PERFORMANCE EVALUATION OF MANET ROUTING PROTOCOLS ON THE BASIS OF TCP TRAFFIC PATTERN

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ABSTRACT

The primary objective of this research work is to study and review the behaviour of AODV, DSR and DSDV routing protocols of MANET. In this paper, we will first discuss the various MANET routing protocols and various studies done on the performance evaluation of mobile Ad-hoc network (MANET). Here, we will study the performance of MANET routing protocols based on TCP traffic patterns. We also analyzed the performance of AODV, DSR and DSDV protocols for TCP traffic pattern on the basis of Packet Delivery Ratio, Throughput and Jitter.

KEYWORDS

Routing, Ad-hoc, Protocol, Simulation, AODV, DSR, DSDV, TCP, NS-2.

1. INTRODUCTION

Mobile ad-hoc network is a collection of wireless mobile hosts forming a temporary network without the aid of any stand-alone infrastructure or centralized administration. Mobile ad-hoc network have the attributes such as wireless connection, continuously changing topology, distributed operation and ease of deployment. The system may operate in isolation, or may have gateways to interface with a fixed network. Ad hoc networks have no fixed routers; all nodes are capable of movement and can be connected dynamically in an arbitrary manner[3]. Nodes of these networks, which function as routers, discover and maintain routes to other nodes in the network. The topology of the ad hoc network depends on the transmission power of the nodes and the location of the mobile nodes, which may change with time. Because of these features, the Ad hoc networks are used where wired network and mobile access is either unproductive or not feasible. A few possible examples include: earthquake hit areas, where infrastructure is destroyed, military soldiers in a destructive environment; virtual classrooms, biological detection, tracking of rare animal, space exploration, and undersea operations. A fundamental problem in ad hoc networking is how to deliver data packets among MNs efficiently without predetermined topology or centralized control, which is the main objective of ad hoc routing protocols. Since mobile ad hoc networks change their topology frequently, routing in such networks is a challenging task.

2. ROUTING IN MANET

Major challenges of Routing in MANET protocols includes a node needs to know at least the reach ability information to its neighbourhood nodes for determining the packet route. Another major challenge includes dynamic nature of Ad-hoc network routing protocols. As the number

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of nodes can be large, finding route to the destination requires large and frequent exchange of routing control information among the nodes. As the nodes are mobile in MANET, it includes rote maintenance overhead. Routing in Mobile Ad-hoc Network has been a subject of extensive research over the past several years. Because of the fact that it may be necessary to pass several hops (multi-hop) before a packet reaches the destination, a routing protocol is needed. Ad-hoc routing protocols can be classified based on different criteria.

2.1 Adhoc On-Demand Distance Vector (AODV)

AODV is a purely reactive routing protocol. In this protocol, each terminal does not need to keep a view of the whole network or a route to every other terminal. Nor does it need to periodically exchange route information with the neighbour terminals. Furthermore, only when a mobile terminal has packets to send to a destination does it need to discover and maintain a route to that destination terminal [6,19]. In AODV, each terminal contains a route table for a destination. A route table stores the following information: destination address and its sequence number, active neighbours for the route, hop count to the destination, and expiration time for the table. The expiration time is updated each time the route is used. If this route has not been used for a specified period of time, it is discarded.

2.2 Destination Sequenced Distance-Vector Routing

DSDV is a proactive, distance vector protocol which uses the Bellmann-Ford algorithm. DSDV is a hop-by-hop distance vector routing protocol, wherein each node maintains a routing table listing the "next hop" and "number of hops" for each reachable destination [6,19]. This protocol requires each mobile station to advertise, to each of its current neighbours, its own routing table (for instance, by broadcasting its entries). The entries in this list may change fairly dynamically over time, so the advertisement must be made often enough to ensure that every mobile computer can almost always locate every other mobile computer of the collection. In addition, each mobile computer agrees to relay data packets to other computers upon request. This agreement places a premium on the ability to determine the shortest number of hops for a route to a destination we would like to avoid unnecessarily disturbing mobile hosts if they are in sleep mode. In this way a mobile computer may exchange data with any other mobile computer in the group even if the target of the data is not within range for direct communication.

2.3 Dynamic Source Routing (DSR)

The Dynamic Source routing algorithm is an innovative approach to routing in a MANET in which nodes communicate along paths stored in source routes carried by the data packets. It is referred as one of the purest examples of an on demand protocol. In DSR, mobile nodes are required to maintain route caches that contain the source routes. Entries in the route cache are continually updated as new routes are learned [19].

