Effect of Mobility Model and Packet Size on PDR and Delay in MANET's

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Abstract – Ad-hoc Mobile/802.11 networks are those networks which has got no fixed topology due to the movement of end nodes. Each node within mobile adhoc network can act both host as well as router. For these mobile nodes to be properly functional and operational, routing protocol is required. And for this purpose, studies have being going on, which protocol is better. Little emphasis has been laid on network Performance indicator as which factors is most important for a specific Performance indicator. To the best of our knowledge no one has done the work on effect of different factors on network performance indicators like Packet delivery Ratio, Delay and Throughput and so on, as how much influence a particular factor or group of factors is having on network performance indicators itself Thus, in this work, effect of routing protocol, packet size and node mobility pause time have been evaluated against one of the most important network performance metric i.e. PDR and Delay. The simulation is done on Glomosim simulator by changing the mobility, scenario & Data packet size, it is seen that as the mobility is increased LAR1 performs well in comparison to AODV and DSR. And it is also observe that as the mobility increases their PDR decreases and their delay increases. Secondly, in the scenario with increasing the data packet size the PDR of LAR1 varies while AODV and DSR have no changes and with larger size data delay is increased.

Index Terms – MANET, AODV, DSR, LAR1, PDR, Delay.

1. INTRODUCTION

Mobile Ad hoc Network (MANET) is a self-configuring network of mobile devices and connected by non-wired links. In other words a MANET is a group of wireless mobile computers in which node moves in independent manner in any direction. The nature of MANETs brings a great challenge to system security. In such a network, each mobile node operates not only as a host but also as a router, forwarding packets for other mobile nodes in the network that may be multiple hops away from each other.

Networks can be classified into two forms (i) Infrastructure network and (ii) ad-hoc network. Infrastructure mobile network is that kind of network in which mobile devices depend on some fixed base station and that base station is controlled by other hand is that network, which is completely infrastructure less and does not depend on any base station. This network is a kind of temporary network and is used for emergency purposes like emergency services, military and so on. In this network, nodes move randomly and thus topology gets changed on regular intervals. Also, as mobile devises have certain power limitations there is limited communication range for these mobile nodes and due to this reason, sometimes nodes receive packets or send packets indirectly. Thus, this network is a kind of multiple hop network also due to different routing paths [1].

As nodes are always on the move, there are various mobility models available like random waypoint mobility model, group mobility model and many other mobility models which help us to depict a particular scenario. The purpose of mobility model is that, it gives us the idea during simulation as how can nodes move, for how much time these nodes can stop and wait, what will be the effect of movement by nodes on the performance of network and so on with varying speeds. Together mobility models and routing protocols help us in designing a particular scenario [3].

MANET is a collection of independent mobile nodes that can communicate to each other via radio waves. The mobile nodes that are in radio range [4] of each other can directly communicate whereas others need the aid of intermediate nodes to route their packets. These networks are fully distributed and can work at any place without the help of any infrastructure. The system may operate in isolation, or may have gateways to interface with a fixed network. This property makes MANET highly robust.

2. ROUTING PROTOCOLS FOR MANETS

Most widely used routing protocols for wireless ad hoc networks used in Glomosim simulator [6] available till today are Bellman-Ford, AODV, DSR, WRP, ZRP, FISHEYE and LAR1. All these protocols are constantly being improved by IETF. Since these protocols have different characteristics, the comparison of all performance differentials is not always possible. In this study we have considered three routing protocols AODV, DSR and LAR1.

2.1 Ad-hoc On Demand Distance Vector (AODV)

AODV [5, 6] shares DSR's on-demand characteristics in that it also discovers routes on an *as needed* basis via a similar route discovery process. However, AODV adopts a very different mechanism to maintain routing information. It uses traditional routing tables, one entry per destination. This is in contrast to DSR, which can maintain multiple route cache entries for each destination. Without source routing, AODV relies on routing table entries to propagate an RREP back to the source and, subsequently, to route data packets to the destination. AODV uses sequence numbers maintained at each destination to determine freshness of routing information and to prevent routing loops [5]. These sequence numbers are carried by all routing packets.

