Performance Evaluation of Mobile Ad-hoc Network Protocols

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Abstract

Mobile Ad-Hoc networks are highly dynamic networks characterized by the absence of physical infrastructure. Nodes of these networks functions as a routers which discovers and maintains the routes to other nodes in the network. In such networks, nodes are able to move and synchronize with their neighbors. Due to mobility, connections in the network can change dynamically and nodes can be added and removed at any time. Each node operates not only as an end system, but also as a router to forward packets. The nodes are free to move about and organize themselves into a network. These nodes change position frequently. The main classes of routing protocols are Proactive, Reactive and Hybrid. This article addresses issues pertaining to three different routing protocols Destination Sequenced Distance vector (DSDV) and Dynamic Source Routing (DSR) protocols, Ad hoc On Demand Distance Vector (AODV) which is used for efficient routing under different scenarios in Mobile Ad-hoc Network (MANET), which plays a critical role in places where wired network are neither available nor economical to deploy.

Mobile ad-hoc networks have gained a lot of importance in wireless communications. Wireless communication is established by nodes acting as routers and transferring packets from one to another in ad-hoc networks. Routing in these networks is highly complex due to moving nodes and hence many protocols have been developed. This research work concentrate mainly on routing protocols and their functionality in Mobile Ad-hoc networks with a discussion being made on three selected protocols DSDV, DSR and AODV with their comparison.

Keywords: *mobile ad-hoc network, MANET, protocol, packet loss, throuthput, DSR, AODV, DSDV.*

1. Introduction

In recent years, mobile computing has enjoyed a huge increase in popularity [1]. The continued miniaturization of mobile computing devices and the exponential growth of processing power which is available in mobile computers involve more and better computer-based applications. At the same time, the markets for wireless telephones and communication devices are experiencing rapid growth. It is well known that nowadays there are more than a billion wireless communication devices in use, and more than 200 million wireless telephone handsets have been purchased annually. The rise of wireless telephony will change what it means to be "in touch". The purpose of this research is to investigate and determine how to best support a challenging mobile ad hoc network (MANET) wireless environment through improved routing strategies and quality of service enhancements; and to accomplish this with minimized routing overhead and efficient use of network resources. This research work will introduce the benefits of ad hoc networking, describe the characteristics of MANETs and identify the challenges faced when implementing routing schemes in support of MANETs. MANET protocols must perform the same functions of their wired counterparts but also perform functions specifically related to the MANET challenges. We describe these functions so that we have a better understanding of how our routing strategy would meet the demands of a MANET. The environment in which a MANET is placed has a significant impact on the success of the routing strategy. Therefore, we chose to base our concepts and analysis on the assumption that we must support what is arguably the most demanding MANET environment, a tactical military environment. We analyze the performance of existing routing protocols, DSDV, DSR and AODV, using the ns-2 network simulator. We turned our efforts toward subsequent analysis of transport layer protocols, fairness and congestion to analyze this unsatisfactory performance in an effort to understand the underlying causes. We find, as a result, that it is not the accuracy and efficiency of routing protocols that affect the true measures of performance such as throughput or utilization.Yet today such obvious communication requirements cannot be easily met using Internet protocols [2].

Nowadays wireless mobile nodes are becoming more and more capable and have improved a lot over those available in the past. But mobile nodes and their applications will become indispensable at the places where necessary infrastructure is not available. Ad hoc networks are the future of existing networks, where all the wireless mobile devices will be capable to communicate with each other in the absence of infrastructure. Ad hoc network allows all wireless devices within range of each other without involving any central access point and administration. Routing protocols are challenging to design as performance degrades with the growth of number of nodes in the environment and a large ad hoc network is difficult to manage. Proactive protocol DSDV is considered to be a traditional protocol which finds routes between all source – destination pairs regardless of the use or need for such routes. The key motivation behind the development of reactive routing protocols like DSR and AODV is the reduction of routing load. There will be impact on performance for low bandwidth wireless link if high routing load is there. There are many simulation study has been done so far for the routing protocols. This paper has been organized as follows: In the following section we briefly review the three protocols DSDV, DSR and AODV. Then we described the performance metrics on the basis of which we compared the protocols. Next to this a simulation model has been explained on which basis results are obtained and graphs are generated to compare and analyze the results with the help of performance metrics. we have presented the simulation based comparative performance analysis of routing protocols DSR, AODV (Reactive) and DSDV (Proactive) and finally concluded which protocol is better under certain traffic conditions and scenarios.

