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Quick Route Reconfiguration Framework in Zone Routing Protocol for MANETs

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ABSTRACT: Mobile Adhoc Networks is non-infrastructure, self configuring and decentralized set of mobile nodes. So the routing protocols for mobile ad-hoc networks have to face the challenge of frequently changing topology low transmission power and asymmetric links. This work deals with one of the most popular routing protocols in MANETs i.e. Zone Routing Protocol (ZRP). In this work, we address the issue of self configuring framework for the ZRP to provide the best performance for a particular network at any time. As the name indicates the MANET's are specially defined for the mobility of the nodes in the networks. The nodes may move at a different speed, which may enter or move out of the network, which leads the delay, jitter, and link failure conditions during the transmission of packets. In the large networks, the more number of nodes will accept these parameters at a same time or random time. Such that scalability problem in the network may arise. Without a fixed infrastructure, mobile ad-hoc networks have to rely on the portable, limited power sources. Therefore the energy-efficiency becomes one of the most important problems in MANETs. Other challenging aspects on MANETs are node cooperation, interoperation with the internet, aggregation, multicast as well as changing the network topologies. Technologies such as smart antennas, software's will also bring new problems along with impetus to ad-hoc to MANETs.

Keywords: Manets, Ad-hoc, ZRP, OLSR

1. INTRODUCTION

In this new era of communication, the advent of mobile computing has revolutionized our information society. The proliferation of new, powerful, efficient and compact communicating devices like personnel digital assistants (PDAs), pagers, laptops and cellular phones, having extraordinary processing power paved the way for advance mobile connectivity. We are moving from the Personal Computer age to the Ubiquitous Computing age in which a user utilizes, at the same time, several electronic platforms through which he can access all the required information whenever and wherever needed. The nature of ubiquitous devices makes wireless networks the easiest solution for their interconnection and, as a consequence, the wireless arena has been experiencing exponential growth in the past decade. Among the myriad of applications and services run by mobile devices, network connections and corresponding data services are without doubt the most demanding ones. Currently, most of the connections among the wireless devices are achieved via fixed infrastructure-based service provider, or private networks. For example, connections between two cell phones are setup by BSC and MSC in cellular networks; laptops are connected to Internet via wireless access points. While infrastructure-based networks provide a great way for mobile devices to get network services, it takes time and potentially high cost to set up the necessary infrastructure. There are, furthermore, situations where user required networking connections are not available in a given geographic area, and providing the needed connectivity and network services in these situations becomes a real challenge. For all these reasons, combined with significance advances in technology and standardization, new alternative ways to deliver mobile connectivity have been emerging. These are focused around having the mobile devices connect to each other in the transmission range through automatic configuration, setting up an *ad hoc mobile network* that is both flexible and powerful. The paper is divided into seven parts. In first section, which is here, gives some introduction and motivation for proposing the Route Reconfiguring framework of Zone Routing Protocol. In second section, we look at mobile ad hoc networking in closer details, covering their specific characteristics, complexities and design constraints.

This is followed by a classification of existing routing algorithms in it. In third section provides brief introduction about the QualNet 5.0 network simulator which is used for the test bedding of the network simulation models, infourth section,describes the detail the design of proposed algorithm for the Zone Routing Protocol, with the problems statement. In this section presents the possible implementation and performance evaluation of the proposed protocol through simulation work.

II. AD HOC NETWORKING

Mobility is becoming increasingly important for users of computing systems. Technologyhas made possible smaller, less expensive and more powerful wireless communicatingdevices and computers. As a result users gain flexibility and the ability to exchangeinformation and maintain connectivity while roaming through a large area. The necessarymobile computing support is being provided in some areas by installing base stations andaccess points. Mobile users can maintain their connectivity by accessing thisinfrastructure from home, from the office, or while on the road.Such mobility support is not available in all locations where mobile communication isdesired. Access points may not be set up due to high cost, low expected usage, or poorperformance. This may happen during outdoor conferences or in emergency situationslike natural disasters and military maneuvers in enemy territory. If mobile users want tocommunicate in the absence of a support structure, they must form an *ad hoc network.* Inthis chapter, we look at mobile ad hoc networking in closer details. We present theircharacteristics, analyze the complexities and design constraints associated with them andclassify the existing routing algorithms in it.

