



A Modified Location Aware Routing Algorithm for MANET

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Abstract: there are many routing protocol used in MANET. In which LAR protocol used to find location of mobile node. The Location-Aided Routing (LAR) protocol is an on-demand scheme. It utilizes location information to limit the route query flooding area. The prerequisite is that every host knows its own location and the global time, which can be provided by a Global Positioning System (GPS). Two scheme are used in LAR protocol i.e. Request zone and Expected zone. This paper has proposed an algorithm for expected zone. Expected zone is divided into four segments and easily finds out destination location. The proposed approach is suitable for both high and low density network. The aims of this paper are easily find the position of node and also find the direction of node using probability distribution function (PDF). Location Aided routing protocol reduce overhead the network so that it needs less calculation to find the location of destination. To implement the Location Aided Routing Protocol (normal), Location Aided Routing Protocol (using PDF) and Dynamic Source Routing protocols (DSR) certain simulation scenario is run. Results show that proposed algorithm increases the throughput in MANET and WLAN. Besides calculating the throughput, proposed approach also enhance data dropped rate, load, and retransmission attempts in ad hoc network.

Keywords: location aware routing, probability distribution function (PDR), routing, LAR, MANET.

I. Introduction

An ad hoc network is an autonomous system which does not need to develop any infrastructure for communication between mobile nodes. It connects to multiple mobile nodes whenever transmission starts for duration of time. Completing the transmission, mobile nodes disconnect from other mobile nodes. A collection of mobile nodes is called mobile ad hoc network which does not require any centralized structures. This type of network introduces a new art of network establishment and it can be well suited for an environment where either the infrastructure is lost or where deploy an infrastructure is not very cost effective. In figure 1.1, there is no base station between mobile nodes. They communicate from each other directly.

Mobile ad hoc network are used in many applications such as, the ad hoc network can be in military area where they can track an enemy tank as it moves through the geographic area covered by the network.

Fig. 1: Mobile Ad Hoc Network



Figure 2: A Wireless LAN



The local community can use an ad-hoc network to search car moving through an intersection, checking the speed and direction of the car. The user can find out the temperature, atmospheric pressure, amount of sunlight and the relative humidity at a number of different locations in an environmental network.

A wireless LAN or WLAN is a wireless local area network in which two or more computers can be link without using wires. WLAN uses spread-spectrum or OFDM (802.11a) modulation technology which is based on radio waves to enable communication between devices in a limited area, also known as the basic service set. WLAN

gives users the mobility to move around within a broad coverage area and still be connected to the network. Now, Wireless LANs have become popular in the home or office due to ease of installation and in commercial complexes offering wireless access to their customers often for free [1]. WLAN structure can be seen in fig.2. In this figure, wireless LAN has access point which can be set as intermediate station between wireless LAN and internet.

LAR is an on-demand or reactive routing protocol. It tries to search for a path from the source to the destination by broadcasting RREQ packets to its neighbors, similar to DSR. But it uses the location information to limit the flooding area of the RREQs [8]. Before the route discovery phase in LAR, the source node defines a circular area called expected zone, in which the destination may be located. The place and size of the circle is decided with the following information:

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

The source node needs to define a *request zone*. Only those MNs propagate the RREQ message which is inside this area. There are two ways proposed to define *request zone*. In Scheme 1, the smallest rectangular area that includes the *expected zone* and the source is the *request zone*. This information is attached to the RREQ by the source and the RREQ is sent out. When an MN receives this packet, it checks whether it is inside the *request zone* and continues to send the packet only if it is. For example, MN_S is the source node, and MN_D is the destination node. MN_S has two neighbors: MN1 and MN2. It is obvious that MN1 is inside the *request zone*, while MN2 is outside the *request zone*. Therefore, MN1 will re-broadcast the RREQ from MN_S while MN2 will drop it instead [6].

In Scheme 2, the source node calculates the distance between the destination and itself. This distance along with the destination location known to the source is included in the RREQ and sent to the neighbors. When the MN receives this packet, it computes its distance to the destination and continues to relay the packet only if its distance to the destination is less than or equal to the distance indicated by the packet. When forwarding the packet, the MN updates the distance field with its distance to the destination.

As it can be observed, LAR is very simple to implement. It helps to reduce the overhead with the available location information. However, LAR uses the location information only to set up the routing path in an efficient way. The data packets are routed with a location-independent protocol. That means just like normal on-demand routing protocols, the MNs still have to store routing tables and need to transmit control messages to keep the routing tables up-to-date [9].

II. Organization of paper

The rest of the paper is organized as follows. Section III describes the proposed approach which includes the proposed work for Location Aided Routing Protocol. It presents a pictorial representation of the proposed work in the form of flowchart. Section IV provides Experimental setup for implementing the routing protocol. This section explains about network simulator and its feature. It describes simulation setup to implement the proposed work. Section V presents simulation result for DSR, LAR and proposed LAR routing protocol. The simulation describes for different scenarios in MANET and wireless LAN. This section also includes performance comparison for both networks. Section VI gives conclusion and future research area on this topic.