An important feature of AODV is the maintenance of timer-based states in each node, regarding utilization of individual routing table entries. A routing table entry is *expired* if not used recently. A set of predecessor nodes is maintained for each routing table entry, indicating the set of neighboring nodes which use that entry to route data packets. These nodes are notified with RERR packets when the next-hop link breaks. Each predecessor node, in turn, forwards the RERR to its own set of predecessors, thus effectively erasing all routes using the broken link. In contrast to DSR, RERR packets in AODV are intended to inform all sources using a link when a failure occurs. Route error propagation in AODV can be visualized conceptually as a tree whose root is the node at the point of failure and all sources using the failed link as the leaves.

The recent specification of AODV [4] includes an optimization technique to control the RREQ flood in the route discovery process. It uses an *expanding ring search* initially to discover routes to an unknown destination. In the expanding ring search, increasingly larger neighborhoods are searched to find the destination. The search is controlled by the Time-To-Live (TTL) field in the IP header of the RREQ packets. If the route to a previously known destination is needed, the prior hop-wise distance is used to optimize the search. This enables computing the TTL value used in the RREQ packets dynamically, by taking into consideration the temporal locality of routes.

2.2 Dynamic Source Routing Protocol (DSR)

The key distinguishing feature of DSR [3, 4] is the use of *source routing*. That is, the sender knows the complete hop-by-hop route to the destination. These routes are stored in a *route cache*. The data packets carry the source route in the packet header.

When a node in the ad hoc network attempts to send a data packet to a destination for which it does not already know the route, it uses a *route discovery* process to dynamically determine such a route. Route discovery works by flooding the network with *route request* (RREQ) packets. Each node receiving an RREQ rebroadcasts it, unless it is the destination or it has a route to the destination in its route cache. Such a node replies to the RREQ with a *route reply* (RREP) packet that is routed back to the original source. RREQ and RREP packets are also source routed. The RREQ builds up the path traversed across the network. The RREP routes itself back to the source by traversing this path backward.1 The route carried back by the RREP packet is cached at the source for future use.

If any link on a source route is broken, the source node is notified using a *route error* (RERR) packet. The source removes any route using this link from its cache. A new route discovery process must be initiated by the source if this route is still needed.

DSR makes very aggressive use of source routing and route caching. No special mechanism to detect routing loops is needed. Also, any forwarding node caches the source route in a packet it forwards for possible future use. Several additional optimizations have been proposed and have been evaluated to be very effective by the authors of the protocol, as described in the following:

- *Salvaging*: An intermediate node can use an alternate route from its own cache when a data packet meets a failed link on its source route.
- *Gratuitous route repair*: A source node receiving an RERR packet piggybacks the RERR in the following RREQ. This helps clean up the caches of other nodes in the network that may have the failed link in one of the cached source routes.
- *Promiscuous listening*: When a node overhears a packet not addressed to it, it checks whether the packet could be routed via itself to gain a shorter route. If so, the node sends a *gratuitous* RREP to the source of the route with this new, better route. Aside from this, promiscuous listening helps a node to learn different routes without directly participating in the routing process.

2.3 Location-Aided Routing Protocol (LAR1)

The Location-Aided routing protocol (LAR) is a reactive (on-demand) routing protocol that uses the location information of the mobile nodes. Location information about nodes is obtained using Global Positioning System (GPS). LAR is advancement over Dynamic Source Routing (DSR) in context of route request packet flooding. In LAR, location information of the mobile nodes are used to flood a route request packet in a forwarding zone only called as request zone instead of the entire ad-hoc network. This request zone is determined by location information of the destination. Routing overhead in an ad-hoc network is reduced by the use of location information; this is one of the advantages of LAR. Complexity of protocol is nullified assuming accurately. A limitation of this protocol is every host requires a GPS device. LAR defines two different types of request zones: LAR Scheme 1 (LAR1) and LAR Scheme 2 (LAR2).