A. Mobile Ad Hoc Networks

A mobile ad hoc network (MANET), sometimes called a *wireless ad hoc network* or a *mobile mesh network* is a wireless network, comprised of mobile computing devices (nodes) that use wireless transmission for communication, without the aid of any established infrastructure or centralized administration such as a base station in cellular network or an access point in wireless local area network [1, 2, 3, 4]. The nodes are free to move randomly and organize themselves arbitrarily; thus, the network's wireless topology may change rapidly and unpredictably. Such a network may operate in a standalone fashion, or may be connected to the larger Internet. In ad hoc network each node acts both as a host (which is capable of sending and receiving) and a router which forwards the data intended for some other node. Hence it is appropriate to call such networks as "multi-hop wireless ad hoc networks". Fig. 1. shows an example of mobile adhoc network and its communication technology. As shown in Figure Fig. 1., an ad hoc network might consist of several home-computing devices, including laptops, cellular phones, and so on. Each node will be able to communicate directly with any other node that resides within its transmission range. For communicating with nodes that reside beyond this range, the node needs to use intermediate nodes to relay the messages hop by hop. Fig. 1. A Typical Mobile Ad Hoc Network.

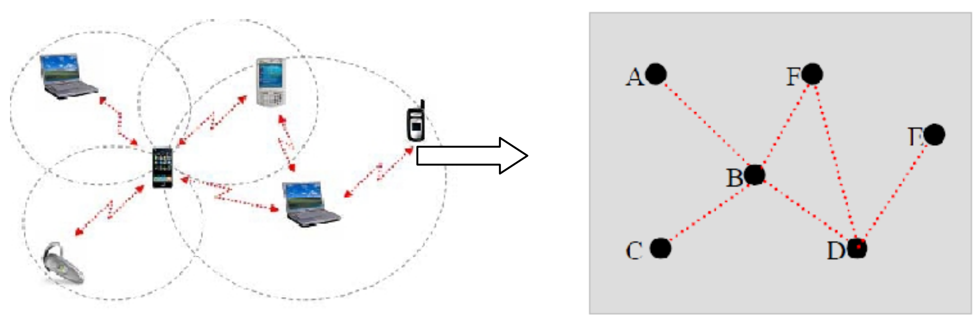

Fig. 1. Multi-Hop Wireless Ad-hoc Networks.

B. Characteristics, Complexities and Design Constraints

Mobile ad hoc networks eliminate the constraint of infrastructure set up and enable devices to create and join networks on the fly, anywhere, any time and virtually for any application. However, these flexibilities and convenience do come at a price. Mobile ad hoc networks inherit the common problems of wireless networking in general, and add their own constraints specific to ad hoc routing [3].

C. Routing protocols in Mobile Ad Hoc Network

Since the advent of Defense Advanced Research Projects Agency (DARPA) packet radio networks in the early 1970s [2], numerous routing protocols have been developed for ad hoc mobile networks [3, 5]. As shown in Fig. 2., these are generally categorized as table-driven or proactive, on-demand or reactive and hybrid routing protocols.