III. Proposed approach

The proposed algorithm increases probability to search for a node in one place. This work has proposed an algorithm for the expected zone of LAR protocol. The expected zone is a circular region where the destination may move from the point of view of the source node. This region is divided into four segments because it does not cause interference. The expected zone is not divided into more segments because it can be overlapping between segments and a mobile node also counts two places at the same time. Therefore, it is divided into four sections and easily finds out the destination location.

The proposed algorithm for this work is implemented in OPNET modeler [13]. The OPNET modeler provides an object-oriented based program and also gives a graphics user interface to interact with the program. Basically, the proposed work will be used in mobile ad hoc network and wireless LAN. This paper proposes an algorithm to implement a new location-aided routing protocol for mobile ad hoc network and wireless LAN which gives good results in high and low density networks.

3.1 In the proposed system

- Each host still has a unique ID (such as IP address or MAC address).
- To be location-aware, each mobile host is equipped with a positioning device such as a GPS receiver from which it can read its current location.
- Each node knows their maximum distance for communication, according to their transmitter power.

3.2 Proposed Algorithm

Let a node S has to transmit the packet to destination D, now two possibilities arrives

1. The S knows the coordinates of D. or
2. The S doesn't know the coordinates of D.

The S will transmit the RREQ packet with (source address, source location, destination address, destination location, I_{dd} , I_{loc}) in above mentioned case 2 it will transmit the zero filled data for destination location.

Let an intermediate node I receives the RREQ packet generated by S, now I checks if transmitting range of I is greater than distance between I and S it will drop the packet also if it thinks that according to its node PDF table that there is no node available for forwarding it will drop the packet, else if it knows the location of D it forward the packet to next node with maximum possibility of successful communication based on pre-calculated PDF function and it will add its own address and location with next node address and location.

3.3 Probability Density Function (PDF) Table

In PDF table, each host contains host ID, Destination ID, Route Request message and Location information of Destination node. Whenever node receives route request message, It will update own PDF table. The source node also keeps the information about all neighbors' last location. If neighbor moves in maximum any direction, source node sends route request (RREQ) message to its neighbor in that direction for reaching the destination node.

Table 1: Probability Density Function with RREQ message

Host ID	Destination ID	Location Information	Route Request Message	Probability of moving node
192.168.1.124	192.168.1.25	A block	Hello	4 times in East
192.168.1.134	192.168.1.123	B block	Hi	2 time in north

This table shows that source node S sends RREQ message to its neighbor in east direction to reach the destination node. Because, S keeps the last location information of destination node and own neighbors. Therefore, every node updates the PDF table according to the location of their neighbor's node. Before, sending the RREQ message it check own PDF table where probability is maximum for reaching of destination node, source node transmits packet to the destination.

