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AN IMPROVED MODEL FOR LOAD BALANCING AND DYNAMIC CHANNEL ALLOCATION IN CLUSTER BASED MANETs

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ABSTRACT

In Mobile ad-hoc networks (MANETs), mobile devices are arranged independently for the use of wireless links and progressively fluctuating system topology. In MANETs, the interconnections are dynamically changing in an increasing rate due to fluctuating non-uniform loads which leads to network congestion and data losses. To handle such interconnections, the channel allocating scheme must be done in such a way to support dynamic allocation mechanism and Cooperative load balancing to handle the heavy load in MANETs. Dynamic channel allocation scheme proves more advantageous over all other channel allocation schemes because it controls network traffic effectively, avoids data loss and is energy efficient. This technique also has some problems like intervention and incompetence under heavy load. In this paper Spectrum sensing mechanism is analyzed as a suitable solution for this problem, which senses the free channels and reduces the network interference. Cooperative load balancing control is associated with controlling incoming traffic in a telecommunication network and is extensively used to avoid congestive crumple or link capability of the intermediate nodes and networks and to reduce the rate of sending packet. Through extensive simulations, we illustrate that both dynamic channel allocation – time reservation using adaptive control for energy efficiency (DCA-TRACE) and cooperative load balancing get better bandwidth efficiency under non-uniform load distributions compared to other protocols that do not use these mechanisms. Simulation results prove that DCA-TRACE provides noteworthy improvement for both uniform and non-uniform traffic heaps.

Keywords: mobile ad hoc network, channel allocation schemes, MAC protocols..

1. INTRODUCTION

Mobile Ad Hoc Network (MANET) is a group of one or more connectivity hubs with wireless communications and networking capability that communicate with each other without the help of any centralized administrator and also the wireless terminals that can dynamically form a network to transmit information without using any existing fixed network infrastructure. In order to channelize communication within the network, a routing protocol is employed to establish routes between the hubs. The main purpose of such an ad-hoc network routing protocol is to provide precise and efficient route formation between a pair of nodes so that data may be delivered in a timely fashion. Route construction should be done with a minimum of overhead and bandwidth consumption. A network of mobile nodes using peer-to-peer communication is called an ad- hoc network. The nodes in such networks are limited by power, memory, bandwidth and computational constraints. These networks have the ability to provide economical communication without any permanent infrastructure. Hence, they are very useful in disaster recovery, joint computing, rescue operations and military surveillance. Various routing algorithms and have been designed for this type of networks.

In dynamic channel allocation algorithm, channel administrators react to the increasing localized network load by increasing their share of bandwidth. In spite of providing effective support for non-uniform network loads, the reactive response taken by the channel administrators increases the interference in the entire system. It also provides low latency links with an efficient communication with all the nodes of the network. In Cooperative Load Balancing algorithm, the loads on the channel administrators initiate from the requirement of the ordinary nodes. Many nodes in a network have access to more than one channel administrator. The basic premise of the cooperative load balancing algorithm is that the active hubs can continuously examine the load of the channel administrators and interchange between the heavily loaded administrators to the ones with available resources. These nodes can detect the depletion of the channels at the administrators and shift their load to the other administrators with more available resources. The resources released by the nodes with capability to switch, can be used for other nodes that do not have access to any other channel coordinators. It increases the total number of nodes that access the channel and hence increases the service rate and the throughput.

In this paper we propose the above two algorithms for managing the non-uniform load distribution in MANETs to get better bandwidth efficiency, energy efficient and real time coordinated network allocation protocol. We present the related work done on the subject and illustrate the results of the analysis through extensive simulation techniques in the subsequent section of this paper. We conclude the paper with the validation of the proposed techniques.