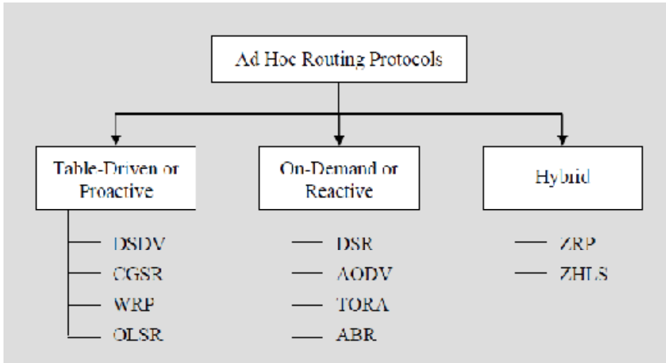

Fig. 2. Classifications of Ad Hoc Routing Protocols.

Optimized Link State Routing (OLSR) Protocol. The Optimized Link State Routing (OLSR) protocol [6] is a variation of traditional link state routing, modified for improved operation in ad hoc networks. The key feature of OLSR is its use of *multipoint relays* (MPRs) to reduce the overhead of network floods and the size of link state updates. Each node computes its MPRs from its set of neighbors. The MPR set is selected such that when a node broadcasts a message, the retransmission of that message by the MPR set will ensure that the message is received by each of its two-hop neighbors.

Ad hoc On Demand Distance Vector (AODV) routing. The Ad Hoc On-Demand Distance Vector (AODV) routing protocol [7] is based on the DSDV algorithm described in [5]. AODV is an improvement on DSDV because it typically minimizes the number of required broadcasts by creating routes on a demand basis, as opposed to maintaining a complete list of routes as in the DSDV algorithm. The authors of AODV classify it as a pure on-demand route acquisition system, since nodes that are not on a selected path do not maintain routing information or participate in routing table exchanges.

Dynamic Source Routing (DSR). Dynamic Source Routing (DSR) is a routing protocol for wireless mesh networks. It is similar to AODV in that it establishes a route on-demand when a transmitting mobile node requests one. However, it uses source routing instead of relying on the routing table at each intermediate device [8]. Dynamic source routing protocol (DSR) is an on-demand, source routing protocol [9**]**, whereby all the routing information is maintained (continually updated) at mobile nodes. DSR allows the network to be completely self-organizing and self-configuring, without the need for any existing network infrastructure or administration.

Zone Routing Protocol (ZRP). As explained earlier, either a purely proactive or purely reactive approach to implement a routing protocol for a MANET has their disadvantages. The Zone Routing Protocol (ZRP) as described in [6] aims at addressing these limitations by combining the best properties of both proactive and reactive approaches and hence it can be classed as a hybrid proactive/reactive routing protocol. In a MANET it can be safely assumed that most communication takes place between nodes close to each other. Therefore, ZRP reduces the proactive scope to a *zone* centered on each node and reactive approach outside the zone. In order to learn about a node's direct neighbors and possible link failures, IARP relies on a Neighbor Discovery Protocol (NDP) provided by the MAC layer. NDP transmits "HELLO" beacons at regular intervals. Upon receiving a beacon, the neighbor table [10] is updated. Neighbors, for which no beacon has been received within a specified time, are removed from the table. For route discovery by IERP, the notion *border casting* [11] is introduced. Border casting utilizes the topology information provided by IARP to direct query request to the border of the zone. The border cast packet delivery service is provided by the Border cast Resolution Protocol (BRP) [11]. BRP uses a map of an extended routing zone to construct border cast trees for the query packets. BRP employs query control mechanisms, to direct route requests away from areas of the network that already have been covered [11]. The relationship between the components is illustrated in Figure 3.

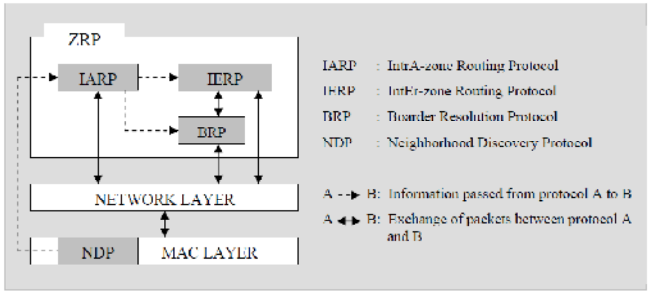

Fig. 3. ZRP Architecture.

