RWP Mobility Model Based Performance Evaluation of DSR, Dymo and FSR in Manet

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ABSTRACT
This paper aims to compare some routing protocols in Mobile ad-hoc network (MANET). A MANET is a dynamic network in which collection of mobile nodes forms a temporary network without using any existing centralized administration or fixed infrastructure. The availability of routes at an instant can increase or decrease due to mobility of nodes. Therefore, the path availability and stability of routes at an instance is an issue in an Ad-hoc network. To support these types of issue in MANET, many routing protocols are designed, such as AODV, DSR, DSDV, FSR, DYMO, LAR etc. In this paper, we analyzed three different types of routing protocols: DSR, DYMO and FSR using QualNet 5.0.2 simulator. Several simulations were conducted in different traffic patterns (CBR and FTP) to analyze the performance of these routing protocols on the basis of performance matrices such as end-to-end dealy, jitter and throughput.

Introduction

A MANET is a collection of wireless mobile nodes that dynamically establishes the network in the absence of fixed infrastructure [1].Minimal configuration, quick deployment and absence of a central governing authority make ad hoc networks suitable for emergency situations like natural disasters, military conflicts, emergency medical situations etc. [2,3]. The MANETs are very prone to link failure due to mobility of nodes and highly dynamic environment and as result the identification of optimal path between any source node to destined node is crucial. Routing in MANETs is a challenging task as topology is not fixed and it changes very frequently. That is why routing in the MANETs has earned a big amount of focus from researchers and scholars.

In MANETs movement of a node from one place to another characterize mobility, thus mobility is directly responsible for the link failure. Mobility is an important factor for MANETs and it plays a vital role in routing protocols evaluation. In one case in MANETs nodes may move in high speed or in a low pause time, but in same direction without changing topology. In another case, nodes may have a low speed or a high pause time, but they move away from each other, by indicating important topological changes. This is the main weakness of mobility in MANETs. The accurate definition of mobility was proposed by Larsson and Hedman [4], which is based on relative nodes movement, and represents the mobility by considering a parameter known as mobility factor (mob) which depends on speed and movement pattern (directions). Under the mobility modeling, the behavior or activity of a user's movement can be described using both analytical and simulation models. Simulation models consider more detailed and realistic mobility scenarios. Such models are useful to drive reliable solutions for complex problems. Some of the mobility models are random waypoint mobility model, random point group mobility model, Manhattan mobility model, random Gauss-Markov mobility model, free way mobility model, random walk mobility model, random direction mobility model, and Markovian mobility model. The random waypoint model has been widely used in performance comparison studies of routing protocols.

Routing is the exchange of information (packets) between two nodes. The major goals of routing are to discover and maintain routes between source to destination in a dynamic topology with discovered link and by using minimum resources. The routing protocol presents the mechanism which reduces route loops and confirms trustworthy message exchange [5]. In the past years, there has been a significant amount of research going on in this area. [6,7,8]. In general, the functions of a routing protocol can be summarized as follows:

The main functions of a routing protocol are as follows:
i.**Path Generation**: In this path is generated from scattered environment of network. There are multiple path generated from sender to destination.
ii.**Path Selection**: In the previous phase, there were multiple path and from them suitable path are chosen for data transmission so that time, memory and overhead will be less and performance is better.
iii.**Data transmission**: In this data is transmitted from sender to destination on that selected path.
iv. **Path Maintenance**: The suitable path must have to maintain using control messages like "Hello". If the link is broken and not active then using hello messages, maintenance of the route is done.

There are many ways to classify the MANETs routing protocols depending on packet delivery mechanism from source to destination such as unicast routing, multicast routing and broad cast routing. In general routing protocols are broadly classified into three types such as proactive, reactive and hybrid protocols [9].
(i) Proactive Protocols: These types of protocols are table driven protocols in which, the routes are consistent and up-to-

date the routing information to all nodes. Packets are transferred over the available route specified in the routing table. Proactive protocols have lower latency because all available routes are maintained at all times for all available nodes. Some of the proactive routing protocols are DSDV, OLSR, WRP, FSR, and STAR.

(ii) **Reactive Protocols**: These types of protocols are also known as on demand routing protocols where routes are not maintained before transferring the packets for routing. When a source wants to send information to a destination, it invokes the route discovery mechanisms to find the path to the destination. This route discovery is done by flooding mechanism, in which a source node just broadcasts the packet to all of its neighboring and intermediate nodes and forward that packet to their neighbors until it reaches to the destination. Reactive techniques have smaller routing overheads because of no prior routing information requirement, but higher latency. The Reactive Protocols are much suited and perform better for Ad hoc networks. Some of the Reactive Routing Protocols are: DSR, AODV, LAR, and DYMO.