However, in future MANETs are expected to be used in various applications with diverse topography and node configuration. Widely varying mobility characteristics are expected to have a significant impact on the performance of the routing protocols like DSR and DSDV. The overall performance of any wireless protocol depends on the duration of interconnections between any two nodes transferring data as well on the duration of interconnections between nodes of a data path containing n-nodes[5]. We will call these parameters averaged over entire network as "Average Connected Paths".

Relationship between protocol performance and mobility model. The mobility of the nodes affects the number of average connected paths, which in turn affect the performance of the routing algorithm.[4] We have also studied the impact of node density on routing performance. With very sparsely populated network the number of possible connection between any two nodes is very less and hence the performance is poor. It is expected that if the node density is increased the throughput of the network shall increase, but beyond a certain level if density is increased the performance degrades in some protocol. We have also studied the effect of number of hops on the protocol performance [3].

Objective

The Objective of this research work is to evaluate three of the proposed routing protocols namely, AODV and DSR, DSDV, for wireless ad-hoc networks based on performance. This evaluation should be done theoretically and through simulation. The Objective of this research work is to assess the relative performance of routing protocols for the considered mobile ad-hoc network and to identify their performance challenges. The outcome for this study is in the form of quantitative results of efficiency of the routing protocols with reference to performance metrics. These results can be used as baseline for selecting routing protocols in a variety of situations. The ad hoc routing protocols DSDV and DSR, AODV are three of the promising routing protocols. They can be used in mobile ad hoc networks to rout packets between mobile nodes. The main objectives of this research work are:

(1) To explore different classifications of routing protocols in Ad-hoc networks and their mobility features. Furthermore, to identify the performance challenges for routing protocols in such networks.

(2) Implementing& analyze the existing DSDV and DSR, AODV routing protocols in ns2

(3) Comparison regarding performance of different routing protocols for the same set of performance metrics in mobile nodes network. For this purpose tabulated results are shown. This comparison helps to see which routing protocol performs best in mobile nodes network.

(4) Comparing the performance of three protocols under following metrics

(i) Packets loss
(ii) Average Delay
(iii) Throughput

Simulation of DSDV, DSR and AODV

Our aim here to implement DSDV and DSR, AODV routing protocol for some nodes sending cbr packets with random speed. First the cbr files and scenario files are generated and then using dsdv protocol simulation is done which gives the nam file and trace file. Then another nam and Trace files are created dsr protocol. For each execution of the same program different nam files are created and we can view the output on the network simulator.

We have taken two On-demand (Reactive) routing protocols, namely Ad hoc On-Demand Distance Vector Routing (AODV) and Dynamic Source Routing (DSR). The mobility model used is Random waypoint mobility model because it models the random movement of the mobile nodes. For all the simulations, the same movement models were used, the number of traffic sources was fixed at 10, and the maximum speed of the nodes was set to 20m /s

Performance Comparison of the protocols

First, an attempt was made to compare all the 3 protocols under the same simulation environment. For the simulations, same random movement models were used, the simulation environment consisted of a 500m x 400m region where nodes were randomly moving with a constant

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average speed. The nodes are equipped with Omni-directional antennas. The simulation end time is set to be at 10 with a single TCP connection established between only two nodes.