3. RELATED WORK AND PROBLEM FORMULATION

The IETF MANET working group mandate was to standardize IP routing protocols in MANETs. The RFC 2501 specifies the charter for the working group. The RFCs still has unanswered questions concerning either implementation or deployment of the protocols. Nevertheless, the working group identifies the proposed algorithms as a trial technology. Aggressive research in this area has continued since then, with prominent studies on routing protocols such as Ad hoc On-demand Distance Vector (AODV), Destination-Sequenced Distance-Vector Routing protocol (DSDV) and Dynamic Source Routing Protocol (DSR). Several studies have been done on the performance evaluation of routing protocols based on CBR traffic pattern using different evaluation methods. Different methods and simulation environments give different results and consequently, there is need to broaden the spectrum to account for effects not taken into consideration in a particular environment.

Table 3.1: Related Work

Author and Year	Protocol used	Traffic Pattern	Parameters						Conclusion
			PDR	End to End Delay	Routing Overhead	Routing Load	Throughput	Jitter	
Karthiga G et al, 2011	AODV DSR DSDV TORA	CBR	√	√	√	X	√	X	DSDV is best considering its ability to maintain connection by periodic exchange of information
Singla et al., 2009	AODV DSR DSDV	CBR	√	√	X	√	X	X	AODV is best for End to End Delay
Kumar R. et al., 2006	AODV DSR	CBR	√	X	X	√	X	X	The poor performances of DSR are mainly attributed to aggressive use of Caching
Samba S, 2004	AODV DSR DSDV TORA	CBR	√	√	X	X	√	X	DSDV is best in case of limited change in topology
Kumar S et al, 2009	AODV DSR	CBR	√	√	√	√	X	X	DSR Is best for UDP
Hussein Mamoun et al 2007	AODV DSR	CBR	√	√	√	√	X	X	DSR often performs better than AODV, because the chances of find the route in one of the caches is much higher.

It is observed that most of the research work is based on CBR traffic pattern whereas most of the traffic approximately 95% on the Internet carries TCP [5]. It is desirable to study and investigate the performance of different MANET routing protocols under both CBR and TCP traffic patterns. In this paper, we will evaluate the performance of AODV, DSR and DSDV protocols of mobile ad-hoc network routing protocols for TCP traffic pattern. The performance of these routing protocols can be evaluated with respect to various parameters such as Packet Delivery Ratio, Throughput and Jitter. There are many discrete-event network simulators available for the MANET community. Simulator used to simulate the ad hoc network routing protocols is the Network Simulator-2 (ns-2.29 version) from Berkeley. Nodes in the simulation are moved according to "random way mobility model". The movement scenario files used in simulation are characterized by changing pause time and number of parallel connections. Simulations are done for TCP traffic pattern. Simulations are done for AODV, DSR and DSDV protocols. The trace files are generated in new trace format of NS2. Trace files are then

analyzed by Java Program and awk scripts. The trace file can also be used to visualize the simulation run with Network Animator.

4. PERFORMANCE PARAMETERS

Mobile ad hoc networks have several inherent characteristics (e.g. dynamic topology, time-varying and bandwidth constrained wireless channels, multi-hop routing, and distributed control and management). Design and performance analysis of routing protocols used for mobile ad hoc network (MANET) is currently an active area of research. To judge the merit of a routing protocol, one needs metrics—both qualitative and quantitative-- with which to measure its suitability and performance. Specifically, performance of AODV, DSR and DSDV routing protocols can be evaluated on the following performance metrics: Packet delivery ratio, Throughput and Jitter.

4.1 Packet Delivery Ratio

Packet delivery ratio is calculated by dividing the number of packets received by the destination through the number of packets originated by the application layer of the source [2]. It specifies the packet loss rate, which limits the maximum throughput of the network. The better the delivery ratio, the more complete and correct is the routing protocol.

4.2 Throughput

The throughput of the protocols can be defined as percentage of the packets received by the destination among the packets sent by the source. It is the amount of data per time unit that is delivered from one node to another via a communication link. The throughput is measured in bits per second.

4.3 Jitter

It is the variation in time between arrivals of packets. It measures the stability of the algorithm's response to topological changes. It is the deviation from the ideal delay or latency. It is caused by network congestion, a sudden network topology change or route changes.

5. RESULTS & DISCUSSIONS

We evaluated the performance of AODV, DSR and DSDV protocols under TCP traffic pattern by varying number of connections and pause time. Trace files produced by applying scenarios and communication files are analyzed by using Java program and awk scripts for evaluation of different protocols based on average Packet Delivery Ratio, Jitter and Throughput.

5.1 Change in Pause Time

Influence of change in pause time (i e.10, 20, 30, 40, 50 sec) on AODV, DSR and DSDV for TCP Traffic pattern is shown in Figures 5.1, 5.2 and 5.3.

