we can say that the stability of paths.

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During a communication between any two nodes if connection exists than communication will not break down otherwise it needs to be re-established. That is why it is an important issue to find out the more stable and optimal path between two nodes. In MANETs route discovery, route establishment and route maintenance is the responsibility of routing protocols. We have conducted this simulation study using QualNet 5.0.2 simulator which allow us to analyze the performance of routing protocols in terms of Jitter of Data Packets, Packet Delivery Ratio, Average-End-To-End Delay and Throughput (Julian *et al*., 2003).

Routing Protocols

There are many routing protocols available for Ad-hoc networks such as AODV, CGSR, DSDV, DSR, DYMO, FSR, GSR, OLSR, STAR, TORA, WRP and ZRP etc. (Ashish K. Maurya *et al*., 2013). In this paper we study two routing protocols: OLSR and STAR and evaluated the performance of both routing protocol using three metrics namely Average Jitter(s), Average-End-To-End Delay(s), Throughput (bits/s).

OLSR

Optimized Link State Routing (OLSR) (Clausen and Jacquet, 2003 and Jacquet *et al*., 2000) protocol is an IP routing protocol. OLSR is a proactive routing protocol which uses hello and topology control (TC) messages to discover and then disseminate link state information throughout the ad-hoc network. As the name suggests, it uses the link-state scheme in an optimized manner to diffuse topology information. In OLSR the optimization is done on the basis of a technique called Multi Point Relaying (MPR). OLSR defines three basic types of control messages and these are:-

HELLO - HELLO messages are transmitted to all neighbors. These messages are used for neighbor sensing and MPR calculation.

TC - Topology Control messages are the link state signaling done by OLSR. This messaging is optimized in several ways using MPRs.

MID - Multiple Interface Declaration messages are transmitted by nodes running OLSR on more than one interface. These messages list all IP addresses used by a node.

The OLSR routing mechanism is shown in **figure-1**.

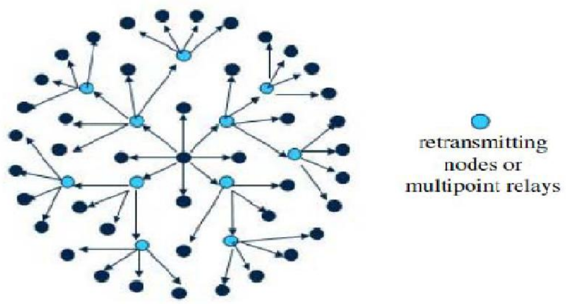

Figure 1. (OLSR Routing Mechanism)

STAR

STAR is a table-driven routing protocol. In STAR, a router sends updates to its neighbors regarding the links in its preferred paths to destinations. Each node discovers and maintains topology information of the network, and builds a shortest path tree (source tree) to store preferred paths to destinations (Garcia-Luna-Aceves and Spohn, 1999). In STAR, there are mainly two mechanisms follows in order to discover neighbors of the node. When a node receives a hello message from another node that it does not know previously, it discovers a new neighbor. If for a certain period a node does not receive any message from a neighbor it means this neighbor is broken or out of its range. STAR perfectly suits for large network as it has significantly reduced the bandwidth consumption for the routing updates. STAR can be used with distributed hierarchical routing schemes proposed in the past for both distance-vector and link state routing (Behrens and Garcia-Luna-Aceves, 1998 and Murthy and Garcia-Luna-Aceves, 1997).

Random Waypoint Mobility Model

RWP model is elementary synthetic model and it is often used in MANETs studies. The Random waypoint model was first proposed by Johnson and Maltz It is one of the most popular mobility model and the "benchmark" mobility model (Fan Bai and Ahmed Helmy, 2006) to evaluate other Mobile ad hoc network (MANET) routing protocols, because of its simplicity and wide availability. In the Random Waypoint model, Vmax and Tpause are the two key parameters that determine the mobility behavior of nodes. If the Vmax < Tpause, the topology of Ad Hoc network becomes relatively stable. On other hand if Vmax > Tpause, the topology is expected to be highly dynamic (Fan Bai and Ahmed Helmy, 2006). In this model, the node selects a random position, moves towards a straight line at a constant speed that is randomly selected from a range, and pauses at that destination. This approach is followed by nodes throughout the simulation process (Bettstetter *et al*., 2003 and Singh *et al*., 2011).

