



A STUDY ON GEOGRAPHICAL ROUTING WITH ADAPTIVE POSITION UPDATE

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Abstract:

Geographical Routing is a routing methodology mainly used for wireless mobile networks (Mobile Adhoc Networks, MANETs). MANETs are comprised of mobile nodes or mobile computing devices which are free to move randomly and thus the network's wireless topology may also change randomly. In Geographical Routing, nodes need to maintain the current positions of their neighbors for making forwarding decisions and hence the Adaptive Position Update (APU) method is proposed. Based on the flexibility of the nodes and the forwarding decisions made in the network, APU dynamically keeps in track of the rate of position updates. It is based on nodes with movements which are complex to predict their updated positions frequently and also the nodes which are closer to forwarding paths and update their positions more frequently. The APU is validated by network simulations showing that APU can potentially reduce the traffic load and acknowledge the mobility of nodes. It also improves the routing performance in terms of packet delivery ratio and packet delays.

Keywords: MANET; Geographical Routing; APU; Mobile Nodes; Network; Wireless Topology.

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1. Introduction

In the emerging technology of wireless communication Mobile Adhoc Networks (MANETs) allows the user to access services deprived of their geographical position. MANETs are multifarious distributed arrangement of wireless mobile nodes connected through random topology without relying on any fundamental organization [1]. If the mobile nodes are within the range of communication it can directly communicate using wireless links, otherwise nodes had to rely on other nodes for transmission. The mobile nodes can act as a network system and a router (forwards packets) at the same time. When acting as routers, they discover routes from one node to other node for forwarding the data packets in the network.

The Mobile Adhoc Networks are very useful in quick search-and-rescue operations for air/ land/ navy defense, disaster rescue, data procurement operations in inhospitable area, meetings, conferences or conventions in which persons wish to quickly share data, environmental monitoring, road safety management and several more applications [15].

1.1. MANET

A Mobile Adhoc Network (MANET) is a wireless network that includes n number of wireless nodes (or mobile computing devices). These nodes use the wireless transmission technology for communication. The MANET can be made quickly available anywhere and anytime as they reduce the complexity of the network [14]. The characteristics of MANET are:

- **Dynamic:** In MANET, nodes can freely move throughout the network rapidly at any time which can be unpredictable, thus the links can be both unidirectional and bidirectional.
- **Controlled Bandwidth with adjustable capacity:** Multiple accesses are done on the wireless network and therefore due to noisiness conditions, the wireless links' capacities are made adjustable with controlled bandwidth.
- **Reserved Energy operation:** The network arrangement in MANET is designed in a form that the nodes reserves energy on each transmission because they rely on batteries.
- **Security:** The MANET is generally inclined to security threats than fixed network. They have a distributed nature of network which is an advantage of providing additional security for carefully considering snooping and service attacks.

2. Routing In MANETS

Establishing and sustaining routes in MANET environment requires more control due to less resources and rapid change in network. MANET routing protocols are divided into two types:

- 1) Location-aware (Position-based)
- 2) Location-unaware (Topology-based)

2.1. Position-Based Routing

This routing is described as Location aware protocols which is based on geographic position of neighboring nodes and does not rely on any connection state as in topology based routing. In this type of routing, the nodes forward packets from source to destination which is intended within the transmission range. Here the neighbor node is closer to the destination than the forwarded node. Generally position based routing have two main protocol operations: the location service protocol and authentic routing protocol [9]. An example of this type of routing is the Predictive Directional Greedy Routing (PDGR).

2.2. Topology-Based Routing

This routing is described as Location-unaware routing which is based on network connections (links) for forwarding packets [2]. Therefore each node has to maintain current positions of

routing by exchanging the information. In this approach, the routing protocols are divided into three types based on routes exposed and updated at time. They are:

- 1) Proactive Routing Protocol (Table Driven)
- 2) Reactive Routing Protocol (On-Demand)
- 3) Hybrid Routing Protocol

2.2.1. Proactive Routing Protocols

The Proactive Routing is a traditional method of routing protocol designed for MANETS. These are Table-driven protocols because the routing information is maintained in tables. One advantage of this routing is that the routes are available at any time and the disadvantage is as the network is wide it is difficult to overcome the rapid changes in the control overhead. Examples of this type of routing are Destination - Sequenced Distance - Vector (DSDV) protocol, Wireless Routing Protocol (WRP), Optimized Link State Routing Protocol (OLSR) etc.

2.2.2. Reactive Routing Protocols

Reactive Routing protocol is far from the traditional Internet routing as it does not maintain routes between the network nodes. Instead, when in need the routes are exposed to the network environment. The process of Reactive Routing protocol is that it first checks the route in the table to send the data from source to destination. If routes are not available then it discovers the route to find a way to the destination and forwards the data. Therefore the route discovery procedure becomes On-Demand. The disadvantage of this type routing is the inactivity of routes. As described, in the Proactive Routing the routes are made available at any time, but this is not applicable in Reactive Routing method. Examples of Reactive Routing protocol include Dynamic Source Routing (DSR) protocol, Ad hoc on-demand Distance Vector (AODV) protocol, Ad hoc On-Demand Multiple Distance Vector (AOMDV) protocol, etc.

