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A Mathematical View of Efficient Energy Aware Mutipath Routing Transmission in Mobile Adhoc Network

Mr. N. Suresh
Research Scholar, Department of Computer Science,
Rathinam College of Arts & Science, Pollachi Main Road, Coimbatore.

Dr. J. Thirumaran
Professor, Department of Computer Science,
Rathinam College of Arts & Science, Pollachi Main Road, Coimbatore.

Abstract

Routing challenge on ad hoc networks is because networks have been created and broken continuously for mobile and connections. The current tracking and hookie routing procedures begin to track the path following breaks, finding the removal and providing the highest cost to create a new route. Specifically, the source is warned about the possibility of disconnecting if it is obliged to break a path. The source then detects completely and avoids the path of discovery. There is an opportunity to break a path when the connection is low.

Our proposed work will increase the final-end-link patches in the network and reduce the deficiencies at the link or / and end level. The collection of multiple trails was set up for use by the energy-efficient alternate test mechanism for resources. It finds a steady path between the source and the target that meets the need for balance balancing the effective load at the nozzle. The proposed protocol shows the performance results based on the delivery rate, performance, rounding overhead and the end result for the average result delay.

Keywords: Energy Efficient, Multipath, MANET, Routing, Energy Aware.

1. INTRODUCTION

Mobile ad hoc networks (MANETs) have opened up many new possibilities in using computer networks in improvised scenarios where traditional networking infrastructure is unavailable. Mobile networks are usually based on wireless communication and hence many of the established technologies developed for wired networks are not directly applicable in mobile networks. In particular, nodes forming a mobile network are not tied to any infrastructure and can form a network on the fly and for a short period of time. The main difficulties in forming a mobile network are the mobility of the nodes, the nature of the wireless medium, the energy constraints of small mobile nodes, and the possibility that nodes may join or leave a network anytime during the lifetime of the network.

Since nodes are mobile, the routes in the network usually have a short life span. A route may or may not exist for the entire duration of a data communication session, unlike in wired networks, where nodes are usually present in fixed geographical positions. The wireless medium has the constraint that any communication by a node is done through broadcasting of a packet. Since the bandwidth in the wireless medium is much less compared to wired networks, this poses the problem that almost all communications take up large amount of bandwidth due to the flooding of packets

In ad-hoc networks, Quality of Service support is becoming an inherent necessity rather than an “additional feature” of the network. Following are the three main reasons that make a strong case for designing QoS enabled ad-hoc networks rather than adding such features as an afterthought.

- **Wireless channel fluctuates rapidly and the fluctuations severely affect multi-hop flows.**

  As opposed to the wired Internet, the capacity of the wireless channel fluctuates rapidly due to various physical layer phenomena including fading and multi-path interference. In addition, background noise and interference from nearby nodes further effect the channel quality. In ad-hoc networks, the end-to-end quality of a connection may vary rapidly as change in channel quality on *any* link may affect the end-to-end QoS metrics of multi-hop paths.

- **Packets contend for the shared media on adjacent links of a flow.**

  Contention between packets of the same stream at different nodes impacts the QoS metrics of a connection. Such contention arises as the wireless channel is *shared* by nodes in the vicinity. Unlike in the Internet, this phenomenon affects the QoS even in the absence of any other flow in the network.

- **Interference can effect transmissions at nodes beyond the neighbors.**

  Interference effects are pronounced in ad-hoc networks where typically a single frequency1 is used for communication in the shared channel. In single-hop infrastructure wireless networks frequency planning is mostly used where nearby base-stations can be configured to function at different frequencies for reducing interference. Transmissions in the wireless media are not received correctly beyond the transmission range. But even beyond the transmission range, the remaining power may be enough to interfere with other transmissions. So, interference from non-neighboring nodes may result in packet drops.

In order to support QoS on multi-hop paths, QoS must be designed for the end-to-end path as well as for each hop.

