Effect of Mobility over Performance of the Ad hoc Networks

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Abstract

An ad hoc network is a collection of wireless mobile nodes dynamically forming a temporary network without the use of any existing network infrastructure or centralized administration. A number of routing protocols like Dynamic Source Routing (DSR), Ad Hoc On-Demand Distance Vector Routing (AODV), Destination-Sequenced Distance-Vector (DSDV) and Temporally Ordered Routing Algorithm (TORA) are normally used in ad hoc networks. In this paper an attempt has been made to compare the effect of mobility in case of on-demand reactive routing protocols for mobile ad hoc networks: AODV with traditional proactive DSDV protocol. The performance is analyzed using varying number of connections in the network, mobility pause and speed of the node. These simulations are carried out using the ns-2 network simulator.

Index terms - Ad hoc networks, AODV, DSR.

1. INTRODUCTION

Wireless communication networks are either infrastructure based networks or ad hoc networks. Infrastructure based networks uses fixed base stations which are responsible for coordinating communication between the mobile hosts. Ad hoc network consists of mobile nodes which communicate with each other through wireless medium without any fixed infrastructure. A mobile ad hoc network is a collection of autonomous mobile nodes that communicate with each other over wireless links. As there is a limitation in wireless transmission range, each host needs the help of nearby hosts to forward the packet. Therefore each host acts as a router for itself. Hence, a routing protocol for ad hoc networks runs on every host and is therefore subject to the limit of the resources at each mobile host. The routing protocols should minimize the computing load and traffic overhead for each node in the network. The traditional protocols such as link-state or distance vector are not suitable for ad hoc networks as they are aimed at finding optimal routes to every host in the network. In case of mobile ad hoc network, as the topology changes frequently, finding and maintaining the route at each node is very expensive. The periodic updates cannot promptly reflect the frequent topological changes in ad hoc networks, which in turn will cause a lot of undelivered packets and undetermine the quality of communication. As a consequence, a mobile ad hoc networking (MANET) working group has been formed within the Internet Engineering Task Force (IETF) to develop a routing framework for IP-based protocols in ad hoc networks. Today, a number of routing protocols have been proposed for ad hoc wireless networks derived from distance-vector or linkstate routing algorithms. Such protocols are classified as proactive or reactive, depending on whether they keep routes continuously updated, or whether they react on demand.

Proactive protocols, also called table-driven protocols, which attempts to continuously determine the network connectivity, so that the route is already available when a packet needs to be forwarded. Some of the proactive protocols are Destination-Sequenced Distance Vector (DSDV) protocol, Wireless Routing Protocol (WRP) , Temporally-Ordered Routing Algorithm (TORA), and Lightweight Mobile Routing (LMR) protocol . In these protocols there will be a little delay until the route is determined. Proactive schemes are not suitable for reconfigurable wireless networks, as they use more time to keep the network routing information current. If the movement of the node is very fast , then every time it needs to calculate the new route which may never be used. This leads to the waste of network capacity.
Reactive protocols, also called on-demand protocols, invoke a route determination procedure only on demand. Some of the Reactive protocols are Ad hoc On Demand Distance Vector (AODV) protocol and Dynamic Source Routing (DSR) protocol. In these protocols, there will be some significant delay to find the route. Because it makes global search such as flooding to find the route, as the routing information may not be available by that time. Furthermore, the global search procedure requires significant traffic implying pure reactive routing protocols may not be applicable to real-time communication. In this paper, we will compare the effect of

1-4244-0731-1/06/$20.00 © 2006 IEEE

mobility over the routing protocols of these two classes. We study and compare the AODV, DSDV using simulation experiments considering the traffic load, mobility pause and speed as the major factors. The remainder of the paper is organized as follows. Section 2 briefly reviews the on-demand routing protocol AODV and a table-driven protocol for mobile ad hoc networks. Section 3 presents the simulation experiments we carried out to find the effect of mobility in these two routing protocols, followed by the conclusion in section 4.

2. ROUTING PROTOCOLS

In this section we briefly study about the two routing protocols AODV and DSDV.