2. RELATED WORKS

As a rule, MAC conventions for remote systems can be named composed and clumsy MAC conventions [2] in view of the coordinated effort level. In awkward conventions, for example, IEEE 802.11, hubs fight with one another to share the regular channel. For low system stacks, these conventions are effective in data transmission

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because of the absence of overhead. A planned channel access convention is suited only for stacked MANET under uniform burden appropriations. It is not suited for non uniform burden dispersions as clumsy channel access convention, because of absence of on interest element channel distribution. In Coordinated MAC conventions the channel access is managed. In clumsy convention as the system expands, their transfer speed proficiency diminishes. Because of unmoving tuning in, these conventions are as a rule not vitality productive. Facilitated channel access convention adjusts just in static environment. In this paper lightweight element station designation instrument and a helpful burden adjusting methodology [3] that are relevant to bunch based MANETs to address this issue. The conventions use these components to enhance execution as far as throughput, vitality utilization and interpacket delay variety (IPDV), transfer speed effectiveness [4] in MANET. It is vital for the Medium access control of a MANET to adjust to the dynamic environment as well as to effectively oversee data transfer capacity use. Macintosh convention configuration is the augmentation of spatial reuse and giving backing to non-uniform burden dispersions.

The obligation of the MAC layer is to organize the hubs' entrance to the common radio channel, minimizing conflicts. In a multi-bounce system, acquiring high transmission capacity efficiency is just conceivable through abusing channel reuse opportunities. To be sure, efficient use of the normal radio channel has been the focal point of consideration since the early improvement phases of remote correspondence [5]. Cidon*et al.* [6] present a disseminated dynamic channel allotment calculation with no optimality ensures for a system with a fixed from the earlier control channel task. On the other hand, there are different diversion theoretic ways to deal with the divert assignment issue in impromptu remote systems [7], [8]. Gao*et al.* [7] model the direct allotment issue in multi-bounce specially appointed remote systems as a static agreeable diversion, in which a few players work together to accomplish a high information rate. Be that as it may, these methodologies are not adaptable, as the many-sided quality of the ideal element channel allotment issue has been appeared to be NP-hard [8]-[9].

Wireless sensor networks have received increasing attention in the recent few years. In many military and civil applications of sensor networks, sensors are constrained in on board energy supply and are left unattended. Energy, size and cost constraints of such sensors limit their communication range. Therefore, they require multi-hop wireless connectivity to forward data on their behalf to a remote command site. In this paper we investigate the performance of an algorithm to network these sensors in to well define clusters with less energy-constrained gateway nodes acting as cluster heads, and balance load among these gateways. Load balanced clustering increases the system stability and improves the communication between different nodes in the system. To evaluate the efficiency of our approach we have studied the performance of sensor networks applying various different routing protocols. Cluster sensor network efficiently around few high-energy gateway nodes. Clustering enables network scalability to large number of sensors and extends the life of the network by allowing the sensors to conserve energy through communication with closer nodes and by balancing the load among the gateway nodes. Simulation results shows that irrespective of the routing protocol used, our approach improves the lifetime of the system.

Bevish*et al*, [10] proposes "a cluster oriented ID based multi-signature scheme to overcome the delay in authentication. In this scheme, the network is clustered and each cluster has a cluster head which is responsible for generating a multi-signature. Experimental analysis shows that this scheme incurs less delay in authentication, communication overhead and loss ratio when compared to existing approaches".

Bevish*et al*, [11] proposes the" concept of recent trends in authentication and privacy preservation based on the signature size, verification time and anonymity. It shows that the id based signatures are suitable for VANET based safety applications due to its reduced signature size. And, the usage of pseudo identities with id based signatures provides a better solution for privacy preservation. Based on this, propose a framework for privacy preserving authentication which includes key generation by the trusted authority, distribution of keys to the registered vehicles, driver authentication, pseudo id generation by the vehicles, id based signature generation and priority based verification for prioritized messages and batch verification for non-prioritized messages".

Bevish*et al*, [12] proposes a novel approach where pseudo IDs are generated dynamically based on the location information when an event is to be reported and verified by the distributed Traffic Management System (TMS).

