DYNAMIC CHANNEL ALLOCATION IN MOBILE AD HOC NETWORK

Swati A. Patel[1],Dhaval Patel[2]
[1]P.G.Student, [2]Asst.Prof.,CO Department, Hasmukh Goswami College Of Engineering, Ahmedabad, India.
Email:[1]swati.patel2222@gmail.com, [2]dhavalpatel651@gmail.com

Abstract— Mobile Ad-hoc network (MANET) is a collection of mobile nodes that are dynamically and arbitrarily located in such a manner that interconnections between the nodes are capable of changing on continuous basis. In this paper, different channel allocation schemes are studied and how they are implemented in mobile ad hoc network and cellular network. We also studied all features of all channel allocation techniques. MH-TRACE and DCA-TRACE are two MAC layer protocols used for fixed channel allocation (FCA) and dynamic channel allocation (DCA) respectively. Dynamic channel allocation scheme proves more advantageous over all other channel allocation schemes. This technique also has some problems like interference and inefficiency under heavy load. So we have to improve these problems by using some mechanism. Spectrum sensing is such kind of mechanism which we use for sensing the free channels and reducing interference. So we can minimize the level of interference between the channels..

Index Terms— MANET, FCA, DCA, MAC, MH-TRACE, DCA-TRACE, TDMA, FDMA, CDMA, ALOHA, CSMA.

I. INTRODUCTION

A network of mobile nodes in which all mobile nodes using peer-to-peer communication is called mobile ad- hoc network. The nodes in mobile ad hoc network are limited by power, memory, bandwidth and computational constraints and all nodes are free to move anywhere within a network. Such networks have the ability to provide cheap communication without any fixed infrastructure. So, they are very useful in disaster recovery, emergency operations, collaborative computing, rescue operations and military surveillance.

Fig 1: A mobile ad-hoc network [13]

Fig. 1 shows the node structure of the mobile ad-hoc network. Table I shows the basic comparisons of cellular network and mobile ad-hoc network.

I. COMPARISON OF CELLULAR NETWORK AND MOBILE AD-HOC NETWORK

Cellular Network	Mobile Ad-hoc Network
Fixed Infrastructure	Infrastructure less
Centralized routing	Distributed routing

Circuit switched	Packet switched
Seamless connectivity	Frequent path breaks due to mobility
Reuse of frequency spectrum through geographical channel reuse	Dynamic frequency reuse based on carrier sense mechanism

II. CHANNEL ALLOCATION SCHEMES

The role of a channel allocation scheme is to allocate the channels to the users in such a way as to minimize call blocking or call dropping probabilities and improve QoS. The main aim of channel allocation schemes is that to assign a required number of channels to each node such that efficient bandwidth utilization is provided and interference effects are minimized. Channel allocation schemes can be divided into a number of different categories. Here we consider the manner in which co-channels are separated; they can be divided into basic two types which are fixed channel allocation (FCA), dynamic channel allocation (DCA). FCA scheme is such a simple scheme in which the area is partitioned into a number of cells and a number of channels are assigned to each cell according to some reuse pattern depending on the desired signal quality. This scheme does not adapt changing traffic conditions and user distributions. This kind of uniform channel distribution is efficient if the traffic distribution of the system is also uniform. Because traffic can be non uniform with temporal and spatial fluctuations, a uniform allocation of channels to cells may result in high blocking in some cells which results in poor channel utilization. So FCA schemes are not able to attain high channel efficiency. To overcome this problem, DCA scheme is introduced in which no fixed relationship between channels and cells. All channels are kept in a central pool and are assigned dynamically to radio cells as new calls arrive in a system and after a call is completed, its channel is returned to the central pool [2]. The main idea behind this scheme is to evaluate the cost of using each candidate channel and select the one with minimum cost provided that certain interference constraints are satisfied. So DCA proves more suitable in such a situation in MANET. Table II shows the comparisons of these both schemes.

II. COMPARISON OF FCA AND DCA [2]

FCA	DCA
Low flexibility in channel assignment	Flexible channel assignment
Sensitive to time and spatial changes	Insensitive to time and spatial changes
Maximum channel reusability	Not always maximum channel reusability
Performs better under heavy traffic	Performs better under low/moderate traffic

