Analysis and Comparison of Modified LAR1 (MYLAR1) Routing Protocol with LAR1, OLSR INRIA, DSR, ZRP, and OSPF v2

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ABSTRACT

In our previous work we created a new ad hoc routing protocol MYLAR1, by modifying LAR1 routing protocol. The previous work showed that MYLAR1 routing protocol showed better performance as compared to LAR1 routing protocol in performance parameters such as: end to end delay, throughput, jitter and packets received without error. This paper discusses the comparison of MYLAR1 with other ad hoc routing protocols such as OLSR INRIA, DSR, ZRP, OSPF v2 and original LAR1 routing protocol. The results show that MYLAR1 routing protocol performs better as compared to other ad hoc routing protocols. QualNet 6.1 Network Simulator is used to simulate the proposed work.

Keywords

MYLAR1, LAR1, OLSR INRIA, DSR, ZRP, OSPF v2

1. INTRODUCTION

In recent times communication is moving from wired to wireless. There has been a boom in the ad hoc wireless communication systems which do not require infrastructure like cellular communication. MANET (Mobile ad hoc network) is an example of a communication system which has the capability to self organise and its nodes (or workstations) communicate via multi hop [1]. Since the component nodes of a MANET are mobile, the network continuously changes dynamically. A number of ad hoc routing protocols have been developed for a successful and efficient communication between different nodes in an ad hoc network. There are three categories of ad hoc routing protocols: flat routing, hierarchical routing and geographical position assisted routing [2]. Flat routing can be further sub-divided into two categories: pro active (table driven) routing and reactive (on demand) routing. In flat routing scheme, equal role is played by each node and scheme of flat addressing is utilised. Proactive routing involves exchange of background routing information by all the nodes in the network. Examples of proactive routing are FSR, FSLS, OLSR, TBRPF etc. Reactive routing is very popular in wireless ad hoc routing scheme category. The basic concept of reactive routing is that all the nodes in the wireless ad hoc network try to reduce the routing overhead by sending routing packets only when communication between any two or more nodes is to take place. Examples of reactive routing are AODV, DSR etc. Hierarchical routing involves nodes in the network organised in groups and each node different functions outside and inside the group. The update packet size and the routing table size of component nodes of the network decreases significantly by including the nodes in only to a part of the network rather than the whole network. This reduces the control overhead in wireless ad hoc hierarchical routing. Examples of hierarchical routing are HSR, CGSR, ZRP, LANMAR etc. Geographic position assisted routing involves transfer of messages using geographical position and other physical parameters (such as velocity etc.) of nodes rather than the logical position only. Examples of geographic position assisted routing are GeoCast, LAR, DREAM, GPSR etc. In this work our modified LAR1 routing protocol (MYLAR1) from our previous work [4] had been analysed and compared with the ad hoc routing protocols from each of the above told categories. MYLAR1 is compared with OLSR INRIA (a pro active routing protocol), DSR (a reactive routing protocol), ZRP (a hierarchical routing protocol) and the original LAR1 itself (a geographical position assisted routing protocol). OSPF v2 is also compared with MYLAR1 and other ad routing protocols. QualNet 6.1 is used in this work to compare the ad hoc routing protocols. QualNet 6.1 is a network simulator that mimics the behaviour of a real network [12].

2. WIRELESS AD HOC ROUTING PROTOCOLS

2.1 MYLAR1

MYLAR1 is the modification of original LAR1 routing protocol which was done in our previous work [4] and resulted in improvement of the original LAR1 routing protocol. In this routing protocol rather than using original three types of routing packets: route request, route reply and route error packets, four types of routing packets: route request, modified route request, route reply and route error packets are used. When communication is to take place modified route request packets are used. The original route request packets are used when the path for data flow is broken. The modified route request packet is different because redundant fields like flooding variable and zone variable are absent in its frame format. Even in the original route request packet flooding variable is removed. Due to the absent fields in the route request frame format the overload of the network decreases increasing the overall efficiency of the network. To avoid too much flooding of routing packets only those nodes where RSS>-85dBm the routing packets will be send.

