Performance Evaluation of Routing Protocols for Mobile Ad-Hoc Networks (MANET) Using Glomosim Simulator

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ABSTRACT

Ad hoc networks are characterized by multi hop wireless connectivity, frequently changing network topology and the need for efficient dynamic routing protocols. This report compares the performance of MANET routing protocol such as Ad-hoc On Demand Distance Vector (AODV), Location-Aided Routing (LAR1) and Wireless Routing Protocol (WRP) protocol at different Simulation time using a parallel discrete event driven simulator, Glomosim. This project is based on energy consumption, signal received and forwarded to MAC and signals transmitted in mobile ad hoc networks. The performance differentials are analyzed using varying simulation time. Based on the observations, I make recommendations about when the performance of either protocol can be the best.

Keywords

Routing protocol, Glomosim, Energy consumption.Signal transmitted.

I. INTRODUCTION

Ad-hoc networks are temporary networks that are used only for the duration of the communication sessions. Cellular phones, laptops etc are the devices that used for mobile networks. However, mobile devices can be classified in to the following two categories:

Networks having a fixed infrastructure using a base station that covers a certain areas. During communication mobile devices communicates with the nearest base station that transmits the information to other base station or wired networks or other mobile devices. Cellular phone is the example of this type of network. Network without having a fixed infrastructure is another promising type of network used in communication. It is used for any planned or unplanned events like in war fields or in a meeting of business people scattered geographically. However, this type of network can be created or destroyed when needed and that is

why the name is mobile ad-hoc network and it has no central; controlling authority.

II. ROUTING PROTOCOLS IN MANET

However, following are the protocols that are used for mobile ad-hoc networks:

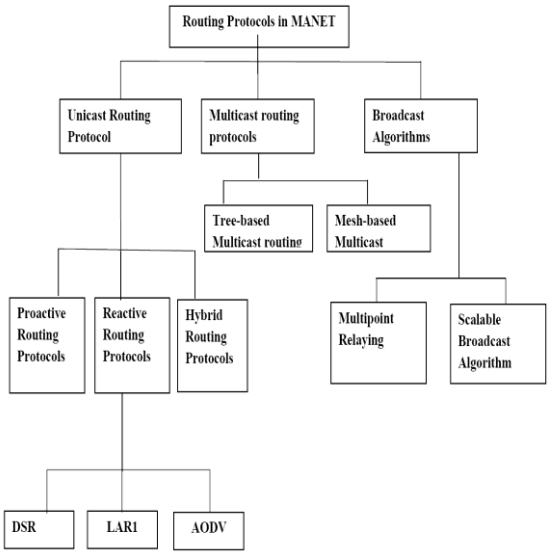

Fig.1: Classification of Routing Protocols in MANET

A. Proactive protocols

In this type of routing protocol, each node in a network maintains one or more routing tables which are updated regularly. Each node sends a broadcast message to the entire network if there is a change in the network topology. However, it incurs additional overhead cost due to maintaining up-to-date information and as a result; throughput of the network may be affected but it provides the actual information to the availability of the network. Distance vector (DV) protocol, Destination Sequenced Distance Vector (DSDV) protocol, Wireless Routing protocol (WRP), Fisheye State Routing (FSR) protocol are the examples of Proactive protocols.

B. Reactive Protocols

In this type of routing protocol, each node in a network discovers or maintains a route based on-demand. It floods a control message by global broadcast during discovering a route and when route is discovered then bandwidth is used for data transmission. The main advantage is that this protocol needs less touting information but the disadvantages are that it produces huge control packets due to route discovery during topology changes which occurs frequently in MANETs and it incurs higher latency. The examples of this type of protocol

are Dynamic Source Routing (DSR), Ad-hoc On Demand Routing (AODV) and Associativity Based Routing (ABR) protocols.

C. Hybrid Protocols

It is a combination of proactive and reactive protocols taking the best features from both worlds. The examples of this type of protocol are Zone Routing Protocol (ZRP), TORA and SSR protocols.

1. Ad hoc On-Demand Distance Vector (AODV)

Ad hoc On-Demand Distance Vector (AODV) Routing is a routing protocol for mobile ad hoc networks (MANETs) and other wireless ad-hoc networks. An ad hoc network is defined as an "infrastructure less" network, meaning a network without the usual routing infrastructure like fixed routers and routing backbones. Typically, the ad hoc nodes are mobile and the underlying communication medium is wireless. Each ad hoc node may be capable of acting as a router. Such ad hoc networks may arise in personal area networking, meeting rooms and conferences, disaster relief and rescue operations, battlefield operations, etc.

