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Quick Routing for Communication in MANET using Zone Routing Protocol

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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 adhoc 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 adhoc 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 adhoc to MANETs. We discuss the factors influencing on improvement in performance of Zone routing protocol, performed in number of related works. This work is based on literature research. The proposed protocol is based on the principle of self reconfiguring, multicast, query detection based, low bit error rate mode of operation. This work aims to optimize the Quality of Service in transmission for the zone routing protocol. Through test-bed simulation, we demonstrate that our proposed work will allow the ZRP to operate a better reconfiguration framework during link failure conditions.

Keywords: *Ad-hoc, MANET, Routing, Throughput, ZRP*, IERP, IARP

I. INTRODUCTION

In this new era of communication, the advent of mobile computing has revolutionized our information society. Now a day's a 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 area has been experiencing exponential growth in the past decade [1].

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. 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 or an access point [1, 2, 3, 4]. Unlike traditional mobile wireless networks, mobile ad hoc networks do not rely on any central coordinator but communicate in a self organized way. Mobile nodes that are within each other's radio range communicate directly via wireless links, while those far apart rely on other nodes to relay messages as routers. 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. Ad hoc wireless networks can be deployed quickly anywhere and anytime as they eliminate the complexity of infrastructure setup. Applications of ad hoc network range from military operations and emergency disaster relief, to commercial uses such as community networking and interaction between attendees at a meeting or students during a lecture. Most of these applications demand a secure and reliable communication.

Mobile wireless networks are generally more vulnerable to information and physical security threats than fixed wired networks. Vulnerability of channels and nodes, absence of infrastructure and dynamically changing topology, make ad hoc networks security a difficult task [1]. Broadcast wireless channels allow message eavesdropping and injection (vulnerability of channels). Nodes do not reside in physically protected places, and hence can easily fall under the attackers' control (node vulnerability). The absence of infrastructure makes the classical security solutions based on certification authorities and on-line servers inapplicable. In addition to this, the security of routing protocols in the MANET dynamic environment is an additional challenge.

Most of the previous research on ad hoc networking has been done focusing only upon the efficiency of the network. There are quite a number of routing protocols proposed [5, 6, 7] that are excellent in terms of efficiency. However, they were generally designed for a non-adversarial network setting, assuming a trusted environment; hence no security mechanism has been considered. But in a more realistic setting such as a battle field or a police rescue operation, in which, an adversary may attempt to disrupt the communication; a secure ad hoc routing protocol is highly desirable. The unique characteristics of ad hoc networks present a host of research areas related to security, such as, key management models, secure routing protocols, instruction detection systems and trust based models.

II. RELATED WORK

In this paper, we are dealing with related works somehow that are proposed for improvement in performance ZRP protocol in asymmetrical networks. Some of them are discussed here which related to our proposed work. The multicast routing and route reconfiguration for Zone Routing Protocol is proposed on [25]. It assume that all the routes in any routing table are active, usable and only need updating when a node joined the network and sent update message or an error message is received regarding to a specific non reachable node or a broken link, then partial updates are needed for some entries which have the non reachable node as a destination or intermediate. Therefore, MDVZRP reduces the proactive scope to a zone centered on each node. MDVZRP uses a topological map of the zone centered on a node to guarantee loop freedom, alternative paths in the case of route failure and disjoint paths. Within the zone, routes are immediately available, but for destinations outside the zone, MDVZRP uses a route discovery mechanism to add routes to the table. In the case of link failure, MDVZRP uses a link-id field to identify routes affected by the failure.

To reduce the network load by limiting the number of control packets when the protocol searches for a new route is proposed in SBZRP [26]. When the node stops for a short period of time, that means the moving degree is high, the SBZRP has higher link usability than ZRP. When node moving degree is high, the route search failure becomes high. For the SBZRP, if the route search fails, a new route search starts from the failed node. Thus, the new route search time is shorter than ZRP and the number of data sent to the DN becomes high.

The performance of the existing ZRP protocol is proposed on [27] this proposed work describes the performance of the ZRP protocol comparing with AODV and DSR protocols with considering two different scenarios. The main characteristics are carried out and a thorough evaluation it is clear that the ZRP against DSR and AODV has low performance and ZRP was not up to the task and it performed poorly throughout all the simulation sequences. In particular it demonstrated a really low packet delivery ratio when compared to DSR and AODV. DSR on the other hand performed admirably and it would be the clear winner if not for its bad behavior in high traffic cases. AODV performed well in most of the network sizes (better than ZRP).

