Integrated Resource Adaptive On Demand Geographic Routing (IRA-ODGR) for MANET

M J.Kalaiselvi[1] K.Sathishkumar[2]
[1]M.E. Student, CSE [2]Assistant Professor, M.E., (Ph.D.)
[1,2]PGP College of Engineering and Technology, Namakkal

Abstract— It is a big challenge to develop routing protocol that can meet different application needs and optimize routing paths according to the topology change in mobile ad hoc networks. The existing work presented two self-adaptive on-demand geographic routing schemes to build efficient paths based on the needs of user applications and adapt to various scenarios for provide efficient and reliable routing. To overcome the impact due to inaccurate local topology knowledge, the topology information is updated at a node in the specific time periods. The on-demand routing mechanism reduces to control overhead made on geographic routing. The route optimization scheme adapts routing path according to the topology changes and actual data traffic requirements. Adaptive parameter setting scheme is introduced to allow each node to determine and adjust the protocol parameter values independently. However, existing work did not address resource parameters such as energy, bandwidth and data loss. The proposal presents and Integrated Resource Adaptive on Demand Geographic Routing (IRA-ODGR) for MANET. The node energy resource is optimized with path energy consumption rate and bandwidth utilization of the path is analysed. Loss rate is reduced in geographic routing with dynamic routes. The simulation conducted to demonstrate IRA-ODGR routing protocols.

Keywords: Routing protocols, wireless communication, ad hoc networks, geographic route, adaptive, on-demand, and topology.

I. INTRODUCTION

A mobile ad-hoc network (MANET) is a self-configuring infrastructure less network of mobile devices connected by wireless. Ad hoc is Latin and means "for this purpose". Each device in a MANET is free to move independently in any direction, and will therefore change its links to other devices frequently. Each must forward traffic unrelated to its own use, and therefore be a router. The primary challenge in building a MANET is equipping each device to continuously maintain the information required to properly route traffic. Such networks may operate by themselves or may be connected to the larger Internet. MANETs are a kind of wireless ad hoc networks that usually has a routable networking environment on top of a Link Layer ad hoc network.

It is challenging to develop robust routing protocol for dynamic Mobile Ad Hoc Networks (MANET). Geographic routing protocols are generally more scalable and reliable than conventional topology-based routing protocols with their forwarding decisions based on the local topology. Geographic routing assumes mobile nodes are aware of their own positions through certain positioning system (e.g., GPS), and a source can obtain the destination's position through some kind of location service However, inaccurate local topology knowledge and the out-dated destination position information can lead to inefficient geographic forwarding and even routing failure. Proactive local position distribution can hardly adapt to the traffic demand. It is also difficult to pre-set protocol parameters correctly to fit in different environments. We have developed two self-adaptive on-demand geographic routing schemes.

The local topology is updated in a timely manner according to network dynamics and traffic demands. Our route optimization scheme adapts the routing path according to both topology changes and actual data traffic requirements. Each node can determine and adjust the protocol parameter values independently according to different network environments, data traffic conditions and node's own requirements. The integrated Resource Adaptive On Demand Geographic Routing is the efficient communication in dynamic MANET topologies. The optimization of on demand geographic routing is done based on measured values of node energy at various time intervals. The node energy level varies for different traffic load conditions that keep update the energy levels of the intermediary node in the selected path between source and destination (S-D). Another resource is the data loss occurrence on the path during routing and data forwarding. Geographic routing path are analysed for the transmission throughput it based on which path allocation is done for the S-D pairs in network.