(iii) **Hybrid Protocols**: Hybrid protocols comprises the features of both reactive and proactive routing protocols and take the advantages of both protocols which results in quick routes discovery in the routing zone. Some of the Hybrid Routing Protocols are: ZRP, and TORA.

In MANET, node mobility and collision (due to interference), are two major factors [10] leading to route/link errors. Through the present study, the authors are trying to analyze the performance of DSR, DYMO and FSR routing protocols in CBR and FTP traffic patterns under random waypoint mobility model in MANET.

The structure of this paper is as follows: Section 1 discusses the introduction about the conceptual framework and Section 2 discusses about the previous work in this area. In Sect. 3 we present the brief concept about random waypoint mobility model. Section 4 provides some guidelines about simulation environment. Section 5 spresents simulation results and analysis including some concluding remarks. In section we have given animation view of this simulation study.

Fisheye State Routing (FSR)

FSR is an implicit hierarchical routing protocol [11] and it is the next generation technology of Global State Routing strategy(GSR) [12]. It uses the 'fisheye' technique proposed by Klein rock and Stevens. FSR maintains Entries of nearby nodes in the routing table are updated and exchanged with neighbours more frequently as an strategy for reducing the update message size. As the eye of a fish captures more accurate and detailed pixels for the all locations which is near to the focal point. The detail relegate as per the distance variation from its focal point. In routing scheme, this approach translates to maintain accurate distance and path quality in sequence about the neighborhood of a node [13].

Dynamic MANET On-demand Routing Protocol (DYMO)

Dymo It is a successor protocol for AODV. It has the combine features of AODV and DSR routing protocols. DYMO has two main operations, route discovery and route preservation just like in AODV[14]. During route discovery, the source node broadcast a RREQ message throught the network to find the suitable route. Throughout this procedure each in among nodes records a route to the source node and rebroadcast the RREQ after appending its own address. When the destination node receives the RREQ, it responds with RREP to the resource node. Each intermediate node that receives the RREP records a route to the principle node [15]. When the basis node receives RREP

message, the route is established between the source node and the destination node. When a link break, the source of the packet is notified RERR message is send to the sender node like acknowledgement.

Dynamic Source Routing (DSR)

DSR is a routing protocol for wireless mesh networks [16]. DSR routing protocol is quite similar in characteristic with AODV. DSR protocol works on the basis of source routing. The protocol can work with cellular telephone systems and mobile networks with up to about 200 nodes. In DSR, each source determines the route to transmitting its packets to selected destinations. DSR perform mainly two functions, called route discovery and route maintenance. Route discovery find out an optimum path for a transmission between a source and destined node. Route maintenance ensures that the transmission path remains optimum and loop-free as network conditions change, even if this requires changing the route during a transmission.

Literature review

Many researchers have studied and analyzed various ad-hoc routing protocols through dissimilar simulators by using various performance matrices.

Arun K et al., [17] have done a simulation study and compared the performance of AODV, DSDV, DSR and OLSR routing protocols for mobile Ad hoc network. In the study they have found that AODV and DSR performed well in high mobility scenarios than DSDV and OLSR. Maashri AA and Khaoua MO, [18] analyzed the performance of three commonly investigated MANET routing protocols, namely DSR, AODV and OLSR in self-similar traffic. The simulation outcomes indicated that DSR outperforms to AODV and OLSR. On the other hand OLSR performed poorly in the presence of self-similar traffic. However result of AODV shows an average performance that is almost stable. Dimitra K and Anastasios AE, [19] have evaluated the performance of AODV, DSR and OLSR routing protocols with FTP traffic pattern. The simulation results of this study indicated that overall OLSR out perform AODV and DSR and they also observed that the type of traffic in the network has a significant impact on the performance of protocols under investigation. A simulation study was conducted by Djenouri D et al., [20] on GloMoSim simulator and investigated the effects of mobility on the performance of ABR, AODV, DSR, LAR, FSR, and WRP protocols. It was shown that mobility in MANETs has negative effects. They investigated that the performance of the proactive protocols goes down when the change in topology occur in the network. Uma M, and Padmavathi VG,[21] have compared AODV, DSR and LAR1. The tremendous improvements have been observed for LAR1 than in the AODV and DSR. Simulation result indicated that LAR1 outperforms AODV and DSR. Yaseer HK et al., [22] have simulated DSDV, AODV, and DSR routing protocols with different node movement speeds and they observed that there is no clear winner among AODV, DSR, and DSDV. Deepa S and Kadhar NDM, [23] have evaluated DSDV, DSR and AODV in different mobility and node density. In the study, from the simulation results they have analyzed that the AODV protocol was affected too much by mobility and network density in compare of DSDV and DSR. Anuj KG et al.,[24] have simulated the AODV, DSR, DSDV and OLSR routing protocols with different mobility models and indicated that the performance ranking of AODV, DSR, DSDV and OLSR changes with the use mobility models. Hamma S et al., [25] have evaluated the performance of DSR, AODV, and OLSR routing protocols for Ad hoc network and observed that OLSR offers better performance for CBR traffic while there is no clear winner