III. QUALNET 5.0 – THE NETWORK SIMULATOR

QualNet 5.0 Simulator is ultra high-fidelity network evaluation software that predicts wireless, wired and mixed-platform network and networking device performance. Designed to take full advantage of the multi-threading capabilities of multi-core 64-bit processors, QualNet supports simulation of thousands of network nodes.QualNet offers unmatched platform portability and interface flexibility. QualNet runs on sequential and parallel UNIX, Windows, Mac OS X and Linux operating systems, and is also designed to link seamlessly with modeling/simulation applications and live networks.

IV. QUALNET ARCHITECTURE

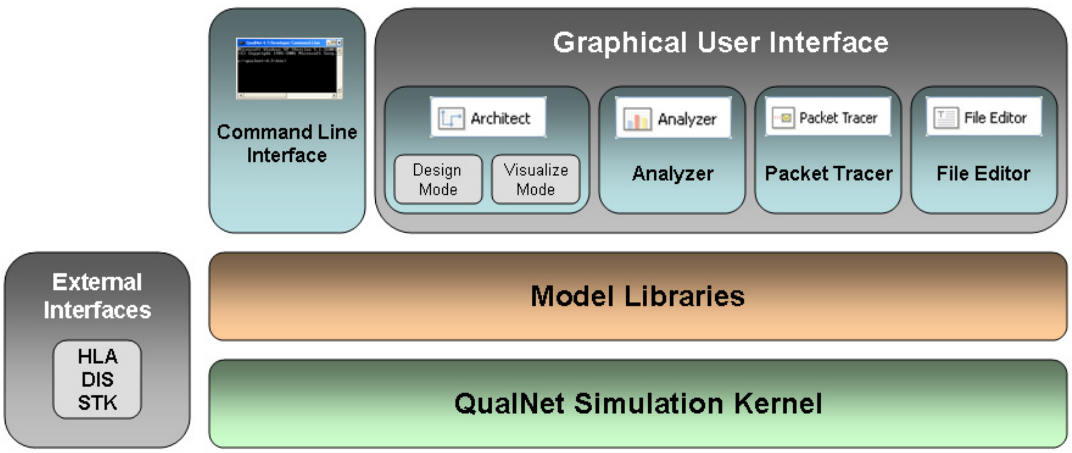

Fig. 4. QualNet Architecture.

V. SIMULATION RESULTS AND ANALYSIS

A. Average Jitter

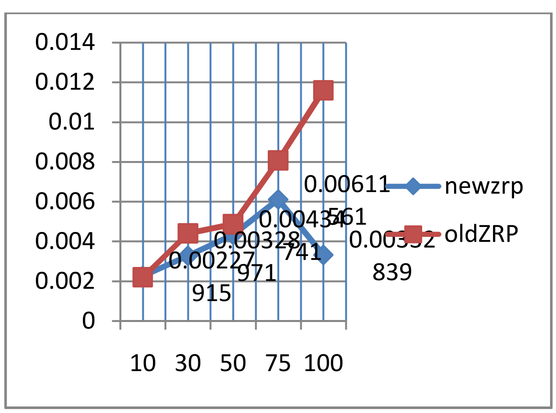

Fig. 5. Average Jitter Vs Time.

In Fig. 5, for both the proposed work of ZRP and existing ZRP in the assymetrical networks topology, the jitter of different node densities for the same network parameters is plotted versus time. The results shown in above graphs prove that the existing ZRP doesn't have any capabilities to differentiate the traffic classes according to jitter but in the proposed algorithm this differentiation is perfectly specified and obivious.

B. First Packet Received

The Fig. 6, describes the first data packet recived ratio on discovered route with the assymetrical links in the network. From the figure it concluded that the proposed alogorithm fives better result when comparing to existing ZRP protocol on deliering the data packets while plotted againest time being parameters.

