

A Survey on Dynamic Channel Allocation in Mobile Ad Hoc Network

Swati A. Patel^{#1}, Dhaval Patel^{*2}, Jignesh Patel^{#3}

^{1#}M.tech Computer Engineering, Gujarat Technological University
Chankheda, Gujarat, India.

^{3#}M.tech Computer Engineering, Uka Tarsadia University
Bardoli, Gujarat, India.

¹swati.patel2222@gmail.com

³jignesh190587@yahoo.com

*Assistant Prof.HGCE.,
Vahelal,Ahmedabad.

²Dhavalpatel651@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.

Keywords— 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.

TABLE 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.

TABLE 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 PROTOCOLS 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.

TABLE 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 increases
Data slots are assigned in sequential order	Dynamic assignment of data slots
Less energy saving	More energy saving

IV. LITERATURE SURVEY ON BOTH CHANNEL ALLOCATION SCHEMES AND THEIR PROTOCOLS

A. *A dynamic channel allocation scheme using spectrum Sensing for mobile ad hoc network [1]*

In this paper, Bora Karaoglu, Wendi Heinzelman presented improved performance of DCA-TRACE over MH-TRACE and 802.11. MH_TRACE is a coordinated MAC protocol where the channel access is regulated by dynamically selected cluster head does not perform as well as possible under non uniform load distribution. 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.

B. *Channel assignment scheme for cellular mobile telecommunication systems: A comprehensive survey [2]*

Authors Katzela and M.Naghshineh elaborates the detailed concept of both FCA and DCA channel allocation schemes. The whole concepts of these channel allocation schemes and also their advantages and disadvantages are explained in detail. FCA do not adapt to changing traffic conditions and user distribution. In order to overcome these problems DCA scheme is introduced. In DCA scheme is the cost of using each candidate channel is evaluated and the one with the minimum cost provided that certain interference constraints are satisfied is selected.

C. *Adaption of TDMA parameters based on network conditions [3]*

In this paper, Bora Karaoglu, Togla Numanoglu, Wendi Heinzelman proposed that soft clustering of the nodes combined with time division multiple access (TDMA) channel access within a cluster has been shown to provide an energy efficient solution for MANET. MH-TRACE is TDMA based clustered protocol which is an analytical model that reflects the relationships between protocol parameters and the overall performance of the protocol under different network conditions. The optimal TDMA structure under various settings has the advantages that can be obtained by adapting protocol parameters as network conditions change.

D. *A Multihop dynamic channel assignment scheme for cellular network [7]*

In this paper, Mr. Chetan Jadav and Prof. A. S. Joshi presented a Multihop DCA technique. A Multihop dynamic channel assignment scheme splits the cell into microcell and macrocell to accept and complete the call. The radio resources are assigned to each call based on the interference information

in surrounding cells. Multihop DCA (MDCA) scheme improves the system capacity and call blocking probability. This scheme works on the information provided by the Interference Information Table. MDCA can efficiently handle the hot-spot traffic.

E. *MH-TRACE: Multihop Time Reservation Using Adaptive Control for Energy Efficiency [6]*

In this paper, Bulent Tavli and Wendi Heinzelman explained the whole concept of MH-TRACE. MH-TARCE is a MAC protocol that combines the features of fully centralized and fully distributed networks for energy efficient for real time packet broadcasting in a Multihop radio network. In MH-TRACE, cluster creation and maintenance overhead is lower compared with other clustering approaches because the only information a node needs to know in order to form a cluster is the interference level in different time frames which is monitored continuously to minimize the interference between clusters. MH-TRACE are it provides energy efficiency due to the use of TDMA slots which allow nodes to enter sleep mode often and it provides higher throughput due to the coordinated channel access.

F. *Dynamic channel selection for wireless mobile ad-hoc network: Adaption and learning [9]*

Dynamic channel selection mechanism for inter-vehicle communication in unlicensed band is presented in this paper by the authors Si-Chen and Rama Vuyuru. A real time video streaming application is built to show the advantages of dynamic channel selection in this paper. Dynamic channel selection approach should be implemented with low latency and high throughput.

G. *Interference-aware dynamic channel allocation scheme for cellular networks [10]*

In this paper, Daniela Martinez, Angel G. Andrade and Anabel Martinez proposed the concept of Interference-aware DCA which attempts to allocate the channels to users in such a way that the average blocking probability and forced termination in the system is minimized. This scheme tries to assign whenever possible, the same channels assigned before to the existing calls which limiting the reassignment of channels.

