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Research Article

Performance of Routing Protocol in a Health Care Scenario

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Abstract

Over last year the rapid growth in wireless network application has encouraged to improve the network service performance. MANETs have become very popular due to growing popularity of mobile device. This network does not have certain topology i.e. it has infrastructure less network. Because of its frequent topology changes and routing overhead, routing protocol in MANET has become one of the challenging issues. Many routing protocols have been proposed so far. Performance of these protocols has been tested for general traffic under CBR traffic with varying network condition. CBR traffic does not reflect the complex nature of traffic in real applications and these traffic scenarios are more representatives of network loads placed on a real world MANETs. In this paper we conducted number of simulation in order to evaluate the performance of four routing protocols OLSR, AODV, LAR1, ZRP for CBR traffic in terms of packet delivery ratio, throughput, jitter, end-to-delay in realistic condition. Various network scenarios are considered like effect of varying node and effect of varying in pause time. The simulations are carried out in Qualnet simulator6.1.

Keywords: *MANET; AODV; OLSR; LAR1; ZRP*

1. Introduction

Nowadays, the rapid growth in wireless network applications like computers, PDAs and cell phones etc. are encouraged by the researchers to improve the network service performance. MANETs have become very popular due to growing popularity of mobile device. A MANET is a collection of wireless mobile nodes that communicate with each other using multi-hop wireless links without predetermined topology or central control (shah, *et al* 2008). MANET can be characterized as having dynamic topologies; bandwidth constrained, variable capacity links, energy constrained and limited security. In MANET each and every mobile node is assumed to be moving with more or less relative speed in arbitrary direction. So routing in MANET has become one of the challenging issues. This led to development of many different routing protocols. Routing is a process of moving information from a source to destination through intermediate nodes. Other challenging task is supporting mobility in MANETs. The mobility of nodes in MANETs increases the complexity of routing protocols and flexible connections. Therefore, it is quite difficult to determine which protocols may perform better under a number of different scenarios such as increasing node density and mobility. This network works in situation where ordinary wired network is feasible like rural areas, third world war countries or disaster areas.

In this paper, we evaluate the performance of four popular routing protocols: one proactive (OLSR), two reactive (AODV, LAR1) and one hybrid (ZRP), when transmitting multimedia data in a multi-hop network. The mobility scenario simulates the environment of a health care scenario, where the patients and doctors (mobile nodes) are connected to each other by CBR and communicate. The patients are almost always moving, maximizing the routing process complexity.

The paper is organized as follows: In section 2, we briefly describe the routing protocols that are used in the performance evaluation process. Section 3 presents the performance evaluation metrics. Section 4 & 5 presents simulation environment & result and discussion. Finally we conclude the paper in section 6.

2. MANET Routing Protocols

OLSR Protocol

OLSR is a proactive routing protocol optimized for mobile ad-hoc network. It has the advantage of having routes immediately available when needed. It inherits the stability of link state algorithm adapted to the requirement of MANET.OLSR reduces the size of control packets, instead of all links; it decreases only a subset of links with its neighbors who are its MPR selectors. Secondly, OLSR minimizes flooding of this control traffic by using only the selected nodes, called MPRs, to retransmit control message. This technique significantly reduces the message overhead where every node retransmits each message received. Each node selects its MPRs from the set of its neighbors saved in the neighbor list (Qayyum *et al 2000*).

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OLSR may optimize the reactivity to topological changes by reducing the maximum time interval for periodic control message transmission. The protocol is particularly suited for large and dense network, as optimization is done by using MPRs which work well in this context and does not depend on any central entity.

The protocol does not require reliable transmission of control message. Each node sends its control messages periodically. Each control message contains a sequence number which is incremented for each message. Thus the recipient of a control message can if required, easily identify which information is more recent even if messages have been re-ordered while in transmission.

ODV Protocol

The Ad-hoc on demand distance vector (AODV) routing algorithm is a packet routing protocol used for dynamic wireless network. It is a collection of mobile nodes without any centralized access point AP or existing in-Fra structure. It establishes a route to destination on demand and maintains these routes as long as they are needed by the sources. It provides loop-free, self-starting and scales to large number of mobile nodes. It allows nodes to respond to link breakages and changes in network topology in timely manner. Routes, which are not in use for long time, are deleted from the table.