III. MAC PROTOCOL FOR MANET

FDMA (Frequency Division Multiple Access), CDMA (Code Division Multiple Access) and TDMA (Time Division Multiple Access) are traditional MAC protocol which used for fixed channel assignment and from which TDMA is the most commonly used in MANET. In FDMA the available bandwidth is divided into frequency bands. In TDMA the channel bandwidth is divided into fixed time slots and in CDMA communication can be done with different codes. Polling and reservation are also MAC protocols which support on-demand assignment approach. Polling works on the concept of primary device and secondary device in which primary device used to determine which device is allowed to use the channel at a given time. In reservation

method, station need to make a reservation on channel before sending the data. Then ALOHA and CSMA (Carrier Sense Multiple Access) are two MAC protocols which are proposed for MANET. ALOHA works on a principle that each station sends a frame whenever it has a frame to send and this protocol divides into pure ALOHA and slotted ALOHA. To minimize the collision. CSMA works on a principle sense before transmit. Based on the collaboration level MAC protocols can be classified into two categories: coordinated and non-coordinated [1]. Non-coordinated protocols are based on contention mechanism between the nodes and IEEE 802.11 is an example of such type of protocol. These protocols are not suitable for highly loaded networks because of the contention mechanism. The coordinated protocols are well suited in a network where the load is high. These types of protocols provide support for QoS, reduce energy dissipation and increase throughput. MH-TRACE is an example of such a protocol which means Multihop time reservation using adaptive control for energy efficiency. It is used for coordinating channels and minimizing interference. It does not provide any channel borrowing mechanism and not perform well under non uniform load distribution. For supporting non-uniform traffic loads dynamic channel allocation scheme is used. To overcome the shortcoming of MH-TRACE, a new protocol called as dynamic channel allocation for TRACE which means DCA-TRACE is formed. DCA-TRACE is a novel MAC protocol that maintains the same energy efficiency and channel regulation principles of MH-TRACE while enabling dynamic and scalable channel assignment [1]. It is a more flexible protocol in which we can adjust the structure of the cluster as per need. It introduces the concept of channel borrowing, consumes less energy, provide more throughput and less inter packet delay variation. Table III shows the comparisons of MH-TRACE and DCA-TRACE.

III. COMPARISON OF MH-TRACE AND DCA-TRACE

MH-TRACE	DCA-TRACE
Less flexible	More flexible
Collision increases	Collision reduces
Level of interference decreases	Level of interference increase
Data slots are assigned in sequential order	Dynamic assignment of data slots
Less energy saving	More energy saving

IV. DYNAMIC CHANNEL ALLOCATION SCHEME

A new protocol DCA-TRACE is forming for MANET, it is a novel MAC protocol that is capable of saving energy, decreasing jitter and increases the transmission for random and localized load distributions. DCA-TRACE includes the mechanism to sense the interference level from the transmitting node in each data slot in each frame and a mechanism to keep the track of interference level in each frame. Channel borrowing scheme is used in this concept in which a dynamically selected channel regulators (CHs) measures the interference level in the channels and then allocates to the nodes. A simple strategy is used for deciding CH by using Beacon packet. If a node does not receive any beacon packet from other nodes in a specific time then that node assume itself as CH. In CA slot, interference is estimated for CHs in the same frame. A node that wants to access the channel randomly selects a contention slot and sends a contention message in that slot [1]. CH knows this node request by sensing the medium and then CH prepares a transmission schedule in which the

free data slots are assigned to the nodes. After that CH sends this schedule to all the nodes including information slot (IS) and data slot (DS). Spectrum sensing is a technique used to sense the free channels before allocating to the nodes. There are Secondary users (SU) in a network which continuously monitor the activities of Primary users (PU) to find spectrum holes which means the spectrum bands that can be used by SUs without interfering PUs. This process is called as spectrum sensing. The PUs have high use spectrum than SUs.

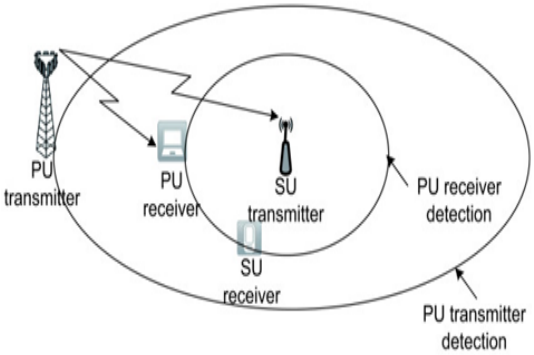

Fig 2: Local Spectrum Sensing

To measure the level of interference in the own frame as well as in other frame is an important tasks performed by CHs. CHs measures the level of interference in their own frame by using other CHs and in the other frames by using CA slot of own frame and Beacon packet of other frames. In case of temporary changes such as an unexpected packet drops, an exponential moving average update is used to mention current interference level in a frame. At the end of the each superframe, CHs determine the number of frames that they need to access based on the reservation in the previous frame [1].

V. PERFORMANCE EVOLUTION

Results are represented in the forms of graphs as follows. In all graphs, PU indicates primary users. As we increase the demand in terms of number of users by increase number of nodes PDR gets decrease.