2.2.3. Hybrid Routing Protocols

Hybrid routing protocol is a combination of Proactive and Reactive routing methods. This routing is widely used in MANETS as the grown area of positioning devices is made useful for several researches. The procedure involved in Hybrid Routing is the protocol selects the neighbor node (next routing hop) which is nearer to the geographical destination. The packets are forwarded with indigenous knowledge and maintain the routes for each destination node. By the advantage of Position – based routing protocols, the rapid change in the network are made highly accessible [5]. Moreover, the forwarded decisions select the next routing hop in the current network structure. This routing enhances the performance for topology – based routing protocols such as Dynamic Source Routing (DSR) and Ad hoc On-Demand Distance Vector (AODV). An example of Hybrid Routing protocol is the Zone Routing Protocol (ZRP) [6].

3. Geographical Routing

Geographical routing also known as Georouting or Position-Based routing uses the location's information for articulating the pointing route towards the destination [10]. This reduces the idleness of the node from various sources and through this the transmission from the server

becomes more efficient. Therefore it is useful in wireless sensor networks with a lump of data been shared between wireless nodes. It is based on only single next hop topology as the routing finds its optimal path with neighbor nodes. The way the Geographical routing approaches the forwarding node, it decreases the overflowing of data from the routing table [7].

In Geographical routing method the nodes within the transmission range can only forward the data packets. This transmission range is well-defined by its source nodes or in-between nodes and excludes the nodes that deviates its routing path from source node. As Geographical routing is also known as Position-based routing, the nodes in it mark the position of its immediate neighbor [8]. Therefore the Greedy Perimeter method is applied here to forward the packet. The Position-based routing reduces the energy of nodes as the overflowing of data is reduced within a single hop [13].

4. Adaptive Position Update (APU)

The APU approach is a routing methodology used for geographical routing in MANETs where the rate of updates is dynamically adjusted. This updating procedure is based on the arrangement of network nodes which forwards the data and the agility of the nodes. This method is based on two simple ideologies: one is based on the nodes which are closer to the destination and updates its position often for the sake of forwarding data packets and the other is based on the nodes which have less activity and difficult to predict its positions [3].

In APU the nodes are responsive of their positions and their link states are bidirectional. The updated beacon packet includes its location, speed of the nodes and the data to be forwarded are attached to its position and hence all the neighboring nodes operate in an uninhibited mode [4]. In Greedy Perimeter Stateless Routing protocol, the nodes intermittently inform its position to its neighboring node. This is considered as the initialization of beacon nodes in network. While receiving the position from neighbor nodes it is saved at each node for transmission and also constantly updates its local topology. This is characterized as the neighbor list. The possible aspirants for forwarding the data are considered only from this neighbor list. Therefore beacons are very important in preserving the exact location in the network. The APU method actually adjusts the movement of the nodes and the rate of data transmission.

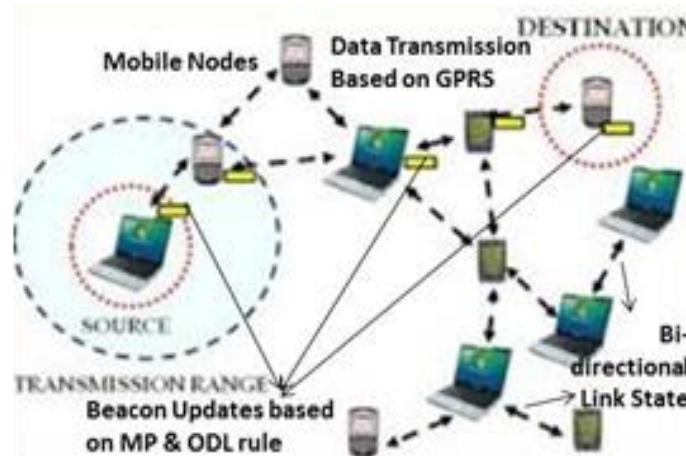


Figure 1: Structural Design of APU

Fig. 1 depicts the structural design of APU which is comprised of mobile nodes. The updating procedure is done on the nodes based on the arrangement of network nodes to forward the data. Mobility Prediction (MP) rule and On-Demand Learning rule are the two basic rules used for beacon updates. In the transmission range of source the neighboring node is updated with the position of the beacon nodes and thus transmits the data to the destination. As the link states are bidirectional each node is responsive of its position. The Greedy Perimeter Stateless Routing (GPSR) method initializes the beacon nodes and selects the finest route to forward the packets.