3. PROPOSED SYSTEM ARCHITECTURE

The system architecture being proposed in this paper is shown in Figure-1. In network formation, nodes and grouping the nodes are created based on coverage of nodes. In district every hub sends "hi" message to different hubs which permits recognizing it. Once a hub recognizes "hi" message from another hub (neighbour), it keeps up a contact record to store data about the neighbour. Utilizing multicast attachment, all hubs are utilized to recognize the neighbour hubs.

To elect a cluster head, each node should know the group in which the node is created. So for this we have to intimate the region of respective nodes. After that the cluster head election process takes place by electing the node with high battery power, mobility and memory capacity. In MH-TRACE certain hubs expect the parts of channel facilitator, here called bunch head. All bunch head convey occasional guide parcels to declare their vicinity to the hubs in their neighborhood .when a hub does not get a reference point bundle from any group head for a predefined measure of time, it expect the part of a channel organizer.

In information transmission of the dynamic channel portion calculation the channel controller screens

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the force level in all the accessible directs in the system. In the event that the heap on the channel controller increments past limit and measured force level is low then the channel facilitator send solicitation to other locale of channel organizer, if other district channel facilitator is having limit, then utilizing CSMA convention it will send affirmation to bunch head. If bunch head get the affirmation it subsequently sends it to hubs. Then we can send data from one node to other nodes within region and also outside the region. Splitting a data in to packet and sending to destination nodes in other region is also possible.

Frequency reuse is firmly connected to the transmission capacity productivity. In element conduct of MANETs the movement burden might be exceedingly non uniform over the system territory. In MAC layer permitting channel organizers to use channel reuse and adjust to any adjustments in the movement dispersion. Frequency reuse based on channel capacity. Cluster head maintain stack depends on size. In stack mechanism, maintains frequency and this frequency can be reuse.

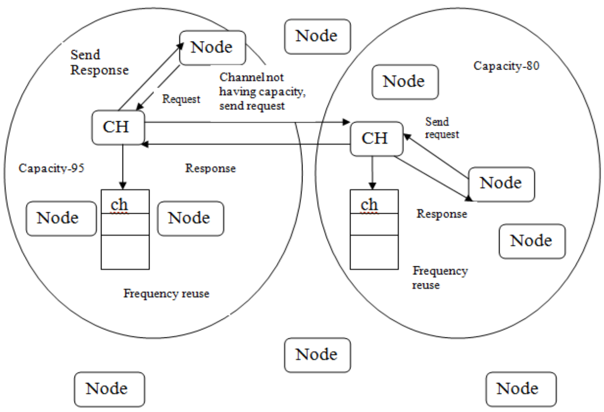

Figure-1. Proposed system architecture.

The thought of the load balancing algorithm is that the dynamic hubs can constantly screen the heap of the channel facilitators and switch from intensely stacked organizers to the ones with accessible assets. These hubs can distinguish the consumption of the channels at the organizer and movement their heap to alternate facilitators with more accessible assets.

The key algorithms used in this paper to achieve the dynamic channel allocation and balancing of the non-uniform loads in the networks are explained in the following section and the steps followed are illustrated below,

Low Energy Adaptive Clustering [LEACH]:

LEACH is one of the most widely used clustering mechanisms; it elects a cluster head (CH) based on a probability model. In LEACH, for the entire network, each round includes a setup phase and a steady-state phase. During the setup phase, each node will choose whether to become a CH or not according to a predefined set of criteria. After CHs are chosen, each of other nodes will select their own CH and join the cluster according to the intensity of many received broadcast messages. Each node will choose the nearest CH in the network. During the steady-state phase, CHs combine the data received from their various cluster members and send the combined data to Base Station (BS) by single-hop communication technique. LEACH uses randomization to rotate CHs for each round in order to evenly distribute the energy consumption.

General Self-Organized Tree-Based Energy-Balance Routing Protocol [GSTEB]:

GSTEB is to achieve a longer network lifetime for different applications. The operation of GSTEB is classified into the following phases namely, Initial Phase, Tree Constructing, Self-Organized Data Collecting and Transmitting Phase, Information Exchanging.

A. Initial phase

BS broadcasts a packet to all the nodes. Then All Sensors sends its packet in a circle and sends a packet which contains all its neighbours' information.