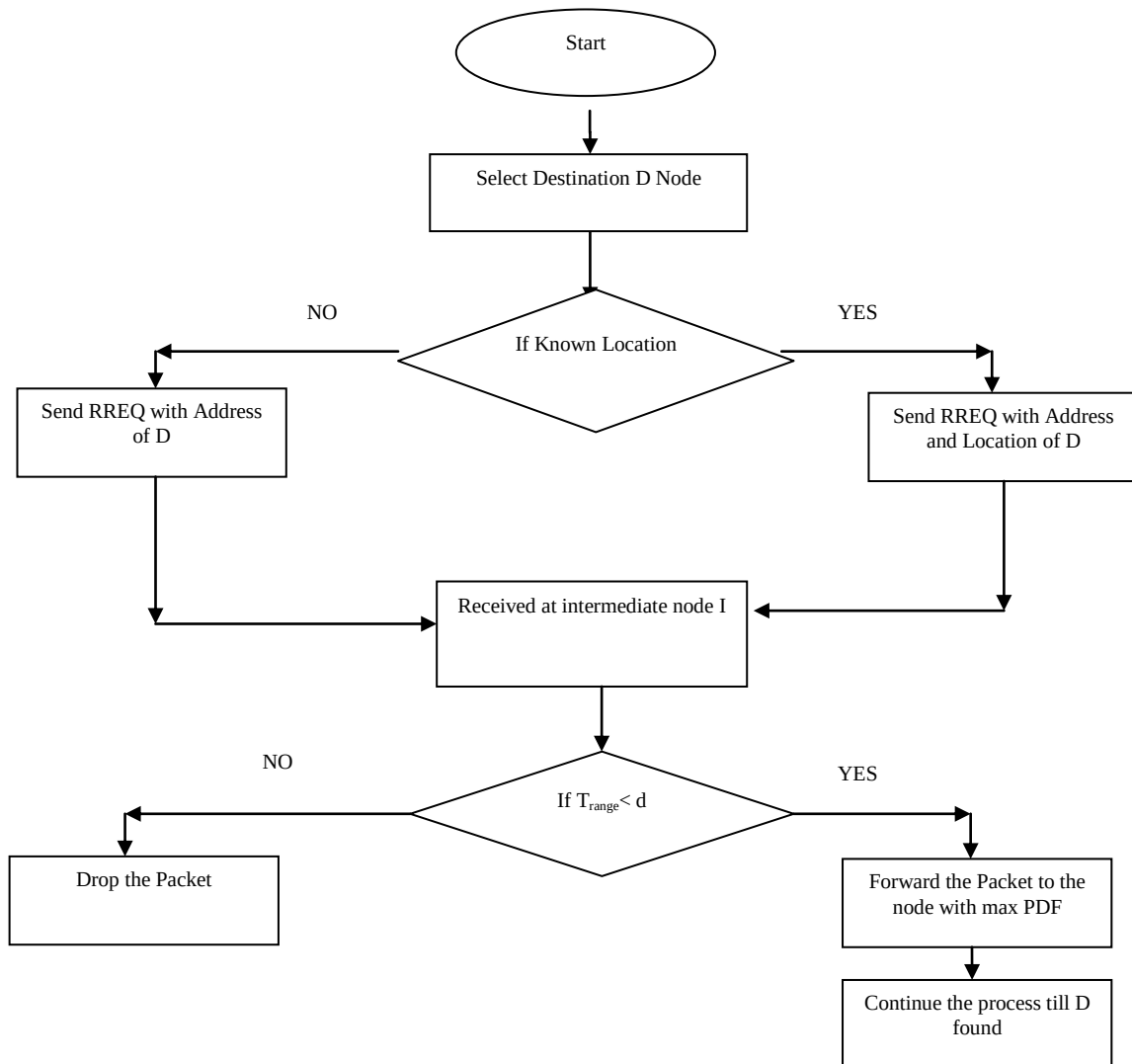
3.4 Flow chart of proposed work

The fig.3 of flowchart presents the description of proposed work. This shows that how to simulate the proposed algorithm. The following step is required to simulate the proposed work which is given below:

1. Consider that source node S wants to transmit packet to the destination node D.
2. The source node selects the destination which has to be transmitted the packet during transmission.
3. If source node knows the location of destination, it sends the RREQ message with Address and Location of D, Otherwise.
4. It sends the RREQ with Address of D.
5. The intermediate node I receives this RREQ packet.
6. If transmitting range of I is greater than distance between I and S it will drop the packet otherwise.
7. The intermediate node I forward the RREQ packet to the destination node with max PDF.
8. The process is continued till the destination node D found.

The above step is repeated until destination node received the RREQ packet and then process is completed. In worst case, if speed of mobile node is increased for transmitting the packet from one mobile node to another node, data packets are lost during transmission.

Figure.3 Flowchart of Proposed Algorithm



IV. Experimental Setup

Network simulation provides a means of testing proposed changes prior to placing them into effect, performing what-if analysis concerning the reliability of key components in a network and the effects of losing a component, planning for future growth, and initial design of a proposed network. The costs associated with the building and operating of a network make simulation a viable option in making choices in the building, modification, and performance analysis of a network.

4.1 OPNET modeler Setup

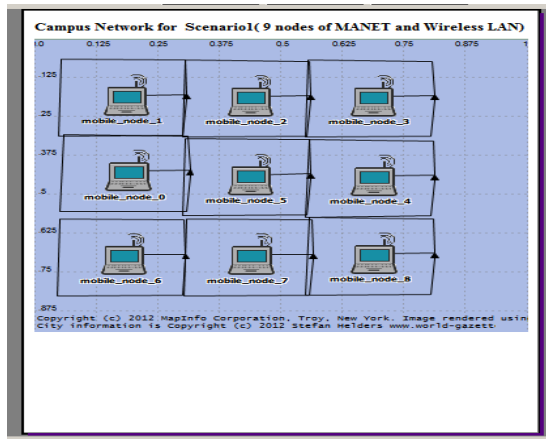
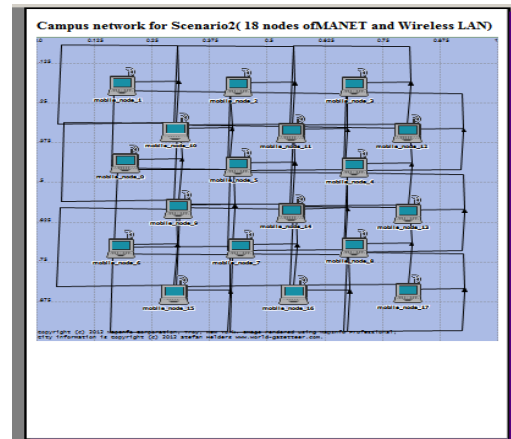
The OPNET modeler has taken two scenarios for 9 and 18 nodes for different simulation parameter. The source is chosen to be a constant bit rate (CBR) source [14]. Each source mobile node generates packets every 0.2 seconds in this study. In other words, each source generates 1 packet per second. Since each packet contains 512 bytes of data, the amount of generated data is $5 \times 512 \times 8 \text{ bit/s} = 20 \text{ kbit/s}$ for each source. The general setting of OPNET modeler is required to implement the proposed algorithm before start the communication between nodes. The simulation setting is given below for both scenarios of 9 nodes and 18 nodes.

4.2 Snapshots of mobile nodes Scenarios setup

Before starting simulation process, OPNET modeler is setup mobile nodes in two scenarios i.e. 9 nodes scenario and 18 nodes scenario. Fig.4 & 5 represent graphical view of 9 and 18 nodes scenarios.

Table 2: General parameter used in simulation process.

