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The Performance Analysis of Routing Protocols for Mobile Ad-hoc Networks

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Abstract: Ad hoc networks are recognized by multi hop wireless connectivity, frequently changing network topology and the need for efficient dynamic routing protocols. Due to highly dynamic environment routing in ad-hoc networks is nontrivial. In recent years, a variety of routing protocols have been proposed and several of these have been already extensively simulated or implemented as well. In this paper, we compare the performance of different protocols for ad hoc networks that is Dynamic Source Routing (DSR) , Ad Hoc On-Demand Distance Vector Routing (AODV), Destination Sequence Distance Vector (DSDV),Temporally Ordered Routing Algorithm (TORA). The performance differentials are analyzed using varying network load, mobility and network size. Based on the observations, we make recommendations about how the performance of either protocol can be improved.

Keywords: AODV, DSDV, DSR, TORA, MANET, Relative performance.

I. INTRODUCTION

A mobile ad hoc network (MANET) is a collection of wireless mobile nodes communicating with each other using multi-hop wireless links without any existing network infrastructure or centralized administration. In recent years, a variety of routing protocols targeted specifically at this environment have been developed and some performance simulations are made. However, the related works took the simulation model with a constant network size and a varying pause times or mobility velocities. And these works do not take into account the influence on the protocols when the mobile nodes' pause time is invariable but the network size is changing.

II. ROUTING PROTOCOLS AND ROUTING BEHAVIOURS

Routing protocols in MANETs are classified as table driven or on-demand. Table driven protocols are proactive, because they attempt to maintain consistent up-to-date information. On demand routing protocols are also known as reactive protocols which are source-initiated and create routes only when desired by a node.[9]

III. DESTINATION SEQUENCE DISTANCE VECTOR (DSDV)

This routing protocol is a table-driven algorithm based on the Bellman-Ford routing mechanism. To avoid routing loops, every mobile node in the network maintains a routing table in which all of the possible destinations within the network and the number of hops to each destination are recorded. Entries are marked with a sequence number assigned by the destination node. The sequence numbers enable the mobile nodes to distinguish stale routes from new ones, thereby avoiding the formation of routing loops. [9]

IV. DYNAMIC SOURCE ROUTING (DSR)

This is a simple and efficient routing protocol composed of two mechanisms, route discovery and route maintenance, which work together to allow nodes discover and maintain source routes to arbitrary destinations in the ad hoc network. The source node uses Route Discovery to find a route when a request arrives and inserts the discovered routes in the packet header. Intermediate nodes do not need to maintain up-to-date routing information apart from participation in the route discovery and maintenance [9].

V. AD HOC ON-DEMAND DISTANCE VECTOR ROUTING (AODV)

The AODV routing protocol is an improvement on DSDV because it typically minimizes the number of required broadcasts by creating routes on a demand basis, as opposed to maintaining a complete list of routes as in the DSDV algorithm. The authors of AODV classify it as a pure on-demand route acquisition system, since nodes that are not on a selected path do not maintain routing information or participate in routing table exchanges. When a source node desires to send a message to some destination node and does not already have a valid route to that destination, it initiates a path discovery process to locate the other node.[9]

VI. THE TEMPORALLY ORDERED ROUTING ALGORITHM (TORA)

The Temporally Ordered Routing Algorithm (TORA) [10,11] is a reactive routing algorithm based on the concept of link reversal. TORA improves the partial link reversal method by detecting partitions and stopping non-productive link reversals. TORA can be used for highly dynamic mobile ad hoc networks TORA has three basic operations: route creation, route maintenance and route erasure. A route creation operation starts with setting the height (propagation ordering parameter in the quintuple) of the destination to 0 and heights of all other nodes to NULL (i.e., undefined).

VII. COMPARISON OF PROTOCOLS

In comparing the protocols, we chose to evaluate them according to the following metrics:

a. ***Throughput:*** It is defined as total number of packets received by the destination. It is a measure of effectiveness of a routing protocol. Finally what matters is the number of packets delivered successfully.

b. ***Packet delivery ratio*****:** the ratio between the number of packets received by the TCP sink at the final destination and the number of packets originated by the "application layer" sources. It is a measure of efficiency of the protocol

c. ***Routing overhead*****:** The total number of routing packets transmitted during the simulation. For packets sent over multiple hops, *each* transmission of the packet (each hop) counts as one transmission. Since End-to-end Network Throughput (data routing performance) is defined as the external measure of effectiveness, efficiency is considered to be the internal measure. To achieve a given level of data routing performance, two different protocols can use differing amounts of overhead, depending on their internal efficiency, and thus protocol efficiency may or may not directly affect data routing performance. If control and data traffic share the same channel, and the channels capacity is limited, then excessive control traffic often impacts data routing performance

d. ***Path optimality*****:** The difference between the number of hops a packet took to reach its destination and the length of the shortest path that physically existed through the network when the packet was originated

e. ***Packets lost:*** it is a measure of the number of packets dropped by the routers due to various reasons. The reasons we have considered for evaluation are Collisions, time outs, looping, errors.

f. ***Average Delay:*** It is a metric which is very significant with multimedia and real-time traffic. It is very important for any application where data is processed online.

