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Energy Efficient And Route Stability Maintenance Routing Protocol In Manet

Kamaleswari.S
II M.E, Computer Science and Engineering,
Maharaja Engineering College for Women, Perundurai, India

Abstract

A fundamental issue arising in Mobile Ad Hoc Networks (MANETs) is the selection of the optimal path between any two nodes. Ensuring a data path to be valid for sufficiently longer period of time is a very difficult problem in MANET due to its highly dynamic nature. A method that has been supported to improve routing efficiency is to select the most stable path so as to reduce the latency and the overhead due to route reconstruction. In this work, both the availability and the duration probability of a routing path were studied that is subject to link failures caused by node mobility. In particular, the network nodes were moved focused that according to the Random Direction model and both exact and approximate (but simple) expressions of these probabilities were derived. Through the results, the problem of selecting an optimal route in terms of path availability was studied. Finally, an approach to improve the efficiency of reactive routing protocols was proposed. An approach for MANET routing based on stability and hop-count was presented, where the stability metric considered is the residual lifetime of a link. The stability based routing not as a separate routing protocol was viewed but as an enhancement to a hop-count based routing protocol (e.g. DSR or AODV), so that the expected residual lifetime as well as hop count of a route are taken into account.

1. Introduction

A mobile ad hoc network is envisaged as a collection of mobile nodes with no fixed infrastructure and with no central authority. Extensive use of portable mobile devices and the increasing demand of connectivity among the devices have made mobile ad hoc network as one of the flourishing frontier of wireless research. A variety of applications exist like personal area networking, disaster management, relief and rescue operation, military, business and other scientific applications. Mobile ad hoc network is a self-configured and self-maintained network with no centralized authority. Other remarkable features of MANET include quick and inexpensive deployment and network with unrestricted mobility. Every node in MANET acts as both a host and a router and must perform some network function. As a consequence MANET faces routing challenges for its dynamic nature. With the development of the MANET, people pay more and more attention to the power aware routing strategy and QoS routing strategy. Because mobile hosts in the network such as PDA, notebook are mostly power constrained, saving their power and consequently prolonging the lifetime of the network is the focus of the power aware routing strategy. While with the wide deployment of MANET, the demand for providing different quality of service in the network has increased much. QoS routing strategy focused on routing strategy for different QoS in this dynamic network. Much progress has been made in both areas. However, there is little research work has been done to combine these two strategies.

It is very evident that there are some contradictories between QoS routing and power aware routing. For the traditional QoS routing scheme in the Internet, all routers in the network should know all nodes and links state before they make their routing decisions. Frequent information exchange about the network status occurs among all the nodes. This will aggravate the energy draining rate of the ad hoc network if it applied without any changes. For the power aware routing strategies in the MANET, its main purpose is to save the energy and to prolong the lifetime of the network. It can't provide any service quality guarantee. It's an interesting and complex problem to combine them together to satisfy both the QoS and the energy requirements.

Variable link conditions are intrinsic characteristics in most mobile ad hoc networks. Rerouting among mobile nodes causes network topology and traffic load conditions to change dynamically. Given the nature of MANET, it is difficult to support real-time applications with appropriate QoS. In some cases it may be impossible to guarantee strict QoS requirements. But at the same time, QoS is of great importance in MANETs since it can improve performance and allow critical information to flow even under difficult conditions. Unlike fixed networks such as the Internet, quality of service support in mobile ad hoc networks depends not only on the available resources in the network but also on the mobility rate of such resources. This is because mobility may result in link failure which in turn may result in a broken path. Furthermore, mobile ad hoc networks potentially have fewer resources than fixed networks. Therefore, more criteria are required in order to capture the quality of the links between nodes.

Quality of service routing is a routing mechanism under which paths are generated based on some knowledge of the quality of network, and then selected according to the quality of service requirements of flows. Hence, the task of QoS routing is to optimize the network resource utilization while satisfying application requirements. From the above discussion it is very evident that two major factors mobility and energy efficiency need to be considered to assure better network performance. Especially while assuring QoS in MANET environment nodes should not die due to power constraint or the links should not expire due to mobility in the middle of the transmission. So our target is to choose a more stable path considering higher link stability and less cost along predicted higher life path. In this paper we combine the idea of link stability calculation based on mobility prediction and best path in terms of cost and lifetime along with QoS support.

2. Related Work

Energy is an important resource that needs to be preserved in order to extend the lifetime of the network, on the other hand, the link and path stability among nodes allows the reduction of control overhead and can offer some benefits also in terms of energy saving over ad hoc networks. However, as will be shown in this contribution, the selection of more stable routes under nodes mobility can lead to the selection of shorter routes. This is not always suitable in terms of energy consumption. Some solutions to routing have been presented also for these cases, starting from the basic epidemic routing, where messages are blindly stored and forwarded to all neighbouring nodes, generating a flood of messages. Existing routing protocols (AODV, DSR) are must take to a "store and forward" approach, where data is incrementally moved and stored throughout the network in hopes that it will eventually reach its destination.