Parameter	Value
Transmissionrange	250m
Simulationtime	1hr
Topology size	1km*1km
Number ofmobilenodes	9,18
Traffic type	constantbitrate
Packet rate	1 packet/s
Packetsize	512 bytes
Maximumspeed	10m/s

Figure.4: 9 nodes Scenario Setup**Figure. 5: 18 nodes Scenario Setup**

V. Simulation Results

To be able to implement the Location Aided Routing Protocol (normal), Location Aided Routing Protocol[9] (using PDF) and Dynamic Source Routing protocols certain simulation scenario must be run. This section describes the details of the simulation which has been done and the results of the simulations done for the protocols. The simulations were conducted under window XP platform. There is basic terminology which will be used during showing graph. The commonly used performance indicators in a Mobile Ad-hoc network and Wireless LAN are as follows [3]:

1. **Packet Delay:** Time required getting the complete packet from source node to destination node. The packet delay is used for both MANET and Wireless LAN. Usually, delay is measured in second. The OPNET gives the raw data as well as the graphical form of the data.
2. **Dropped packet:** The mobile node drops the packet until it comes in given transmitter range. Therefore packets are dropped during transmission in wireless LAN. The OPNET has option of keeping track of this occurrence in the network operation.
3. **Load:** It represents all control packets sent by the nodes in the network for the discovering and maintaining the route during the emulation in wireless LAN. Loading ability can be used to compare the scalability, efficiency as well as the competence of adapting network congestion in different networks. Routing protocols with large loading capability have more probability of packet collision and delay.
4. **Media Access delay:** This indicator refers the average time of the packet travelling from the source node to the destination node between layers in wireless LAN network. It includes the buffer delay in the route discovery, the sending delay in the MAC layer and the transmission time. The media access delay presents in seconds.
5. **Retransmission Attempts:** The source node sends the packet to the destination node if packets are lost or dropped during transmission.
6. **Throughput:** It is the total accumulated number of bits that all the destination nodes have received in the wireless LAN station. Actual amount of data is being transmitted in a given time. This figure is generally lower than the channel utilization. Typically, it gives in bit per seconds, Kbit/s, M bit/s.
7. **Routing Traffic Sent and Received:** It refers to the total amount of packet sent and received in the entire network. It represents in bits per second and packets per second. The graph is not generated for this parameter because it does not show comparison for DSR, LAR and proposed LAR protocol.

5.1 SimulationParameters

The other simulation parameter is used in simulation process but graphs are not generated for these parameters [2].

1. *Message Size PDF*: This defines how the message to be transmitted is distributed. It must define this window for both message source and response source. For example, if message size distribution is uniformly distributed between 10K byte and 20 Kbytes, the average message size transmitted will be 15K byte, and the range of the messages sizes generated to be transmitted will range from 10Kbyte to 20Kbyte.
2. *Buffer (input and output)*: The temporary storage for the data either just received or ready to be transmitted. The buffer may be physically a storage device such as hard drive, or RAM.
3. *Inter arrival rate and Inter arrival PDF*: Interarrival rate is the average rate at which message source is generated in terms of seconds (default). For example, interarrival rate of 10seconds means that a new message is generated every 10 seconds.
4. *Inter-arrival*: Literally means between arrival and time between successive arrivals. Another word, how long can wait before next message arrives to be transmitted.

5.2 Simulation Results for Mobile Ad Hoc Network

We established two simulation ad-hoc networks with 9 nodes and 18 nodes respectively with LAR, DSR and modified LAR (MLAR) routing protocol. Both networks were running and the simulation time is one hour.

5.2.1 Delay versus Simulation time

A figure 6 and 7 shows that while using number of nodes 9 in MANET, LAR proposed Protocol has minor delay during simulation process as compare to DSR and LAR protocol. While number of node is increasing in MANET, delays are increased.

Figure. 7: Delay in MANET for 18 nodes

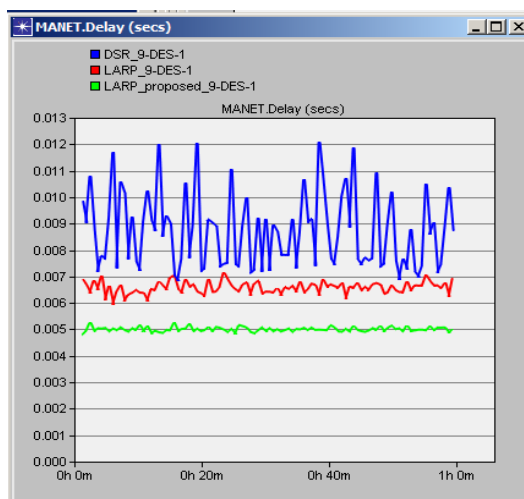
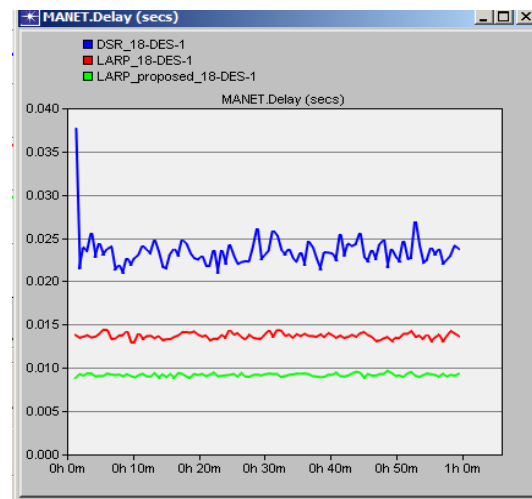