B. Tree constructing phase

BS assigns a node as root node and it coordinates to all sensor nodes. Each node tries to select parent in neighbours using Energy Level. Parent nodes are computing every Node neighbours' Record.

C. Self-organized data collecting and transmitting phase

Leaf Node (L) sends Beacon packets to Parent Node (P) and it tries to receive Beacon from Leaf Node. If more than one (L) need to send data, then (P) monitors the channel which is to be chosen and sends the data to it while others are kept in hibernation.

D. Information exchanging

Each node needs to transmit data in every round; so it may exhaust its energy and die in due course. The dying of any sensor node can influence the topography. So it is critical for every node to inform other nodes of it condition and if it is going to die.

Load Balancing algorithm:
Step 1: Ch-Cluster head
Step 2: Ch frequency count is x(number of frequency)
Step 3: Mobile nodes(m) is start to send
Step 4: m->Ch
if(Ch(x)>2)
Ch->stack checking
if(Ch frequency is free)
data->sent to destination through cluster head
else
Ch->request to nearbyanotherCh
else
Ch->data forward to another cluster head

Step 5: m->get acknowledge from destination

Dynamic channel allocation algorithm

In dynamic channel allocation algorithm, the channel controllers constantly screen the force level in all

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the accessible directs in the system and survey the accessibility of the channels by contrasting the deliberate power levels and a limit. On the off chance that the heap on the channel controller increments past limit, gave that the deliberate power level is sufficiently low, the channel facilitator begins utilizing an extra channel with the most minimal power level estimation.

Step 1: Each group (4) cluster nodes electing cluster head
Step 2: Every cluster head is updated to ->authority
Step 3: Chcapacity(memory,battery,mobility)
Step 4: Ch capacity is calculated
if(Ch>another(Ch))
arranging order(m) is descending order

At the point when all the accessible information spaces for a "Ch" are dispensed, with a likelihood 'p', the dynamic hubs endeavor to trigger the helpful burden adjusting calculation. At the point when the helpful burden adjusting is set off, the hub that is as of now utilizing an information opening from the intensely stacked "Ch" fights for information spaces from other adjacent 'Ch's while keeping and utilizing its saved information space until it secures another information space from another 'Ch'.

4. RESULTS AND DISCUSSIONS

In this section of the paper, we analyze and compare the performance of different algorithms proposed for handling non-uniform load patterns at the centralized network based on the parameters such as Packet Delivery Ratio (PDR), Delay and Throughput using simulation techniques.

Packet delivery ratio (PDR) that is calculated by dividing the number of packets received by the destination through the number of packets originated by the application layer of the source is shown in the equation 1. In graph, PDR decreases due to the number of demand increase, but system still continues to serve all the demand in a dense network and this is done by increasing the number of nodes as shown below:

$$\text{Packet delivery ratio} = \frac{\sum \text{Number of packet receive}}{\sum \text{Number of packet send}} \ldots\ldots\ldots \quad (1)$$

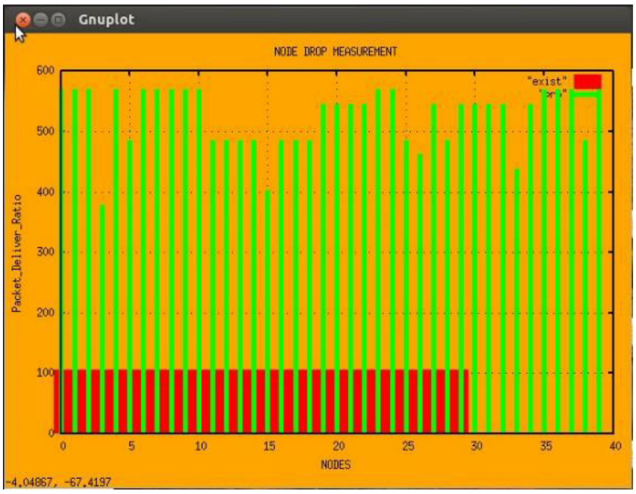

Figure-2. Packet delivery ratio.