A. Ad hoc on Demand Distance Vector protocol (AODV)

In AODV, each host maintains a traditional routing table, one entry per destination. Each entry records the next hop to that destination and a sequence number generated by the destination which indicates the freshness of this information. In addition, each entry also records the addresses of active neighbors through which packets for the given destination are received. Therefore, once the corresponding link of this entry is down, the upstream hosts using this link can be notified immediately. It discovers a route through network-wide broadcasting. The source host starts a route discovery by broadcasting a route request to its neighbors. In the route request, there is a requested destination sequence number which is 1 greater than the destination sequence number currently known to the source. This number prevents old routing information being used as reply to the request, which is the essential reason for the routing loop problem in the traditional distance vector algorithm. The route request does not record the nodes it has passed but only counts the number of such nodes. Instead, each node the request has passed sets up a temporary reverse link pointing to the previous node from which the request has come, so that the reply can be re turned to the source host. An intermediate node can reply to a request only if it has a route entry for the destination which has the same or higher destination sequence number than the requested number. A route reply contains the total hop count of the route and its destination sequence number. As a reply travels back to the source, each intermediate node sets up the forward link as a route entry and records the destination sequence number. If the node receives further route replies later, it updates its routing entry and propagates the reply back to the source only if the reply has either a greater destination sequence number, or the same sequence number with a smaller hop count. An invalid link can be detected through link layer acknowledgement, or by letting each host broadcasting periodic hello messages to neighbors. Hello messages can also be used to discover neighbors. Whenever a link in use is no longer valid, the upstream host of that link immediately notifies the active neighbors of the link, which in turn notify their active neighbors for the route and so on until the source hosts using that link are reached. The notification is done by sending an unsolicited route reply with a fresh sequence number and hop count of ∞. The fresh destination sequence number makes the active neighbors unconditionally updates their corresponding route entries, and the∞ hop count simply means the route is no longer valid.

B. Destination Sequenced Distance Vector (DSDV) Protocol

In the DSDV protocol, each mobile host in an ad hoc network keeps the information about the node's age or sequence number, a set of its current neighbors, and a routing table with entries for each other host in the network, including a known age or a sequence number of the entry, a neighbor and the cost. Messages directed to host destination are routed through the neighbors of each node, which is the next hop along the route to the destination. The sequence number is indicative of the recentness of the route from source to the destination. Recent data replace old data to reflect topology changes. Every mobile host is required to periodically advertise its routing table to its neighbors, together with its age. Any neighbor receiving the advertised routing table, updates its own routing table. Like AODV, DSDV is also a distance vector protocol, and it triggers an update when the network is changed. The packet will be queued under a reply came back from the destination.

3. SIMULATION EXPERIMENTS

The simulation experiments are carried out using NS2 network simulator. The simulation model contains 50 nodes. Two Ray Ground reflection model as the propagation model. Each nodes transmission range is 250m and the nodes movements are according to random waypoint model. The simulation is carried out in 600m x 600m simulation area for 100 seconds. The data transmission rate is 10Kbps and packet size is 512 bytes. The two routing protocols AODV and DSDV are compared to find the effect of mobility over the performance of the ad hoc networks.

The following metrics are used to compare the two routing protocols.

1). Packet delivery ratio: It is the ratio of total number of CBR packets received by CBR sinks over total number of CBR packets sent by the CBR sources.

2). Normalized Routing overhead: The ratio of total number of routing packets transmitted during the simulation over the total the total number of receives.

3). Average End to End delay: The average time taken to route the packet from source to destination.

4. SIMULATION RESULTS

The Simulation is carried out to check the behavior of the routing protocols considering the number of connections, speed of the mobility and pause time. Figure 1, Figure 2 and 3 shows the experiments results obtained by varying the total number of connections from 10 to 100 in steps of 10, with a fixed speed 20m/s and with high mobility i.e., pause time as 0. AODV has more average End-to-end delay and minimum amount of routing overhead compared to DSDV.

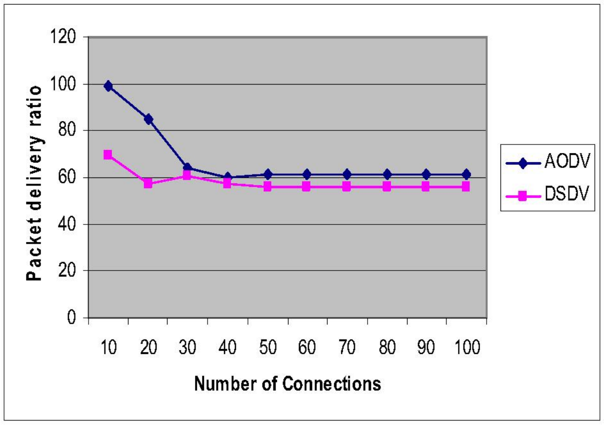

Figure1: Packet delivery ratio with varying total number of connections.