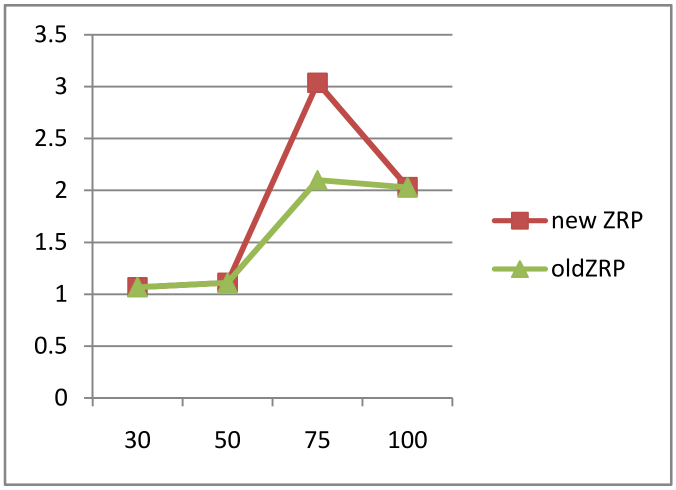

Fig. 6. First data packet received Vs Time.

C. Total Bytes

From the Fig. 7., it is clear that route reconfiguration increases the ratio of throughput. Hence the the receiced bytes were also increased while comparing the existing ZRP protocol, it is performing the less in the delivering ratio. Hence the increasing value of the data packets to the destination through the assymetrical links is also increased. The reconfiguration framework provides alternative way of forwarding the data packets in the networks until unless simple dropping of packets due to link failure or route failure in the discovered routes. The packets ratiohas shown in the following Fig. 8.

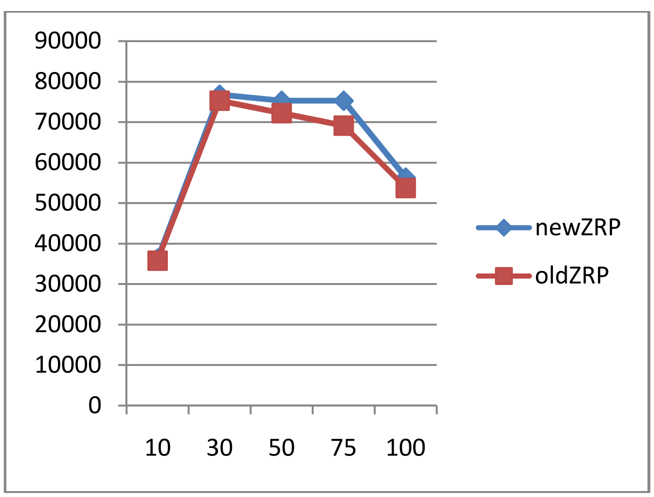

Fig. 7. Total bytes Vs Node Density

D. Total Packets

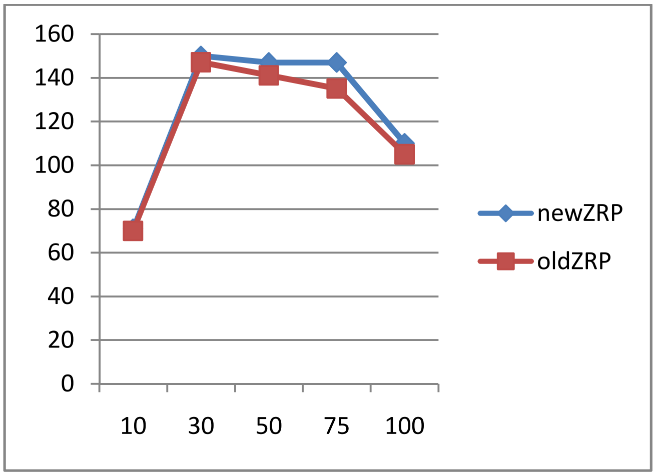

Fig. 8. Total packets received Vs node density.