To address the issue of configuring the ZRP to provide the best performance for a particular network, at any time. Adaptation of the ZRP to changing network conditions requires both an understanding of the ZRP and reacts to changes in network behavior and a mechanism to allow individual nodes to identify these changes, given only limited knowledge of the network behavior.

III. PROPOSED WORK:

The proposed ZRP uses for intra-zone routing the IARP the same as ZRP, but uses a new IERP for inter-zone routing. To explain IARP let consider Fig.1 . The node A generates the IARP packet (S is Source Node (SN)

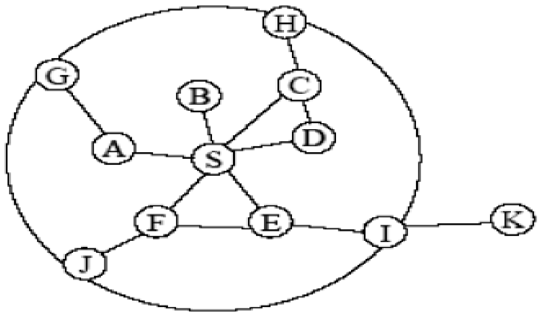

Figure1. Routing zone of node S with zone radius ρ =2

and the HC is 2) and sends it to all neighbor nodes (nodes A, B, C, D, E, F). The node after receiving IARP packet updates its own routing table using IARP packet information. The nodes are moving so the route information may be inappropriate after a period of time.

Since ZRP assumes that local neighbor discovery is implemented on the link-layer and is provided by the NDP, the first protocol to be part of ZRP is the *Intrazone Routing Protocol*, or IARP. This protocol is used by a node to communicate with the interior nodes of its zone and as such is limited by the zones radius ρ (the number of hops from the node to its peripheral nodes). Since the local neighborhood of a node may rapidly changing, and since changes in the local topology are likely to have a bigger impact on a nodes routing behavior than a change on the other end of the network.

As the global reactive routing component of the ZRP, the Interzone Routing Protocol, or IERP, takes advantage of the known local topology of a node's zone and, using a reactive approach enables communication with nodes in other zones. The reactive route discovery process consists of two phases: the route request phase and the route reply phase. The route request phase is initiated when a node requires a route to a destination, but does not have the route stored in its route table. This query source issues a route request packet and sends this packet to each of its neighbors. When a node with an active route to the query destination receives the request, it may respond with a reply. Otherwise, it forwards the request packet to its neighbors. Subsequent copies of the route request are considered to be redundant and are discarded.

When a queried node can provide a route to the destination, a reply containing information about the discovered route is sent back to the query source. In order to relay the reply, the request needs to accumulate route information as it progresses through the network. Before forwarding a query packet, a node appends its address and relevant node/link metrics to the packet. When a query packet reaches the destination, the sequence of recorded nodes represents a route from the source to the destination. This route may be reversed and used to send the reply back to the query source. Transmission resources can be saved during the route request phase by distributing previous hop information among the intermediate nodes, instead of appending node addresses to increasingly longer packets. A similar approach can be used during the reply phase.

The query source may receive an entire source route to the query destination, or each route node can record the next-hop address to the destination in its routing table. A route request broadcast traverses all network links, allowing any reachable destination to be discovered. However, the undirected nature of broadcasting results in redundant coverage. Nodes are sent copies of the same route request by each neighbor. An optimal probing mechanism would direct the query outward, away from the query source and away from regions that have already been covered by the query.

When a node has no valid route to forward a data packet, it launches a route discovery, probing the network via broadcast RREQ packets. When a node receives a RREQ packet, it appends its IP address along with metrics for the link on which the packet was received. It then checks its Routing Tables for a valid route to the query destination. If a valid route to the query destination is known, then the route is appended to the RREQ's accumulated route. The complete route is copied to a RREP packet. The RREP is forwarded back to the query source, by IERP, along the reversed accumulated route. The IERP Packet format has shown in figure 2.