Figure. 6: Delay in MANET for 9 nodes

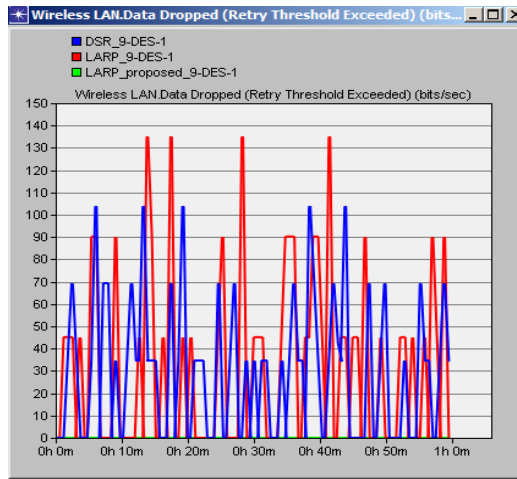
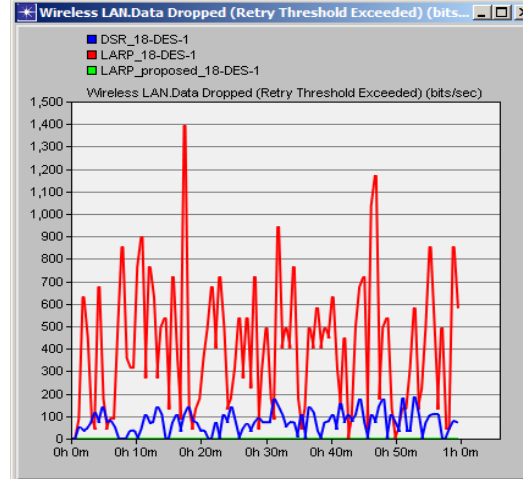


5.3 Simulation Results for Wireless LAN

We established two scenarios for low density network and high density network in wireless LAN. These graph presents simulation for DSR, LAR and LAR proposed protocol [10]. It shows that how changes dropped rate for less or more nodes are communicated in network.

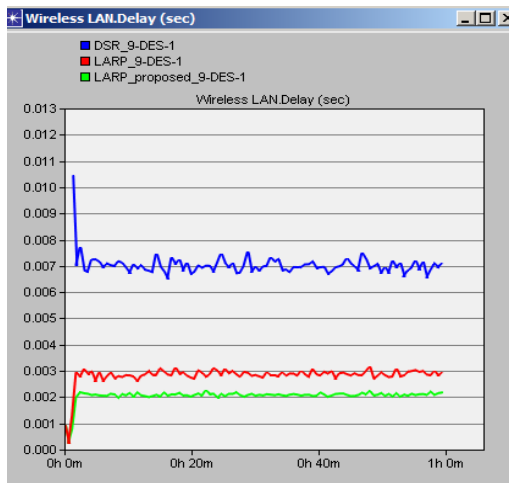
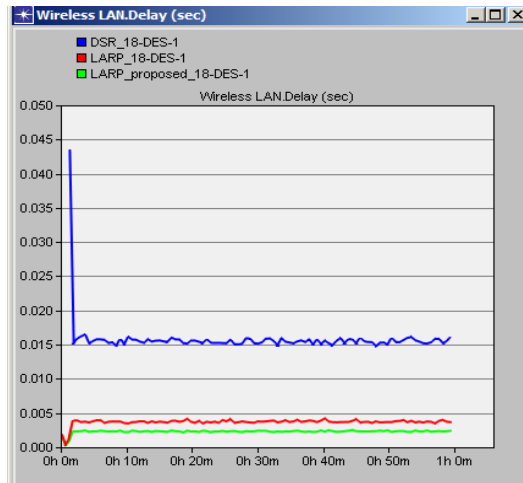
5.3.1Dropped rate versus simulation time

Figure 8 and 9 shows that data dropped rate for 9 and 18 nodes are rising and falling in DSR and LAR routing protocol. While increasing the number of node in wireless LAN Data dropped has maximum for LAR routing protocol as compare to DSR protocol. In both cases, number of nodes is increasing in Wireless LAN data never dropped in LAR proposed protocol. The blue line shows graph for DSR, the red line shows graph for LAR protocol and the green line shows the graph for LAR proposed protocol.

