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Simulation Based Analysis of DSR, LAR and DREAM Routing Protocol for Mobile Ad hoc Networks

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Abstract

Mobile ad hoc network (MANET) is an autonomous system of mobile nodes connected by wireless links. 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 a network. These nodes change position frequently. The main classes of routing protocols are Proactive, Reactive and Hybrid. A Reactive (on-demand) routing strategy is a popular routing category for wireless ad hoc routing. It is a relatively new routing philosophy that provides a scalable solution to relatively large network topologies. The design follows the idea that each node tries to reduce routing overhead by sending routing packets whenever a communication is requested. In this work an attempt has been made to compare the performance of three prominent on- demand reactive routing protocols for MANETs:-Dynamic Source Routing (DSR) protocols, Location Aided Routing protocol (LAR), DSR and AODV is a reactive gateway discovery algorithms where a mobile device of MANET connects by gateway only when it is needed. As per our findings the differences in the protocol mechanics lead to significant performance differentials for both of these protocols. The performance differentials are analysed using varying simulation time. These simulations are carried out using the ns-2 network simulator. The results presented in this work illustrate the importance in carefully evaluating and implementing routing protocols in an ad hoc environment.

1. Introduction

Mobile ad hoc networks consist of wireless mobile hosts that communicate with each other, in the absence of a fixed infrastructure. Each node in an ad hoc network is in the network. Since ad hoc networks have proven benefits, they are the subject of much current research. Many unicast routing protocols have been proposed for ad hoc networks. Charge of routing information between its neighbors, thus contributing to and maintaining connectivity of In this paper we provide a detailed, quantitative evaluation comparing the performance of DSR and two location based ad hoc network routing protocols: LAR and DREAM. Simulation results on LAR, DREAM, and other location based protocol sexist on the individual protocols. We compare the simulation results for LAR and DREAM with the Dynamic Source Routing (DSR) protocol, a unicast routing protocol that does not use location information. We have chosen DSR as it performs well in many of the performance evaluations of unicast routing protocols. During implementation, we followed the protocol descriptions provided for LAR and DREAM. At the end of this paper, we give conclusion which summarizes our findings.

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2. Protocols Studied

2.1 Dynamic Source Routing (DSR)

DSR is a source routing protocol which determines routes on demand. It is reactive like AODV which means that it requests a route only when it needs one and does not require nodes to maintain routes to destinations that are not communicating. Source routing means that the source

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must know the complete hop sequence to destination. In DSR each node maintains a route cache, in which all routes it knows are kept. Route discovery is initiated only if the route to destination node cannot found in the route cache. To limit the number of route requests propagated, a node processes the route request message only if it has not already received the message and its address is not present in the route record of the message.

In a source routing protocol, each packet carries the full route (a sequenced list of nodes) that the packet should be able to traverse in its header. In an on demand routing protocol (or reactive protocol), a route to a destination is requested only when there is data to send to that destination and a route to that destination is unknown or expired. DSR uses source routing, i.e. the source determines the complete sequence of hops that each packet should traverse. This requires that the sequence of hops is included in each packet's header. A negative consequence of this is the routing overhead every packet has to carry. However, one big advantage is that intermediate nodes can learn routes from the source routes in the packets they receive. Since finding a route is generally a costly operation in terms of time, bandwidth and energy, this is a strong argument for using source routing. Another advantage of source routing is that it avoids the need for up-to-date routing information in the intermediate is included in the packets. Finally, it avoids routing loops easily because the complete route is determined by a single node instead of making the decision hop-by-hop.

2.2 Location Aided Routing (LAR)

Protocol Overview: Like DSR, LAR is an on-demand source routing protocol. The main difference between DSR and LAR is that LAR sends location information in all packets to decrease the overhead of a future route discovery. In DSR, if the neighbours of *S* do not have a route to *D*, *S* floods the entire ad hoc network with a route request packet for *D*. LAR uses location information for MNs to flood route request packet for D in a request zone instead of in the entire ad hoc network. This request zone is defined by location information on *D*. Two schemes are proposed by author of which are used by intermediate nodes between *S* and *D* to determine the request zone of a route request packet.