E. End to End Delay

In this Fig. 9, it represents the plotting ratio of End-to-End Delay measurements for both protocols which shows the End-to-End delay of flows. Looking at the figure, it can be recognised that the End-to-End Delay of traffic flows in existing ZRP in incresed as the number of the nodes density increases in the network, but in the proposed algorithm, the end-to-end delay has less osscilations and also average delay in each class is less than existing ZRP algorithms. So the throughput of the packets or bytes is more while comparing to existing ZRP. The result is shown in Fig. 10.

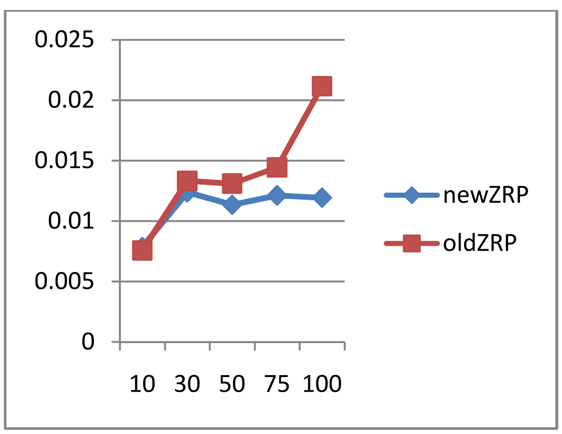

Fig. 9. End-toEnd Delay vs node Density.

F. Throughput

The simulation results for proposed Zone Routing Protocol under different mobility patterns and traffic scenarios show that the proposed protocol is as efficient than ZRP in discovering and maintaining routes, at the cost of using larger routing packets which result in a higher overall routing load, and at the cost of higher latency in reroute discovery because of the cryptographic computation that must occur.

VI. CONCLUSION AND FUTURE WORK

The Zone Routing Protocol (ZRP) provides a flexible solution to the challenge of discovering andmaintaining routes in the Reconfigurable Wireless Network communication environment. ZRP combines two radically different methods of routing into one protocol. Interzone route discovery is based on a reactive route request/route reply scheme.

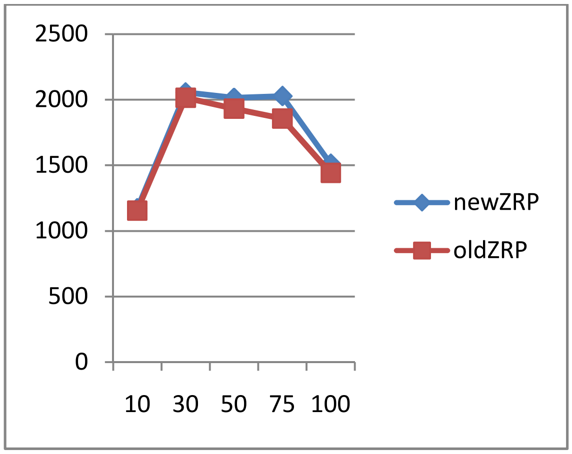

Fig. 10. Throughput Vs Node Density.

By contrast, intrazone routing uses a proactive protocol to maintain up-to-date routing information to all nodes within its routing zone.We have presented the design and analysis of a new algorithm in Zone Routing Protocol to reconfiguring the route for mobile ad hoc networks. The proposed protocol is hybrid in nature and developed on the concept of zone routing protocol (ZRP). It provides a solution for link failure conditions asymmetrical environments. In designing proposed work, we carefully fit the algorithms to each part of the protocol functionality to create an efficient protocol that is robust against link failure conditions in the network. The proposed protocol gives a better solution towards achieving the high throughput goals like packet ratio, minimizing of End-to-end delay, minimum jitter and low latency in transmission of data packets.

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