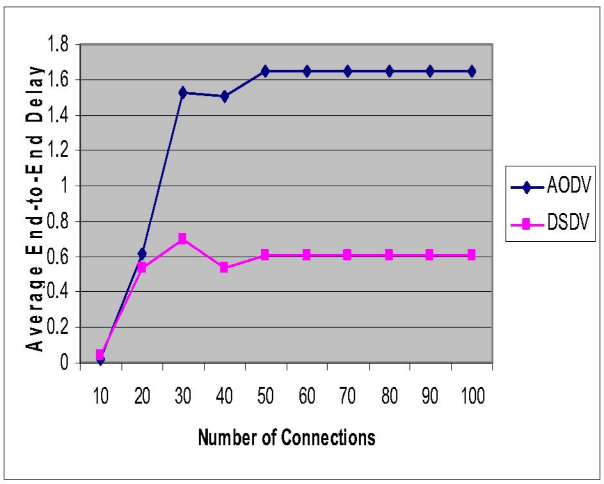

Figure 2:Average End-to-End delay with Varying total number of connections.

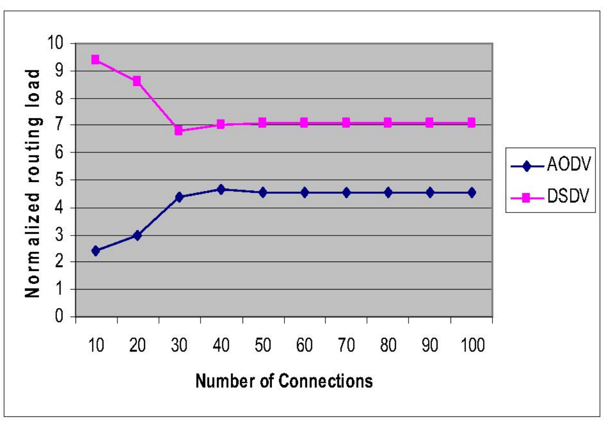

Figure 3: Normalized routing load with varying total number of connections.

Figure 4, Figure 5 and 6 shows the results of speed versus packet delivery ratio, Normalized routing overhead and Average End-to-End delay respectively. Two pause time values are considered here to know the effect of speed over the variation in pause time.

In case of AODV, the packet delivery ratio is more compared to DSDV. It also shows that , the packet delivery ratio increases with the mobility i.e., with pause time. The routing overhead of AODV is considerably minimum compared to DSDV. The routing overhead increases with increase in pause time for AODV and DSDV. The average end-to-end delay of AODV is more than the DSDV with varying speed and it increases with the increase in pause time.

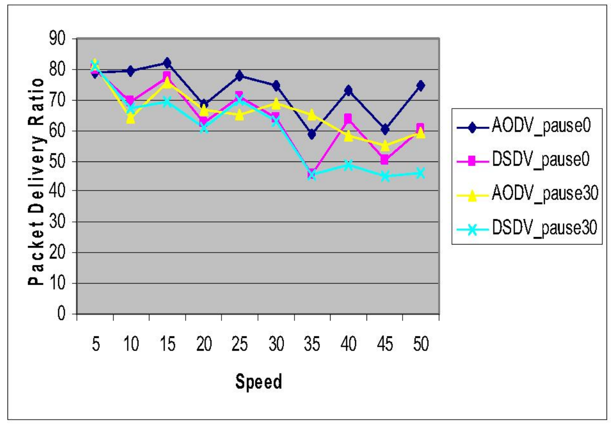

Figure 4: Packet delivery ratio with variation of speed and pause time.

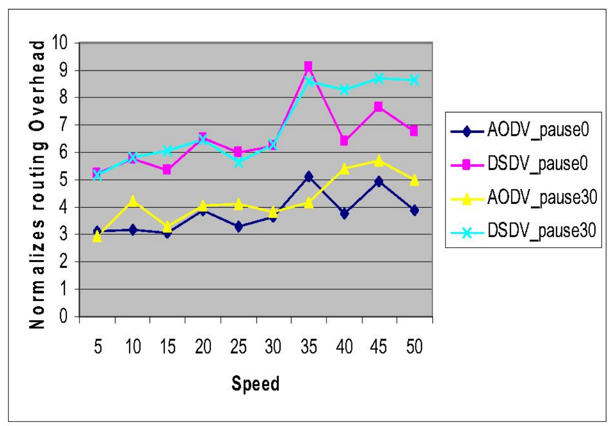

Figure 5: Normal routing overhead with variation of speed and pause time.

