IJCTA, 9(36), 2016, pp. 229-235

Adaptive Energy-Efficient Clustering for Multichannel MAC Protocol

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Abstract : Ad hoc networking is a concept in computer communications, which means that users wanting to communicate with each other form a temporary network, without any form of centralized administration. Each node participating in the network acts both as host and a router and must therefore is willing to forward packets for other nodes. Asynchronous serial communication is an asynchronous serial transmission protocol in which a start signal is sent prior to each byte, character or code word and a stop signal is sent after each code word. The start signal serves to prepare the receiving mechanism for the reception and registration of a symbol and the stop signal serves to bring the receiving mechanism to rest in preparation for the reception of the next symbol. The "stop bit" is actually a "stop period "the stop period of the transmitter may be arbitrarily long. The receiver requires a shorter stop period than the transmitter. At the end of each character, the receiver stops briefly to wait for the next start bit. It is this difference which keeps the transmitter and receiver synchronized. The approach is to detect the multichannel coordination problem (MCC) and vulnerabilities occur in the overall network. In existing, it was implemented by DISH protocol to improve the energy efficiency of the wireless network through multi channel Mac protocol. In proposed system, the Adaptive Energy Efficient protocol is implemented to enhance the wireless network performance by reduce the energy consumption during the data dissemination.

Keywords : ANET, DISH, Sensor Medium Access protocol, Energy reduction.

1. INTRODUCTION

1.1. About Mobile ADHOC Network

A wireless ad-hoc network is a collection of mobile/semi-mobile nodes with no pre-established infrastructure, forming a temporary network. Each of the nodes has a wireless interface and communicates with each other over either radio or infrared. Laptop computers and personal digital assistants that communicate directly with each other are some examples of nodes in an ad-hoc network. Nodes in the ad- hoc network are often mobile, but can also consist of stationary nodes, such as access points to the Internet. The outermost nodes are not within transmitter range of each other. However the middle node can be used to forward packets between the outermost nodes. The middle node is acting as a router and the three nodes have formed an ad-hoc network. Every node wishing to participate in an ad-hoc network must be willing to forward packets for other nodes. Thus every node acts both as a host and as a router. A node can be viewed as an abstract entity consisting of a router and a set of affiliated mobile hosts. A router is an entity, which, among other things runs a routing protocol. A mobile host is simply an IP-addressable host/entity in the traditional sense. Ad-hoc networks are also capable of handling topology changes and malfunctions in nodes. It is fixed through network reconfiguration. For instance, if a node leaves the network and causes link breakages, affected nodes can easily request new routes and the problem will be solved. This will slightly increase the delay, but the network will still be operational. Wireless ad-hoc networks take advantage of the nature of the wireless communication medium.

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1.2. Charecteristics of Manet

Ad-hoc networks are often characterized by a dynamic topology due to the fact that nodes change their physical location by moving around. This favors routing protocols that dynamically discover routes over conventional routing algorithms like distant vector and link state Another characteristic is that a host/ node have very limited CPU capacity, storage capacity, battery power and bandwidth, also referred to as a "thin client". This means that the power usage must be limited thus leading to a limited transmitter range. The access media, the radio environment, also has special characteristics that must be considered when designing protocols for ad-hoc networks. One example of this may be unidirectional links. These links arise when for example two nodes have different strength on their transmitters, allowing only one of the hosts to hear the other, but can also arise from disturbances from the surroundings. Multi hop in a radio environment may result in an overall transmit capacity gain and power gain, due to the squared relation between coverage and required output power. By using multi hop, nodes can transmit the packets with a much lower output power. It is important to acknowledge the properties or characteristics of mobile ad hoc networks (MANETs), since these properties have a significant impact on the design of security protocols for MANETs.

1.3. Network Infrastructure

Hybrid ad hoc networks combine conventional network infrastructure with multi-hopping. This derivative of ad hoc networks will find useful application where fixed infrastructure can be extended through multi-hop networks or where the functionality (and performance) of multi-hop networks can be enhanced by relying on some infrastructure. The access point does not just control medium access, but also acts as a bridge to other wireless or wired networks. Several wireless networks may form one logical wireless network, so the access points together with the fixed network in between can connect several wireless networks to form a larger network beyond actual radio coverage

1.4. Network Topology

Nodes in ad hoc networks may be mobile resulting in a dynamic, weakly connected topology. Since node mobility is unrestricted, the topology may be unpredictable. The network will however demonstrate global mobility patterns which may not be completely random. The topology is weakly connected due to transient, error-prone wireless connectivity. The users may therefore experience unavailability of essential security services. Node mobility and wireless connectivity allow nodes to spontaneously join and leave the network, which makes the network amorphous. Security services must be able to scale seamlessly with rapid changes in network density.

