A Competent Study of Hybrid Routing Protocols of MANETs Using NS-2 Simulator

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***Abstract*—An ad-hoc network refers to any set of networks where all devices have equal status on the network and are free to associate with any other adhoc network devices in link range. Mobile Adhoc Networks (MANETs) are an integral part of next generation networks because of its flexibility, ease of maintenance, infrastructure less nature, self administration capabilities, auto configuration and cost effectiveness. Various researchers in MANETs focus on proactive and reactive routing protocols. But this paper focuses on the combination of these two i.e. the third type of routing protocol i.e. hybrid protocols. The three types of hybrid protocols considered in this paper are TORA, ZHLS and ZRP. The performance metrics used for comparison purpose are routing overhead, network overload and average end to end delay.**

Keywords: MANET, TORA, ZHLS, ZRP

I. INTRODUCTION

An ad hoc network is usually thought of as a network with nodes that are relatively mobile compared to a wired networks. Hence, the topology of the network is dynamic and the changes often unpredictable oppose to the Internet which is a wired network [5]. In Mobile Ad Hoc Networking, the communication does not rely on any existing infrastructure such as dedicated routers, transceiver base stations etc. Mobile devices (e.g. notebook computers, PDAs, cell phones, etc.) with wireless radio equipment are supposed to communicate with each other, without the help of any other (fixed) devices. In order to make it possible, typically each node needs to act as a router to relay packets to nodes out of direct communication area. Under these conditions, routing is much more complex than in conventional (static) networks. Many of the possible solutions are dogged by the characteristics of the media, the conduct of nodes and the data flow [4]. Mobile Adhoc networks are very attractive for tactical communication in military and law enforcement. They are also expected to play an important role in civilian forums such as convention centers, electronic-conferences, and electronic classrooms. Nodes in this network model share the same random access wireless channel [3].

II. ROUTING IN MANETS

The growing interest in Mobile adhoc Network techniques has resulted in many routing protocol proposals [3]. The routing protocols used in MANETs are dissimilar from routing protocols of conventional wired networks. Some of the reasons are scheduled below:

1. Mobility.
2. Limited transmission range.
3. Frequent Route updates.

The performance criterion of nodes in MANETs are diverse than that of wired networks. A few of the performance metrics of MANET routing protocols are shown below:

1. Energy consumption.
2. Route Stability despite mobility.

Routing protocols used for Mobile Adhoc Networks are basically of three types:

1. Proactive Routing Protocols (Table-Driven)
2. Reactive Routing Protocols (On-Demand)
3. Hybrid Routing protocols

This research paper mainly concentrates on hybrid routing protocols which is combination of both the reactive and proactive routing protocols [10].

III. BRIEF OVERVIEW OF ZRP, ZHLS AND TORA

A. Zone Routing Protocol (ZRP)

In case of ZRP, a node proactively preserves routes to the destinations within a local neighborhood area which is known as a routing zone. In ZRP, each node retains its zone radius and there is an overlap of neighboring zones. The ZRP maintains routing zones through a proactive component called intra-zone routing protocol (IARP) which is implemented as a modified distance vector scheme. In contrast, the inter-zone routing protocol (IERP) is responsible for attaining routes to destinations which are located outside the routing zone. The IERP employs a query-response mechanism to find out routes on demand [1].

B. Zone-based Hierarchical Link State (ZHLS) Routing Protocol

The Zone-based Hierarchical Link State routing (ZHLS) is a type of hybrid routing protocols. In ZHLS, mobile nodes are aware of their physical locations with support from a locating system like GPS i.e. Global Positioning System. Here, the network for ZHLS is divided into non-overlapping zones which are based on the geographical information. ZHLS employs a

hierarchical addressing scheme which contains zone ID and node ID. A node verifies its zone ID according to its location and the pre-defined zone map is renowned to all nodes within the network. It is understood that a virtual link connects two zones if at least a single physical link between the zones is present. A two-level network topology configuration is defined in ZHLS, the node topology and the zone topology [2].

C. Temporary Ordered Routing Algorithm (TORA)

TORA is a kind hybrid protocol, which is dispersed and routers only preserve information about neighboring routers. TORA has the unique property of being highly adaptive and quick in route repair during link failure and it provides multiple routes to destination node. It does not always execute a shortest path calculation and the metric used to launch the routing structure does not signify a distance. It consists of link reversal of the Directed Acyclic Graph (ACG). It makes use of Internet MANET Encapsulation Protocol (IMEP) for link status and Neighbor Connectivity Sensing (NCS). IMEP offers reliable and in-order delivery of all the routing control messages from a node to all of its neighbors, and a notification to the routing protocols each time a link neighbors is formed or busted [7].

IV. Simulation Set Up

The comparative analysis of the routing protocols is performed using NS-2 simulator on Windows-7 operating system. The table listed below describes the hybrid routing protocols used and the conditions specified for simulation purpose.