2. PROBLEM DEFINITION

The network connectivity is controlled with limited power to their main function until the tip of energy is dissolved sooner. Due to energy disabilities, systemic failures can cause system failure and reduce the connection to the end-end network in the network. The movement and jam of more nodes can lead to frequent connection failures and packet losses affecting the QoS performance of the protocol. In this work, we are using a useful program, balanced and energy efficient multivitam routing, MANET over strong mobile transmissions over mobile temporary networks.

Our proposed scheme which maximizes end-to-end connectivity in the network and minimizes faults at link or/and node level. A set of multiple paths are established from source to multicast destinations using energy efficient neighbor node selection mechanism. It provides effective load balancing at the node and finds a stable path between the source and destination meeting the delay requirement. Simulation results show that the proposed protocol outperforms in terms of packet delivery ratio, throughput, routing overhead and average end to end delay.

3. RELATED WORK

In this work, we used an effective proposed scheme, Balanced and Energy Efficient Multipath Routing with Robust Transmission in MANET to overcome limitations in mobile ad hoc networks. Our proposed scheme which maximizes end-to-end connectivity in the network and minimizes faults at link or/and node level. A set of multiple paths are established from source to multicast destinations using energy efficient neighbor node selection mechanism. It provides effective load balancing at the node and finds a stable path between the source and destination meeting the delay requirement. Simulation results show that the proposed protocol outperforms in terms of packet delivery ratio, throughput, routing overhead and average end to end delay.

Obaidat et al. [16] A variation of the single path AODV routing protocol. The proposed system has established tip-coordinated paths with minimal delays in terms of coordinating factors from different layers. The performance of the proposed protocol was analyzed and the Operation Network (OPNET) compared to one-way AODV and multi-AOMDV protocols. Results show improved performance of the proposed method in terms of throughput and end-toend delay.

Chen et al., [10], extended AOMDV routing protocol channel fires up. The new channel AOMDV (CA-AOMDV) used non-standard metric, satellite metric, channel average nonfading time. Using this information, the available ways are reused and rejected. The proposed system has ensured less workers. Simplicity of good intelligence in the performance differences between CA-AOMDV and AOMDV has been demonstrated by typical network performance activities.

Yu et al. [6] The proposed connection time is useful (LEAT). The mobile connection is a way to find a way to connect the connecting time by measuring the measurements between the two ends rather than the local connection information. A new routing connection was spent, which reduced the connection breakage. Routing was formulated as an optimal routing problem based on new cost, using a heuristic algorithm. Simulation shows that LEAT improved network performance in delay, hop counts, and throughput when compared to present routing algorithms.

Misra et al. [7] Think about the location of renewals in MANETs. They proposed a node stability based renewal approach. They compare their performance with the performance of the usual performance renewal process. They have different types of results with different parameters such as the number of ends and the terrain dimensions.

Dhurandher et al. [8] have proposed an energyefficient ad hoc on-demand routing (EEAODR) algorithm that balances energy load among nodes so that a minimum energy level is maintained among nodes and the network life is increased.

Node mobility is a major factor link stability in MANETs. **Cai and Liu [4]** Connection Stability Based on AOMDV Multi-Steering Protocol - AOMDV (PLS-AOMDV) forecast is recommended, which predicts the connection stability ahead of both directive and energy consumption to choose a high level of stability. Simulation shows the PLS-AOMDV packet delivery rate improvement.

Link availability estimation was used to select most stable route from alternate paths was proposed by **Mazumdar et al. [3]** and was implemented in AOMDV for route selection. Results show that selecting stable route leads to a higher throughput in dynamic network topologies.

4. ENERGY EFFICIENT MULTIPATH ROUTING TRANSMISSION

In previous work, we used a stable and energy-efficient routing technique. In the proposed method, quality of service (QoS) monitoring agents collect and calculate the link reliability metrics such as link expiration time (LET), probabilistic link reliable time (PLRT), link packet error rate (LPER) and link received signal strength (LRSS). In addition, residual battery power (RBP) is implemented to maintain the energy efficiency in the network. Finally, route selection probability (RSP) is calculated based on these estimated parameters using fuzzy logic.