MATERIALS AND METHODS

Simulation Environment

We have used the QualNet 5.0.2 simulator in the analysis. QualNet5.0.2 is a network simulator widely used to model the wired and wireless network. We can predict the behavior and

Table 1.

Parameters	Values
Routing Protocols	OLSR, STAR
No. of Nodes	50
Node Placement Strategy	Random
Seed Value	5
Terrain Size	1500 X 1500
Radio Type	802.11b
Mobility Model	Random Way Point
Shadowing Model	Constant
Fading Model	Rayleigh
Speed(Min, Max)	(0, 30)
Channel Frequency	2.4 GHZ
Application Layer Traffic Source	CBR Traffic (3 Connections)
Data link Layer	802.11f
Antenna Model	Omni-Directional Antenna
Simulation Time	120 second
Pause Time	30 second

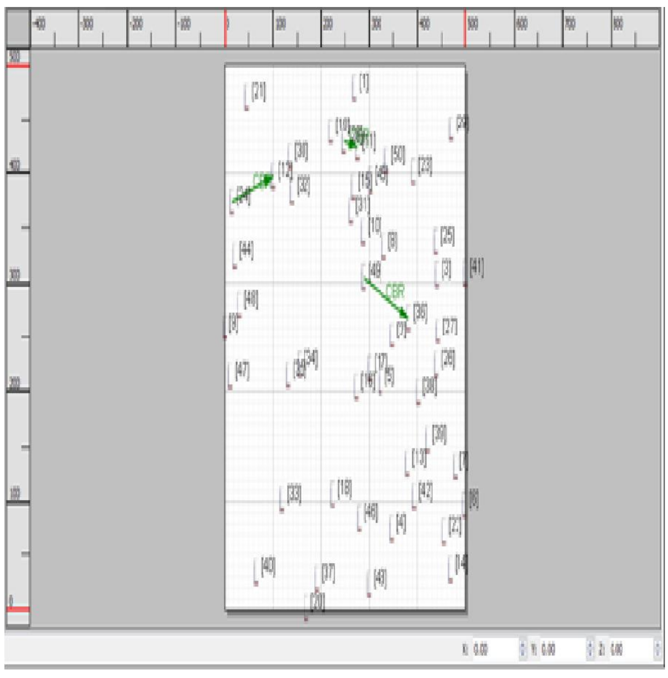

Figure 2.

performance of the networks to improve the design, operation and management using the QualNet5.0.2 simulator. We have considered a 50 nodes scenario which is randomly deployed over the deployment region. QualNet 5.0.2 network simulator is used to conduct the simulation of the above mention protocols. We have considered a deployment area of 1500m X 1500m with 50 randomly distributed nodes with Random Waypoint (RWP) node mobility models. In the scenario the User Datagram Protocol (UDP) is used as the transport layer protocol and Constant Bit Rate (CBR) data traffic is applied between 3 different source destination pairs. These pairs are namely (24, 12), (28, 11) and (49, 36) respectively as depicted in **figure-2**. The **Table-1** represents the list of the different simulation parameters considered in this study.

View of Simulator Scenario

The **Figure-2** shows the node placement scenarios for the OLSR and STAR routing protocols. The random node deployment strategy is followed in node placement.

Animation View of Scenario

The **figure-3** indicates the animated simulation view of the 50 nodes with 3 CBR connections:

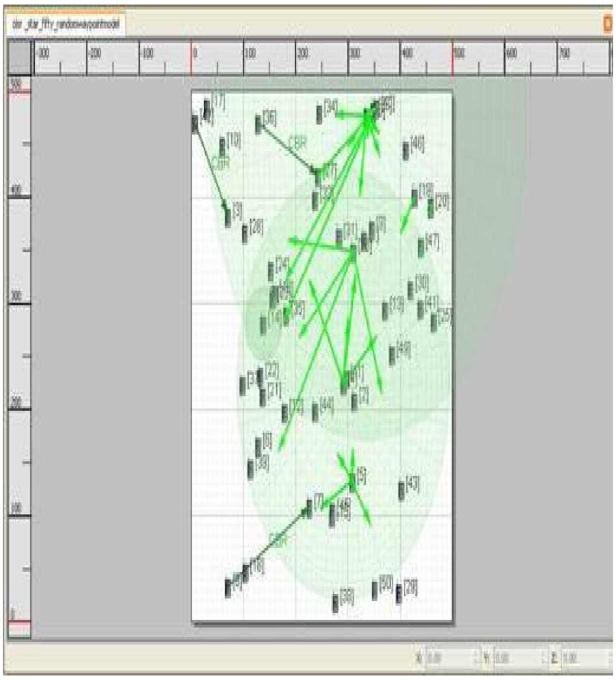

Figure 3.