Figure.8: Data dropped in wireless LAN for 9 nodes

Figure.9: Data dropped in wireless LAN for 18 nodes


5.3.2 Delay versus simulation time

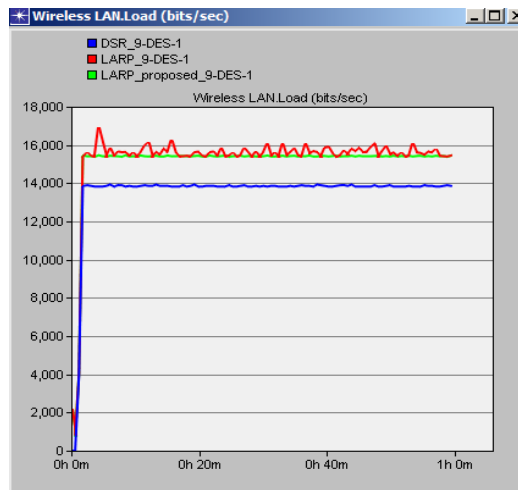
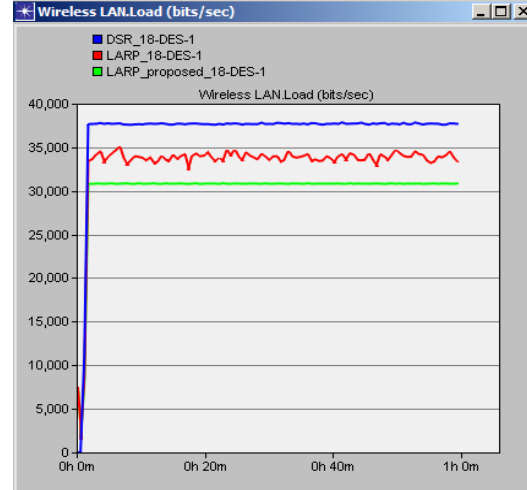
This graph presents the delay in transmission and receiving the packet in network of wireless LAN. This graph also indicates that what changes comes while increasing the number of nodes in wireless LAN or high density networks.

Figure.10: Delay in wireless LAN for 9 nodes

Figure. 11: Delay in wireless LAN for 9 nodes


A figures 10 and 11 show that while increasing the number of node in wireless LAN network data delay in DSR routing protocol is greater than LAR and LAR proposed protocol. Data delay is decreasing in both LAR and LAR proposed protocol when numbers of node are increased in wireless LAN network. It shows that LAR and LAR proposed protocol is better than DSR for wireless LAN.

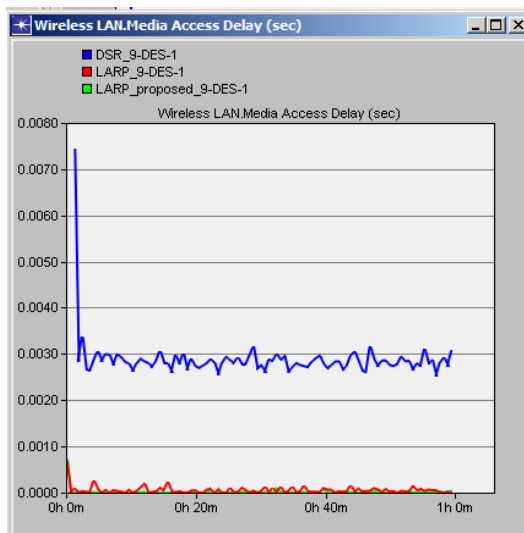
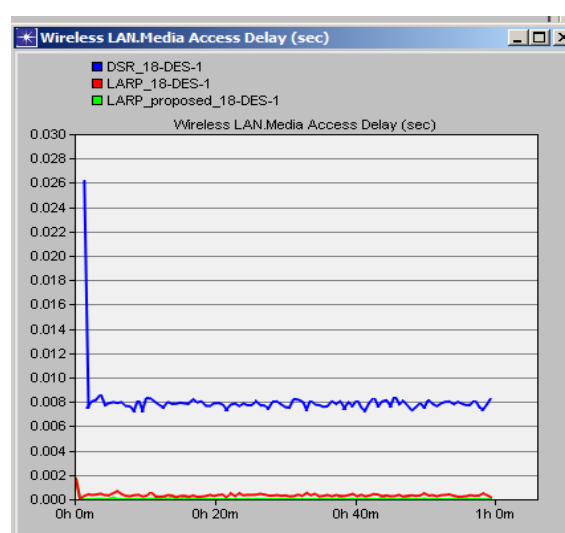
5.3.3 Load versus Simulation Time

Normally, load is defined in wireless LAN while network route overhead is increased during transmission. It means that packets is not transmitted or received during transmission from one node to another node. A figure 12 and 13 illustrates that data packet load for each node is constant after a moment in DSR protocol. Data load is increasing in LAR protocol when numbers of node are less in wireless LAN. While nodes are increasing in network, data load is decreased in LAR protocol. LAR proposed Protocol has constant data load for both cases.

Figure 12: Load in wireless LAN for 9 nodes**Figure 13: Load in wireless LAN for 18 nodes**

5.3.4 Media Access Delay versus Simulation Time

Media Access Delay (MAD) is defined as a delay between layer to layer for communication in wireless LAN. In this paper media access delay compared simulation time for DSR, LAR, proposed LAR routing protocols in wireless LAN.

Figure 14: Media access delay in wireless LAN for 9 nodes**Figure 15: Media access delay in wireless LAN for 18 nodes**

In figure 14 and 15, media access delay of LAR proposed protocol is less than DSR and LAR routing protocol. While nodes increase in wireless LAN network, media access delay of DSR protocol also decreased. It means that LAR proposed protocol is better than for transmission of packet in network.

5.3.5 Retransmission Attempts versus Simulation Time

For wireless LAN data transmission system, retransmission attempts are compared for three routing protocol DSR, LAR and proposed LAR routing protocol. Retransmission attempts defined as a number of packets transmitted after failure of receiving packets. Therefore, packets are retransmitted from source node to destination node.