Here we consider these major issues and propose a balanced Energy efficient QoS based Routing protocol in which route discovery mechanism of AODV is modified to include multiple metrics of signal strength, queue length, drain rate and the delay. The protocol finds a stable path between source and destination based on received signal strength and provides load balancing at every node by adding some constraints (queue length and drain rate) before finding the path between source and destination.

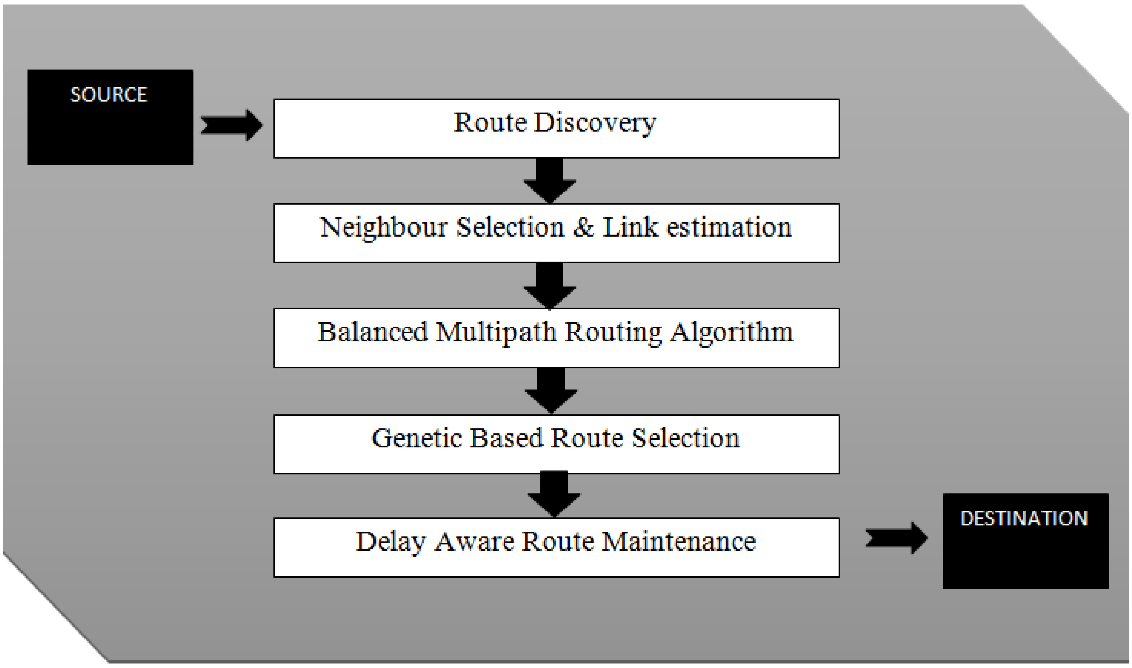

Figure 1: Proposed System Architecture

Multipath routing is nothing but establishing a multiple routes between the source node and destination node. Due to the multipath routing the source nodes are capable of maintaining connections even if one route failure occurs during fault tolerance. Through the multipath routing protocols it is possible to reduce the data transmission failures and the delay times caused by route disconnection.

4.1. Route Discovery

The EEPMM routing protocol is used to find multiple paths between a pair of source node and destination node. It has three phases, the initialization phase, the paths search phase, and the data transmission and maintenance phase.

In route discovery procedure, the EEPMM builds a route between source to destination using a route request and route reply query cycle. When a source node wants to send a packet to destination for which it does not already have a route, it broadcasts a route request (RREQ) packet to all the neighbors across the network, each node will update its neighboring node table with the forward node ID, mark the node *n* id as its parent and forward node energy information. Next, the node verifies if the node type is set to be source node. In such case, the sender ID is compared with the source list of the node. A new entry is created in the source table if necessary, with the hop distance updated only when it is smaller than the value recorded. When RREQ receives at the destination node, it forwards a RREP packet back to the source. In EEPMM the route is selected on the basis of energy entropy.