5. Materials and Methods

The Adaptive Position Update is done by applying two methods (rules):

- 1) Mobility Prediction (MP) Rule
- 2) On-Demand Learning (ODL) Rule

5.1. Mobility Prediction (MP) Rule

The Mobility Prediction Rule characterizes the frequency of change in nodes and manages the velocity of the nodes. This velocity management is adapted in the Beacon’s neighbor nodes. These neighbor nodes then discover their path using some linear calculations for motion. The network would be comprised of nodes with less motion. The nodes with frequent motion need to frequently update their position as the changes takes place and nodes with less motion are not in need of updating its positions. Existing methodology cannot help in handling this simultaneous mode of operations and thus the Mobility Rule helps in managing the frequent node updates.

5.2. On-Demand Learning (ODL) Rule

The On-Demand Learning rule is used to maintain the exact position of the node within the network. It helps the nodes to respond its neighbor node on the forwarding path [12].



Figure 2: ODL Rule

In Fig. 2, S is the source node and D is the destination node. If the ODL rule fixes its position to the next hop node B within the transmission range of S then, A and C will be its neighbor node. These nodes will receive the data packets from S and responds back. Now B sends data to A and C. If C doesn’t respond, then the next hop node is moved to A from B and sends to D. Thus the optimal path will be S-B-A-D. The ODL rule in mobile communication is used for wide range Internet access.

Greedy Perimeter Stateless Routing (GPSR)

Greedy Perimeter Stateless Routing (GPSR) is a unique routing protocol for mobile, wireless networks. It uses a greedy algorithm to do the routing and orbits around a perimeter. GPSR selects the best path for forwarding data packets even when no neighbor node is found. Selection of route is based on the location of the routers from source to destination [11].

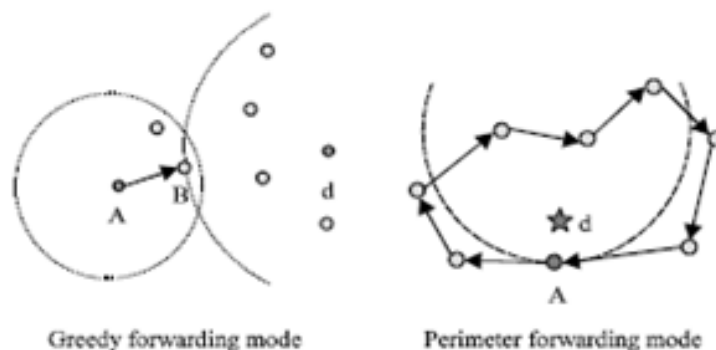


Figure 3: GPSR Routing

Fig. 3 describes the forwarding mode of greedy perimeter method. If a packet is made impossible of reaching the region in greedy forwarding mode then the algorithm improves the routing towards the perimeter of the transmission range. This greedy algorithm is a responsive requiring algorithm and finds a valid route as the network topology changes quite often. The algorithm uses the graph theoretic idea of the shortest paths for forwarding packets. If the greedy path is not found in the region then the GPSR tends to forward packets in perimeter mode [18]. Here the forwarded nodes are successive until it reaches the destination with full broadcasting network connectivity, while the greedy forwarding is resumed. GPSR builds network that cannot be measured using the earlier algorithms for wireless networks. Such networks include Rooftop networks, Ad-hoc networks, Sensor networks and Vehicular networks.

By extending GPSR on the wireless networks the position and capacity are interconnected; distributing load geographically influences spatial reuse and cuts the average load in transmission regions where there is strenuous traffic [16].

6. Results and Discussions

The projected method addresses the issues of routing, network traffic, packet loss and delay. To estimate the performance of the APU method, the network simulator is used considering the factors of the multipath transmission. The network simulation is a technique where the software (simulator) predicts the behaviour of the network. The performance of the network is analysed by the simulator using devices, links, applications, etc. The simulators supports the Mobile Adhoc Network [17] as it describes the network such as nodes, routers, switches, links and events such as data transmission, packet errors, etc. In the simulation the transmission of data is done in multipath. The throughput of the Adaptive Position Update is made visible from the initial position of nodes. The throughput of APU is high due to increase in number of successive node data transfer. It is seen that the packet delivery ratio is efficient for APU with respect to time and location.

7. Conclusion

The study on APU shows the adaption of beacon updates engaged in geographical routing. The mobility of nodes and the traffic load is acknowledged and thus APU solves these problems. The two rules deployed in APU are Mobility Prediction (MP) rule and On-Demand Learning (ODL) rule. The MP rule predicts the exact position of the nodes and familiarises the beacon updates with respect to time. The ODL rule helps the node to exchange the data packet as a result it maintains the forwarding path with response to its neighbour nodes. The accuracy of APU with the beacon packets and network topology are validated through the simulation results.

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