In Scheme 1, which we call LAR 1, a neighbour of *S* determines if it is within the request zone by using the location of *S* and the expected zone for *D*. The expected zone is a circular area determined by the most recent location information on *D*, (X_D, Y_D), the time of this location information, (t_0), the average velocity of *D*, (V_{avg}), and the current time, (t_1). This information creates a circle with radius:

$R = V_{avg} \times (t_1 - t_0)$ cantered at $(X_{\mathbf{D}}, Y_{\mathbf{D}})$.

The request zone is a rectangle with *S* in one corner, (X_S, Y_S), and the circle containing *D* in the other corner, (Figure 1).If a neighbour of *S* determines it is within the request zone, it forwards the route request packet further. An MN that is not a neighbour of *S* determines if it is within the request zone by using the location of the neighbour that sent the MN the route request packet and the expected zone for *D* based on the most recent available information. Thus the request zone and the expected zone adapt during transmission.

In Scheme 2, which we call LAR 2, an intermediate MN determines if it is within the request zone if the MN is closer to *D* than the neighbour that sent the MN the route request packet. Specifically, if the distance of the neighbour that sent the MN the route request packet to *D* is S_{dist}, and the distance of the MN that received the route request packet to *D* is C_{dist}, then the MN will forward the route request packet if $C_{dist} \leq S_{dist}$. In both LAR 1 and LAR 2, offers the option to increase or decrease the size of the request zone via an error factor, δ. With this error factor, the above formulas become:

LAR 1: $R = (V_{avg} \times (t_1 - t_0)) + \delta$

LAR 2: $C_{dist} \leq (S_{dist} + \delta)$

Both LAR 1 and LAR 2 include a two stage route discovery method. In the first stage, the route request packets forwarded according to either LAR 1 or LAR 2. If a route reply packet is not received within the route request time out period, then a second route request packet is flooded through the entire ad hoc network. If again a route reply packet is not received within the route request timeout period, then *D* is considered unreachable. If *D* remains unreachable for 30 seconds, packets for *D* are dropped.

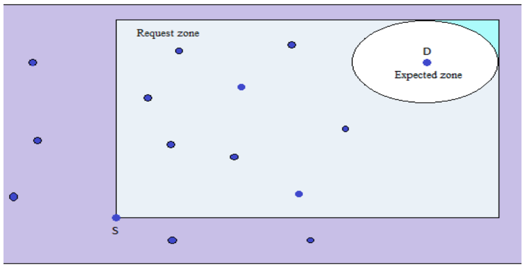

Fig: 1. Request and Expected Zones in LAR

2.3 Distance Routing Effect Algorithm for MANET (DREAM)

The DREAM routing protocol employs a different approach to routing when compared to the routing protocols described so far. In DREAM, each node uses a GPS to know its geographical coordinates. These coordinates are exchanged periodically between each node and stored in arousing table (called a location table). The benefit of exchanging location information is that it consumes less bandwidth than exchanging complete link state or distance vector information, which makes it more scalable than other routing protocols. In DREAM, routing overhead is further reduced, by making the frequency at which update messages are disseminated proportional to mobility and the distance effect. This means that stationary nodes donor need to send any update messages.

Each node maintains a location table to store the position information of other nodes which belong to the network. Each node regularly floods the position or location packet, called control packet, to update the position information maintained by its neighbours. Two algorithms are implemented in DREAM protocol. In first the location information packets are distributed and in second the data packets (messages) are disseminated. The first scheme is based on restricted flooding idea. To restrict the flooding the maximum distance is defined that a position packet can travel. Principle of „distance effect‟ is also used in which the location table update frequency is determined by the distance of registered nodes. In other words, the closer the node, the more updates sent to it. Thus nodes departing far away normally have a more stable relative location relationship. As a result when a node maintains the location information of another node that is far apart, less frequent updates are used. In second algorithm the data packets are disseminated using directional flooding where the source S forwards the packet to all one hop neighbours that are lying in the direction of destination D. To determine the forwarding zone in the direction of D, the source node S calculates the region that is likely to hold D, called the Expected Region (ER) as shown in Figure 1.