4.2. Neighbor Selection & Link Estimation

In the first step, each node broadcasts its id to its 1-hop neighbors (simply called neighbors). Thus, at the last part of the first step, each node has a list of its neighbors. The proposed broadcast algorithm is a cross algorithm, and so every node that broadcasts the message could select several neighbors to forward the message.

In our proposed work, every broadcasting node chooses at most one of its neighbors. A node has to broadcast the message only if it is selected to forward and selection is based on coverage condition. This decision is made based on a self-pruning condition called the coverage condition.

In the mobile ad hoc networks, every node takes different amount of energy for transmitting and receiving the data packets. If the energy consumption decreases, then the lifetime of the nodes is increased. So, by using this energy metric the node has to be selected for data transmission and reception.

The energy needed to transmit a packet from node i:

$$E_{tx}(p,i) = I.v.t_b \text{ Joules}$$

Where `I` is the current and `v` is the voltage. The total energy E(p, i) is taken to transmit a packet is:

$$E(p, i) = E_{tx}(p, i) + E_{rx}(p,j)$$

Where E_{tx} is the amount of energy spent to transmit the packet from node i to node j and E_{rx} is the Amount of energy spent to receive the packet at node j.

Residual Energy=Available Energy– (Transmission Energy+ Reception Energy)

$$E_{res}(i) = E_{ave}(i) - (E_{tx}(p, i) + E_{rx}(p, j))$$

Where $E_{res}(i)$ is the residual energy of node i and $E_{ave}(i)$ is the available energy.

Link quality estimation (LQE) mechanism is used to select the most stable paths for data delivery. For this we pick links with the maximum quality and remove those of bad quality. If we use stable routes for data delivery it will increase the throughput and life time of the network.

To estimate Link quality Estimator (LQE):

LQE= PRR+RNP

PRR is Packet reception rate, it is calculated by: *PRR= No of Received Packets ÷ No of sent Packets* RNP is required number of packet transmissions:

RNP = No of transmitted and Retransmitted packets ÷ number of successfully received packets.

4.3. Balanced Multipath Routing Algorithm

We present an algorithm which is based on AOMDV protocol which analyses the load on the neighbor nodes of the current node to choose a path to the destination. The neighbor nodes are analyzed under the different parameters such as loss rate, communication rate and delay. According to this analysis, priorities such as high, low and medium are assigned to the neighbor nodes.

The nodes having energy less than threshold value are placed at low priority. Then those neighbor nodes are get selected which are placed with high priority. Then load is analyzed on these selected nodes, and that node will be chosen for the path to the destination which having minimum load. Here load is referred as the packets that a node consists in its queue length. The following are the steps need to be followed:

- Step 1: Define a network with N nodes with Source and Destination node specifications.
- Step 2: Set the current node as the source node and repeat the process until the destination node is arrived.
- Step 3: Identify the neighbor nodes of current node and represent them as neighbor list. And process all the neighbors.
- Step 4: Analyze the neighbor list under different parameters called Loss Rate, Communication Rate and Delay and set priorities (high, low, medium).
- Step 5: The nodes in neighbor list with energy less than threshold valve is set to be low priority.
- Step 6: Identify the nodes with high priority.
- Step 7: Perform the load analysis under Communication Count and identify the node with minimum load.
- Step 8: Set next hop with selected nodes and form a path to the destination.

4.4. Genetic based route selection

A communication network is simulated as a directed graph G (V,E), where V is the set of nodes representing the routers and E is the set of edges representing the links that connect between the routers. For a network supporting multiple QoS metrics, each edge (i, j) is associated with 4 independent metrics of having numerical value from 0 to 1. The values of static resource capacity, dynamic resource availability, neighborhood quality, link quality are also initialized.

In this primary path selection algorithm, GA is utilized to find the possible number of routing paths based on the link metrics.

At first, population is initialized. The values of static resource capacity, dynamic resource availability, neighborhood quality, link quality. Each chromosome value is calculated. Mating pool is created and which consists of all the chromosomes in the current population.

