

Scalability Performance of MANET Routing Protocols with Reference to Variable Pause Time

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ABSTRACT- As mobile networking continues to experience increasing popularity, the need to connect large numbers of wireless devices will become more prevalent. Many recent proposals for ad hoc routing have certain characteristics. A mobile ad hoc network is a collection of autonomous mobile nodes that communicate with each other over wireless links. Such networks does play important role in civilian and military settings, being useful for providing communication support where no fixed infrastructure exists or the deployment of a fixed infrastructure is possible. It is a crucial part in the performance evaluation of MANET to select suitable mobility model and routing protocols. Therefore, a number of routing protocols as well as mobility models have been proposed for ad hoc wireless networks based on different scenarios. In this paper, we study and compare the performance of the two reactive routing protocols AODV and DSR with reference to varying Pause Time. For experimental purposes, we have considered increasing Pause Time from 5 sec to 40 sec and illustrate the performance of the routing protocol across Packet Delivery Ratio parameter. Our simulation result shows that both AODV & DSR is performing equally good until the Pause Time cross a certain limit.

Keywords- AODV, DSR, RANDOM WAYPOINT, PACKET DELIVERY RATIO, OVERHEAD, PAUSE TIME

1. INTRODUCTION

MANET is collection of wireless nodes that can dynamically form a network to exchange the information without any pre-existing fixed network Next generation of mobile communications will include both prestigious infrastructure wireless networks and novel infrastructure less mobile ad hoc networks (MANETs). The special features of MANET bring these technology great opportunities together with severe challenges. Since the 1970s, wireless networks have become increasingly popular in the computing industry. This is particularly true within the past decade, which has seen wireless networks being adapted to enable mobility. There are currently two variations of mobile wireless networks. The first is known as the infrastructure network (i.e., a network with fixed and wired gateways). The bridges for these networks are known as base stations. A mobile unit within these networks connects to, and communicates with, the nearest base station that is within its communication Radius. As the mobile travels out of range of one base station and into the range of another, a "handoff" occurs from the old base station to the new, and the mobile is able to continue. Typical applications of this type

of network include office wireless local area networks (WLANs) [1].

The second type of mobile wireless network is the infrastructure less mobile network, commonly known as an ad hoc network. Infrastructure less networks has no fixed routers; all nodes are capable of movement and can be connected dynamically in an arbitrary manner. Nodes of these networks function as routers, which discover and maintain routes to other nodes in the network. Example applications of ad hoc networks are emergency search-and-rescue operations, meetings or conventions in which persons wish to quickly share information, and data acquisition operations in inhospitable terrain [1].

2. ADHOC ROUTING PROTOCOLS

Ad hoc routing protocols can be characterized into two categories: proactive and reactive (on-demand) [2]. Among the tested protocols in this work, only DSDV is proactive and the other two (DSR, AODV) are reactive. Proactive protocols update route information periodically, while reactive ones establish routes only when needed. [1]

A. Destination-Sequenced Distance Vector Routing (DSDV)

DSDV is an improved version of traditional Distance Vector routing algorithms. It prevents routing loops by adding a sequence number to every destination entry in the routing table. The table therefore contains the information of destination, next hop, distance to the destination, and the sequence number associated with the destination. Each node periodically broadcasts its routing table to its neighbors. After receiving updates from neighbor nodes, each node updates its routing table by comparing sequence number of each entry. If the received information is found to be more recent, it replaces the old entry with the newly received one. Data traffic is routed according to the (destination, next hop) pair in the routing table. When a link to a next hop is broken, any route through that next hop is immediately assigned an infinite value with a new sequence number. When a node receives an infinite count and has an equal or greater sequence number with a finite metric, a route update broadcast is triggered. Thus, real routes propagated from the newly located destination will quickly replace the routes with infinite value [3].

B. Ad hoc On-demand Distance Vector Routing (AODV)

AODV is an on-demand protocol, which initiates route request only when needed. When a source node needs a route to a certain destination, it broadcasts a route request packet (RREQ) to its neighbors. Each receiving neighbor checks its routing table to see if it has a route to the destination. If it doesn't have a route to this destination, it will re-broadcast the RREQ packet and let it propagate to other neighbors. If the receiving node is the destination or has the route to the destination, a route reply (RREP) packet will be sent back to the source node. Routing entries for the destination node are created in each intermediate node on the way RREP packet propagates back. A hello message is a local advertisement for the continued presence of the node. Neighbors that are using routes through the broadcasting node will continue to mark the routes as valid. If hello messages from a particular node stop coming, the neighbor can assume that the node has moved away. When that happens, the neighbor will mark the link to the node as broken and may trigger a notification to some of its neighbors telling that the link is broken. In AODV, each router maintains route table entries with the destination IP address, destination sequence number, hop count, next hop ID and lifetime. Data traffic is then routed according to the information provided by these entries [4].