The radius r of this expected region is set to the value $(t_1 - t_0)v_{max}$, where t_0 is the timestamp of the position information that S has about D, t1 is the current time, and v_{max} is the local known speed that the node D may travel in ad hoc network. The line between S and D with the angle φ represents the direction towards D. When the source node S wishes to send a message to a destination node D, the position table is checked to retrieve information about its geographical position. If the direction of D is valid, the message is forwarded by S to the all one hop neighbours in the forwarding zone using that direction. If case no one hop neighbour is found in the required direction i.e. no location information is available for D, then a recovery procedure is started by flooding partly or totally the network in order to reach D. When any node receives the data packet and it itself a destination D, an acknowledgement is replies back to the source node regarding message receiving otherwise all other nodes except D replicate the same method by sending it to all one hop neighbours that are in the direction of D. This method is replicated by each of these nodes, until destination D is reached.

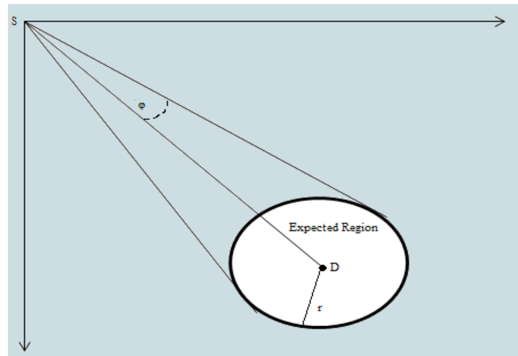

Fig: 2. Expected Region in DREAM

3. Experiments and Results

This section presents the simulation results carried out with the purpose of analyzing the performance of DSR, DREAM and LAR routing protocols. Extensive simulations have been carried out to evaluate and compare the performances of the protocols in MANETs by using the network simulator ns-2 in its version 2.32. It is freely available and widely used for research in mobile ad hoc networks. It is assumed that every vehicle is equipped with GPS and can obtain its current location.

3.1. System Model

The mobility model used is Random way point mobility model because it models the random movement of the mobile nodes. Other parameters are given in Table 1.

Table: 1. Simulation Parameters

Parameters	Value
No. of nodes	10, 20, 30, 30, 40, 50, 60
Simulation Time	1000 sec
Pause Time	5ms
Simulation Area	1000m x 1000m
Transmission Range	250 m
Traffic Size	CBR (Constant Bit Rate)
Packet Size	512 bytes
Packet Rate	5 packets/s
Maximum Speed	20 m/s
Queue Length	50
Simulator	ns-2.32
Mobility Model	Random Waypoint
Antenna Model	Omni Antenna

MAC Type	802.11
Channel	Wireless Channel
Antenna Type	Omni directional
No. of Connections	60% of no. of nodes
Routing Protocol	DSR, LAR, DREAM

3.2 Results and Discussion

The protocols are evaluated for packet delivery ratio, end-to-end delay, and drop packet ratio and routing overhead at varying node densities.

3.2.1 Packet Delivery Ratio

It is the ratio of the data packets delivered to the destinations to those generated by the CBR sources. The PDR shows how successful a protocol performs delivering packets from source to destination. The higher for the value give use the better results.

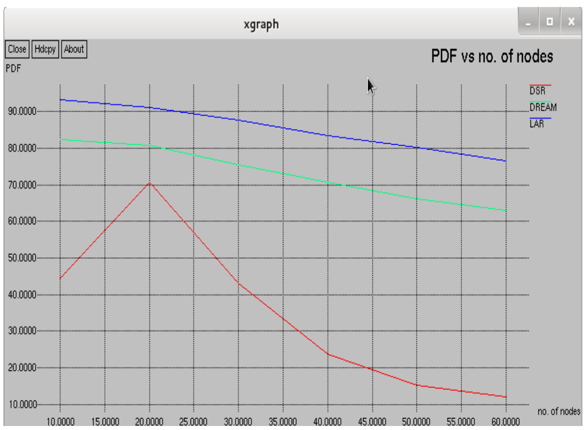

Fig: 3. PDR vs No. of nodes

The result of simulation shows that packet delivery ratio (PDR) of LAR, DREAM and DSR degrades as number of nodes increases. However LAR shows the best result. (Fig: 3).