On demand routing protocols for ad hoc networks discover and maintain routes on a reactive, “as-needed” basis. These protocols are attractive for their low routing overheads. We develop a technique to make these protocols energy-aware in order to increase the operational lifetime of an ad hoc network. The quality of service support in mobile ad hoc networks depends not only on the available resources in the network but also on the mobility rate of such resources. This is because mobility may result in link failure which in turn may result in a broken path. Furthermore, mobile ad hoc networks potentially have fewer resources than fixed networks. Therefore, more criteria are required in order to capture the quality of the links between nodes. Quality of service routing is a routing mechanism under which paths are generated based on some knowledge of the quality of network, and then selected according to the quality of service requirements of flows. Thus, it is evident that both the aforementioned parameters (i.e., link stability associated with the nodes mobility and energy consumption) should be considered in designing routing protocols, which allow right trade-off between route stability and minimum energy consumption to be achieved.

3. System Analysis and Design

3.1. MANET Framework Setup

We are going to give structure for our routing process in an ad hoc network that includes setting up of node placement, node partition etc. Simulation framework is formulated by linking all layers and sub layers into a single process because we can’t get results by running each and every layers. Framework includes topology design like grid based or random or uniform or user specification.

3.2. Kalman Filter Based Prediction Technique

We propose an algorithm to predict the link lifetime in MANETs by the Kalman Filter (KF). The algorithm recursively computes the KF states, modelled as a nonlinear system, using periodically measured node current stability value as inputs. The KF states are then utilized to compute the estimates of the remaining link lifetime. A host or node willing to send a message to a recipient or any host in the multihop path to it uses a Kalman Filter predict to choose the best next hop (or carrier) for the message. The use of Kalman filters at strategic network locations to allow predictions of future network congestion. The premise is that intelligent agents can use such predictions to form context aware, cognitive processes for managing communication in mobile networks.

3.3. EFRSP Routing Protocol

Energy Efficient and Route Stability Protocol (EFRSP) is the proposed protocol. It is very evident that two major factors mobility and energy efficiency need to be considered to assure better network performance. Especially while assuring QoS in MANET environment nodes should not die due to power constraint or the links should not expire due to mobility in the middle of the transmission. So our target is to choose a more stable path considering higher link stability and less cost along predicted higher life path. In this paper we combine the idea of link stability calculation based on mobility prediction and best path in terms of cost and lifetime along with QoS support. To achieve QoS path along with prolonging the network life time and to reduce packet loss we need to calculate three parameters for a path:

i. Path Stability,
ii. Lifetime prediction and
iii. Ratio of QoS support and requirements

To calculate the above parameter for path selection we define the network model first and then we will subsequently describe the process of calculation for each the parameters.

3.4 Protocol Configuration Setup

We need to configure some attributes which is supported to execute our routing protocol like Number of nodes, Mobility, Mac protocol, Simulation time, Band width, Transmission range etc… by setting these kinds of attributes we execute out routing protocol with layers interaction. We setup the layer wise results in the configuration process.

The sequence of events at run time:

1. The main function in driver.pc is run. This is the C main function, where GloMoSim starts.
2. The main function calls parsec main () to start the Parsec simulation engine, initialize the simulation runtime variables and create the driver entity. The parsec main function is used when the user wants to write his own main and is found at PCC DIRECTORY/include/pc api.h (since the function is part of the Parsec runtime system, it is not possible to access the source for it).
3. When the simulation ends, parsec main () returns, and the rest of the main function is executed.

In GloMoSim, the driver entity(in ./main/driver.pc) reads the input file descriptor, establishes partitions, allocates memory for node information, calls appropriate functions depending on the read input values such as simulation time and node placement, and finally starts simulation by sending a StartSim message to the partitionEntityName instance of the GLOMOPartition entity type (defined in the glomo.pc file).

Table 1. Simulation Parameter

Simulation-time	140s
Number-of-nodes	20
Node speed	1-20 m/s
Channel capacity	2 Mbps
Packet size	512 bytes
Temperature	290.0
Routing-protocol	AODV
Terrain dimensions	(900, 600)
Radio-bandwidth	2000000
Mobility	Random-waypoint

3.5 Performance Evaluation

First, we need to specify the necessary input parameters in the Config.in file as said above. For our simulation procedure, we have been specific about certain parameters as mentioned below to enable hassle free simulation Terrain range – (500,500) Number of nodes – 20 (This is a scalable simulator. Hence number of nodes can be increased at will.)These parameters were adhered to for the whole process of experimentation with the new protocol. The performance of the proposed algorithm is evaluated via glomosim simulator.