2.2 LAR1

LAR1 (Location Aided Routing scheme 1) is a reactive, position and velocity based routing protocol. The nodes in the network use GPS (Global Positioning System) location of the nodes to transfer data from one place in the network to another. If a node in the network wants to communicate with another node in the network first a wireless communication link needs to be established. LAR1 uses route request, route reply and route error packets to establish and re-establish (when the communication link breaks due to some error) communication link. First the source node calculates the expected zone which is the area where the destination node could be found. Expected zone is a circular area calculated on the basis of previous location and average velocity of the

destination node. Based on the expected zone a smallest possible rectangle is estimated containing the expected zone circle and the source node with farthest most corner of the rectangle as shown in Fig. 1. The rectangular area is called request zone. The route request packets are flooded only in the request zone, if a node outside the request zone receives a route request packet it will simply drop the route request packet. For example as shown in Fig. 1 if node M receives the route request packet from source S it will process the packet further since it lies inside the request zone, however if node N receives the route request packet it will simply drop the packet.
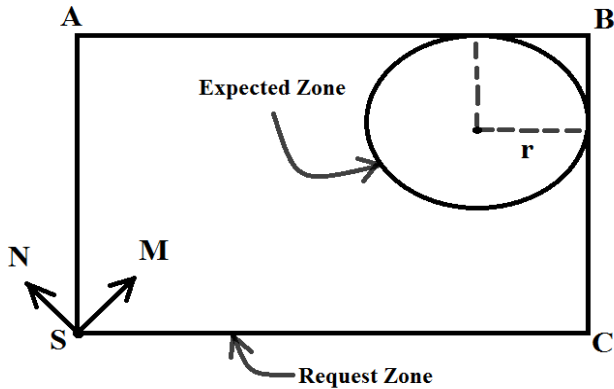

Fig 1: LAR scheme 1

2.3 OLSR INRIA

OLSR (Optimised Link State Routing) was developed by French National Institute for Research in Computer Science and Control (INRIA). OLSR was created for mobile ad hoc networks. OLSR functions in a pro active and table driven manner; hence topology information is exchanged between all the nodes on a periodic basis. The primary goal of this protocol is to minimize as far as possible the control traffic. To do this the tropical information is flooded by only a group of small number of nodes called Multi Point Relays (MPR). MPRs are used when an optimal route needs to be calculated from source to destination. OLSR is well suited for large and dense network.

2.4 DSR

DSR (Dynamic Source Routing) is a reactive or on demand routing protocol. It is designed mainly for use in wireless ad hoc multi hop networks of mobile nodes. It is quite similar to LAR1. It builds the route on demand when a node in the network wants to communicate by simply flooding the route request packets without the prior knowledge of any known route. DSR may use a set of optimizations to route the packets more efficiently and reduce the control overheads.

2.5 ZRP

ZRP (Zone Routing Protocol) is a hierarchical ad hoc routing protocol. It is a hybrid routing protocol which divides the network into overlapping zones. It runs independent protocols between and within the zones created. ZRP uses IERP (Inter zone Routing Protocol) for inter zone routing; IARP (Intra zone Routing Protocol) for intra zone routing and BRP (Bordercast Resolution Protocol) is used to optimize the routing process between the perimeter nodes. IARP is a pro active routing protocol used inside a zone. It can also be used as a standalone mode. IERP is used to discover a route to remote nodes outside the zone of the node. It can also be used as a standalone routing protocol. It is an on demand or

reactive routing protocol. BRP is used to efficiently flood broadcast packets throughout the network. It is not a full featured routing protocol.

2.6 OSPF v2

OSPF (Open Shortest Path First) is a link state routing protocol. OSPF is defined as OSPF v2 in RFC 2327 (1998) for IP v4. It is designed to be run to a single autonomous system. Each OSPF router maintains an identical database describing the autonomous system's topology. From this database, a routing table is calculated by constructing a shortest path tree. OSPF recalculates routes quickly during topological changes, using a minimum of routing protocol traffic.