The Ad hoc On-Demand Distance Vector (AODV) algorithm enables dynamic, quick adaptation to dynamic link conditions, low processing and memory overhead, low network utilization, multi hop routing between participating mobile nodes wishing to establish and maintain an ad hoc network. AODV is capable of both unicast and multicast routing of self starting. It is a reactive routing protocol, meaning that it establishes a route to a destination only on demand. It maintains these routes as long as they are needed by the sources. The operation of AODV is loop-free, and by avoiding the Bellman-Ford "Counting to infinity" problem offers quick convergence when the ad hoc network topology changes (typically, when a node moves in the network).

2. Location-Aided Routing (LAR)

Ad hoc on-demand distance vector routing (AODV) that has been previously described is both based on different variations of flooding. The goal of Location-Aided Routing (LAR) described is to reduce the routing overhead by the use of location information. Position information will be used by LAR for restricting the flooding to a certain area. In the LAR routing technique, route request and route reply packets similar to DSR and AODV are being proposed. The its average speed. Source node S is going to use this information for a route discovery in the future.

LAR Scheme 2 (LAR2): The second LAR scheme is defined by specifying (estimated) destination coordinates (xd, yd) plus the distance to the destination. The estimated destination and the current distance to it are included in the route request. Now, a node may only forward the route request packet if it is closer or at maximum _ farther away than the previous node. _ is a system parameter which is dependent on implementation. Every forwarding node overwrites the distance field in the packet with its own current distance to the destination. This process ensures that the packet moves towards the destination.

3. Wireless Routing Protocol (WRP)

implementation in the simulator follows the LAR1 algorithm similar to DSR.

Location Information:-

When using LAR, any node needs to know its physical location. This can be achieved by using the Global Positioning System (GPS). Since the position information always includes a small error, GPS is currently not capable of determining a node's exact position. However, differential GPS5 offers accuracies within only a few meters.

LAR Scheme 1 (LAR1): The request zone of LAR1 is a rectangular geographic region. Remember: If source node S knows a previous location P of destination node D at time t0, if it also knows its average speed v and the current time t1, then the expected zone at time t1 is a circle around P with radius $r = v(t1 - t0)$.

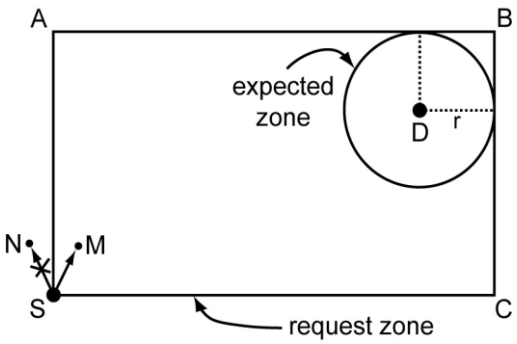

Fig 2: Lar Scheme 1 - Request Zone

The request zone now is defined as the smallest possible rectangle that includes source node S and the circular expected zone. Further should the ides of the rectangle be parallel to the x and y axes. The source node is capable of determining the four corners of the rectangular request zone.

This four coordinates are now included in the route request packet when initiating the route discovery process. Every node which is outside the rectangle specified by the four corners in the packet just drops the packet. As soon as the destination D receives the route request packet, it sends back a route reply packet as described in the flooding algorithms. Its reply differs by containing its current position, the actual time, and as an option

The Wireless Routing Protocol (WRP) is a proactive unicast routing protocol for mobile ad-hoc networks (MANETs). WRP uses an enhanced version of the distance-vector routing protocol, which uses to calculate paths. Because of the mobile nature of the nodes within the MANET, the protocol introduces mechanisms which reduce route loops and ensure reliable message exchange. The wireless routing protocol (WRP), similar to DSDV, inherits the properties of the distributed Bellman-Ford algorithm. It employs a unique method of maintaining information regarding the shortest distance to every destination node in the network and the penultimate hop node on the path to every destination node. Since WRP, like DSDV, maintains an up-to-date view of the network, every node has a readily available route to every destination node in the network. It differs from DSDV in table maintenance and in the update procedures. While DSDV

maintains only one topology table, WRP uses a set of tables to maintain more accurate information.