(1) DSDV Protocol (No. of Node Vs Throughput)

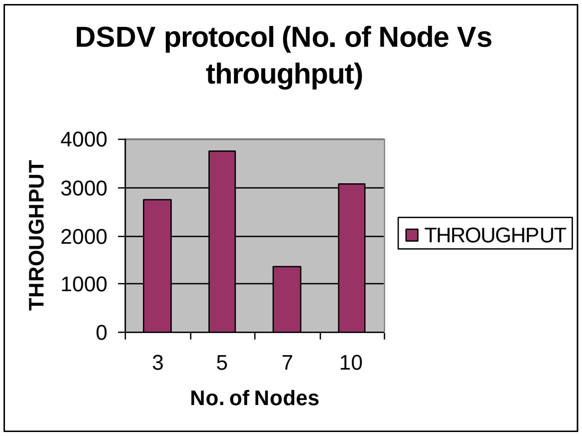

Fig 1 DSDV Protocol (No. of Node Vs Throughput)

(2) AODV Protocol (No. of Node Vs Throughput)

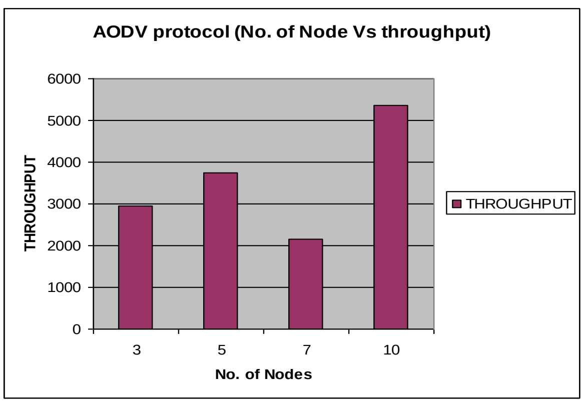

Fig 2 AODV Protocol (No. of Node Vs Throughput)

(3) DSR Protocol (No. of Node Vs Throughput)

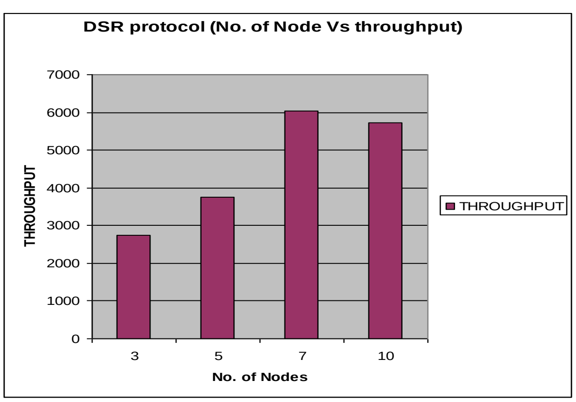

Fig 3 DSR Protocol (No. of Node Vs Throughput)

(4) DSDV Protocol (No. of Node Vs Delay)

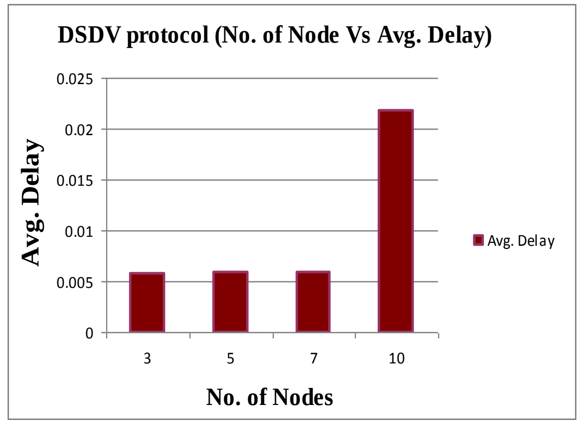

Fig 4 DSDV Protocol (No. of Node Vs Delay)

(5)AODV Protocol (No. of Node Vs Delay)