2. RELATED WORKS

Energy Efficient Strategies for Cooperative Multichannel MAC Protocols[1] as proposed by Tie Luo explains about DISH based protocol. Control information is crucial to communications but can be missing due to various reasons such as shadowing and noise.The dominant reason, however, in a multichannel environment, is that nodes fail to tune radios to certain channels in time, or that a radio can only listen to one channel at a time. This causes the multichannel coordination (MCC) problem which has two variants: 1) channel conflict problem, created when a node selects a busy channel (being used by other nodes), and 2) deaf terminal problem, created when a sender attempts to communicate with a receiver that is on a different channel. The basic idea of DISH is to compensate for nodes' missing information via cooperation. It exploits neighboring nodes as a resource to "retrieve" missing information from, like from a distributed database, when needed. The need for multiple radios or time synchronization, naturally becomes not necessary.

Using In-Situ Energy Conscious DISH strategy, all the existing nodes are made to rotate the responsibility of information sharing (*i.e.*, cooperation) such that nodes without the responsibility can

sleep when idle. Using Altruistic DISH strategy, additional nodes called altruists are deployed to take over the responsibility of information sharing (i.e., cooperation) from the existing nodes, which we call peers to distinguish from altruists, so that peers can sleep when idle. Altruists are the same as peers in terms of hardware, but are different in terms of software: they solely cooperate (do not carry data traffic) and always stay awake.

3. ENERGY EFFICIENT GEOGRAPHY DISTANCE PROTOCOL

One of the major problems of routing schemes in MANETs is the reduction of routing and other control information overheads required for an autonomous organization in the face of node mobility. Cluster based routing scheme provides a solution to this problem by organizing the nodes into clusters to reduce communication overhead. Thus a virtual network infrastructure is created which resembles fixed network infrastructure. This is crucial for scalability of media access protocols, routing protocols and the security infrastructure besides the advantage of reducing communication and control overheads due to pre determined paths of communication through cluster heads. One node from each cluster acts as cluster head. A cluster head does all the resource allocation to all nodes belonging to its cluster. Some of the major issues to be handled by a cluster based routing protocol is the division of a dynamic mobile network into clusters and determination of clusterheads for each cluster in the face of highly dynamic and unstable nature of MANETs

3.1. Cluster Formation

Initially each node is assigned a random ID value. It broadcasts its ID value to its neighbours and builds its neighbourhood table. Each node calculates its own energy based on the following factors:

- **Node connectivity :** The number of nodes that can communicate directly with the given node that are in its transmission range.
- **Battery Power :** The power currently left in each node. The energy is consumed by sending and receiving of messages.
- **Mobility :** Running average of speed of each node. If mobility is less, the node is more suitable to become clusterhead.
- **Distance :** Sum of distance of the node from all its neighbours. After finding its remaining energy, each node broadcasts its data to its neighbours.The node with maximum energy broadcasts clhead message to other nodes. On receiving a clhead message, a node checks all the nodes from which it receives clhead message. The node with maximum energy becomes the clusterhead of that node. A node sends a unicast message to the clusterheads.

3.2. Distributed Adaptive Clustering Algorithm

The key part of the algorithm lies on the meeting event between any pair of nodes. A node then decides its actions subsequently. Specifically, a node will enter into a new cluster if it is qualified to be a member. Similarly, when a non-cluster head node moves out its clusters and doesn't enter into any existing cluster, it becomes a new cluster head, forming a new Cluster. When two member nodes meet, they trigger the synchronization process to update their information. During initialization, Node which creates a cluster that consists of itself only and two empty tables. Its cluster ID is set to be its node ID appended with a sequence number. Each node maintains its own sequence number, which increases by one whenever the node creates a new cluster, to avoid duplication. The Algorithm steps are given below.

- If a cluster member leaves from a cluster and come into another cluster, it will not change the status of the existing cluster head even if it has a lower communicate probability than the cluster head.

- If two cluster heads travel within communication range, the node with the higher communicate probability will give up its status as a cluster head.
- If a cluster member becomes separated from any cluster include better contact with other members, it will become a cluster head, and a new cluster is formed.
- A group of nodes which travels out of a cluster will form a new cluster according to the algorithm.