Performance metrics are utilized in the simulations for performance comparison:

Average end-to-end delay

The average time elapsed for delivering a data packet within a successful transmission. Average end to end delay is explained in figure 1.

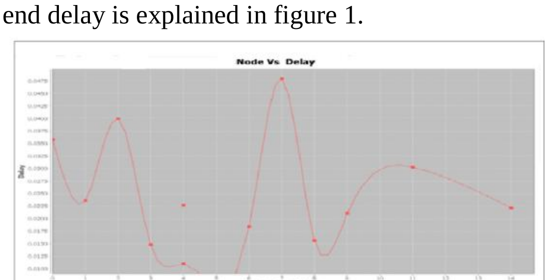

Figure 1.Comparison with Node and Delay

In the above figure 1 is compared between node and delay of each node. The delay means that a packet takes longer time to reach the destination. The above diagram is derived the average delay of among nodes. Because of some nodes are not participated in routing.

Packet arrival rate

The ratio of the number of received data packets to the number of total data packets sent by the source. The below Figure 2 is explained about comparison between nodes and collision of each node.

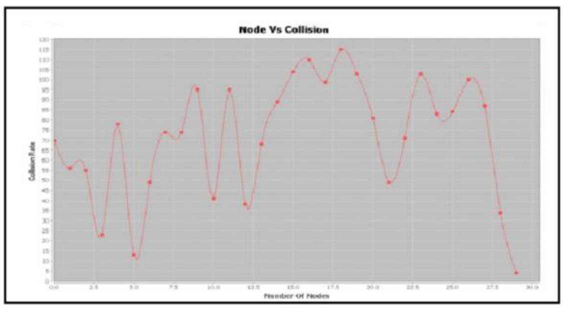

Figure 2. Comparison with node and Collision

Communication overhead

The average number of transmitted control bytes per second, including both the data packet header and the control packets.

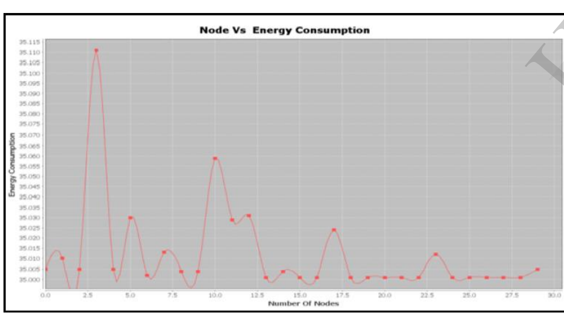

Figure 3. Node versus Energy consumption

Energy consumption

The energy consumption is calculated for the entire network, including transmission energy consumption for both the data and control packets.

4. Proposed System

To the best of our knowledge, only two published works consider simultaneously link stability and energy consumption for path selection, which is the focus of this study. Specifically, a routing protocol called Power Efficient Reliable Routing protocol for mobile Ad hoc networks was proposed. This algorithm applies the following three metrics for path selection: 1) the estimated total energy to transmit and process a data packet; 2) the residual energy; 3) the path stability. Route maintenance and route discovery procedures are similar to the DSR protocol, but with the route selection based on the three aforementioned metrics. A delivery probability of each node is used to select link stability path over dynamic route discovery.

4.1 Delivery Probabilities

Delivery probabilities are synthesized locally from context information. We define context as the set of attributes that describe the aspects of the system that can be used to drive the process of message delivery. An example of context information can be the change rate of connectivity, i.e., the number of connections and disconnections that a host experienced over the last T seconds.

The process of prediction and evaluation of the context information can be summarized as follows:

1. Each host calculates its delivery probabilities for a given set of hosts.
2. This process is based on the calculation of utilities for each attribute describing the context.
3. The calculated delivery probabilities are periodically sent to the other hosts in the connected cloud as part of the update of routing information.
4. Each host maintains a logical forwarding table of tuples describing the next logical hop and its associated delivery probability for all known destinations.
5. Each host uses local prediction of delivery probabilities between updates of information.

6. Conclusion

Routes are pre computed and stored in a table, so that route will be available whenever a packet is available for transmission. The selection and maintenance of a multihop path, however, is a fundamental problem in MANETs. Node mobility, signal interference, and power outages make the network topology frequently change; as a consequence, the links along a path may fail and an alternate path must be found. The last category based on link stability is unique to wireless network. Link stability refers to the ability of a link to survive for certain duration. The higher the link stability, the longer is the link duration. We focus on the stability of a routing path, which is subject to link failures caused by node mobility.

The duration and availability probabilities of routing paths in MANET area fundamental issue to provide reliable routes and short route disruption times were studied. The Random Direction mobility model was focused and derived both exact and approximate (but simple) expressions for the probability of path duration and availability. These results to determine the optimal path in terms of route stability was used. In particular, some properties of the optimal path were showed and an approximate yet accurate expression for the optimal number of hops was provided.

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