A Recent Survey on Increasing Routing Efficiency in MANET

R.Maheshwari,
Department of Computer Science &Engineering,
K.S.R. College of Engineering,
K.S.R. Kalvi nagar,
Tiruchengode-637215,
Namakkal District,
Tamil Nadu State,
India.
r.maheshcse@gmail.com
+91-9578621753

R.Velumani
Department of CSE,
K.S.R. College of Engineering,
K.S.R. Kalvi nagar,
Tiruchengode-637215,
Namakkal District,
Tamil Nadu State,
India.

A*bstract*- Mobile Ad-hoc Networks (MANETs) are widely used self-configured networks without any centralized infrastructure support. In MANET every node has to act as a router and has the responsibilities to discover a route and the node mobility makes unpredictable topology changes. The rapid change of network topology causes the link failure thereby increasing the network traffic and wasting the energy consumption of a mobile node. Hence the routing process is difficult in MANET. For improving routing efficiency as well as minimizing the energy consumption, the existing protocol chooses the most stable link along with their residual energy. This survey discusses the above mentioned problem and solution proposed.

Key words: Mobile Ad-hoc Network, proactive and reactive routing protocol, mobility model.

I. INTRODUCTION

A Mobile Ad Hoc Network **(MANET)** is a collection of mobile nodes connected by wireless links and there is no centralized infrastructure such as base stations. Each node in the network will make decision independently based on the current network situation and the nodes are expected to behave as routers. Since, nodes are acting as router that must assist in route discovery and maintenance procedures. The main characteristics of MANET are mobility and multihop.In this discussion we are considering about the mobility characteristics. Because the mobility of a node changes the network topology and resulting in route changes, which leads to network partitions and in most instances some packet losses. The some challenges of MANET are routing process, QoS requirements, limited power usage. The routing process and power consumption are taken into account for this discussion. The main problem in Mobile Ad Hoc networking is how to forward a packet from one node to another node through the radio interface while the nodes are randomly moving in the network so the network topology of an Ad Hoc network is changing dynamically and it will be very difficult for routing process. Secondly energy is an important constraint that needs to be preserved in order to extend the lifetime of a network because MANETs are characterized by limited power resource, high mobility and limited bandwidth. The network lifetime can be improved by increasing the routing efficiency. The routing efficiency can be improved by selecting the stable link between any two nodes. Different types of routing protocols are used for selecting the available route in the network needed to deliver a packet from source to destination. This network can be used for many applications such as Military scenarios, Sensor networks, Rescue operations, Students on campus, Free Internet connection sharing, Conferences due to its mobility. The section 2 describes about the ad-hoc routing protocols, section 3 and 4 describes about the existing protocols that separately account for selecting the stable link and minimizing the energy consumption, and section 5 describes a few concepts on joint-metric (i.e. link stability and energy metrics).

II. CLASSIFICATION OF ROUTING PROTOCOL

Routing protocols use metrics to evaluate what path will be the best for a packet to travel. A metric is a standard of measurement; such as path bandwidth, reliability, delay, current load on that path etc; that is used by routing algorithms to determine the optimal path to a destination. To aid the process of path determination, routing algorithms initialize and maintain routing tables, which contain route information. Route information varies depending on the routing algorithm used.

There are many types of ad-hoc routing protocols are available such as proactive routing protocol, reactive routing protocol, hybrid routing protocol for routing in MANET. The figure 1 shows the classification of ad-hoc routing protocol. In these types of protocol we are going to consider the reactive and proactive routing under the flat routing protocol since those types of protocols are mostly used for routing in MANET. The expected properties of routing protocols are

- A routing protocol should be aware of Quality of Service (QoS).
- The routing protocol should be power-efficient.

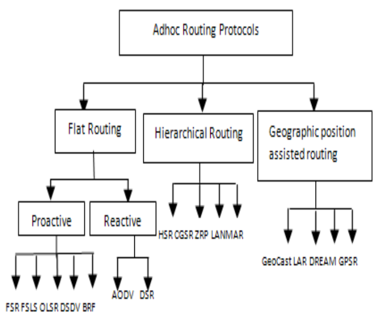

Figure 2.1 depicts broad classification of different routing protocols.