The fitness function of each route in the network is based on various parameters like node’s static resource capacity, dynamic resource availability, neighborhood quality, link quality in such a way that it satisfies set of QoS requirement. Each parameter is assigned with a weight. These weighted parameters are combined into a single function, which is known as fitness function. Cross over operator function is applied for several times to create m new children for the new population. The parents are selected using the selection operator.

Apply mutation operator is applied on the chromosomes in the mating pool. Each chromosome has a certain probability to be mutated. Mutation result must not be the same as any of the chromosome in the current population or else it would be ignored.

4.5. Delay aware route Maintenance

MAODV detects a broken route by monitoring the “Hello” messages. If a node does not receive a “Hello” message from a specific neighbor within a predefined interval, it marks the routes using that neighbor host invalid and sends a corresponding error message RERR to the upstream hosts. Only the source host reinitiates the route discovery once receiving the error message. Thus cache memory of the host is not utilized to respond to route break.

MAODV cannot be implemented in QoS aware routing scheme as bandwidth is not released at the same time whenever there is a route break. It is not possible to calculate the new route without exactly knowing how much bandwidth is consumed by each host in the route. A simple scenario has been used in Figure 2 to illustrate what will happen if MAODV’s route maintenance scheme used without any modification.

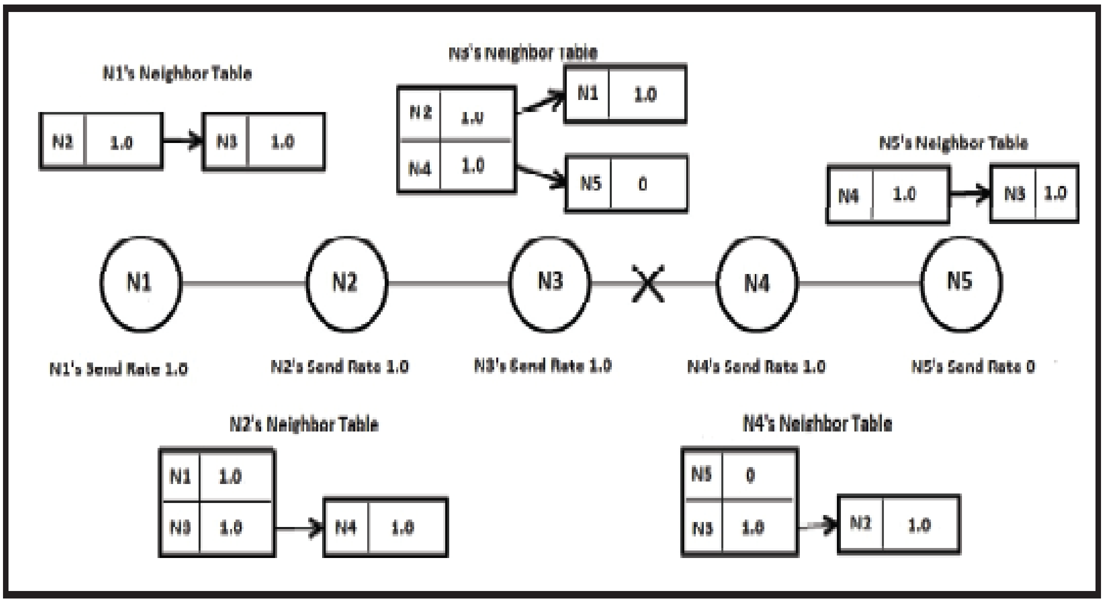

Figure 2: - Delay aware Route Maintenance

The topology is a single chain and is composed of five hosts N1, N2, N3, N4, and N5.

Every host is in its neighbor's transmission range and its second neighbor's interference range.

5. SIMULATION AND RESULTS

The NS2 or Network Simulator is discrete event network simulator. NS is popularly used in the simulation of routing and multicast protocols, and is heavily used in ad-hoc networking research. NS is an object oriented simulator, written in C++, with an OTcl interpreter as a frontend. Some of the list of simulator commands commonly use in simulation scripts:

1. To create an instance of the simulator object and working with instance.
2. Creating a node and working with nodes
3. Creating Links between the nodes
4. Queue Management
5. Attaching Agents

Simulation includes different parameters, conditions for performance analysis. The performance analysis is done by using number of nodes, simulation time, and number of packets. Results analysis is done in terms of packet delivery ratio, energy consumption, control overhead, and delay by considering different no of nodes, packet size, and simulation time.