TABLE I SIMULATION ARRANGEMENT

Routing Protocols Used	TORA, ZHLS and ZRP
Packet Rate	50 packets/ sec
Simulation Area	5Km x5Km
Number of Nodes	25,50,75,100,125,150
Traffic Type	High Quality GSM Voice
Simulation Time	1000 sec.
Node Speed	10m/s
Physical Standard	802.11b

V. Performance Metrics Used

A. Routing Overhead

Ad-hoc networks are intended to be scalable. As the network develops, various routing protocols executes in a different way. The measure of routing traffic raises as the network develops. An important measure of the scalability of the protocol, and the network, is known as routing overhead. It is also defined as the entire number of routing packets transmitted over the network, and is expressed in bits per second (bps) or packets per second (pps) [6].

B. Network Overload

In wireless mobile adhoc networks, when there is congestion in the network due outsized number of nodes which are sending and receiving data beyond the limit of its communication area, this is known as network overload.

C. Average End to End Delay

Average End to End delay of a data packet is time taken by the packets from source node to destination node. Average End to end delay time includes average of all the delays taken by router to seek the path in network consumption, processing delay, propagation delay, and End to end delay for a particular packet which was sent by a pre-specified node, as a source node and received successfully at the destination node is

Average End to end delay, $\mathbf{t_d = t_s - t_e}$

Where t_s is the time when sending of the packet at the pre-specified node starts, and time t_e, is the time when the packet is send by the pre-specified node is received successfully at destination node [9].

VI. Results and Observations

In this research paper, three distinct types of hybrid routing protocols are used for performance evaluation by varying the number of nodes and by keeping the simulation area constant. The performance metrics which are used for discussion purposes i.e. routing overhead, network overload and average end-to-end delay are displayed below graphically.

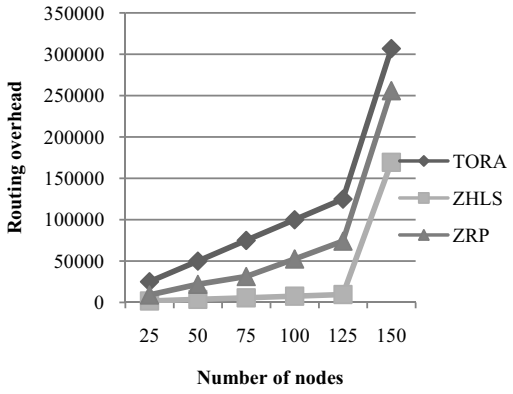

Fig. 1 Routing Overhead for ZRP, ZHLS and TORA by Varying Number of Nodes

Figure 1 illustrates that Routing Overhead for ZHLS is less as compared to ZRP and TORA. Because the number of control packets required by ZHLS is very less in comparison to ZRP and TORA due to the presence of non-overlapping zones. Due to this reason the comparative analysis is in the favor of ZHLS.

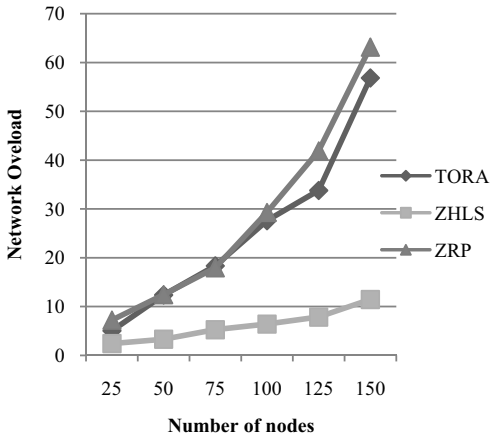

Fig. 2 Network Overload for ZRP, ZHLS and TORA by Varying Number of Nodes

Figure 2 explains that the network overload is less in case of ZHLS than TORA and ZRP i.e. very less congestion is present in case of ZHLS. So, for this performance parameter again the results favor ZHLS.

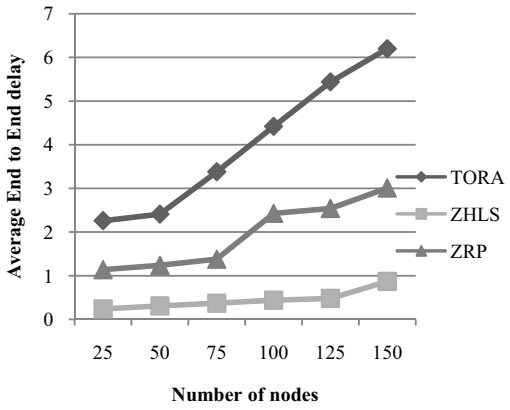

Fig. 3 Average End to End Delay for ZRP, ZHLS and TORA by Varying Number of Nodes

Figure 3 shows that the value of average end to end delay for ZHLS is less in comparison to ZRP and TORA which is one of the important requirements of a routing protocol. So, for a third time for this parameter, ZHLS performs well.

VII. Conclusion

For an adhoc network with large number of nodes which move with different node speed and have different traffic patterns, the hybrid routing protocol is the best selection. In this research paper, when we take review of above discussed performance parameters, ZHLS provides outstanding results than ZRP which is further better than TORA because of least values of routing overhead, network overload and average end to end delay in case of ZHLS.

VIII. Future Scope

In future, this work can be extended by increasing the number of nodes and by increasing the simulation area. Also, the work can be altered by using the other simulators like MATLAB, Glomosim etc.

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