AODV avoids loop formation and the counting-to-infinity problem of other distance vector protocols by using sequence number on route updates. AODV builds routes using a route request/route reply query cycle. To find a route to a particular destination node, the source node broadcasts a RREQ to its immediate neighbors. If one of these neighbors has a route to the destination, then it replies back with a RREP. Otherwise the neighbors in turn rebroadcast the request. This continues until the RREQ hits the final destination or a node with a route to the destination. At that point a chain of RREP messages is sent back and the original source node finally has a route to the destination. Route error propagation in AODV is wider and is achieved using a per destination predecessor list at each destination.

LAR1 Protocol

The LAR is a reactive on-demand source routing protocol that uses the location information of the mobile nodes to improve performance of routing protocols of MANETs. This protocol assumes that each node knows its location through global positioning system (GPS). Y.B. Ko et.al in (Ko *et al 1998*) proposed two different location aided schemes for transmitting a message from source to destination known as LAR scheme 1 and LAR scheme 2. Both the schemes used the location information of source and destination nodes to reduce the routing overhead. In LAR scheme 1, an expected zone is computed for the possible position of the destination node. It is a circle around the destination that contains the estimated location of the destination node. The Request Zone is a rectangle with source node S and the Expected Zone containing destination D. In this protocol, only those neighbors of source node that are present within the request zone forwards the route request packet further. The source node S knows the location of destination node D at time t_0 and average speed v with which D is moving. Every time node S initiates a new route discovery process, it the circular expected zone at time t_1 with the radius $r = v\,(t_1 - t_0)$and center at location D. In Fig.1, M and N are neighbors of Source node S. But, only node M forwards the packets received from S to its neighbors, since M is within the request zone. The node N discards the message received from S since J is outside the request zone.

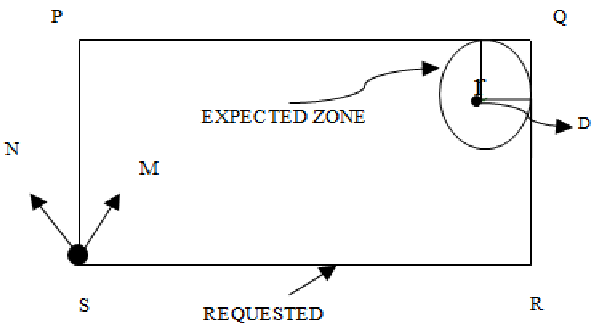

Fig. 1 LAR1 Routing Protocol

ZRP Protocol

Zone routing protocol (ZRP) is a hybrid of proactive and reactive protocol. By using it we can take advantage of both table driven and on demand driven protocol according to the application (chaumann, *et al 2002*). ZRP reduces the proactive scope to a zone centered on each node. It uses proactive protocols for finding zone neighbors (instantly sending hello messages) as well as reactive protocols for routing purposes between different zones (a route is only established if needed). ZRP has a flat view over the network. In this way, the organizational overhead related to hierarchical protocols can be avoided. . ZRP can be categorized as a flat Protocol because the zones overlap. Hence, optimal routes can be detected and network congestion can be reduced. ZRP consists of three parts: IARP (Hass, *et al 2002*) proactive part, IERP (Hass, *et al 2002*) reactive part, BRP (Hass, *et al 2002*) used with IERP to reduce the query traffic.

3. Performance evaluation metrics

Evaluating the performance of any routing protocol is one of the challenging issues and is related to the metrics that are used for evaluation. In this work, we based our evaluation on quantitative metrics. Quantitative metrics include statistical data, which provide the tools to assess the performance of the routing protocols.
The following four performance metrics have been chosen to compare the four routing protocols.

Throughput: It is defined as the number of packets delivered successfully to destination over an observation time. It is measured in bits per second.

Throughput=$\frac{CBR_{sent}\times 8\times 12}{Sim\ Time}$

Where, CBR_{sent} is the number of packets sent. 512 is the packet size in bytes which is multiplied by 8 to obtain the number of bits. *SimTime* is the duration of simulation.