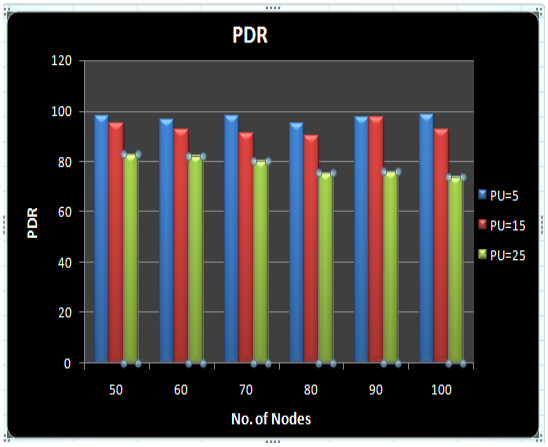

Fig 3: Packet Delivery Ratio

Fig 3 shows Packet delivery ratio 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. In graph, PDR decreases due to the number of demand increase but still system is able to serve the all demand in dense network and it shows by incrementing of more number of node.

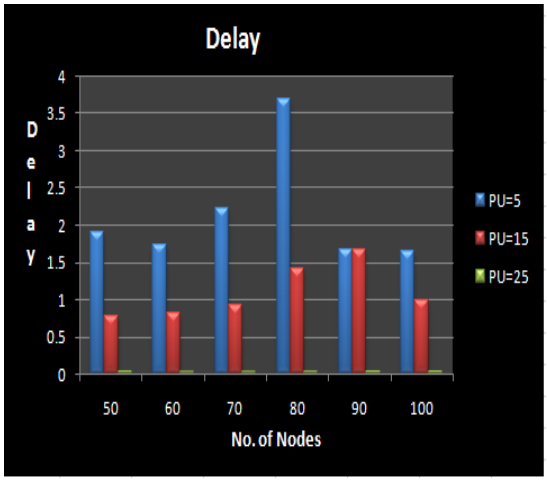

Fig 4: End to End Delay

Fig 4 Shows the end-to end delay of a packet which is defined as the time a packet takes to travel from the source to the destination. In this graph, once number of active user in terms of demand increases, delay start reducing that interprets initially it get some delay for connecting to centralized control.

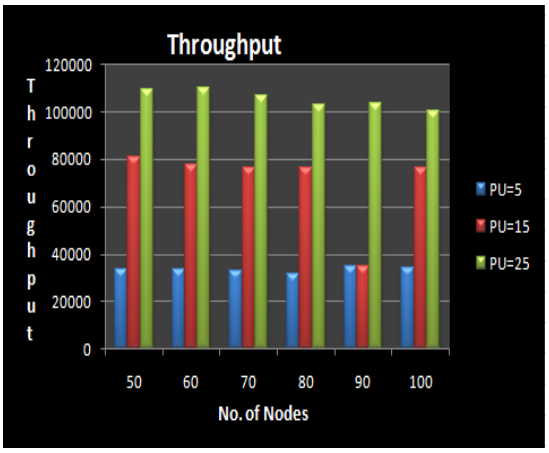

Fig 5: Throughput

Fig 5 shows the Throughput that 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.

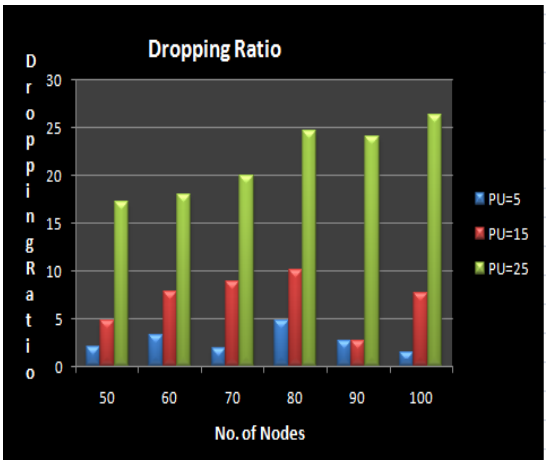

Fig 6: Dropping Ratio

Fig 6 shows the Dropping ratio indicates the number of packets drops during transmission. As the demand increase, the dropping ratio also gets increases as it effects on the transmission capacity of the network

VI. CONCLUSION

MANET is a kind of network in which nothing. So that DCA-TRACE proves more advantageous in MANET because it provides flexible channel allocation and also handles non uniform load distribution. DCA-TRACE with spectrum sensing and multiple channel assignment provides us the efficient solution for MANET with minimum interference. DCA-TRACE give the improved performance in the MANET as it reduced the number of blocked nodes, increases the rate of transmission, increases the throughput, less energy consumption and decreasing the delay and it also not increase much overhead of within a system.

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