F. *Performance analysis of cellular mobile communication System with dynamic channel assignment [11]*

David Everitt and David Manfield analyse the dynamic channel allocation scheme in mobile communication environment. DCA concept performs better under low to moderate traffic loads but it can produce the network blocking condition under high traffic load. The main idea is to allocate the channels only in groups of a fixed size which can reduces the blocking rate under high traffic load.

V. CONCLUSION

In this paper, we have presented two important channel allocation schemes FCA and DCA with their advantages and disadvantages. MANET is self-organising and self-maintaining kind of network. So the major issues that must be handling in MANET are channel bandwidth, processing power, lack of fixed infrastructure and central administration. The protocols used for assigning the both channel allocation schemes are MH-TRACE and DCA-TRACE respectively. In MANET, the main problem is of non uniform load distribution which cannot be handled by FCA. So that DCA-TRACE proves more advantageous in MANET because it provides flexible channel allocation and also handles non uniform load distribution. So DCA-TRACE with spectrum sensing 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 jitter and it also not increase any overhead of within a system.

REFERENCES

- [1] Bora Karaoglu, Wendi Heinzelman, , "A Dynamic Channel Allocation Scheme Using Spectrum Sensing for Mobile Ad Hoc Networks", Dept. of Electr. & Comput. Eng., Univ. of Rochester, Rochester, IEEE Ad hoc and Sensor Networking Symposiu Pages.- 397 – 402, Dec-2012.
- [2] Katzela and M.Naghshineh, , "Channel Assignment Schemes for Cellular Mobile Telecommunication System:A Comprehensive Survey", IBM Thomas J. Watson Research Center, Yorktown Heights, New York, IEEE Personal Communications Pages-10-31, June-1996.
- [3] Bora Karaoglu, Togla Numanoglu, Wendi Heinzelman, , "Adaption od TDMA Paratemerts Based on Network Conditions", Dept. of Electr. & Comput. Eng., Univ. of Rochester, Rochester, IEEE Pages-1-6, Dec-2009.
- [4] Krishna Gorantala, "Routing Protocols in Mobile Ad-hoc Networks", Umea University Department of Computing Science SE-901 87 UMEA SWEDEN, june 15, 2006.
- [5] Saleh Ali K.Al-Omari, Putra Sumari, , "An Overview of Mobile Adhoc Networks For Existing Protocols And Applications", International Jourbal on The Applications of Graph Theory in a Wireless Adhoc Networks and Sensor Networks, Vol.2, No.2, March-2010.
- [6] B. Tavli and W. Heinzelman, "MH-TRACE: Multi hop time reservation using adaptive control for energy efficiency," IEEE Journal on Selected Areas of Communications, vol. 22, no. 5, pp. 942–953, June 2004.
- [7] Mr. Chetan D. Jadhav, Prof. A.S.Joshi, "A Multihop Dynamic Channel Assignment Scheme For Cellular Network," Internation Journal of Computational Engineering Research, Vol-3, February-2013.
- [8] Chin-Lin I and Pi-Hui Chao, "Local Packing-Distributed Dynamic Channel Allocation at Cellular Base Station," AT&T Bell Laboratories, Holmdel, NJ, IEEE Vol.1 Pages-293-301, Dec 1993.
- [9] Si Chen, Rama Vuyyuru, "Dynamic channel allocation for wireless mobile ad hoc networks: Adaption and learning", Wireless and Mobile Computing, Networking and Communications (WiMob), 2013 IEEE 9th International Conference in Lyon, IEEE Pages-75-82, Oct 2013.
- [10] Daniela Martinez, Angel G.Andrade, Anabel Martinez,"Interference-Aware dynamic channel allocation scheme for cellular networks", Performance Evaluation of Computer and Telecommunication Systems (SPECTS), International Symposium in Ottawa, ON, IEEE Pages-295-300, July 2010.
- [11] David Everitt, David Manfield, "Performance analysis of cellular mobile communication systems with dynamic channel assignment", Selected Areas in Communications, IEEE Journal on (Volume:7 , Issue: 8),Pages- 1172 - 1180, Aug 2002.
- [12] Tarik ANOUARI, Abdelkrim HAQIQ,"Performance Analysis of Routing Protocols in WiMAX Using Random Waypoint Model",Telecommunications (ICT), 2013 20th International Conference on,6-8 May 2013,pp 1-5.
- [13] Riri Fitri Sari, Abdusy Syarif, Kalamullah Ramli, Bagio Budiardjo, "performance evaluation of AODV routing protocol on ad hoc hybrid network testbed using PDAS ", Center for Information and Communication Engineering Research, University of Indonesia,IEEE 2005.