A figure 16 and 17 show that packets retransmission attempt in DSR protocol is lower than LAR and LAR proposed protocol. Packets retransmission attempt is varying between from 1.2 to 1.4 in LAR proposed protocol. While packet retransmission attempt in LAR protocol is higher than both protocol i.e. DSR and LAR protocol. It means that DSR does not forward packets to neighbor node if transmission is failure.

Figure. 16: Retransmission attempts in wireless LAN for 9 Nodes

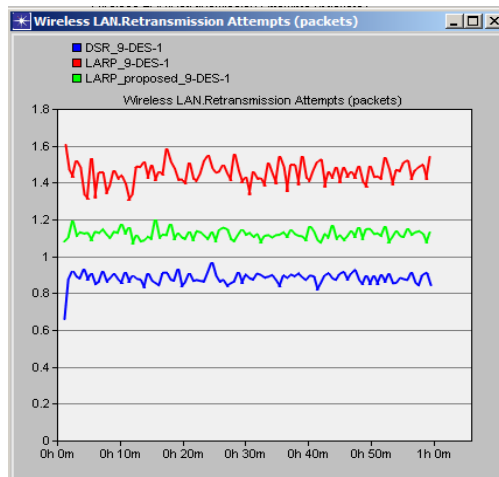
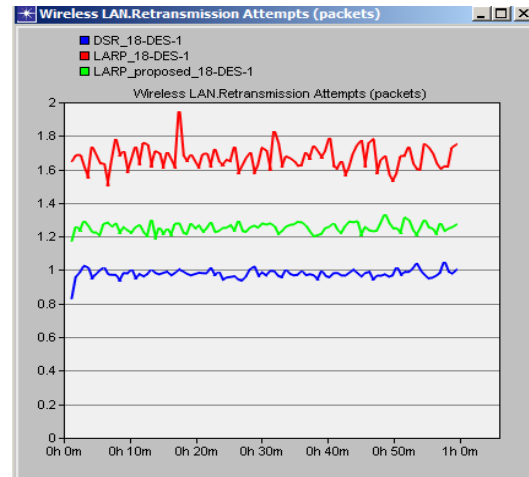


Figure. 17: Retransmission attempts in WLAN for 18 nodes



5.3.6 Throughput versus Simulation Time

Throughput is compared with simulation time in OPNET modeler. Throughput means actual amount of data is successfully transmitted in given time. If throughput is high, it gives better results for wireless LAN. Throughput graph represents for three routing protocol namely DSR [5] , LAR and proposed LAR. If throughput is low, the system gives poor result. Therefore, Throughput should be high as possible as for any system.

Figure 18 and 19 shows that while increasing the number of nodes in wireless LAN, throughput of LAR proposed protocol is also increased as compare to DSR and LAR protocol. The both figure 1 and 2 shows that DSR protocol has decreased throughput while number of nodes are increased in wireless LAN. Therefore, LAR proposed protocol is suitable for wireless LAN.

Figure.18: Throughput in wireless LAN for 9 nodes

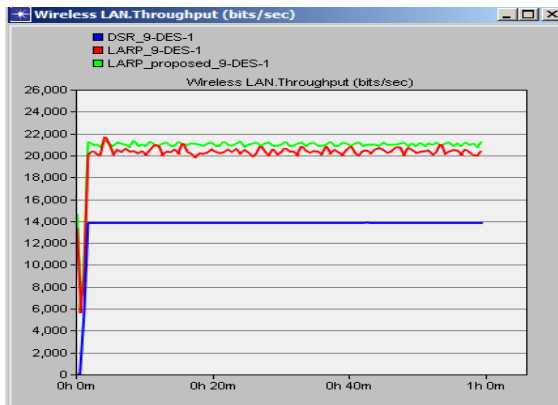
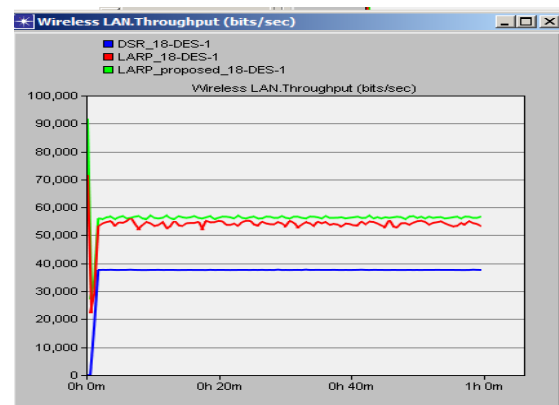


Figure.19: Throughput in wireless LAN for 18 nodes



5.4 Performance Comparison of MANET and WLAN

In this work I have compared two different scenarios for MANET and Wireless LAN with DSR, LAR and LAR Proposed Protocol on basis of simulation parameter. The first table presents comparison of three protocols for 9 nodes. This table shows that number of nodes is less in MANET and Wireless LAN for changing effect [15]. The first table 3 represents performance comparison for different simulation parameters. The second table 4 presents comparison for 18 nodes. This table shows the changes in MANET and Wireless LAN while increasing the number of nodes in both networks. The paper is implemented in OPNET modeler for three routing protocol i.e. DSR, LAR and proposed LAR by using various simulation parameters for two scenarios i.e. 9 nodes scenarios and 18 nodes scenarios in MANET and Wireless LAN. The proposed LAR has minimum delay in MANET for 9 nodes scenarios as well as 18 nodes scenarios as compared with DSR and previous LAR protocols. Media Access Delay is also same for both type scenarios for proposed LAR protocol. In case of data dropped rate for 9 and 18 node scenarios, the proposed LAR does not drop data as compared to DSR and previous LAR in wireless LAN.