VIII. RESULTS

Following figures shows the performance comparison of all the four routing protocols vrz: DSDV,AODV,DSR,TORA [12]

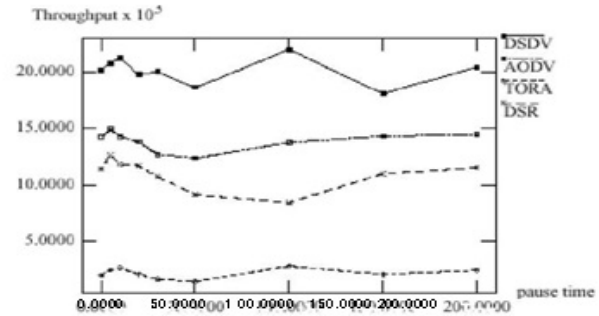

Figure 1: Total number of packets received at various levels of mobility

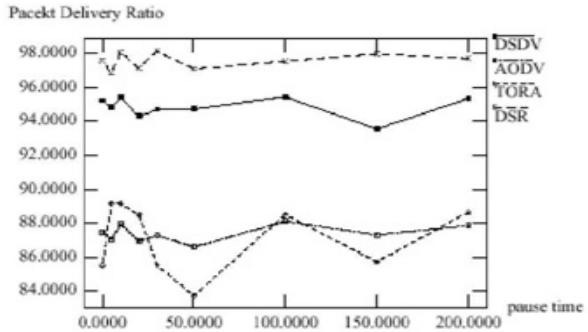

Figure 2: Ratio of packets delivered/Packets transmitted at different levels of mobility