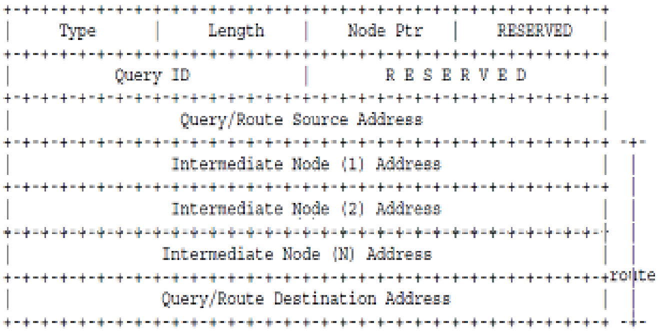

Figure 2. The IERP packet structure.

3.1 Field Description:

* Type (char) (8 bits)

Identifies the type of IERP packet. The current version of IERP contains two packet types:

1. ROUTE_REQUEST (RREQ): Request for a route to the Query Destination. The RREQ records the path that it has traveled from the Query Source.
2. ROUTE_REPLY (RREP): Response to a ROUTE_REQUEST packet, issued by the node that discovers a route to the Query Destination, and sent back to the Query Source.

* Length (char) (8 bits)

Length of the packet, in multiples of 32 bit words.

* Node Pointer (char) (8 bits)

Index into the route (see below) corresponding to the node that has just received, or is next to receive, this packet.

* Query ID (unsigned int) (16 bits)

Sequence number which, along with the Query Source Address (see below) uniquely identifies any RREQ in the network.

* Query/Route Source Address (node_id) (32 bits)

IP address of the node that initiates the RREQ. In subsequent stages, this corresponds to the IP address of the discovered route's source node.

* Query/Route Destination Address (node_id) (32 bits)

IP address to be located during the RREQ phase. In subsequent stages, this field contains the IP address of the discovered route's destination node.

* Route (node_id) (N * 32 bits)

Variable length field that contains the recorded IP addresses of nodes along the path traveled by this RREQ packet from the Query Source. After a route to the Query Destination has been discovered, this set of IP addresses provides a specification of the route between the Route Source and Route Destination.

The IERP routing table is shown in Fig 3.

Dest Addr (node_id)	Subnet Mask (node_id)	Route (node_id list)	Route Metrics (metric list)

Figure3. IERP Routing Table

a. Proposed algorithm for the reconfigure the broken link

The following algorithm were proposed for the IERP protocol in ZRP which selects another optimum route from the routing table such that dropping factor of the data packets is to be minimized. The proposed algorithm for the ZRP protocol is shown Fig 4.

Condition that the next hop (neighbor node) is not reachable in the sense it is moved out of current node's coverage area.

Condition 1: If (next hop node == UNREACHABLE)
{
Step 1: delete failed nodes routing entry in the routing table.
}
Step 2: Search another optimum route in IERP's routing table.
Step 3: get another route from the table.
Condition 2: If (IERP routing Table!= NULL)
{
Step 4: add route address to the data packet.
Step 5: enter IERP to Route the Packet on alternative route.
}
Else
{
Step 6: update from the IARP
Step 7: send RREQ packets to discover the new route to the destination.
Step 8: update new route in routing table which holds the routing path to destination.
}

Figure 4. The proposed algorithm for Zone Routing Protocol

The Route Discovery procedure is shown in Figure 5. The source node S sends a packet to the destination D. To find a route within the network, S first checks whether D is within its routing zone. Since D does not lie within S's routing zone, S broadcasts a route request to all of its peripheral nodes: that is, to nodes C, G, and H. Upon receiving the route request, nodes C,H and G determine that D is not in their routing zones and they therefore broadcast the request to their peripheral nodes. One of H's peripheral nodes, B, recognizes D as being in its routing zone and responds to the route request, indicating the forwarding path: S-H-B-D. as shown in Fig 6,

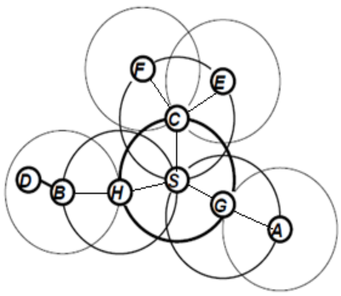

Figure 5. The IERP operation in proposed protocol.

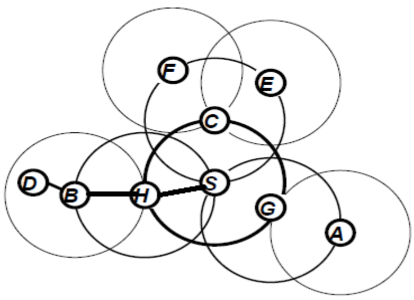

Figure 6. The shortest path in proposed IERP protocol.