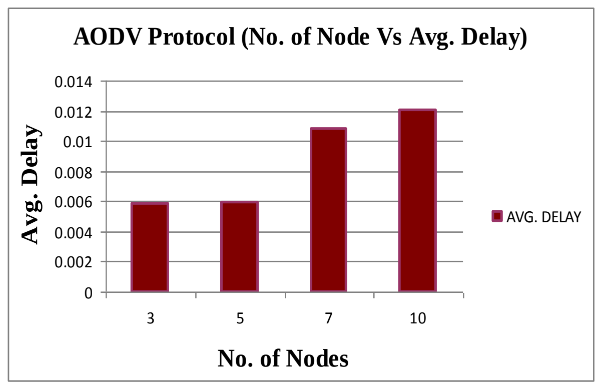

Fig 5 AODV Protocol (No. of Node Vs Delay)

(6) DSR Protocol (No. of Node Vs Delay)

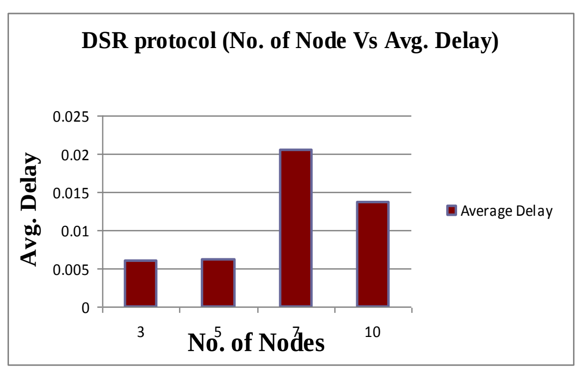

Fig 6 DSR Protocol (No. of Node Vs Delay)

(7) Throughput Vs No. of Node

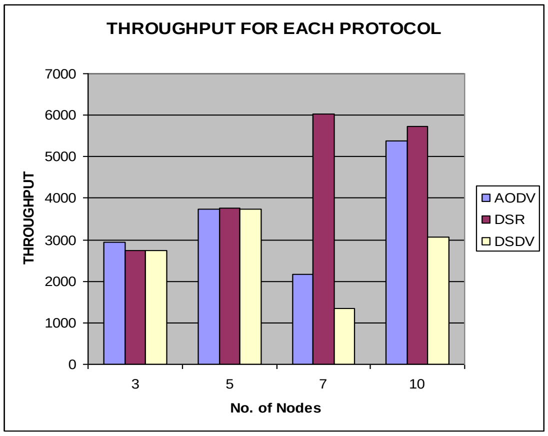

Fig 7 Throughput for each Protocol versus Different values of Nodes.

(8) Average Delay Vs No. of node

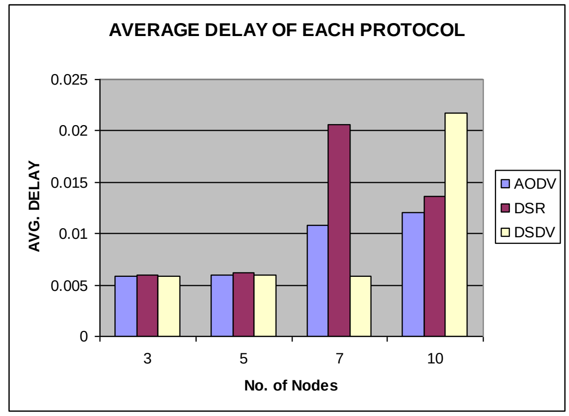

Fig 8 Average Delay for each Protocol versus Different values of Nodes.

(9) Packet Loss comparison

Table shows the packet send and receive for each of DSDV, AODV, and DSR Protocol respectively calculate the packet delivery ratio.

Table 1: Packet sends and receives for DSDV, AODV and DSR Protocols.