A. *Proactive Routing Protocol*

Proactive protocols are periodically updating the routing table by continuously learn the topology of the network by exchanging topological information among the network nodes. Thus, when there is a need for a route to a destination, the route has been chosen from that updated information. If the network topology changes too frequently, the cost of maintaining the routing table information about the network might be very high. The examples of such proactive routing protocols are DSDV (Destination Sequence Distance Vector), OLSR (Optimized Link State Routing).

In DSDV [6] routing protocol, each mobile node in the network maintains a routing table. Each of the routing table consist the list of all available destinations and the number of hops to each marked with sequence number, which is originated by the destination node.

The OLSR [3] protocol inherits the stability of link state algorithm to provide the power efficient routing. This protocol performs hop-by-hop routing; that is, each node in the network uses its most recent information to route a packet. However these proactive routing protocols are not suited for ad-hoc networks because the updating of routing tables in periodic manner is difficult in MANET due to its mobility. The most dynamic network uses reactive protocols because they don't need periodic transmission of network topology information.

B. *Reactive Routing Protocol*

These types of protocols are often called as 'On-Demand' routing protocols. This means that whenever a node wants to forward the packet from source to the destination, it establishes the route for that destination based on the current network situation. There are so many different approaches under those routing protocol [3] such as DSR, ABR, and SSA.

DSR [3] allows nodes in the MANET to dynamically discover a source route across multiple network hops to any destination.

There are some other routing protocols that separately considering the link stability metrics and energy consumption or power aware metrics.

III. LINK STABILITY METRICS AND ALGORITHMS

This section provides the assumption of link stability metrics [6].The stable links are chosen based on the following assumptions.

- Select the oldest link.
- Select the youngest link.
- Select the link with maximum residual lifetime.
- Select the link with maximum persistence probability.
- Select the link with the lowest failure probability.

Each algorithm described below are discussed the stability metrics based on this assumptions.

A. *OSRR Mechanism*

To provide QoS the **O**ptimized **S**table and **R**eliable **R**outing mechanism was used in [15].The OSRR selects the optimal link based on the constraints such as path cost, provider selection, power aware source to provide the better throughput. This mechanism uses two schemes for selecting the optimal path.

- Address allocation scheme
- Node selection scheme

The address allocation scheme uses Duplicate Address Detection to avoid the duplication of nodes and the node selection scheme uses the parameters such as packet delivery ratio, node degree, battery power, link expiration time. The link expiration time [20] is used to identify the duration of the link between any two nodes.

B. Random Direction Mobility Model

In [16], they have focused on the stability of a routing path subject to link failures (fifth assumption in link stability metrics) caused by the node mobility. In [13] bidirectional random mobility model two activities are handled. They are a) move phase b) pause phase, at the beginning of each move phase a node independently selects its new direction and speed and those are kept constant during this phase.

Need for Route Stability Analysis:

The route stability analysis is considered to meet the QoS requirements. The requirements of QoS are

- Stable routes
- Efficient route repair
- Network connectivity
- Performance evaluation
- Throughput

The path availability under the random mobility model consists of new value of node speed and direction. This model considers only about the move phase for path availability and it does not include the pause phase where the move phase describes the nodes that are in active mode and pause phase indicating the nodes that are in not active (sleep mode) mode. The path duration and path availability of a node is considered based on their speed and direction using the exponential distribution.

C. Location Updating Algorithm

In [13], the stable links are choosing based on the location of its neighbor nodes. A node in the network collects information about the location of its neighbor node and that information will be stored in a table called "neighbor table" and the updating of that neighbor node is called as "Location Updating table".

If a source wants to send a packet to the destination, it will select the link or path based on the location information presents in the location updating table.