among DSR and AODV. An earlier protocol performance evaluation was carried out by Guangyu Pei et. al.[26], they have compare AODV, FSR, DYMO, STAR, RIP, Bellman Ford, LANMAR and LAR. This study simulation results show that AODV, DYMO and Bellman Ford protocols are showing higher end-to-end delays than other protocols while LANMAR and RIP shows the condiderable delay in scaled-up environment. Surbhi Sharma, Himanshu Sharma [27], "Performance Comparison of AODV, DSR, DYMO and ANODR using QUALNET simulator" This paper presents the effect of node density on the performance of four reactive routing protocols . Parma Nand ,S C Sharma [28] , "Traffic Load based Performance Analysis of DSR, STAR & AODV Adhoc Routing Protocol" In this paper table driven protocol STAR and on demand routing protocol AODV, DSR based on IEEE 802.11 are surveyed .

Random waypoint mobility model

Random waypoint model is versatile, it can be used to describe the movement patterns of mobile users , their location, velocity and acceleration change over time. In this model, the node selects a random position, moves towards it in a straight line at a constant speed selected randomly from a range, and pauses at that destination. This process is repeated by the node throughout the simulation time [29].

Simulation Environment

The performance evaluation of one proactive routing protocol FSR and two reactive routing protocols DSR,and DYMO were conducted through the simulation. To conduct the simulation various parameters such as node, mobility rate, traffic patterns and random waypoint mobility model used. We have performed simulations on QualNet 5.0.2 simulator [30] and performance of DSR, DYMO and FSR routing protocols are evaluated for 30 nodes in 600 m X 600 m terrian size scenario with CBR and FTP traffic patterns (3 connction each). Performance of routing protocols are compared as on the basis performance matrices such as average end-to-end delay, average jitter and average throughput. Simulation were conducted for the 200 seconds with 4000 packets and packet size of 2048.

Simulation results and analysis

The performance comparison of DSR, DYMO and FSR routing protocols using random waypoint mobility model for 30 nodes scenario under speed (0, 10) is presented. The simulation results for DSR, DYMO and FSR routing protocols are as follows:

i. Average End-to-End Delay(s)

The average end-to-end delay of DYMO routing protocol is least in comparison of DSR and FSR routing protocols. However, the average end-to-end delay is higher for DSR routing protocols in comparison of DYMO and FSR routing protocols. The simulation results for average end-to-end delay is shown in table 1 and figure 1.

Table 1. Average Jitter, and Average End-to-End Delay for DSR, DYMO and FSR routing protocols

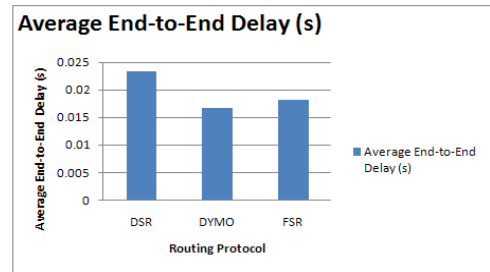| Protocol	Average Jitter (s)	Average End-to-End Delay (s)
DSR	0.00916284	0.023368
DYMO	0.00740851	0.016842
FSR	0.0118188	0.0182156

Figure 1. Average End-to-End Delay of DSR, DYMO and FSR routing protocols

i. Average Jitter(s):

The average jitter is least for DYMO routing protocol than that of DSR and FSR. The FSR routing protocol indicated the higher jitter than that of DSR and DYMO. The simulation results for average jitter is shown in table 1 and figure 2.
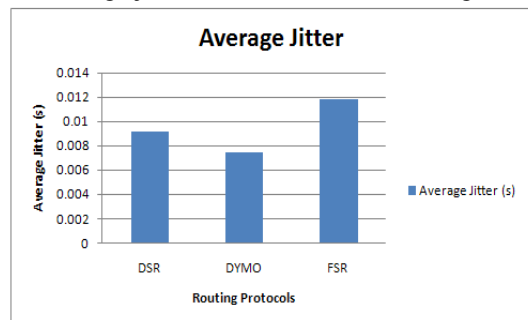

