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Research Article

Mobile Relay Configuration using Effective Data Transmission in MANET

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ABSTRACT

MANET is the wireless network that is self-configured and the nodes run without fixed infrastructure. As networks are growing in technology and bandwidth, they are able to render multimedia applications as well. Topology control is one of the approaches in MANET to improve performance. Network capacity can be improved with different parameters when optimized. In the literature it is found that delay and inference are two important aspects that cause performance issues. Optimizing them is very important. In addition to this, transmission efficiency needs to be taken care of. In this paper we proposed a mechanism based on mobile relay which ensures that relay nodes move appropriately before data is transmitted. It can cause reduction in delay and interference besides improving throughput. Before the relay node is moved to different location, it considers the benefits of moving as per the algorithm and makes well informed decisions. We implemented the proposed approach using NS2 simulations. The results showed that the proposed approach is useful in improving the performance of MANET communications.

Keywords: Mobile Ad Hoc Networks, topology control, relay configuration, delay.

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COMPUTERS RESEARCH ARTICLE

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ABSTRACT

MANET is the wireless network that is self-configured and the nodes run without fixed infrastructure. As networks are growing in technology and bandwidth, they are able to render multimedia applications as well. Topology control is one of the approaches in MANET to improve performance. Network capacity can be improved with different parameters when optimized. In the literature it is found that delay and inference are two important aspects that cause performance issues. Optimizing them is very important. In addition to this, transmission efficiency needs to be taken care of. In this paper we proposed a mechanism based on mobile relay which ensures that relay nodes move appropriately before data is transmitted. It can cause reduction in delay and interference besides improving throughput. Before the relay node is moved to different location, it considers the benefits of moving as per the algorithm and makes well informed decisions. We implemented the proposed approach using NS2 simulations. The results showed that the proposed approach is useful in improving the performance of MANET communications.

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1. INTRODUCTION

Mobile Ad Hoc Networks (MANET) is an autonomous collection of mobile users that communicate over relatively bandwidth constrained wireless links. Since the nodes are mobile, the network topology may change rapidly and unpredictably over time. The network is decentralized, where all network activity including discovering the topology and delivering messages must be executed by the nodes they, i.e., routing functionality will be incorporated into mobile nodes. With the increasing attention and development in mobile ad hoc networks (MANETS), there is a growing demand of applications that require quality of service provision such as voice over IP (VoIP), multimedia real time collaborative work. Different applications often have different QoS requirements in terms of bandwidth, packet loss rate, delay, packet jitter, path reliability and power consumption.

In MANET, energy consumption and network connectivity are the two very important issues. Due to the mobility of nodes, the network partition occurs unlimitedly. Several researches have focused mainly on interference and delay constrained but energy consumption is not addressed. In this project energy efficient topology control algorithm will be developed to attain both network connectivity and energy consumption.

This paper is aimed at reducing the transmission power by using the mobile relay configuration algorithm on top of topology control algorithm. It not only provides a better service for routing layer but also saves energy, increases network capacity and satisfies the QoS requirement. The remainder of the paper is structured as follows. Section II provides review of literature. Section III presents the proposed system in detail. Section IV presents experimental results while section V concludes the paper.

2. RELATED WORKS

This section reviews literature on interference, delay and other issues in MANET. As explored in [1] delay is of two types. They are known as Queuing Delay and Transmission Delay. However, it does not consider the problem of

channel contention. A channel with contention can cause delay and collusion at MAC layer. Routing and MAC decisions are affected by physical layer. Therefore MAC layer needs to be in touch with physical layer for effective scheduling and allocation of wireless channel [2]. Single layered approach cannot provide optimal results. Therefore it is suggested in [3] and [4] that cross layer design can reap advantages of layering and help in improving communications in MANET. They mainly focused on scheduling problem and achieved satisfactory results with respect to Quality of Service (QoS).