- It is observed from the Figure 5.1 that In case of TCP traffic, Packet Delivery Ratio of different MANET protocols changes with respect to change in pause time. It is seen that PDR of DSDV protocol is better as compared to AODV and DSR protocols. PDR degrades with increase in pause time for different MANET protocols.
- It is observed from the Figure 5.2 that Jitter in case of DSDV protocol is too less as compared to AODV and DSR protocols. Jitter of DSDV protocols is almost constant and change in pause time has less influence on Jitter of DSR and DSDV protocols as compared to AODV protocol.
- It is observed from the Figure 5.3 that change in pause time has opposite impact on DSDV protocol as compared to AODV and DSR protocol. DSDV protocol provides maximum throughput.

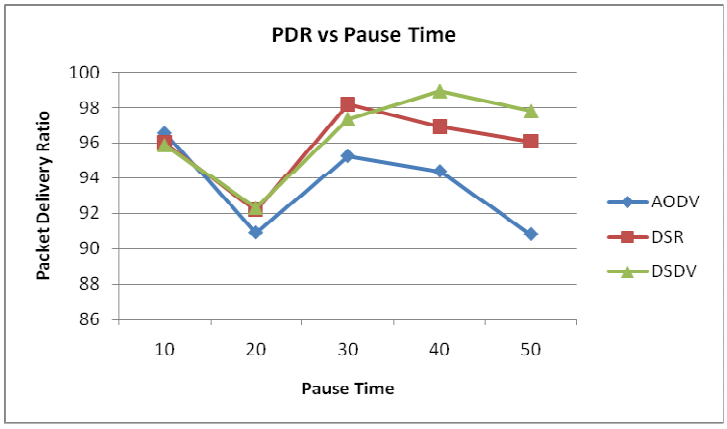

Figure 5.1: Packet Delivery Ratio for TCP Traffic Pattern w.r.t change in pause time.

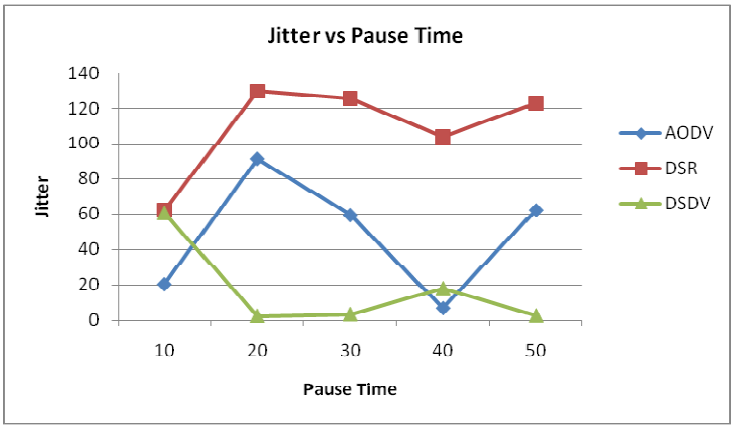

Figure 5.2: Jitter for TCP Traffic Pattern w.r.t change in pause time

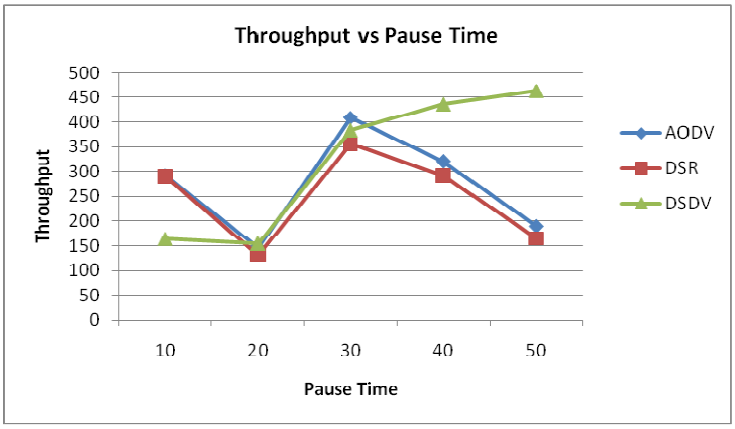

Figure 5.3: Throughput for TCP Traffic Pattern w.r.t change in pause time

5.2 Change in number of Connections

Impact of change in number of connections (i e. 20, 40, 60, 80, 100) on different MANET protocols i.e. AODV, DSR and DSDV for TCP Traffic pattern is shown in Figures 5.4, 5.5 and 5.6.

- It is observed from the Figure 5.4 that DSR protocol provides almost 100% packet delivery ratio. Change in number of connections has minimum impact on packet

delivery ratio. DSDV protocol provides minimum packet delivery ratio as compared to AODV and DSR protocols for TCP traffic pattern.