	DSDV			AODV			DSR		
No. of Node	Pkt send	Pkt receive	Packet Loss Ratio %	Pkt send	Pkt receive	Packet Loss Ratio %	Pkt send	Pkt receive	Packet Loss Ratio %
3	91	46	49.4505495	95	50	47.3684211	90	46	48.89
5	134	90	32.8358209	136	90	33.8235294	133	89	33.08
7	177	46	74.0112994	172	70	59.3023256	34	33	2.94
10	310	156	49.6774194	289	288	0.34602076	37	36	2.70

Table 2: Packets delivery ratio for for DSDV, AODV and DSR Protocols.

Pkt Delivery Ratio %		
DSDV	AODV	DSR
49.45054945	47.368421	48.888889
32.8358209	33.823529	33.082707
74.01129944	59.302326	2.9411765
49.67741935	0.3460208	2.7027027

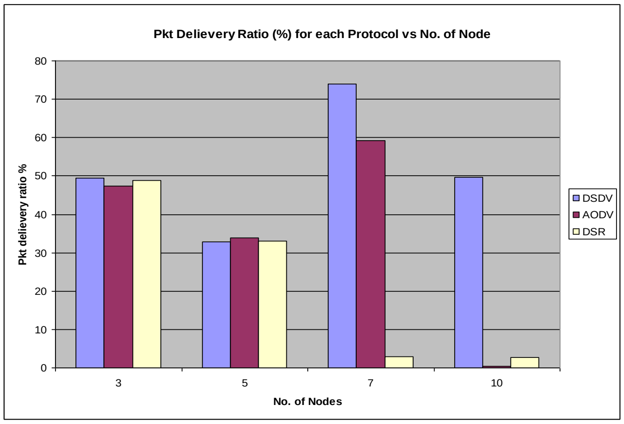

Fig 9 Packet Delivery Loss Ratio (%) for Each Protocol versus Different values of Nodes.

Conclusion

In recent years more and more researchers have become interested in ad hoc networks, as now the availability of wireless networking and mobile computing hardware can promise to support that kind of networks. In the last few years, a set of new routing protocols, which are especially developed for ad hoc networks, have been proposed. The large number of different routing protocols shows how important and forceful this field is. In this paper were considered the features and principles of three routing protocols for ad-hoc wireless networks such as AODV, DSR and DSDV. Also the performance of these protocols was estimated and compared using the NS-2 simulator. Input values for these models try to fairly correspond to real conditions. The represented simulations for accurately corresponding network layer models were obtained by using the NS-2 simulator. During the simulations it was concluded that varying the speed of the nodes, the network size, and the number of route changes influences the protocol performance.

Nowadays, unique choice of routing protocols for ad hoc networks does not exist because the values of performance metrics are situation dependent. Thus the evaluation of routing protocols helps to determine the situation when a particular protocol will be useful. As a result of this evaluation can be implemented a multi-protocol system, which changes automatically the routing protocol depending on the situation.

This paper presents a brief description of several routing protocols which are proposed for ad-hoc mobile networks and also provides a classification of these protocols according to the routing strategy (i.e. table driven, on-demand routing protocol).

We have conducted a performance study of DSDV, DSR, AODV routing protocol in MANET. We used a simulation model to demonstrate the performance of these protocols. The simulation model consists of region where nodes are randomly moving to each other. For each protocol, we calculated three performance criteria:

- Average throughput,
- Average delay,
- Packet Loss Rate

By simulating we can argue that if delay is our main criteria than DSR can be our best choice only in small network. But if throughput and packet loss ratio are our main parameters for selection then AODV gives better results compare to others because its throughput and packet delivery ratio is best among others. If we consider the parameter, Maximum number of packet, we notice that that the throughput for the three routing protocols is almost constant for a maximum queue length greater than 30. As the maximum queue length decreases, the throughput decreases. For the same queue length DSDV performs better than DSR which performs better than AODV

While we focus only on the network throughput, and the delay, it would also be interesting to consider other metrics like power consumption, the number of hops to route the packet, fault tolerance, minimizing the number of control packets etc.

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