In MANET's the main problems with routing protocols is link failure conditions due to mobility of the nodes. Consider Fig 7, which the link between B and H are broken and similarly the node F has moved near to the node of shortest route so the proposed protocol uses alternative way as shown in the figure which adds new route address to the data packet and continues the data transmission. Hence the cost of route discovery can be significantly reduced by using alternative path by using routing table. The path repair procedure substitutes a broken link by a mini-path between the ends of the broken link. A path update is then generated and sent to the end points of the path. Path repair procedures tend to reduce the path optimality (e.g., increase the length for shortest path routing). Thus, after some number of repairs, the path end points will initiate a new Route Discovery procedure to replace the path with a new optimal one.

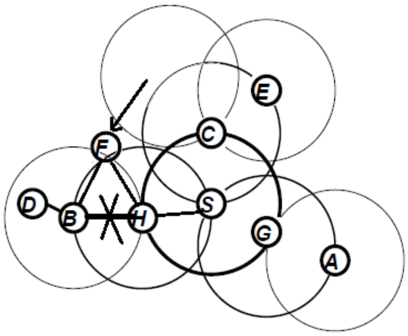

Figure 7. A case of broken link occurs during transmission.

When a destination node moves outside a zone, but the period of time from the last search is short, it can be considered that node is not too far from the route recorded in the IERP. Therefore, a node in the IERP can search to find a new route to node J. In Fig. 8, when a RP arrives in node G, but it has not found a route to node J, a new search is started from node G. Thus, the number of the border nodes and IERP packets can be decreased resulting in the increase of the throughput and the decrease of packet mean delay.

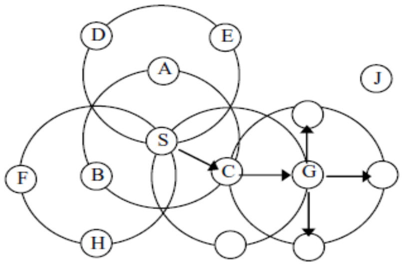

Figure 8. A case when DN moves outside the zone.

A node is moving for a period of time then stops for a moment of time. This pattern is repeated in a random way. When the node stops for a short period of time, that means the moving degree is high, the proposed ZRP protocol has higher link usability than existing ZRP. When node moving degree is high, the route search failure becomes high. For the proposed ZRP, if the route search fails, a new route search starts from the failed node. Thus, the new route search time is shorter than ZRP and the number of data sent to the DN becomes high.

IV. SIMULATION RESULTS AND ANALYSIS

4.1. Throughput without mobility

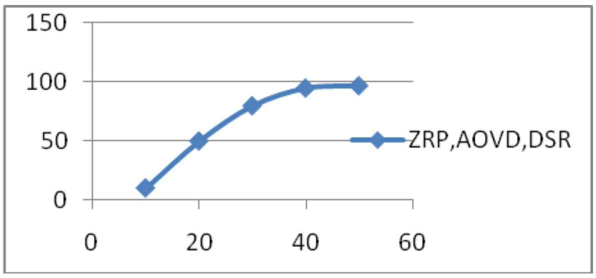

Figure 9. Throughput Vs Node Density

In Fig 9, the simulation results for proposed ZRP and AOVD, DSR under no mobility patterns and traffic scenarios show that both the protocols gives same efficient result.

4.2. Throughput with mobility

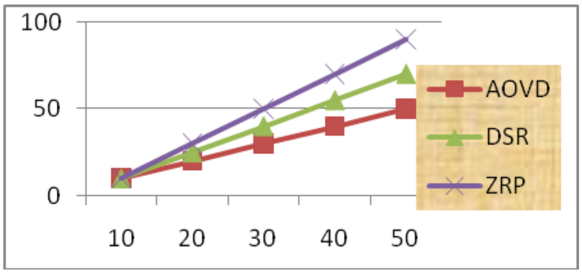

Figure 10: Throughput Vs Node Density

The Fig 10, the simulation results for proposed ZRP and AOVD, DSR under different mobility patterns and traffic scenarios show that the proposed protocol is as efficient than AOVD and DSR 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.