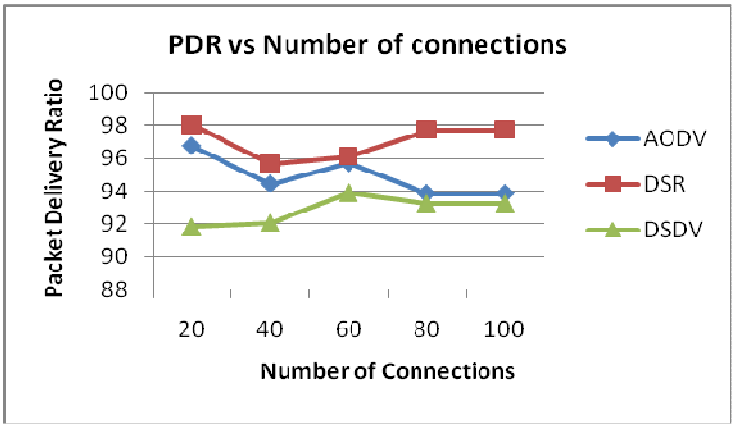

Figure 5.4: Packet Delivery Ratio for TCP Traffic Pattern w.r.t change in number of connections

- It is observed from the Figure 5.5 that Change in number of connections has minimum impact on jitter of DSDV protocol as compared to AODV and DSR protocols. It is seen that Jitter increases with the increase in number of connections for AODV and DSR protocols.

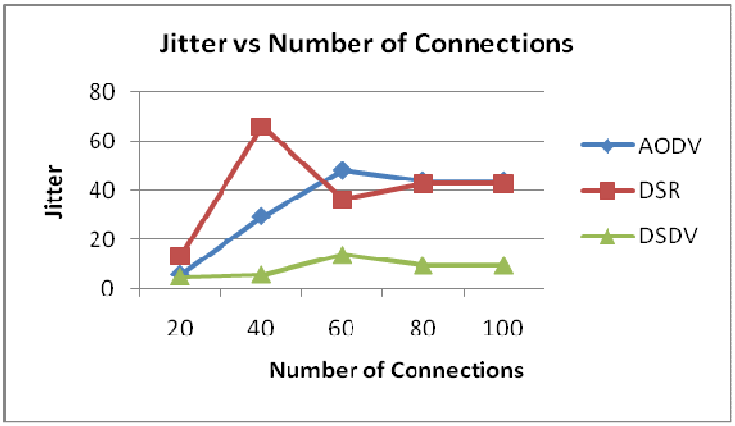

Figure 5.5: Jitter for TCP Traffic Pattern w.r.t change in number of connections

- It is observed from figure 5.6 that Throughput is almost constant for AODV, DSR and DSDV protocols with respect to increase in number of connections. DSDV protocol has less throughput as compared to AODV and DSR protocols.

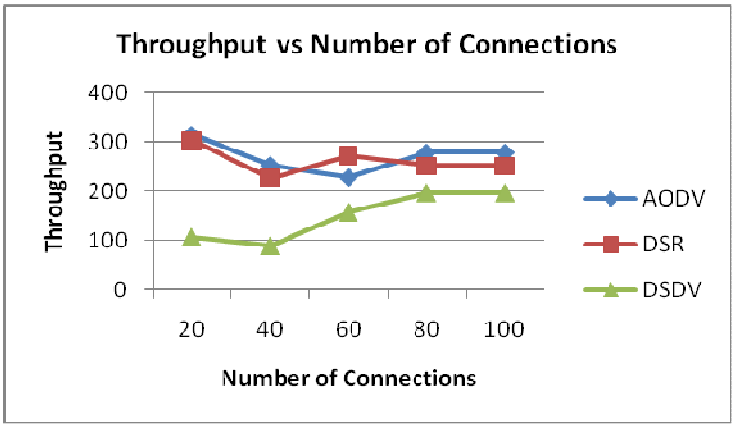

Figure 5.6: Throughput for TCP Traffic Pattern w.r.t change in number of connections

6. CONCLUSIONS & FUTURE WORK

This study was conducted to study the behaviour of various routing protocols of MANET and to investigate the performance AODV, DSR and DSDV protocols of MANET based on TCP traffic pattern. These routing protocols are studied in terms of Packet delivery ratio, Throughput and Jitter when subjected to change in pause time and number of connections. It is concluded that DSDV protocol performs better as compared to AODV and DSR protocols for TCP traffic pattern. It is also concluded that performance of these protocols is more affected while subject to change in pause time as compared to change in number of connections. The performance of these protocols can also be evaluated in future for CBR traffic pattern and comparison for both types of traffic can be done. Future work will be to evaluate the performance of these protocols by varying the speed, pause time. Performance can also be analyzed for other parameters like Average End-to-End Delay, Routing Overhead. Performance of MANET routing protocols can be evaluated on the basis of various mobility patterns.

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