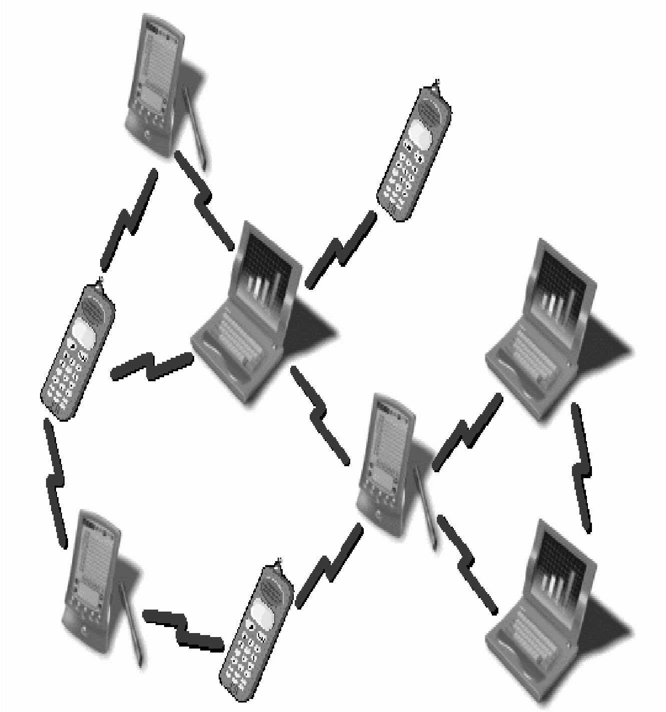

Fig 1: Mobile Ad hoc Network

II. LITERATURE SURVEY

The multiple directional cover sets (MDCS) problem of organizing the directions of sensors into a group of non-disjoint cover sets to extend the network lifetime. One cover set in which the directions cover all the targets is activated at one time. MDCS-Greedy is not based on the optimization problem, which has much shorter runtime. Finally, a distributed algorithm called MDCS-Dist is presented [1]. The inherent locality of our scheme makes it fault tolerant both to node failure and to network partitions. When the network partitions, nodes within a connected component can locate each other because the location service is also collocated with them within the component. As for node failures, when some node containing location information fails, there is sufficient redundancy at incrementally increasing distances in the network to transparently make up for it [2].

CBF improves position-based forwarding in five important aspects: first, removing the beacons eliminates a major part of routing overhead which occurs independently of actual data traffic. Second, the nodes do not have to store neighbour tables, reducing their individual resource usage. Third, the neighbour tables may be inconsistent, in particular if the beacon interval is long, if beacons are lost, or if nodes change their positions very frequently. Inconsistent neighbour tables can lead, among other things, to the following problem: when a neighbour is selected for forwarding it may already have moved out of transmission range [3]. This work suggests an approach to utilize location information (for instance, obtained using the global positioning system) to improve performance of routing protocols for ad hoc networks [4].

Supporting scalable and efficient routing and service provision in Mobile Ad Hoc Networks (MANET) has been a big research challenge. Conventional topology-based unicast and multicast protocols are normally hard to scale due to the big overhead in their routing schemes. Supported by these routing protocols, conventional service discovery schemes also have limited scalability and efficiency [5]. Structure-Aware Self-Adaptive sensor system, SASA, aims to address the challenges and provide a feasible framework for underground monitoring in coal mines. The design objectives of SASA include: (1) to rapidly detect the collapse area and report to the sink node; (2) to maintain the system integrity when the sensor network structure is altered; and (3) provide a sound and robust mechanism for efficiently handling queries over the sensor network under unstable circumstances [6].

The work describes the first distributed algorithms for routing that do not require duplication of packets or memory at the nodes and yet guarantee that a packet is delivered to its destination. These algorithms can be extended to yield algorithms for broadcasting and geocaching that do not require packet duplication [7]. GPSR makes greedy forwarding decisions using only information about a router's immediate neighbours in the network topology. When a packet reaches a region where greedy forwarding is impossible, the algorithm recovers by routing around the perimeter of the region [8]. Routing algebra system investigates the compatibilities between routing metrics and three geographic routing protocols including greedy, face and combined-greedy face routing. Four important algebraic properties, respectively named odd symmetry, transitivity, source independence and local minimum freeness, are defined in this algebra system [9].

Geographic Routing (GR) algorithms require nodes to periodically transmit HELLO messages to allow neighbors know their positions (beaconing mechanism). To reduce the control overhead due to theses messages, beacon-less routing algorithms have recently been proposed. However, existing beacon-less algorithms have not considered realistic physical layers. Therefore, those algorithms can not work properly in realistic scenarios [10].

The phases involved in the proposed schemes are

1. MANET On Demand Routing
2. Self-Adaptive Geographic Routing
3. Optimization and Route Adaption
4. Energy and Bandwidth Routing
5. Resource Adaptive On Demand Routing

A. MANET On Demand Routing

The on demand routing only create and maintain the routes on demand and topology of MANET is dynamic. On demand protocols is used to network-range or restricted-range flooding for route discovery that maintenance limits the scalability that need of search for an end-to-end path prior to the packet transmission incurs large transmission delay. It needs to support long-term and continuous traffic. Data traffic is sporadic that nodes are involved in long period of services with only occasional data exchanges for collaboration or upon events.

B. Self-Adaptive Geographic Routing

Each and every mobile node is aware of its own position through GPS or in-door localization technique. The source obtains the destination's position through location service. It makes use of broadcast feature of wireless network to improve routing performance and mobile nodes enable promiscuous mode on network interfaces. It provides transmission paths based on the need of applications and to reduce control overhead. Routing path is built and position information is distributed on traffic demand. Flexible position distribution mechanism forwarding nodes are notified of topology change in a timely manner and more efficient routing is achieved. Optimization schemes are designed to make routing paths adaptive to the change of topology and traffic. Robust to position inaccuracy routing scheme handle destination position inaccuracy. Each and every node can set and adapt protocol parameters independently based on environment change and its own condition.