4.3. End-toEnd Delay without mobility

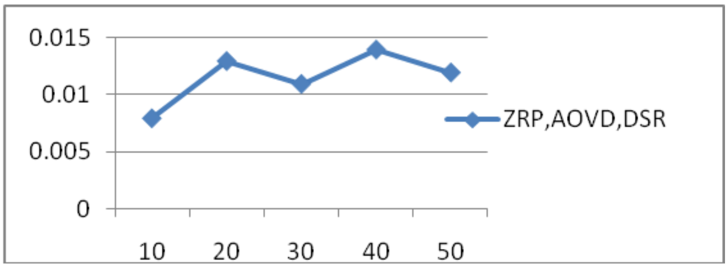

Figure11. End-toEnd Delay vs node Density

From the Fig 11, 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 with no mobility and traffic gives same efficient Delay.

4.4. End-toEnd Delay with mobility

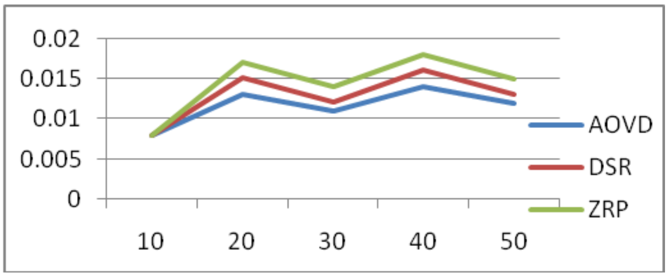

Figure12.End-toEnd Delay vs node Density

From the Fig 12, 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 AOVD and DSR algorithms. So the throughput of the packets or bytes is more while comparing to existing AOVD and DSR.

4.5. Total Packets received without mobility

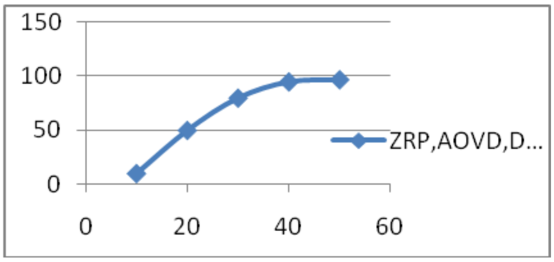

Figure 13. Total packets received Vs node density

In this Fig 13, it represents the plotting ratio of packet receiving capacity of all the three protocols.

4.6. Total Packets received with mobility

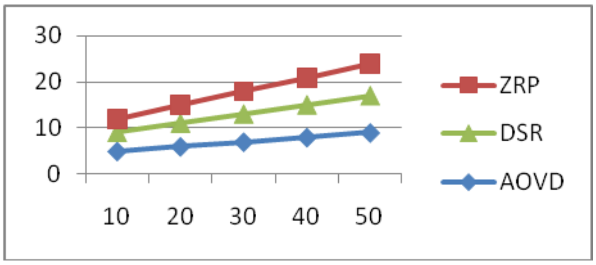

Figure 14. Total packets received Vs node density

The Fig 14, describes the 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 protocols on deliering the data packets while plotted againest time being parameters. From the Fig, it is clear that route reconfiguration increases the ratio of throughput. Hence the the receiced bytes were also increased while comparing the existing protocols, which 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.

V. CONCLUSION

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

We have simulated the proposed work for the ZRP protocol under different network scenarios and different traffic with different node densities, it's quite clear that proposed algorithm for the reconfiguration of route for link failure problems in the asymmetrical networks, will provide a better result for the Zone Routing Protocol while comparing to the existing protocols. The proposed ZRP can compete with other two protocols with somewhat difference may visible but better performance than existing protocols.

There are many areas in network movement planning that must still be researched to determine the true impact of a network plan. The direct areas of research stemming from this study include creating a more robust protocol to investigate high-speed movement and protocol optimization. The addition of mobility to a wireless structure network, in the form of mobile routers, can also be investigated for throughput improvements. Other aspects of protocol performance, such as network control overhead, end-to-end delay and dropped packets could be researched.

Many areas in planning can be explored, such as exploring alternative implementations of planning, attempting to design and implement a self-sustaining plan, and exploring locally omniscient plan compared to the centralized plan used in the test simulations. The effects of planning with respect to various protocol algorithms could be explored, to determine what the most efficient protocol-planning combination would be.

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