In the location updating algorithm they did not consider about for choosing the alternate path if the selected link gets failed. So there may be packet loss and also increasing delay because the node has to wait until new route has been found.

IV. ENERGY AWARE METRICS

The metrics used in energy are power, residual energy, total energy, transmission power, bandwidth of a node. Some routing protocols considering those metrics for reducing the power consumption of a mobile node. The protocols or algorithms used are

A. QoS based Power Aware Routing Algorithm

The QoS provisioning is very challenging in routing because of the dynamic nature of the mobile nodes. The QoS routing would be obtained by

- Selecting the stable path in the network that has enough resources to satisfy the QoS requirement.
- Obtaining the energy efficiency in resource utilization.

The Q-PAR [14] selects the path in the network based on the bandwidth constraints of a node for reducing the power consumption of a node. Each node sends a HELLO packet to the neighbor nodes and updates the information of those nodes along with their bandwidth. The sender will select the best node to forward the packet based on that bandwidth.

It selects only a small number of paths and limits the routing overhead. This also considers the energy consumption model by using the residual energy of a node. It does not consider other parameters of the node such as number of nodes in the network, node's mobility and energy metric. We could not select the more stable link or path based on single parameter of a node.

B. Distributed Power Control

The power control is quite simple in wired network whereas it is great challenge to realize the power in wireless ad-hoc network. The DPC mechanism was proposed in [4], to reduce the power consumption and to increase the network performance. To reduce the energy consumption it chooses the hop-by-hop transmit power level selection.

It uses two effective algorithms such as Dijkstra and Link State scheme for the path selection that reduces the energy consumption. In Dijkstra the final path is chosen by selecting the route which minimizes the sum of the power needed for each link, whereas in Link state the final path is chosen by minimizing the sum of the transmit power needed for each link. The power can be calculated using the formula

$$P'TX = P\ TXmax - P\ RX + SR + Secth$$

The P'TX is the transmission power of receiver and SR is the minimum power level required for correct packet reception and Secth (Security Threshold) is a power margin. The performance can be improved by varying other system parameters**.**

V. LINK STABILITY METRICS AND ENERGY METRICS

The above mentioned existing algorithms separately describe stability and energy metrics. This section describes about the routing protocol which combine both energy as well as link stability metrics such protocols are LSLP and LAER.

A. LSLP (Link Stability and Lifetime Prediction) Protocol

In [12], the LSLP designed for satisfying the above mentioned QoS requirements. The QoS arises in the application layer and that demands the transport layer to provide the QoS services. Finally the transport layer requests the network layer (routing layer) to compute routes for satisfying the QoS requirements. The Cost Effective Lifetime Prediction method has been used to identify the lifetime. The network lifetime can be determined by using the parameter called link expiration time. It is the maximum time of a link that exists between any two nodes. For minimizing energy, it considers total energy of a node. So by considering the link expiration time as well as the total energy of a node, the stable link will be choosing for delivering the packet. This reduces the packet loss and increasing the lifetime of a network.

B. LAER (Link Stability and Energy Aware Routing Protocol)

In [11], the main focus of this routing is to maximize the link stability so as to reduce the energy consumption, routing overhead. First, the mobility of the node is predicted using the Random Direction Mobility model [16].In additions to the mobility pattern they have include the energy metric such as node's residual energy. Each node in the network will calculate its probability based on the path availability, path duration and residual energy of a node. This probabilistic measure can be sending to all the neighbor nodes through the HELLO packet for that the reactive routing protocol is used. Each node updates this information and selects the route based on those values. The probabilistic measure can be improved by including some other node parameter along to this metrics.

VI. CONCLUSION

This study discusses the various routing protocols and various metrics used for selecting the stable link. In future, to improve the routing efficiency, maximize the link stability and minimize the energy consumption, the random direction mobility model can be used for predicting the mobility pattern. This predicts the path availability, path duration for selecting the stable link between the nodes. For minimizing the energy we can use the residual energy of a node. For improving routing efficiency we can add some additional parameter such as packet delivery ratio, number of nodes and current node situation.

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