Topology control in the presence of dynamic changes in the nodes and their transmission range is given importance in [5] where certain parameters considered for research are reliability, antennas, QoS, broadcast, interference and power consumption. There are two major research directions known as backbone [6] and power control [7] used for topology control. Topology control is also explored in [8], [9] and [10] where reducing interference is given importance. In this regard, energy efficiency is also considered in [11] in addition to topology control. They proposed an algorithm for minimizing node power consumption and control topology as well. The QoS requirements they considered are delay and bandwidth. However, they assumed traffic demands. The notion of residual-hop-count is used in [12] for estimation of power level and bandwidth in order to improve performance. Interference-aware topology control came into existence layer as it is explored in [13].

More topology control information can be found in [14]. Another important parameters considered by the researchers is delay. Mobility of nodes in MANET can affect delay as well. Delay is studied in [15] and [16] with respect to throughput scaling and cost of delay respectively. In [17] the research continued in the similar lines studying the delay ad mobility besides interference in order to reduce overhead. It was understood that mobility can lead to incorrect availability of information pertaining to view consistency and link availability [14]. Mobility affects delay and controlling nodes mobility has its role in the performance. In this paper we threw light into the concept of mobile relay configuration for reducing energy while transmitting huge amount of data in MANET.

3. PROPOSED SYSTEM AND IMPLEMENTATION OF ALGORITHM

In the existing system importance is given to delay and QoS needs including interference by using topology controlling. In this paper we proposed a mobile rely algorithm where relay node can move to an optimal location and send data to the next hop or destination. The node which acts as relay node can have benefits of computing distance and fining optimal position which can save energy usage besides improving throughput, and delay performance. The problem with the existing system is to have reduced quality of service in the presence of issues such as delay and interference.

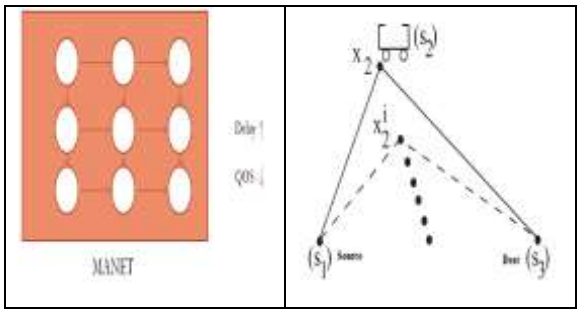

Figure 1 – Shows existing (left) and proposed approaches

This Algorithm is meant for calculating optimal position of a relay node which receives data from a node and forwards it to another node. As shown in Figure 1 (right) there is relay node which can take decisions to move before transmitting data so as to reduce energy consumption and improve throughput.

The following equations are used to compute cost of configuration and transmission and movement energy cost.

Cost of configuration:

$$c(\langle E,U\rangle) = \sum_{(s_i,s_j)\in E} am_i + b\|u_i - u_j\|^2 m_i + k\|o_i - u_i\|.$$

transmission and movement energy cost

$$c_i(U) = k\|u_i - o_i\| + am + b\|u_{i+1} - u_i\|^2 m.$$

More technical details on the equations can be found in [18]

Algorithm: Relay Configuration
Initialize benefit threshold ***bt***
Initialize interference threshold ***it***
Initialize delay threshold ***dt***
Initialize relay benefits ***RB***
Initialize delay ***d***
Initialize interference ***int***
Initialize direction ***dir***
Initialize ***valid*** to false
Compute ***d***
Computer ***int***
Do while ***valid*** = false and ***d***<***dt*** and ***int*** < ***it***
  Consider moving right
  Compute configuration benefit ***RB***
  IF ***RB*** > ***bt***
    valid = true
    dir = right
  END IF
  Consider moving left
  Compute configuration benefit ***RB***
  IF ***RB*** > ***bt***
    valid = true
    dir = left
  END IF
  Move as per ***dir***
  Relay content
End While

Algorithm 1 – Relay configuration

As shown in the relay configuration algorithm delay and interference thresholds are used in order to analyze relay benefits. If the relay benefits are good a decision is taken to move to different place and then relay the content efficiently. The implementation of the simulation is divided into four modules. In other words the functional requirements of the project are logically divided into the following four modules namely MANET Construction Module, Topology Control Module, Delay Analysis Module and Relay Configuration Module.