Average End-to-End Delay: It can be defined as average delay a data packets takes to travel from source to destination.

E2E delay=$\sum_i^n (CBR_{ST} - CBR_{RT})$

Where, *n* is the number of packets received. CBR_{ST} is the CBR sent time. CBR_{RT} is the CBR received time and *i* vary from 0 to *n*.

Jitter: It is defined as the difference in end-to-end delay between selected packets in a single connection. Any lost packets are ignored from this metric.

Packet Delivery Ratio (PDR): PDR is defined as the ratio of the number of data packets delivered to the destinations to those generated by the sources.

PDR%=$\frac{\sum_i^n CBR_{Received}}{\sum_i^m CBR_{Sent}} \times 100$

Where, *n* is the number of packets received. *m* is the number of packets sent and *i* varies from 0 to *n*.

4. Simulation Environment and Analysis

The objective of the simulation is to evaluate the performance of four routing protocols (OLSR, AODV, LAR1, ZRP) based on various performance metrics for MANET. Simulations were carried out using qualnet simulator and taking into account realistic conditions for health care scenario.

In simulation we generate scenario files considering the area of $1500 \times 1500m^2$ and divided them into two categories:

- Scenario files for varying number of nodes and keeping pause time constant (10sec). Node density is increased from 50-200 in steps on 25 nodes.
- Scenario files for varying pause time and keeping number of nodes constant (250) with varying mobility. Pause time is increased from 10-50sec in steps on 10sec.

The simulation parameter of our thesis work is as follows

Table 1 Scenario Specification

Simulation Area	$1500 \times 1500m^2$
Node movement model	Random waypoint mobility
Traffic Types	2 CBR sources
Number of nodes	25,50,75 upto 200
Simulation Time	501 sec
Varying Pause Time	10,20,30,40,50 sec
Protocols Studied	OLSR,AODV,LAR1,ZRP
Rate of packet generation	4 packets/sec
Mobility of nodes	Min speed=1m/sec, Max speed=10m/sec
MAC Protocol	IEEE 802.11
Size	512 bytes

5. Result and discussion

Varying number of nodes with constant pause time: Scenario 1

Throughput

With the varying no. of nodes (with constant mobility) the throughput is analysed. It is observed that AODV performs better than LAR1, OLSR and ZRP.OLSR performs better than LAR1 and ZRP. Here the performance of LAR1 protocol is weak in case of throughput with varying nodes.

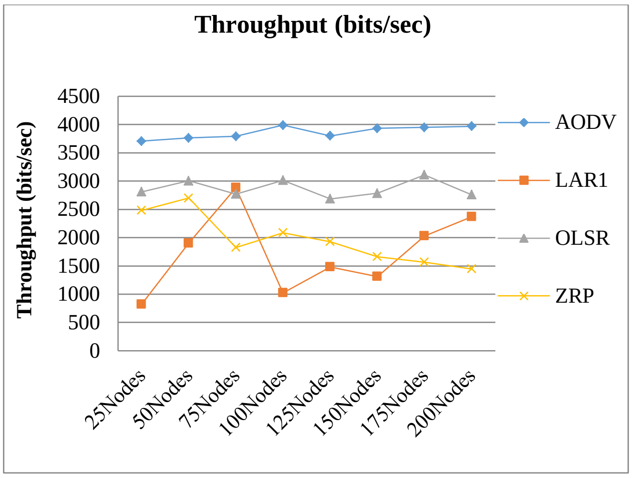

Fig. 2 Average Throughput in bits/sec with varying nodes.

End To End Delay

When a packet is transmitted from source to destination it takes time to reach. This time includes different delays as described in its definition above. In this analysis it is observed as expected the delays are increasing as the traffic load and no. of nodes are increasing. The average end to end delay very high in LAR1 than AODV, ZRP and OLSR, when no. of nodes increases. The AODV has least end to end delay. The end to end delay in OLSR and ZRP is also minimum.