3. SIMULATION PARAMETERS

Table 1. Simulation Parameters

Parameter Name	Parameter Value
Terrain Size	1500m×1500m
Channel Frequency	2.4 GHz
Number of Nodes	100
Physical Layer	IEEE 802.11b
Network Layer	IP v4
Mobility Model	Random Waypoint
Simulation Time	30s
No. Of Packets Sent	24 per CBR
Minimum/Maximum Speed	0, 5, 10, 15, 20 m/s
Pause Time	0 s

The above mentioned simulation parameters are used to compare the ad hoc routing protocols. 5 CBR (Constant Bit Rate) applications between 5 different pairs of nodes are used. The performance parameters i.e. messages received, end to end delay, throughput and jitter are the average of the performance parameters between these 5 pairs.
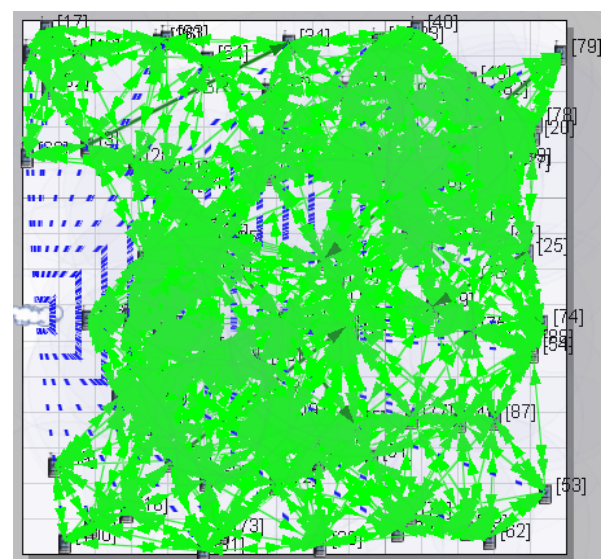

Fig. 2: A simulation canvas running on QualNet 6.1 using MYLAR1 with 100 nodes and 5 CBR

4. RESULTS
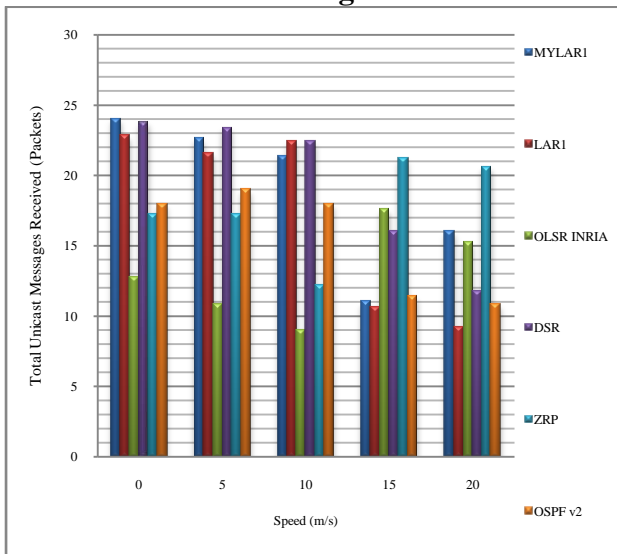## 4.1 Total Unicast Messages Received

Fig. 3: Total Unicast Messages Received

Total unicast messages received is the total number of unicast messages received (messages received without error) from the beginning of simulation up to the time specified in the timestamp column by all unicast session receivers. From the scenario we see that 24 message packets were send from sender to receiver. From Fig. 3 we observe that MYLAR1 performs significantly well up to 10 m/s but above this speed the performance significantly degrades. It is to be noted that up to 10 m/s DSR performs the best but above 10 m/s its performance degrades. At speed above 10 m/s ZRP excels.
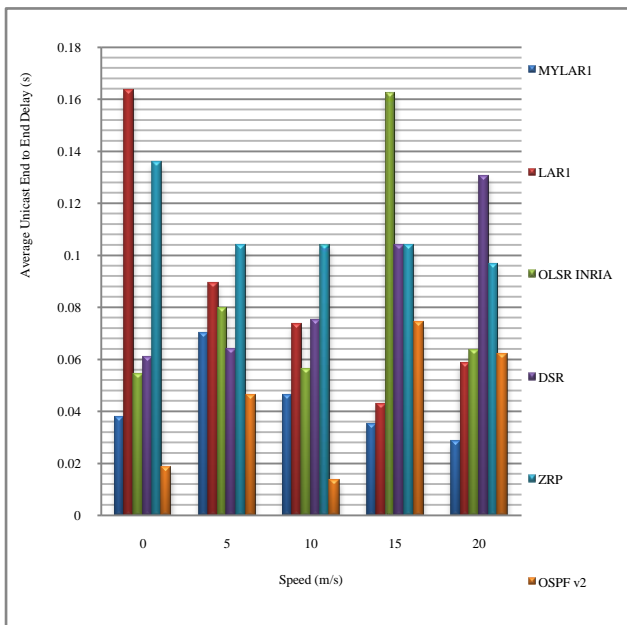
4.2 Average Unicast End to End Delay (s)

Fig. 4: Average Unicast End to End Delay (s)

Average unicast end to end delay is the overall average unicast message delay from beginning of simulation up to the time specified in the timestamp column. Fig. 4 shows that MYLAR1 performs far better than LAR1 and best above 10 m/s.