3.2.2 End-to-End delay

End-to-End delay refers to the time taken by a packet to be transmitted across a network from source node to destination node that includes all possible delays caused during route discovery latency, retransmission delays at the MAC, propagation and transfer times. The protocol which shows higher end-to-end delay it means the performance of the protocol is not good due to network congestion.

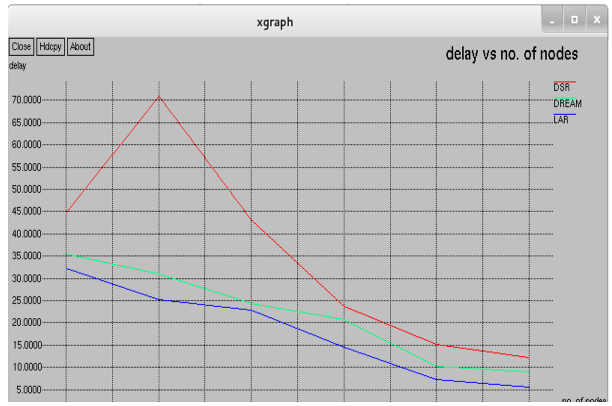

Fig: 4. Delay vs no. of nodes

The result of simulation shows that delay of LAR, DREAM and DSR decreases as number of nodes increases. LAR shows the best result. (Fig: 4).

3.2.3 Overhead

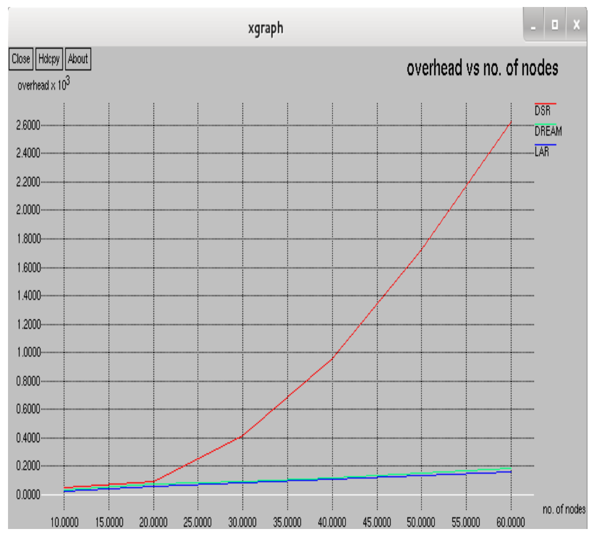

Fig: 5. overhead vs no. of nodes

The result of simulation shows that overhead of LAR, DREAM and DSR increases as number of nodes increases. DSR shows the worst result. LAR and DREAM gives approximately same result (Fig: 5)

3.2.4 Drop Packet Ratio (DPR)

Packet loss occurs when there is a link break and source node is unaware of it and continues to send data. A packet is dropped in two cases: the buffer is full when the packet needs to be buffered and the time that the packet has been buffered exceeds the limit.

Fig: 6. DPR vs no. of nodes

The result of simulation shows that packet drop ratio of LAR is minimum. Packet drop in DSR is too much as number of nodes increases. DSR shows the worst result (Fig: 6).

4. Conclusion

We have compared three routing protocols, namely, Dynamic Source Routing (DSR), Location Aided Routing (LAR); Distance Routing Effect Algorithm for Mobility (DREAM) The simulation of these protocols has been carried out using Ns-2 simulator. It is observed that packet delivery ratio is high in LAR and DREAM than DSR. Also the overhead is less in LAR and DREAM than DSR. Drop packet ratio is also less in LAR and DREAM than DSR. End-to-End Delay is much less in LAR and DREAM than DSR. So on simulation basis we conclude that the LAR routing protocol gives best performance compare to DREAM and DSR routing protocol.

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