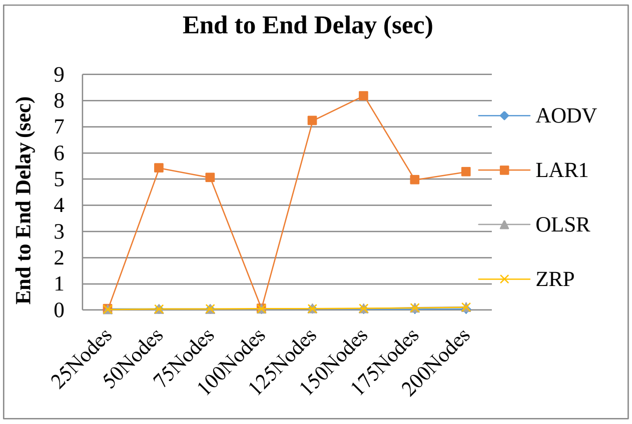

Fig. 3 Average end-to-end delay in sec with varying nodes.

Jitter

Jitter, the variation of packet arrival time, is an important metrics for any routing protocol. In this analysis with varying number of nodes it is observed LAR1 has largest Jitter. The performance is shown in figure.

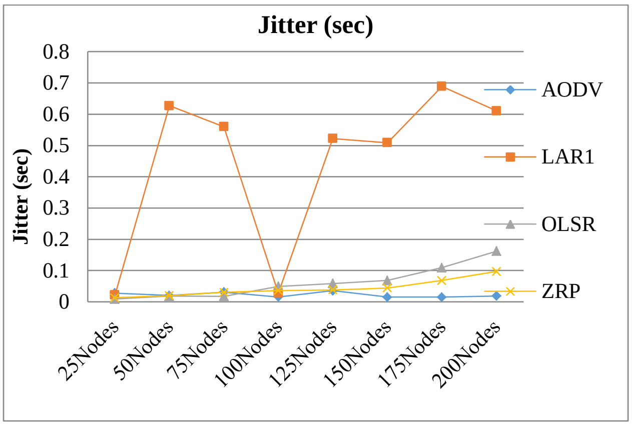

Fig.4 Average Jitter in sec with varying nodes

Packet Delivery Ratio

PDR performance is analysed. It is observed that, AODV routing protocol performs better than ZRP, LAR1 and OLSR when no. of nodes increases. And LAR1 performs inferior to all these three protocols (OLSR, ZRP, and AODV).Though when number of nodes are 75 at this time LAR1 is performing better than ZRP.

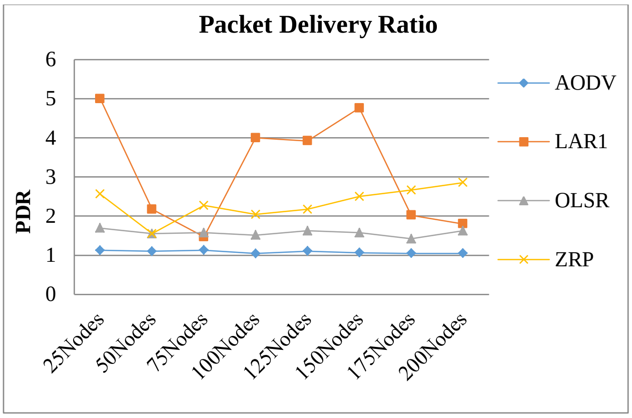

Fig. 5 Average packet delivery ratio with varying nodes.

Varying pause time with nodes constant

Scenario 2

Throughput

With the constant nodes and varying mobility the throughput is analysed. It is observed that AODV performs better than LAR1, OLSR and ZRP. OLSR performs better than LAR1 and ZRP.Here the performance of ZRP protocol is weak in case of throughput as mobility is varying.

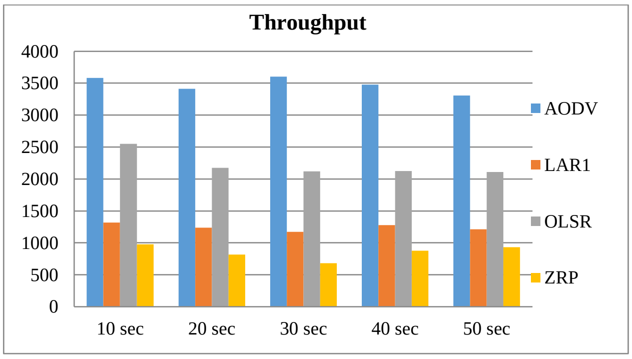

Fig. 6 Average Throughput in bits/sec with varying pause time.