Table 3: Performance comparison for 9 nodes

Network	Parameter	DSR	LAR	Proposed LAR
MANET	Delay (sec)	Maximum	Medium	Minimum
Wireless LAN	Data Dropped (bits/sec)	Medium	Maximum	No change
	Delay (sec)	Maximum	Medium	Minimum
	Load (bits/sec)	Low	High	Moderate
	Media Access Delay (sec)	Maximum	Minimum	No delay
	Retransmission Attempts (packets)	Minimum	Maximum	Medium
	Throughput (bits/sec)	No change	High	High

Table 4: Performance comparison for 18 nodes

Network	Parameter	DSR	LAR	Proposed LAR
MANET	Delay (sec)	Maximum	Medium	Minimum
Wireless LAN	Data dropped (bits/sec)	Medium	Maximum	No change
	Delay (sec)	Maximum	Minimum	No delay
	Load (bits/sec)	High	Moderate	Low
	Media Access Delay (sec)	Maximum	Minimum	No delay
	Retransmission Attempts (packets)	Minimum	Maximum	Medium
	Throughput (bits/sec)	No change	High	High

Load is changed for these protocols for both scenarios in wireless LAN. DSR does not retransmit data packet if transmission is fail as compare to LAR and proposed LAR. In both scenarios i.e. 9 and 18 nodes, throughput is always high for LAR and proposed LAR in wireless as compare to DSR [7].

VI. Conclusion and Future Work

The work has implemented routing protocols, modified LAR proposed for different scenarios in the OPNET simulation environment. The paper is implemented for both type network namely MANET and Wireless LAN. It found that DSR, LAR is not better for high density network like Wireless LAN. While number of nodes is less in Ad hoc network, DSR and LAR are good for transmission of packet [12]. Whenever increasing the number of nodes in Ad Hoc network, DSR and LAR protocol does not get well results.

During simulation process, found that delay is less in LAR proposed protocol for low density network as well as high density network. DSR indicates maximum delay for both networks. LAR indicates medium delay in low density network and less delay in high density network.

When data is transmitted from source node to destination node, data dropped rate is maximum in case of LAR protocol as compare to DSR because it does not search the location of destination node. Therefore, packet is always dropped during transmission. In DSR, data dropped rate is medium because it broadcasts the packet to all node which in network and it ensures that packets are reached to the destination. Likewise, in proposed protocol does not drop any packet during transmission. When it sends the packet to destination, it does not forward next packet until it receive acknowledgement from destination. So, it is little chance to drop the packet. While number of nodes is less in wireless LAN, these protocols have different results. In case of DSR and LAR protocol has maximum delay to sending and receiving the packets from source node to destination node. Beside this LAR proposed protocol has no delay or less delay to sending and receiving packets. On the other hand, the number of nodes is increasing in wireless LAN; DSR has maximum delay in network. LAR protocol decreased delay while number of node is increased in wireless LAN. The proposed protocol does never delay in wireless LAN even number of nodes are increased or decreased in wireless network.

While load is increased in wireless LAN, proposed LAR protocol remains constant. It does effect on this protocol for increasing or decreasing number of node in network. In LAR and DSR protocols, load is less while number of nodes is less in network and increasing the number of nodes is wireless LAN, load also increased.

In wireless LAN, number of nodes is increased or decreased, media access delay will always maximum or less in case of DSR and LAR protocol. Media access delay will always constant in proposed protocol so it is better for low or high density network.

Retransmissions of packets will less in DSR protocol whenever nodes are less or more. When data transmission is failed in LAR protocol for high or low density network, it sends continue packets from sender to destination node without receiving acknowledgement of packet because it wait for time bound.

The basic LAR may be optimized to improve its performance. The proposed algorithms limit the request zone which results in reducing the route request overhead. Simulation results indicate that can reduce the routing overhead using alternative definition of request zone as compared to LAR algorithm especially for dense and highly dynamic ad hoc networks. Several other optimizations are possible to achieve more efficient performance of the basic LAR (enlarging the request-zone area after the failure of a route-request rather than using the flooding algorithm, adaptation of the request-zone area according to node density, using directional antenna, etc.) and are intended to be dealt with and evaluated in the future works.

Future work includes developing a method to adaptively use one of the forwarding methods of the position-based routing protocol based on the surrounding environments, and dividing the network into a number of areas that varies dynamically based on the node mobility pattern.

Further, it introduces the concept of anchors, which are geographical points imagined by sources for routing to specific destinations, and proposes low overhead methods for computing anchors. Last, a special form of restricted search mode (Restricted Local Flooding, RLF), solves problems due to the inaccuracy of location information, in particular for control packets

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