LAR1 [15] schemes use two zones: Expected zone and Request zone

Expected zone

Suppose, source node (S) knows that the destination node (D) was at some position P at time t0 and current time is t1. The expected zone of the node D from the viewpoint of node S is the region that node S expects to have node D at time t1 based on the information that node D was at position P at time t0. The expected zone is only an estimation of node S for determining the possible positions of node D.

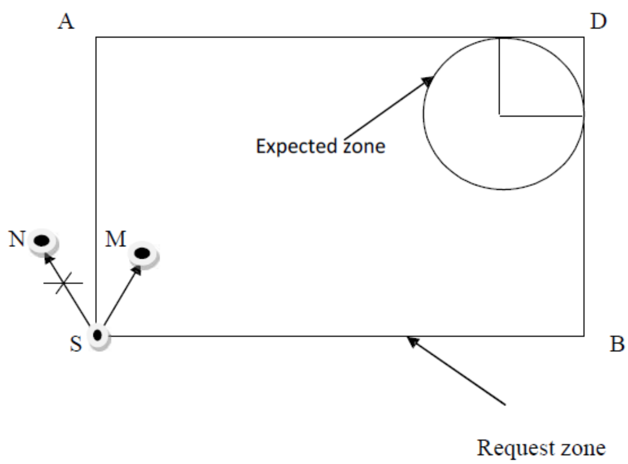

Figure 1: LAR1 routing mechanism

Request zone

Request zone for the route request packet forwarding is determined by the node S. An intermediate node forwards the route request packet only, if it belongs to request zone. The request zone includes expected zone and other surrounding zone around it. Routing mechanism of LAR1 is shown in figure 1. A rectangular shape request zone is the characteristic of LAR1. Once source knows that destination node was at a position (x0, y0) at time t0, expected zone at time t1 is defined by a circle with radius 'R = V(t1-t0)' centered at a position (x0, y0) where V is the average speed with which destination can move. Now a smallest rectangle defines the request zone that includes current source position and expected such that the sides of the rectangle are parallel to the X and Y axis. Source node S determines the four corners of the rectangular request zone and includes these coordinates in the route request packet when initiating the route discovery process. The neighboring nodes which are inside the request zone only forward the route request packet further while the outer nodes just drop the packets. Destination node sends backs a route reply packet with its current location, average speed and time as soon as it receives the route request packet. Node S uses this information for a route discovery process in future.

Location-Aided Routing (LAR1) routing protocol is an on-demand routing protocol which exploits location information. It is similar to Dynamic Source Routing (DSR) Routing protocol, but with the additional requirement of GPS information. In scheme 1 (implemented), the source defines a circular area in which the destination may be located, determined by the following information:

- The destination location known to the source
- The time instant when the destination was located at that position
- The average moving speed of the destination

The smallest rectangular area that includes this circle and the source is the request zone. This information is attached to a ROUTE REQUEST by the source and only nodes inside the request zone propagate the packet. If no ROUTE REPLY is received within the timeout period, the source retransmits a ROUTE REQUEST via pure flooding.

3. RELATED WORK

In one of the paper by Ajay Kumar, Amit Kumar Kar et. al. (2016) title "Performance analysis of AODV, DSR & LAR1 Routing protocols for MANET" published in ACEIT-16 sponsored by IEEE conference in Integral University in March 2016. In this paper author work with AODV, DSR and LAR1 routing protocols with mobility and MAC Layer protocols [1].

In one of the paper by Ankit Chopra and Rajeev G. Vishwakarma (2014) title "Comparison of Ad hoc Reactive Routing Protocols: AODV and DSR with Respect to Performance Parameters for Different Number of Nodes" published in IEEE. The authors have compared performance of two protocols- AODV and DSR different number of source and have concluded which protocol are better [3].