MANET Construction Module
This module is responsible for construction of a delay-constrained MANET which is the basis for the proposed work. The network is used to demonstrate the proof of concept pertaining to interference-based topology control and mobile relay configuration for reducing delay and improving quality of services in the network.

Topology Control Module
This module is responsible to monitor the topology of MANET and adjust it or control it from time to time based on the interference in order to minimize delay and interference so as to ensure high quality of service in communications. This module is crucial for the performance of the MANET.

Delay Analysis
This algorithm helps in analyzing delay in order to make well informed decisions in topology control. The delay constraint is used as threshold for improving the topology which can reduce interference as well besides converging network towards optimal performance in terms of quality of service.

Relay Configuration Module
This module is to further optimize MANET communications. It is achieved by using Relation Configuration Algorithm which runs in every MANET node to check whether the position of node needs to be adjusted to relay data to reduce delay and interference. The node movement is determined using the algorithm which is subject to the delay and interference constraints. This module computes both the cost of mobility and the cost of data transfer. If there is an advantage in moving and relying data, it does it.

4. SIMULATION RESULTS

Simulations are made to demonstrate the proof of concept pertaining to mobile relay configuration in MANET for increased efficiency in terms of power consumption and delay. Table 1 shows the environmental settings in NS2. The NS2 simulation results are also provided in this section.

S.No	Parameter Type	Parameter Value
1	Channel Type	Wireless Channel
2	Radio-Propagation	Propagation/Two RayGround
3	Network Interface	WirelessPhy
4	Interface Queue Type	DropTail
5	Antenna Model	OmniAntenna
6	Interface Queue Length	50
7	Routing	AODV

	Protocol	
8	CTSThreshold	2000
9	RTSThreshold	5000
10	basicRate	1MB
11	dataRate	5MB

Table 1 – NS2 environment settings

Different environment settings are presented that are used while making NS2 simulations. The routing protocol used in AODV. Mobile relay configuration algorithm is employed in order to have relay nodes moving slightly before making decisions pertaining to data transfer.

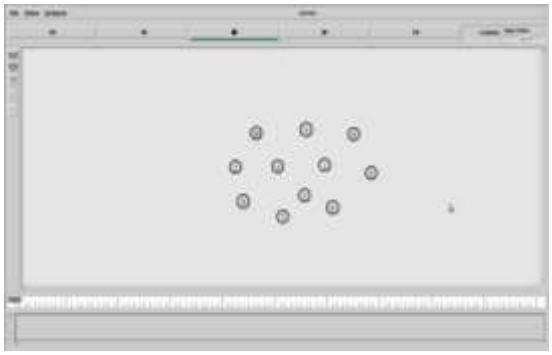

Fig. 1-Wireless network with 10 nodes

As shown in Figure 1 the nodes of wireless network are created and network is formed. The simulation shown in subsequent figures demonstrate mobile relay configuration for energy-efficient data transmission.

Fig 2 - The wireless network started and routing protocol (AODV) shows protocol propagation

As shown in Figure 2, the AODV protocol started working in the wireless network. The protocol propagation is visible which includes various activities such as protocol handshaking.

Fig 3 - It shows link between the nodes, bandwidth and packet interval.

As shown in Figure 3, there is communication established between nodes and the details shown include the delay, packet interval and bandwidth.

Fig 4 - It shows sending the packets between source (node 2) and destination (node 3), packet type is CBR.

As shown in Figure 4, there is simulation showing packets flown between source and destination nodes. The packet type used for simulation is CBR.