C. Dynamic Source Routing (DSR)

The key feature of DSR is the use of source routing, which means the sender knows the complete hop-by-hop route to the destination. The node maintains route caches containing the source routes that it is aware of. Each node updates entries in the route cache as and when it learns about new routes. The data packets carry the source route in the packet headers. The delay and throughput penalties of DSR are mainly attributed to aggressive use of caching and lack of any mechanism to detect expired stale routes or to determine the freshness of routes when multiple choices are available. Aggressive caching, however, helps DSR at low loads and also keeps its routing load down. Several additional optimizations have been proposed and evaluated to be very effective. These improvements include:

Salvaging: An intermediate node can replace a failed route in the data packet with route information in its own cache.

Gratuitous route repair: Source node notifies the neighbors the error found in its packet, in order to clean up similar error in the caches of its neighbors.

Promiscuous listening: A node can update its own source routes in cache by overhearing a packet not addressed to it. The node also checks if the packet could be routed via it to gain a shorter path [5].

3. RANDOM WAYPOINT MOBILITY MODEL

The random waypoint mobility model is simple and is widely used to evaluate the performance of MANETs. The random waypoint mobility model contains pause time

between changes in direction and/or speed. Once a Mobile Node begins to move, it stays in one location for a specified pause time. After the specified pause time is elapsed, the MN randomly selects the next destination in the simulation area and chooses a speed uniformly distributed between the minimum speed and maximum speed and travels with a speed v whose value is uniformly chosen in the interval $(0, V_{max})$. V_{max} is some parameter that can be set to reflect the degree of mobility. Then, the MN continues its journey toward the newly selected destination at the chosen speed. As soon as the MN arrives at the destination, it stays again for the indicated pause time before repeating the process. The traveling pattern of a mobile node using the random waypoint mobility model starts at a randomly chosen point or position [6].

4. THE TRAFFIC AND SCENARIO GENERATOR

Continuous bit rate (CBR) [9] traffic sources are used. The source-destination pairs are spread randomly over the network. The mobility model uses Random Waypoint mobility model in a 1020 m x 1020 m field with network load of 4 packet/s whereas pause time is varied from 5 secs to 40 secs while keeping the network size constant at 100 nodes. Here, each packet starts its journey from a random location to a random destination with a randomly chosen speed. Once the destination is reached, another random destination is targeted after a pause. Simulations are run for 100 simulated seconds whereas Maximum speed is 10 m/s.

5. PERFORMANCE METRICS

Following important metrics are evaluated-

Packet Delivery ratio (PDR) - Packet delivery ratio is calculated by dividing the number of packets received by the destination through the number of packets originated by the CBR source.

Loss Packet Ratio (LPR) - Loss Packet Ratio is calculated by dividing the number of packets that never reached the destination through the number of packets originated by the CBR source.

Routing Overhead - Routing overhead, which measures the ratio of total routing packets sent and the total number of packets sent.

6. SIMULATION SETUP

Simulation has been carried out by Network Simulator 2.33. In our simulation, we have used network load at the rate of 4 packets / s. Network size is kept constant at 100 nodes. Pause Time is increased gradually from 5 sec to 40 secs.

In this simulation we wanted to investigate how the protocols behave with increasing Pause Time.

TABLE 1. EVALUATION WITH VARYING NETWORK SIZE

Parameter	Value
Protocols	AODV, DSR
Simulation Time	100 s
Number of Nodes	100
Network Load	4 Packets / sec
Pause Time	5, 10, 15, 20, 25, 30, 35, 40 sec
Environment Size	1020 m x 1020 m
Traffic Type	Constant Bit Rate
Maximum Speed	10 m / s
Mobility Model	Random Waypoint
Network Simulator	NS 2.33

7. RESULTS AND DISCUSSIONS

During the simulation we have increased the pause time gradually while keeping the network size constant at 100 nodes and recorded the performance of both the protocols. We did this simulation for 100 secs with maximum 8 cbr connections. Readings were taken for different pause times (5, 10, 15, 20, 25, 30, 35, 40 secs). From the results it is evident that as the pause time increases the Packet Delivery Ratio decreases, Loss Packet Ratio Increases and Routing Overhead increases.