In one of the paper by Ashish Bagrani, Raman Jee, et. al. (2012) title, "Performance of AODV routing protocol with increasing the MANET nodes and its effects on QoS of mobile ad hoc networks," published in IEEE International Conference on Communication Systems and Network Technologies, Shri Mata Vaishno Devi University Katra, India. In this paper the author work with AODV routing protocol with varying the nodes [4].

Most of the routing protocols are qualitatively enabled but lot of simulation studies were carried out in the paper by B. Mohammed [5] to review the quantitative properties of routing protocols. In our study we have compared two quantitative properties(packet delivery ratio and normalized routing overhead) of AODV,DSR and DSDV routing protocols when run over different models constructed by taking four different scenarios including varied mobility in terms of pause time and speed of nodes ,varied traffic connection and varied network size.

From the above mentioned studies, we can conclude that although routing protocols has been compared from each other with respect to performance under different number of nodes. From the above studies I have decided to go through the study of Routing Protocols like AODV, DSR and LAR1 with Respect to Performance Parameters like packet delivery ratio and delay. For our study we choose AODV, DSR and LAR1 routing protocols and two performance metric End-to End delay, Packet Delivery Ratio [2].

4. SIMULATION RESULT

To analyses and simulate the different scenarios for comparison, the Glomosim network simulator [6] is being used. For this firstly the scenario is created then after simulation the results are analyses from the analyses option. In this paper we have used nodes model in which we are varying the pause time and data packet size from 40 to 200 second and 128 to 2048 bits respectively and simulate the network with following parameters as shown in Table 1

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4.1 CASE 1 - Comparison of AODV, DSR & LAR1 by changing the node mobility

In order to compare AODV, DSR & LAR1 on the basis of mobility, random waypoint mobility model is selected for a scenario having 30 nodes and the mobility (pause time) of nodes is gradually increased from 40s to 200s.

In order to compare AODV, DSR & LAR1on the basis of changing the mobility (pause time), random waypoint mobility model is selected for a scenario having 40, 80,120, 160 and 200 second using tertian dimension 2000*2000. 30 nodes are used here and maximum speed is 50 m/s.

From the graph of packet delivery ratio versus mobility in fir 2, it is seen that LAR1has higher PDR in comparison to DSR and LAR1. And here we can see that as we increase the mobility the PDR decreases.

Table 1. Parameters for simulation evaluation

Parameter	Value
Traffic Pattern	CBR
Simulation Time	500 Seconds
Terrain-Dimensions	2000*2000
Number of Nodes	30
Node Placement	Uniform
Mobility	Random-Waypoint
Min. Speed Of Node	0 M/S
Max. Speed Of Node	50 M/S
Pause Time	40, 80, 120, 160 and 200 Sec.
RADIO-FREQUENCY	2.4e9 (in heltz)
RADIO-BANDWIDTH	2000000 (in bits per second)
RADIO-TX-POWER	15.0 (in dBm)
Mac-Protocol	802.11
Routing-Protocol	AODV, DSR, LAR1

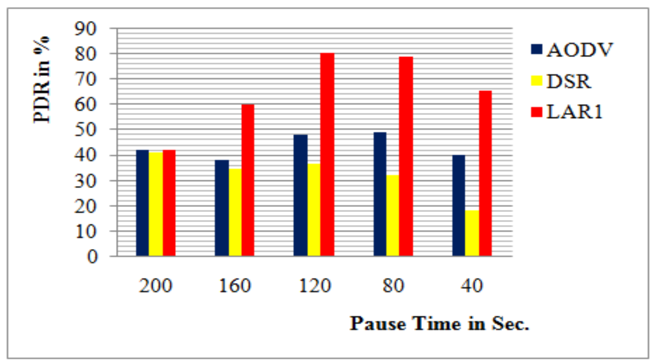

Figure 2. PDR vs. Mobility

From the graph of delay verses mobility, in fig 3, it is seen that AODV and DSR has lower delay in comparison to LAR1. And it is also seen that as we increase the mobility delay is also increasing.