End To End Delay

When a packet is transmitted from source to destination it takes time to reach. This time includes different delay as described in its definition above. In this analysis it is observed as expected the delays are increasing as the mobility is increasing. The average end to end delay very high in LAR1 than AODV, ZRP and OLSR, when nodes are mobile. The AODV has least end to end delay, or we can say almost constant end to end delay with varying mobility, The end to end delay in OLSR is also minimum than ZRP and LAR1.

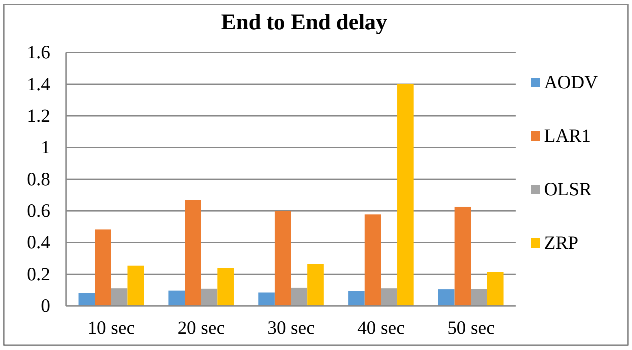

Fig. 7 Average end-to-end delay with varying pause time.

Jitter

Jitter, the variation of packet arrival time, is an important metrics for any routing protocol. In this analysis with varying mobility. It is observed LAR1 has largest Jitter.

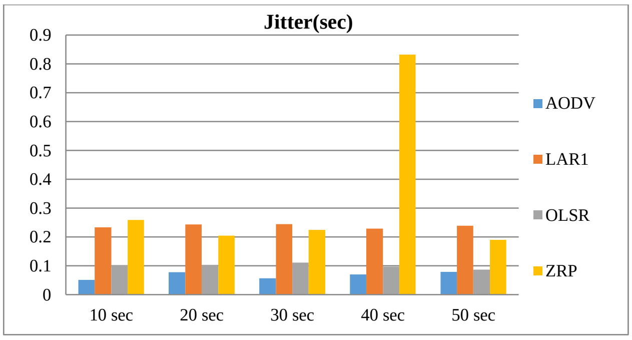

Fig. 8 Average Jitter in sec with varying pause time.

Packet Delivery Ratio

PDR performance is analyzed. It is observed that, AODV routing protocol performs better than ZRP, LAR1 and OLSR when mobility is varying. And ZRP performs inferior to all these three protocols (OLSR, LAR1, AODV).Although OLSR is performing better than LAR1 and ZRP.

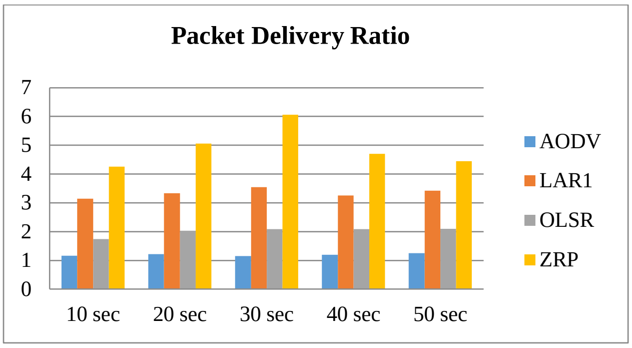

Fig. 9 Packet delivery Ratio with varying pause time.

5. Conclusion

In this paper, we studied and analysed the performance of different routing protocol in realistic condition. The focus was put on the performance evaluation of metrics with varying pause time, node density and mobility values. AODV performs better in terms of packet delivery ratio and throughput and least in end-to-end delay. LAR1 is high in end-to-end delay and jitter and weak in terms of throughput and packet delivery ratio with varying node. ZRP presents least performance in terms of throughput and packed delivery ratio with varying pause time. OLSR is minimum in all cases.

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