RESULTS AND DISCUSSIONS

The both proactive routing protocols comparison carried out by using the three metrics. These metrics are Average Jitter, Average End-To-End Delay, and Throughput. The performance of these metrics and graphical view is given below.

Average Jitter

Jitter is the variation in the time between packets arriving, caused by network congestion, timing drift, or route changes. Jitter should be small for a routing protocol to perform better. The variation of average jitter of OLSR and STAR routing protocols with respect to node density 50 nodes is given in **figure-4** OLSR indicates the least average jitter in 50 nodes scenarios for mobile ad-hoc network as compared to STAR protocol. OLSR performs better in comparison of STAR with the value of 0.00715626 and 0.0087288 respectively.

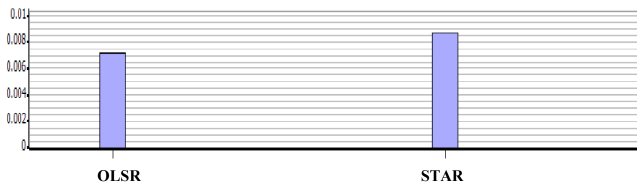

Figure 4. CBR (Server): Average Jitter (s) Vs Node of Routing Protocols

Average End-to-End Delay

The delay of the packet is the time it takes the packet to achieve the destination after it leaves the source. **Figure-5** shows the variation of average-end-to-end delay of OLSR and STAR routing protocols. The simulation result is indicated that the average end-to-end delay is more for STAR protocol in comparison to OLSR protocol with the value 0.127594 and 0.065354 respectively. The end-to-end delay of OLSR is less because it has reduced routing overhead and queuing delay thus it has less delay than the STAR.

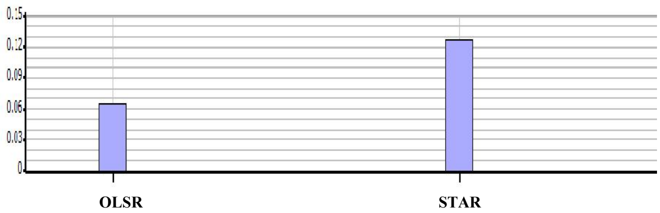

Figure 5. CBR (Server): Average End-to-End Delay (s) Vs Node of Routing Protocol

Received Throughput

Throughput is the ratio of successfully transmitted data per second. The throughput is analyzed with 3 CBR connections. The variation of throughput of OLSR and STAR routing protocols with respect to node density 50 nodes is showing in the following **figure-6**. According to our simulation results STAR protocols indicates the least throughput in 50 nodes scenario for mobile ad-hoc network as compared to OLSR protocol. OLSR protocol with throughput 163780(bits/s) outperforms STAR protocol with the throughput 163370(bits/s).

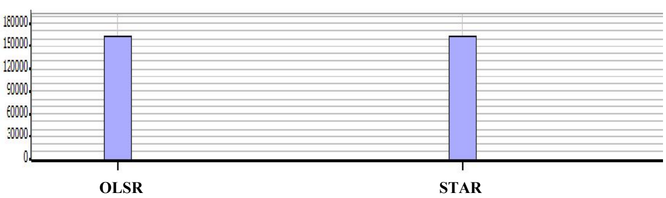

Figure-6 CBR (Server): Throughput (bits/s) Vs Node of Routing Protocols

Conclusion

In this paper, a performance comparison of two proactive routing protocols namely OLSR, STAR for 50 mobile nodes with CBR traffic (3 connections) and Random waypoint mobility model using QualNet 5.0.2 network simulator is presented. We have analyzed the performance of OLSR and STAR routing protocols on the basis of three performance matrices such as Average Jitter (s), Average End-to-End Delay (s), and Throughput (bits/s). From the above discussion it is clear that the OLSR routing protocol gives the better performance in comparison of STAR routing protocol in case of Average Jitter (s), Average End-to-End Delay (s), and Throughput (bits/s).

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