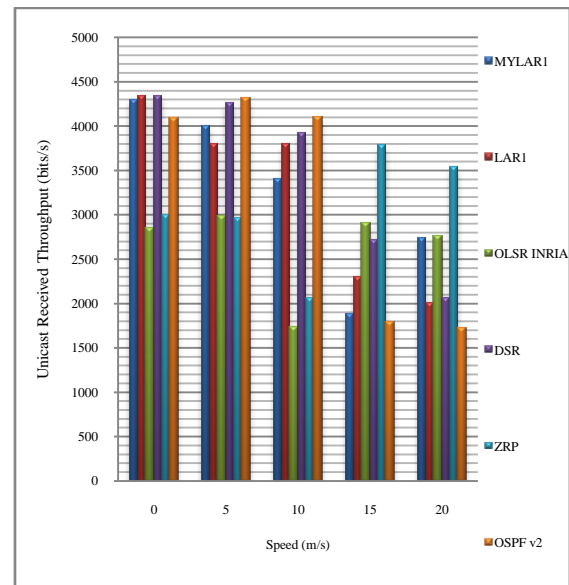## 4.3 Unicast Received Throughput (bits/s)

Fig. 5: Unicast Received Throughput (bits/s)

Unicast received throughput is the rate of successful delivery of packets at the receiver. MYLAR1 performs fairly well but at speed greater than 10 m/s ZRP outperforms other routing protocols by a significant margin.

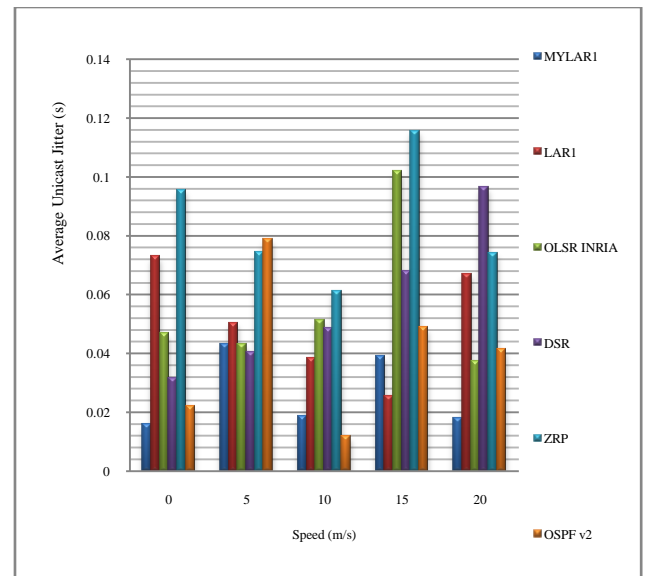## 4.4 Average Unicast Jitter (s)

Fig. 6 Average Unicast Jitter (s)

Average unicast jitter is the average difference between end to end delays of successive packets. MYLAR1 clearly outperforms all other routing protocols.

5. CONCLUSION

The paper verifies the previous work done that the proposed routing protocol (MYLAR1) is well suited for MANET (Mobile Ad hoc Network) rather than VANET (Vehicular Area Network) because the performance of MYLAR1 degrades with the increasing speed of the nodes in the network. The comparison and analysis of ad hoc routing protocol using QualNet 6.1 Network Simulator shows that the

proposed modified LAR1 routing protocol i.e. MYLAR1 is a very stable and consistent routing protocol and overall (i.e. taking all the four performance parameters discussed) performs better than LAR1, OLSR INRIA, DSR, ZRP and OSPF v2. The future scope of this work will be to further improve the performance of MYLAR1 by making it more efficient by further reduction of the header size of route request packets and searching for alternative techniques to make MYLAR1 better in all aspects than other routing protocols.

6. REFERENCES

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