4. PERFORMANCE EVALUVATION

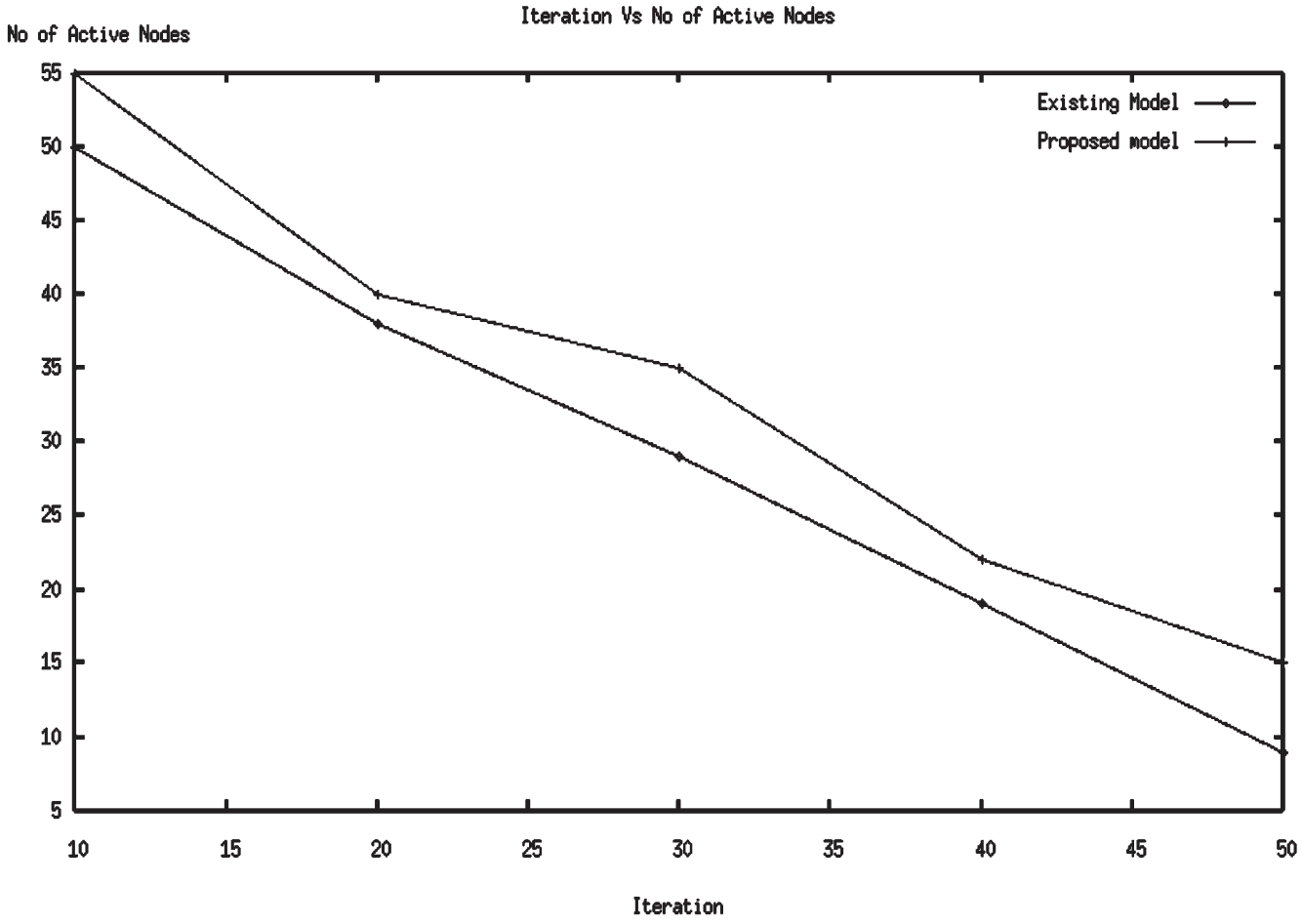

Figure 1: Iteration vs no of active nodes

In order to evaluate our proposal, we use simulation. Our experiments were conducted in the Network Simulator 2 (NS2). The mobile network model assumed in this project consists of random number of mobile nodes with each node having fixed energy and random mobility. The number of nodes can be determined initially. The transmission range of each node can also be specified and each node can pass messages to all the nodes in its transmission range. The mobility has been provided by assigning a random value to each node. If the value of random number is greater than some specified value then the node is mobile otherwise it is stationary. A mobile node moves to some random direction for random interval and then changes its direction to a new random location.