Throughput: Throughput is the measure of how fast we can actually send packets through network. The number of packets delivered to the receiver provides the throughput of the network. The throughput is defined as the total amount of data a receiver actually receives from the sender divided by the time it takes for receiver to get the last packet .

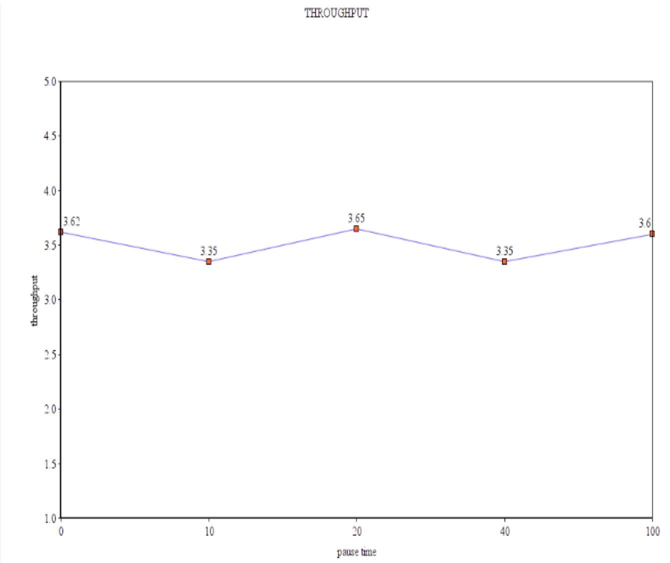

Figure 3: Throughput

Routing Overhead: The number of routing packets transmitted per data packet delivered at the destination. Each hop-wise transmission of a routing packet is counted as one transmission. The routing overhead describes how many routing packets for route discovery and route maintenance need to be sent in order to propagate the data packets.

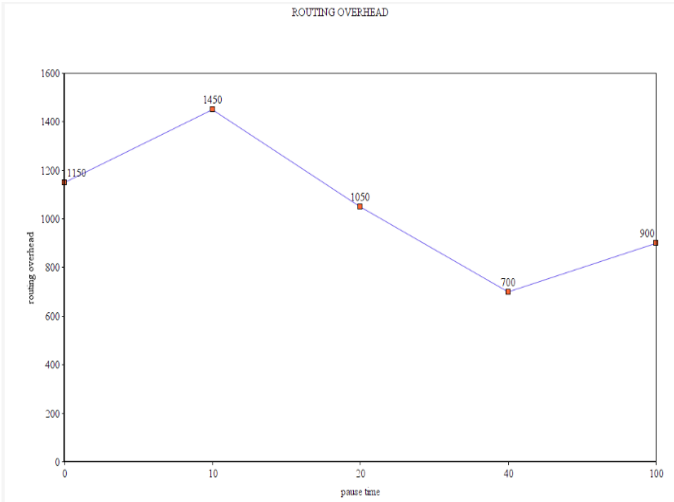

Figure 4: Routing Overhead

6. CONCLUSION

Mobile Ad-hoc Networks (MANETs) have received increasing Research attention in recent years. Mobile ad hoc networks are wireless networks that use multi-hop routing instead of static networks infrastructure to provide network connectivity. MANETs have applications in rapidly deployed and dynamic military and civilian systems. The network topology in MANETs usually changes with time.

The output performs proposed in terms of normalized routing overhead and throughput. The proposed work obtained motion parameters i.e. velocity, direction of the nodes. Based on these parameters the network selects the path to transmit the data packets between the nodes. This approach is that best path can be chosen during the routing based on all these factors. Also the battery level of the node scan is taken care in the network. This results in network's good throughput and high efficiency.

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