C. Optimization and Route Adaption

Route optimization adapts the path according to topology change and traffic conditions. The validity of cached topology information is evaluated before packet forwarding to avoid forwarding failure due to out-dated neighbour information. Routing path is optimized with cooperation of the forwarding node and its neighbours. To avoid non-optimal routing due to the inaccuracy in topology knowledge and validity estimation of next hop after the route searching phase. Current best next hop is cached for a period when there is no significant topology change and reduce the delay and control overhead for route searching. Optimization for forwarding path is local topology change that cached next hop may no longer be the best one towards destination. To achieve more optimal routing the neighbours monitor whether forwarding path makes correct forwarding decisions that improve transmission path opportunistically.

D. Energy and Bandwidth Routing

Intermediate node in the routing path is kept update of its energy drain rate based on traffic load variation and node energy drain rate changes according to application demand. Intermediate node in the routing path is kept update of its energy drain rate. Path is generalized to accommodate the data transmission bandwidth capacity. Node mobility affects the resource capability of the network path. Dynamic network characteristic have influence of bandwidth availability to the nodes in the route path. The bandwidth consumption resource is optimized with path energy consumption rate. Power resource required to locate node position is measured with localized node batteries of the path.

E. Resource Adaptive On Demand Routing

The resource adaption is made for on demand geographic routing that data loss occurrence on the path during routing and data forwarding are measured. To minimize the loss with adaptive resource usage across the network throughput of on demand routing is calculated to know the data delivery rate on the adaptive routing path. Transmission Geographic routing path are analysed for the transmission throughput that path allocated for respective S-D pairs are resource minimized. Resources constrained are sorted out with path of less resource usage on specific time period.

III. EXPERIMENTAL RESULTS AND CONCLUSION

In this section we evaluate performance of integrated resource adaptive geographic Routing for Dynamic Ad hoc Networks through NS2 simulation. One of the major contributions of this work is the designing routing protocols based on the Integrated Resource Adaptive on Demand Geographic Routing. To confirm the analytical results, we implemented Integrated Resource Adaptive on Demand Geographic Routing in the network simulator ns-2 and evaluated the performance of services.

Mobility Rates	Existing Holistic Geographic Routing Schemes	Proposed Integrated Resource Adaptive On Demand Geographic Routing
2	500	865
4	430	790
6	360	643
8	240	510
10	100	460

Table 1: Node Energy

In order to construct performance evaluations, we have simulated Integrated Resource Adaptive on Demand Geographic Routing using the NS2 simulator which simulates several integrated resource adaptive on MANET. The performance of Integrated Resource Adaptive on Demand Geographic Routing is evaluated by the following Metrics.

1 Node Energy
2 Path Bandwidth
3 Path Loss Rate

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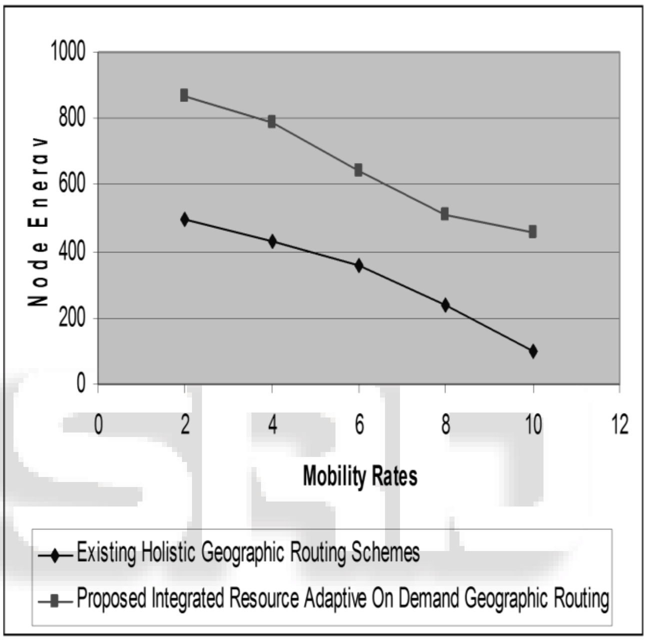

Fig. 2: Node Energy

Figure 2 demonstrates the node energy. X axis represents mobility rates whereas Y axis denotes the node energy using both the existing Holistic Geographic Routing Schemes and proposed Integrated Resource Adaptive on Demand Geographic Routing. When the rate of mobility increased node energy gets decreased. All the curves show a more of less yet steady descendant when mobility rates increases. Figure 2 shows better energy for node of Integrated Resource Adaptive on Demand Geographic Routing. Integrated Resource Adaptive on Demand Geographic Routing achieves 20% to 40% more node energy result.