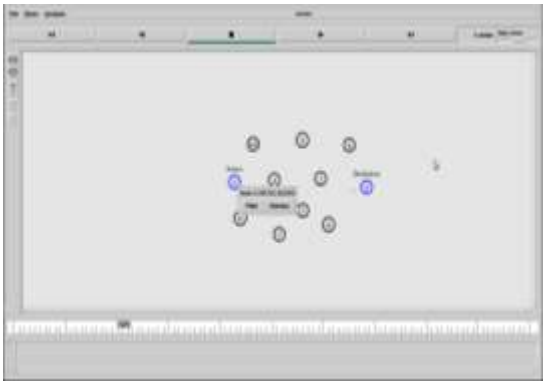

Fig 5 - Shows the packet sending as well as node movement based on mobile relay algorithm

As can be seen in Figure 5, there is node movement started as per the mobile relay algorithm. The node movement is completed as shown in Figure 6 before data is transmitted.

Fig 9: It shows the packet sending as well as Intermediate (node3) movement based on mobile relay algorithm

As shown in Figure 6, the node 3 is the intermediate node which moved a bit as per the mobile relay configuration algorithm before sending data to the destination node.

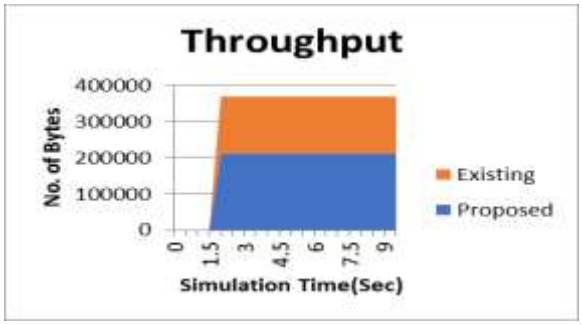

Fig 7 – Throughput performance comparison

As shown in Figure 7, it is evident that the horizontal axis represents simulation time while the vertical axis represents throughput. The results revealed that the proposed system outperforms the existing system with respect to throughput. The reason behind is the optimization of data transmission with mobile relay configuration.

Fig 8 – End to end delay performance comparison

As shown in Figure 8, it is evident that the horizontal axis represents simulation time while the vertical axis represents delay. The results revealed that the proposed system outperforms the existing system with respect to delay. The reason behind is the optimization of data transmission with mobile relay configuration.

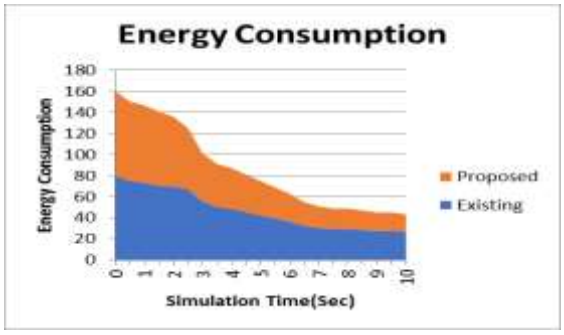

Fig 9 – Energy consumption performance comparison

As shown in Figure 9, it is evident that the horizontal axis represents simulation time while the vertical axis represents energy consumption. The results revealed that the proposed system outperforms the existing system with respect to energy consumption. The reason behind is the optimization of data transmission with mobile relay configuration.

6. CONCLUSIONS AND FUTURE WORK

MANETs are widely used communication networks that help in communications in case of emergencies. Of late, MANETs are used for a variety of purposes. They can also be used to have data transmission due to technology innovations. In such networks, it is important to have efficient communications. Two things such as delay and interference cause issues with the network. These two are to be overcome with topology control and mobile relay configuration. In this paper, we proposed an algorithm for efficient data transfer with mobile relay configuration. The topology control and mobile relay configuration reflect in the efficient data transmission. When a relay node moves to appropriate place before transmission of data, it can optimize the process of data transmission. The algorithm helps in determining the movements so as to improve transmission performance. Our NS2 simulations revealed the improved performance of MANET. In future, we intend to improve it further with an alternative approach and evaluate it.

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