End-to end delay of a packet which is defined as the time a packet takes to travel from the source to the destination is shown in equation (2). Figure-3 shows that as a result of Cooperative load balancing, once the number of active user in terms of demand increases, delay starts reducing though initially there was a delay in connecting to centralized control.

$$\text{End} - \text{to end delay} = \frac{\sum(\text{Arrive time} - \text{Send time})}{\sum \text{Number of connections}} \ldots\ldots\ldots.(2)$$

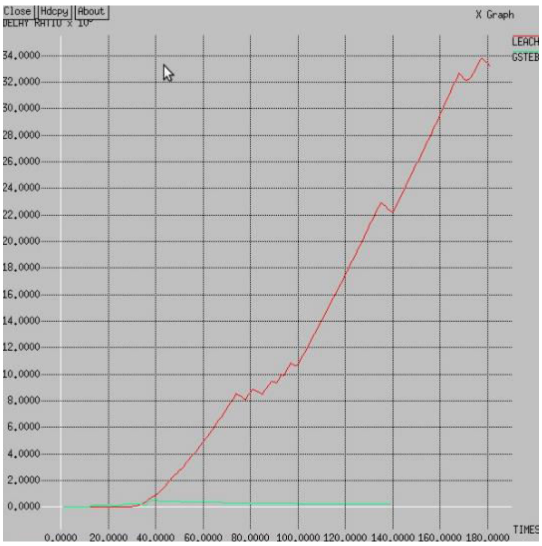

Figure-3. End-to-End delay.

Throughput is the packet received by the destination in the given time period. Throughput increases with increment in number of demand as more data sent to centralized station.

$$\text{Throughput} = \frac{\sum \text{Number of packets received}}{\text{Time}} \ldots\ldots\ldots.(3)$$

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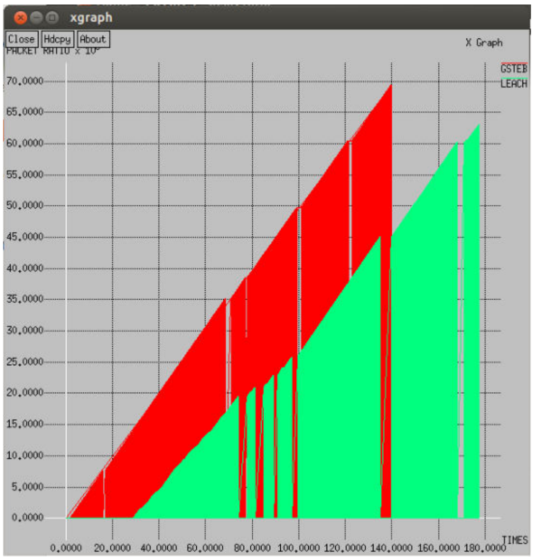

Figure-4. Throughput.

The helpful burden adjusting calculation has less effect on the execution, contrasted with the dynamic channel allotment calculation. We had demonstrated that these two calculations can be utilized at the same time, amplifying the upgrades in the framework. The consolidated framework has been appeared to perform at any rate and additionally the frameworks with every calculation alone and performs better for some situations. Both of the calculations and in addition the consolidated framework likewise have a quick reaction time, which is on the request of a superframe term of 25 ms, permitting the framework to alter under changing framework load.

5. CONCLUSIONS

In this paper we have studied the advantages of using dynamic channel allocation and cooperative load balancing to address the network congestion and data losses due to fluctuating non-uniform load in MANETs. We have also analyzed and illustrated that Spectrum sensing mechanism can address the few existing issues in the dynamic channel allocation like intervention and incompetence under heavy load. We have illustrated that the dynamic channel allocation works through carrier sensing and does not increase the channel overhead providing additional advantage. We have validated the effectiveness of the cooperative load balancing technique using extensive simulations and the results are presented in this paper. We have elucidated that the Frequency reuse technique serves as a suitable enhancement to the cooperative load balancing which successfully handovers the channel.

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