Node Density	Existing Holistic Geographic Routing Schemes	Proposed Integrated Resource Adaptive On Demand Geographic Routing
10	60	20
20	100	40
30	120	60
40	160	80
50	200	100

Table 2: Path Bandwidth

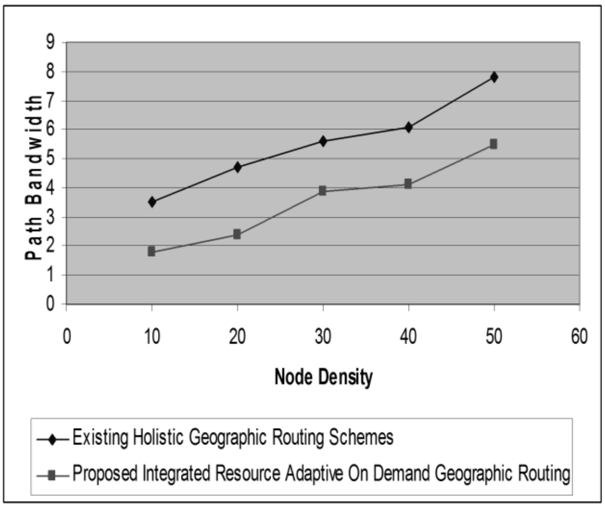

Fig 3: Path Bandwidth

Figure 3 demonstrates the path bandwidth. X axis represents node density whereas Y axis denotes the path bandwidth using both the existing Holistic Geographic Routing Schemes and proposed Integrated Resource Adaptive on Demand Geographic Routing.

When the node density increased path bandwidth also gets increased. Figure 3 shows the effectiveness of path bandwidth over different node density than existing Holistic Geographic Routing Schemes and proposed Integrated Resource Adaptive on Demand Geographic Routing. Integrated Resource Adaptive on Demand Geographic Routing achieves 30% to 45% less path bandwidth when compared with existing schemes.

Node Density	Existing Holistic Geographic Routing Schemes	Proposed Integrated Resource Adaptive On Demand Geographic Routing
10	3.5	1.8
20	4.7	2.4
30	5.6	3.9
40	6.1	4.1
50	7.8	5.5

Table 3: Path Loss Rate

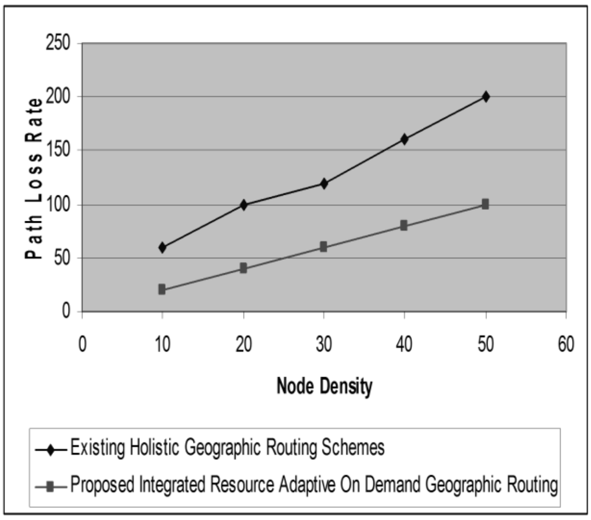

Fig 4: Path Loss Rate

Figure 4 describes the path loss rate. X axis represents the node density whereas Y axis denotes the path loss rate using both the Holistic Geographic Routing Schemes and proposed Integrated Resource Adaptive on Demand Geographic Routing. When the node density increased, path loss rate also gets increases accordingly. The rate of path loss is illustrated using the existing Holistic Geographic Routing Schemes and proposed Integrated Resource Adaptive on Demand Geographic Routing. Figure 4 shows better performance of Proposed Integrated Resource Adaptive on Demand Geographic Routing in terms of path loss than existing Holistic Geographic Routing Schemes and proposed Integrated Resource Adaptive on Demand Geographic Routing. Integrated Resource Adaptive on Demand Geographic Routing achieves 50 to 65% less path loss rate variation when compared with existing system.

IV. CONCLUSION

The focus of this paper is to design adaptive geographic routing protocols to achieve higher performance in a mobile ad hoc network and meet the need of various applications which may have different traffic patterns. The neighbour detection is based on measured control message strength among neighbours and hence considers the impact of channel fading. The Integrated Resource Adaptive On Demand Geographic Routing is implemented for efficient communication in dynamic MANET topologies. Loss rate is reduced in geographic routing with dynamic routes and minimal bandwidth consumption. Increased throughput on the geographic routing of dynamic traffic condition and network life time.

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