WRP is a distance vector routing protocol. Each node maintains 4 tables:

- Distance Table(DT)
- Routing Table (RT)
- Link Cost Table (LCT)
- Message Retransmission List table (MRL)

III. PERFORMANCE ANALYSIS

We simulate this protocol on GloMoSim, [23, 24] a scalable discrete-event simulator developed by UCLA. This software provides a high fidelity simulation for wireless communication with detailed propagation, radio and MAC layers. We compare the routing protocol named as AODV, LAR1 and WRP.

A. Simulation Model

There are some initial values used in the simulation. The experiment is repeated for varying simulation time. FTP traffic is assumed in the model.

B. Performance Metrics

For the evaluation of protocols the following metrics have been chosen. Experimental modeling, design, results and analysis are described below to compare the performance of three routing protocols such as AODV, LAR1 and WRP.

1. Simulation Results

Experiment 1: In this experiment I calculate the energy consumed at different simulation time using three protocols AODV, LAR1, WRP.

Fig represents that energy consumption will increase as simulation time increases in all the three protocols.

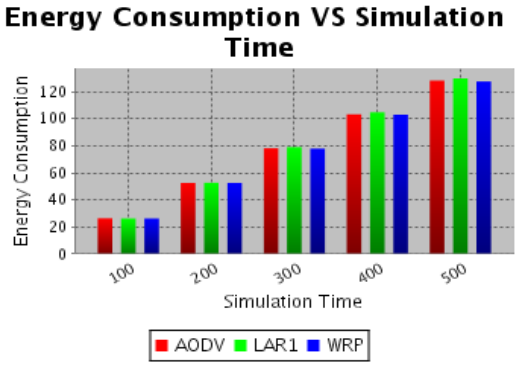

Fig 3: Energy consumed at different simulation time

Experiment 2: In this experiment I calculate the signals received and forwarded to MAC at different simulation time using three protocols AODV, LAR1, WRP.

Table 1: Assumed Parameters

Routing	AODV,LAR1, WRP
MAC layer	802.11
Bandwidth, bps	2000000
Simulation Time, s	100, 200, 300, 400, 500
TERRAIN-DIMENSIONS	1500 x 1500
Nodes	10
Node placement	Random
Mobility model	RANDOM-WAYPOINT
Data traffic	FTP
Pause time, s	30
PROPAGATION-PATHLOSS	FREE-SPACE
RADIO-TYPE	RADIO-ACCNOISE

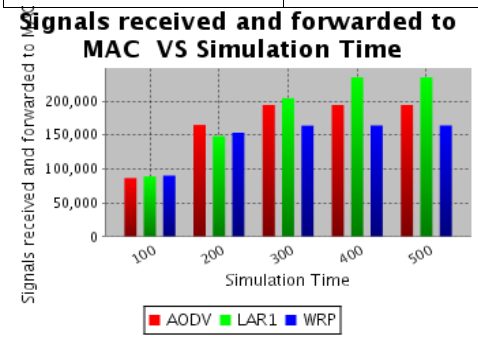

Fig 4: Signals received and forwarded to MAC with simulation time

Fig represents that signals received and forwarded to MAC will increase as simulation time increases in all the three protocols because as the time increases more signals will be transmitted. But LAR1 forward highest signals.

Experiment 3: In this experiment I calculate the signal transmitted at different simulation time using three protocols AODV, LAR1, WRP.

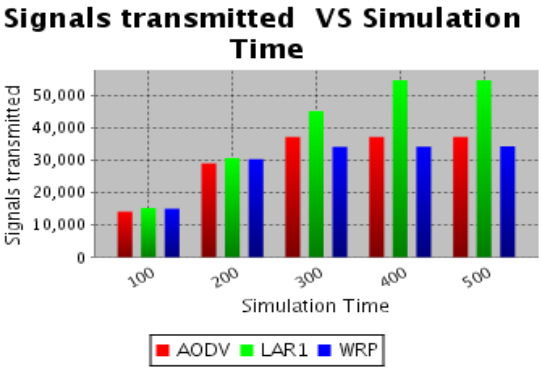

Fig 5: Signals transmitted with simulation time

Fig represents that signal transmitted will increase as simulation time increases in all the three protocols. But LAR1 transmit highest signals.

IV. CONCLUSIONS AND FUTURE WORK

A comparison between AODV, LAR1 and WRP routing protocol MANETs has been made in this report based on energy consumption, signal received and forwarded to MAC and signal transmitted. I developed three experiments such as Experiment 1 for 'Energy consumption', Experiment 2 for 'Signal received and forwarded to MAC' and Experiment 3 for 'Signal transmitted' at different simulation time.

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