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its direction to a new random location. New nodes can also randomly be added to the network. Further each node starts with some energy and its energy decreases each time it passes a message. A node fails if its whole energy has been consumed. Figure 1explains about Iteration vs no of active nodes. The active nodes represents the life time of the node that a node can survive with the necessary energy. Figure2 explains about Time vs Energy dissipated. When the time increases the energy consumption is less when compared to proposed system as plotted in the fig2. Figure3 explains about Error rate vs Message cast. The error rate in the proposed model is lesser than the existing model it provides better services. Figure4 explains about Estimated error rate vs Average error rate. This module represents the energy savings and also about reducing the error rate for improved performance in mobile adhoc network.

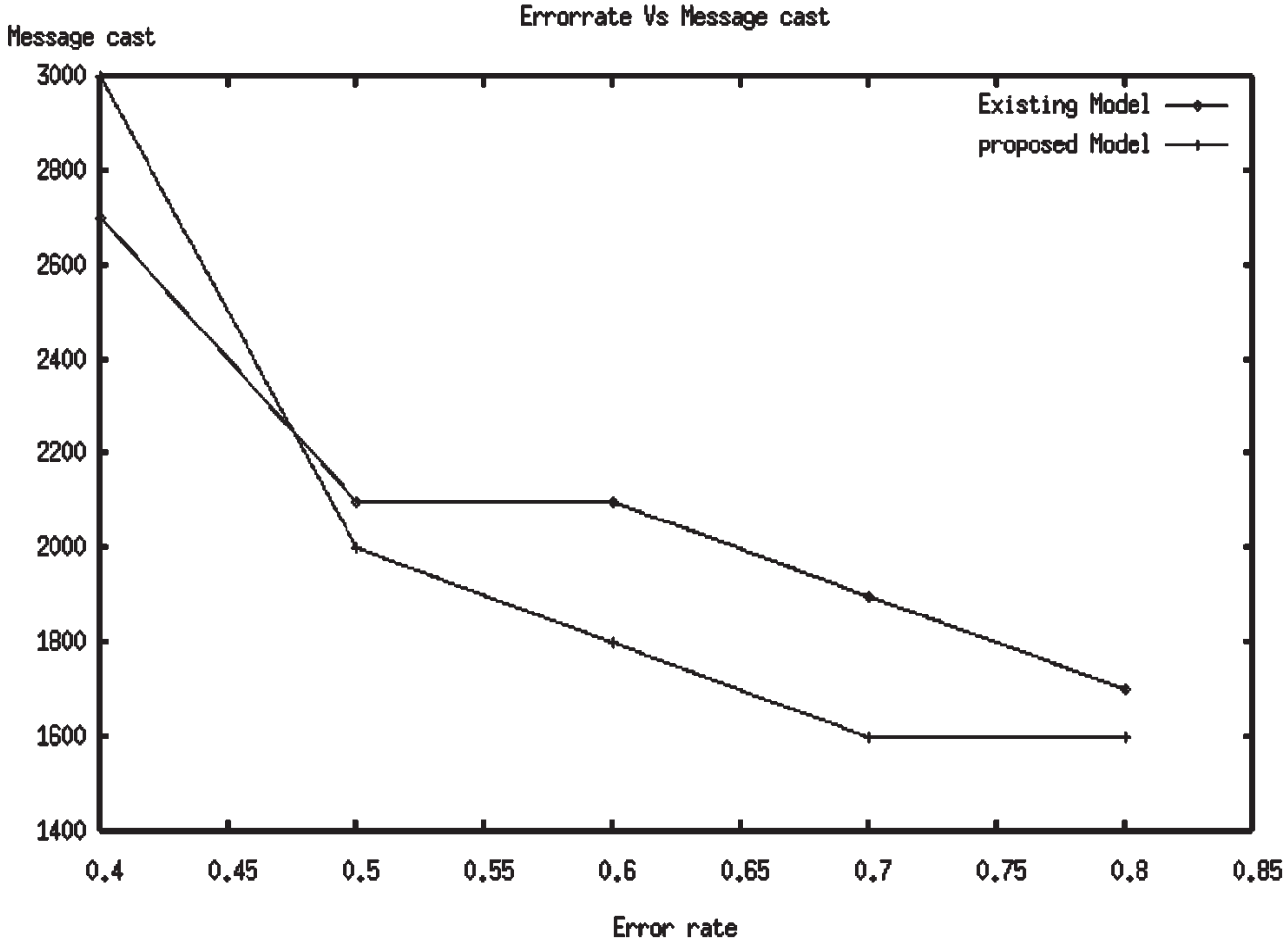

Figure 3: Error rate vs Message cast

5. CONCLUSION

In this paper, an overview of energy efficiency issues in ad hoc networks was given. Energy models widely used in analyzing and devising ad hoc protocols were discussed. The sources of energy consumption that pertain to communications in ad hoc network were shown to exist in four main modes of operation: transmitting, receiving, idle and sleep modes. The sources of energy consumption overhead such as idle condition, collisions and protocol control messages have been discussed. The metrics used for energy-efficiency strategies have also been explored briefly. The experimental results in the NS-2 simulation environment demonstrate that the proposed approach achieves the lower consumption of energy in the efficient manner.