Figure 2. Average Jitter of DSR, DYMO and FSR routing protocols

i. Throughput Analysis

The simulation results are clearly indicating that the overall performance of FSR routing protocol is better as compared to DSR and DYMO routing protocols under the FTP traffic (see figure 4). At the same time, the performance of DYMO routing protocol is quite satisfactory in comparison of DSR routing protocol. Further more, DSR routing protocol clearly outperform DYMO and FSR in case of CBR traffic (see figure 3). The simulation results for average throughput is shown in table 3, graphical representation for DSR, DYMO and FSR with FTP traffic is shown in figure 4 and graphical representation for DSR, DYMO and FSR with CBR traffic is shown in figure 3 and. The comparative results of DSR, DYMO and FSR with CBR, and FTP traffic is graphically represented in figure 5.

Table 2. Throughput for DSR, DYMO and FSR routing protocols under CBR and FTP traffic pattern

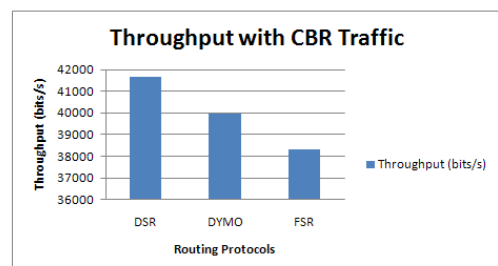| Protocol	Throughput (bits/s)	
	FTP Traffic	CBR Traffic
DSR	179517	41723.7
DYMO	201380	40007
FSR	229597	38333.3

Figure 3. Average Throughput of DSR, DYMO and FSR routing protocols with CBR traffic pattern
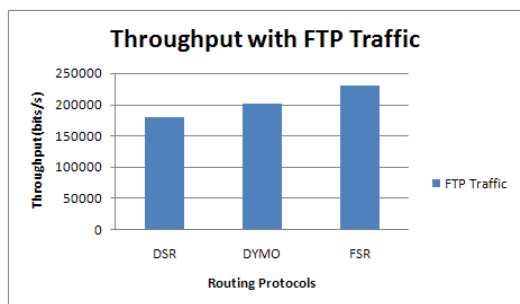
Figure 4. Average Throughput of DSR, DYMO and FSR routing protocols with FTP traffic pattern
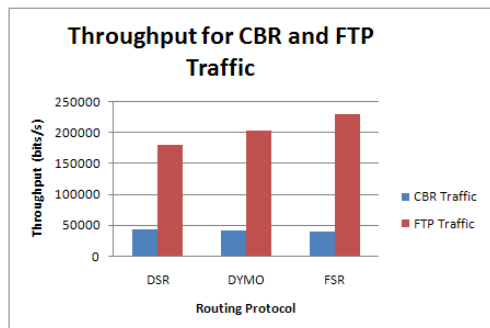

Figure 5. Comparison of Average Throughput for DSR, DYMO and FSR routing protocols with CBR and FTP traffic pattern

Conclusion

Given the simulation results and above discussion, it is obvious that the performance of FSR, DSR, and DYMO routing protocols is degrading under the CBR traffic pattern in comparison of FTP traffic pattern. The DSR routing protocol outperform DYMO and FSR in case of CBR traffic while FSR outperform in case of FTP traffic. However, the DYMO routing protocol gives the quite satisfactory results for average-end-to-end delay and average jitter rate in comparison of DSR and FSR routing protocols. Therefore, it can be concluded that traffic pattern have the significant effect on the performance of routing protocols.

Animation View

Animation view of simulation scenario for the performance comparison of DSR, DYMO and FSR is given in the figure 6.
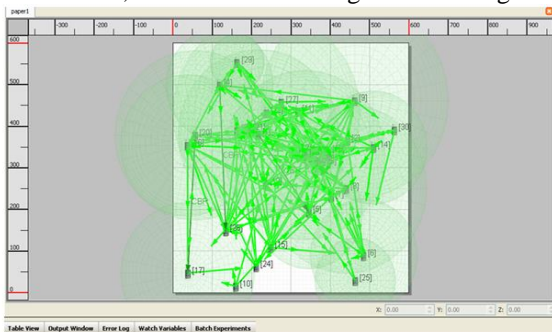
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