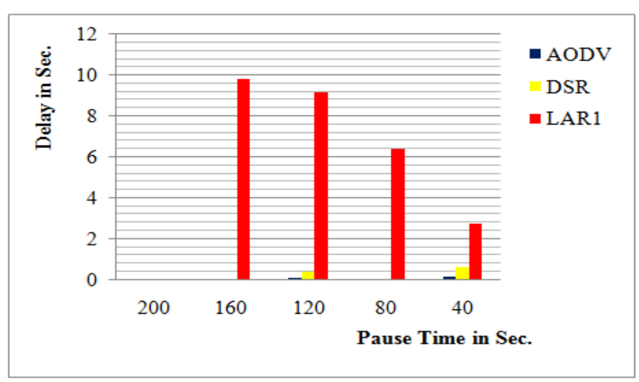

Figure 3. Delay vs. Mobility

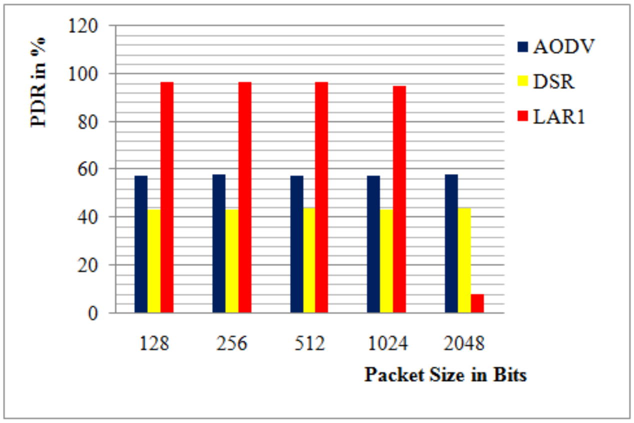

Figure 4. PDR vs. Packet Size

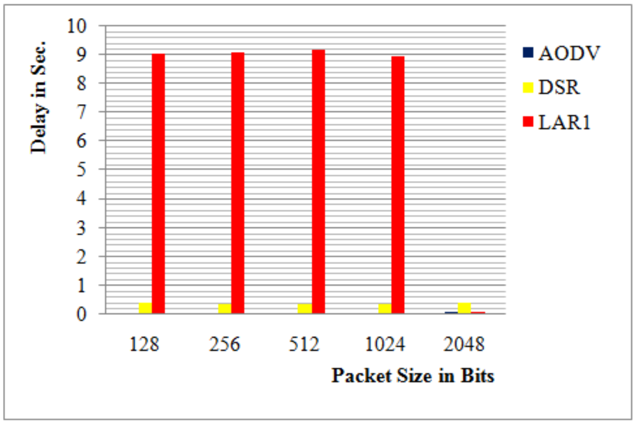

Figure 5. Delay vs. Packet Size

4.2 CASE 2- Comparison of AODV, DSR & LAR1 by changing Data Packet Size

In order to compare AODV, DSR and LAR1 by changing the data packet size from 128 bit to 2048 bits scenario is used.

From the graph of packet delivery ratio versus data packet size in fir 4, it is seen that LAR1has higher PDR in comparison to AODV and DSR. And here we can see that as we increase the packet size the PDR of LAR1 is slightly changed but in case of AODV and DSR it is unchanged.

From the graph of delay verses packet size, in fig 5, it is seen that AODV and DSR has lower delay in comparison to LAR1. And it is also seen that as we increase the data packet size the delay is also increases.

5. CONCLUSION

In this paper, analysis of AODV, DSR & LAR1 routing protocols is done to understand that which one performs well in which set of conditions. Focus is mainly done on the network parameters like packet delivery ratio and end to end delay. By changing the mobility, scenario & Data packet size, it is seen that as the mobility is increased LAR1 performs well in comparison to AODV and DSR. And it is also observe that as the mobility increases their PDR decreases and their delay increases. Secondly, in the scenario with increasing the data packet size the PDR of LAR1 varies while AODV and DSR have no changes and with larger size data delay is increased. LAR1 has larger delay in comparison to AODV and DSR.

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