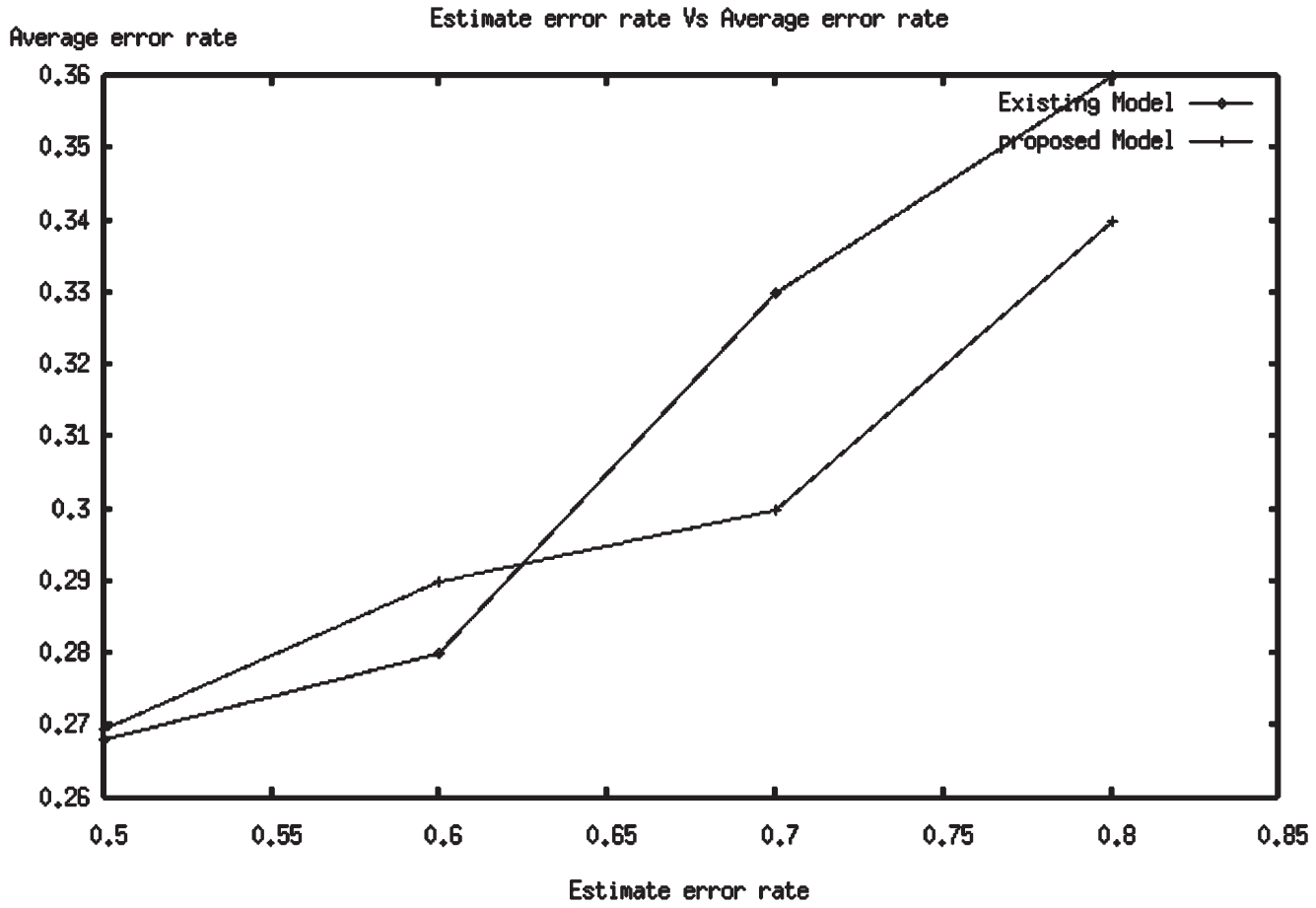

Figure 4: Estimated error rate vs Average error rate

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