The figure 7, figure 8 and figure 9 shows the results of normalized routing load, packet delivery ratio and average end to end delay with variation of pause time keeping speed of the node as 20m/s. The AODV performs better with routing overhead and packet delivery ratio, and it DSDV shows better performance in case of Average end to end delay.

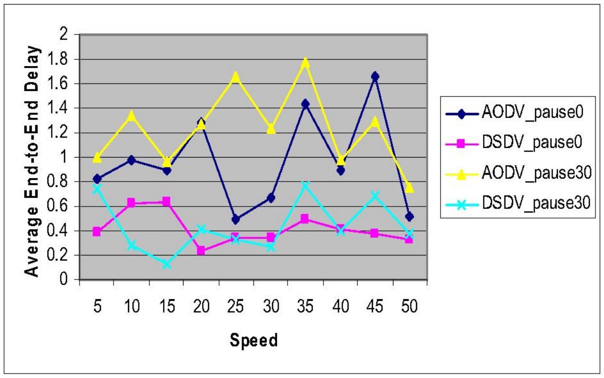

Figure 6: Average end-to-end delay with variation of speed and pause time .

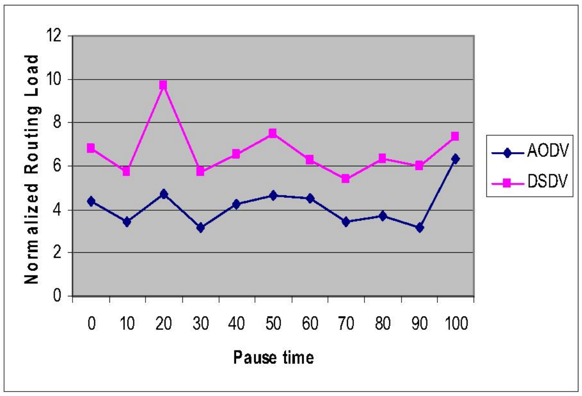

Figure 7: Normalized routing load with variation of pause time.

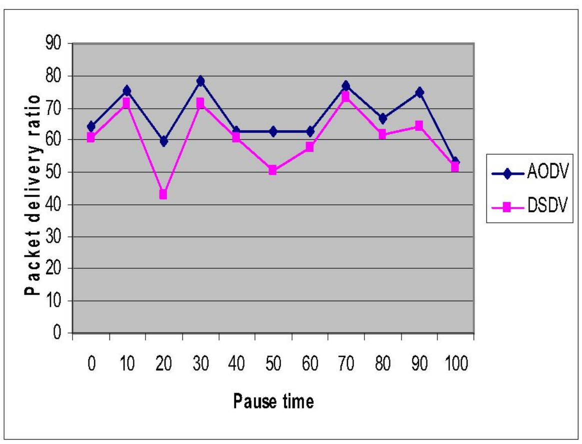

Figure 8: Packet delivery ratio with variation of Pause time.

The AODV is a reactive routing protocol. The routing overhead is minimum as the route is discovered only on demand. The DSDV is a table driven protocol. So it needs to update the routing table frequently. Hence the routing overhead is increases. The routing overhead also increases with the increase in mobility as there will be more number of link failures. The routing overhead decreases as the pause time increases.

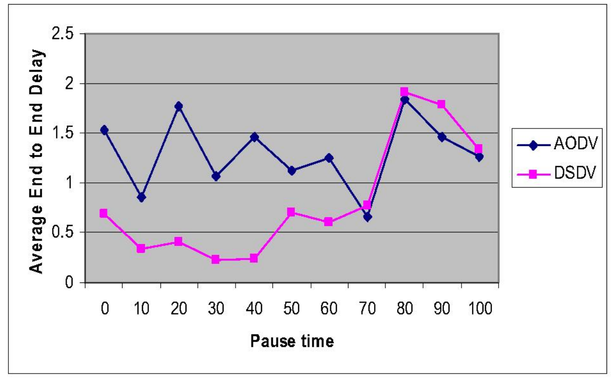

Figure 9:Average End to End Delay with variation of pause time.

Similarly, the packet delivery ratio gets effected by the mobility of nodes because of the link failures due to the mobility.

CONCLUSION

In this paper, we have analyzed the effect of mobility over two ad hoc routing protocols, AODV and DSDV. The results are analyzed for packet delivery ratio, normalized routing overhead and average end-to-end delay by varying the number of connections, speed and pause time. The analysis shows that there will be considerable amount of packet loss and routing overhead due to the mobility. It shows that if we are able to predict the rate at which the nodes are moving , then there may be the chances of improvement in the performance of the network, which can be considered as the future work to this paper.

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