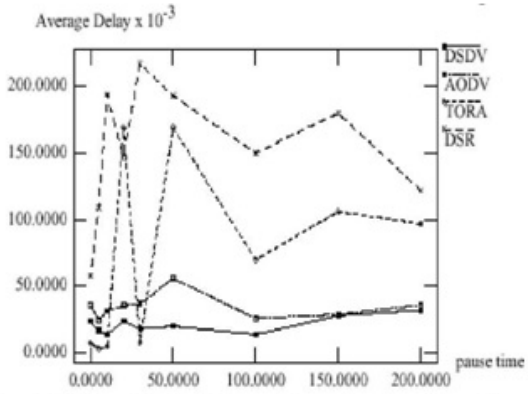

Figure 3: Delay introduced by routing protocols with variation in mobility

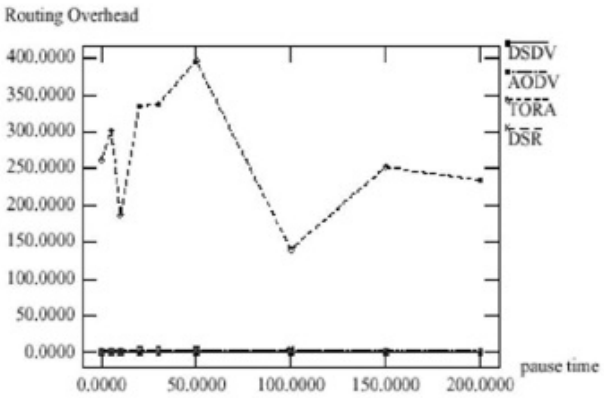

Figure 4: Variation of Routing overhead with mobility

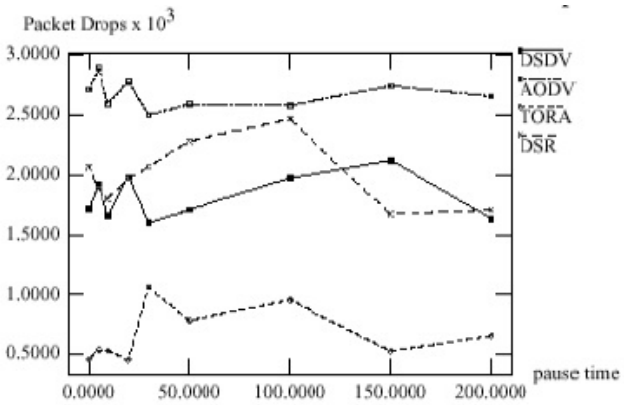

Figure 5: Total number of packets dropped with variation in mobility

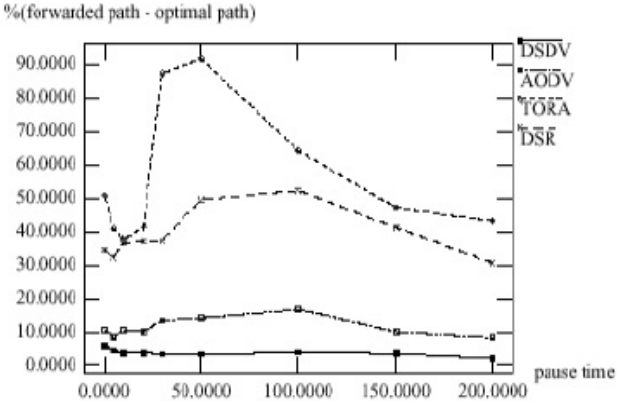

Figure 6: Percentage difference between forwarded path and optimal path

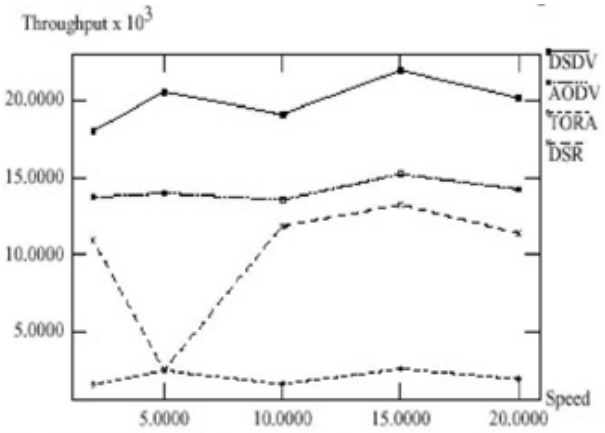

Figure 7: Total number of packets received at various levels of s peed

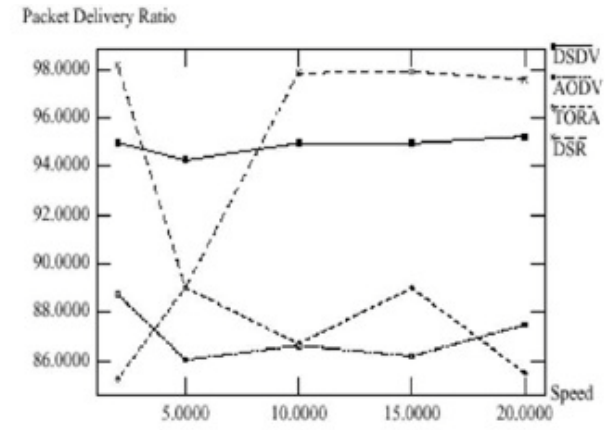

Figure 8: Ratio of packets delivered/Packets transmitted at diffe rent speeds path with mobility

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X. CONCLUSION

Ad hoc wireless networks are composed of mobile stations communicating solely through wireless channels. Our results indicate that the two source routing based protocols, DSR have very high throughputs while the distance-vector based protocol, AODV, exhibits a very short end-to-end delay of data packets. DSDV performs well in weighted path optimality while TORA has the worst performance. We observed that DSDV and AODV have the best performance in terms of delay. DSR has the best performance with respect to load balancing. DSDV has the best average jitter and then AODV, TORA, and DSR are in order. This result is valid for maximum and deviation of jitter too.

XI. FUTURE SCOPE

Dynamic source routing protocol is designed for use in multi-hop wireless ad hoc networks of mobile nodes. DSR uses source routing and does not depend on timer based activities. So it is a fully reactive protocol which initiates a route discovery process only when it has data to send. Though there are some disadvantages of this protocol, it is a robust protocol for use in mobile ad hoc network. Our future works will include the modification to the basic DSR so as to reduce the routing overhead for the performance optimization. Our work can be extended to various other protocols. In this simulation study, we have not used large no of nodes and simulation time was 1000s. Increasing both of them will increase computational time which was limited due to various reasons. Thus, in future we will try to carry out more vigorous simulation so as to gain better understanding of such networks and subsequently helps in development of new protocols or modification in existing protocols. Security considerations and the problem of non cooperative nodes are not addressed here and the future work may be the addressed of these issues. Interconnection of mobile ad-hoc network with an infrastructure based network may also be part of the future work.

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