8. PERFORMANCE EVALUATION

It can be observed in figure 1 that, throughout the simulation performance of AODV [14] are consistent till Pause time reach 10 secs, and then it shows the drop in the PDR till pause time of 15 secs. Again it shows the great improvement till the pause time reach 20 secs, and then it shows a big drop in performance till the pause time of 30 secs. PDR of AODV is increased drastically as it reaches the pause time of 35 secs and it performs consistently till the pause time of 40 secs. On the other hand, DSR makes a poor start as compared to AODV and reach a good level as it reach the pause time of 10 secs and after that in spite of ups and downs in the performance, it maintains better PDR as compared to AODV till the pause time reach 35 secs. DSR [29] shows a big drop in PDR as it crosses the pause time of 35 secs.

It can be observed in figure 2, that Loss Packet Ratio in AODV is always greater as compared to DSR from the pause time of 10 secs to 35 secs, even though it can be observed that performance of AODV [14] is drastically improved as the pause time exceeds 35 secs., while DSR starts to perform poorly at the same point.

After observing in figure 3, AODV is performing poorly in terms of Routing Overhead [19] factor as compared to DSR until it reaches pause time of 35 secs. Even though DSR performs much better as compared to AODV, until a point where pause time exceeds 35 secs.

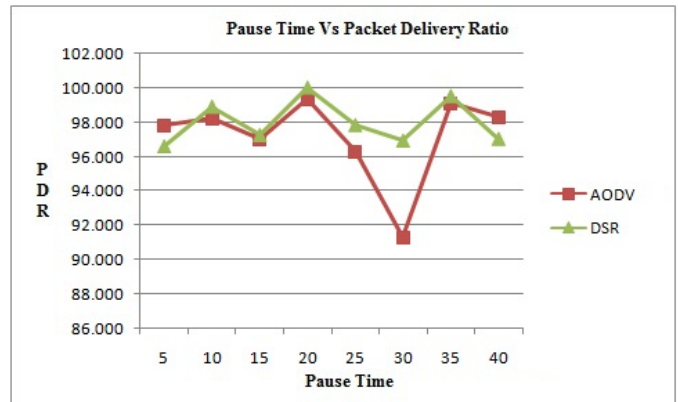


Figure 1: Pause Time Vs Packet Delivery Ratio

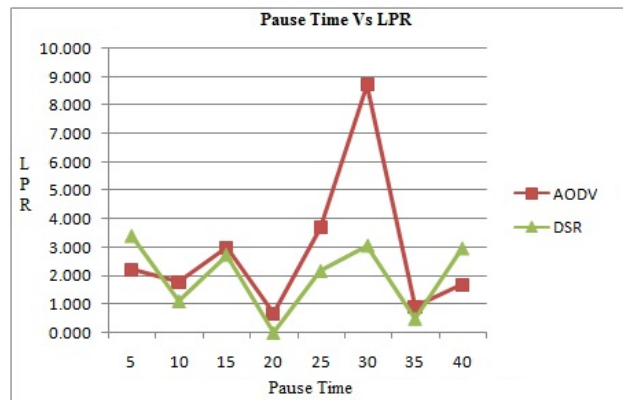


Figure 2: Pause Time Vs Loss Packet Ratio

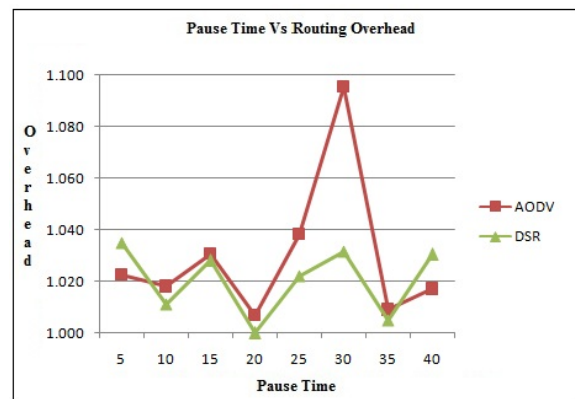


Figure 3: Pause Time Vs Routing Overhead

9. CONCLUSION AND FUTURE WORK

Above results illustrate that the performance of a routing protocols varies widely across different network sizes and hence the study results from one scenario cannot be applied to other scenario. Hence we have to consider the pause time required in an application while selecting a routing protocol. Our simulation results have given an indication that AODV performs better on bigger pause time with given scenario while, DSR is performs better on lesser pause time with the same scenario.

The future scope is to find out what factors are responsible for these simulation results, as performance of AODV in various situations as compared to DSR are not as expected. Further simulation needs to be carried out for the performance evaluation with not only increased pause time but also varying other related parameters like Network size, Network load, Speed, Mobility modes etc.

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