Techniques Based on Resource Allocation in Chunk Based OFDMA: A Survey

Mukesh Kumar Yadav[1], Garima Saini[2]

[1]M.E. Student, NITTTR Chandigarh, India
[2]Assistant Professor, NITTTR Chandigarh, India

Abstract— *The emerging demand for diverse data applications in next generation wireless networks entails both high data rate wireless connections and intelligent multiuser scheduling designs. Orthogonal frequency division multiple access is capable of delivering high speed connections in a multipath environment by dividing an entire channel into many orthogonal narrow band subcarriers and thus eliminating inter symbol interferences, which limits the available data rates. In this paper, we have investigated about resource allocation problem for the downlink of Orthogonal Frequency Division Multiple Access (OFDMA) wireless multicast systems. It is assumed that the Base Station (BS) consists of multiple antennas in a Distributed Antenna System (DAS) or Collected Antenna System (CAS), whereas each user is equipped with a single antenna., The allocation unit is a set of contiguous subcarriers (chunk) in conventional OFDMA systems. The aim of this investigation is to propose an efficient algorithm to maximize the total throughput with respect to total available power and average Bit Error Rate (BER) over a chunk.*

Keywords— MISO-OFDMA, multicast systems, DAS, CAS, multiuser diversity, chunk allocation.

I. INTRODUCTION

The systems based on OFDMA, are able to deliver high data rate and can operate in the hostile multipath radio environment. OFDMA-based systems allow efficient sharing of limited resources among multiple users such as spectrum and transmit power [1]-[3].

With various Quality-of-Service (QoS) requirements OFDMA has been developed to support various multimedia applications. The frequency band divides into a group of mutually orthogonal subcarriers in OFDMA, each group having a much lower bandwidth than the coherence bandwidth of the channel. It provides better protection facility to inter symbol interference and frequency selective fading. Each user is dynamically assigned to a subset of subcarriers in multi-user environment in each frame which take advantage of the fact that at any time, the channel responses are different for different users and at different subcarriers [2]-[4].

In OFDMA, it is considered that both user and the base station is used single antenna. The allocation unit in OFDMA is not the subcarrier, but a set of contiguous subcarriers which are called chunks. The Distributed Antenna System, in which a cell is divided into a number of sectors with at least one antenna per sector. It is different from the conventionally collocated antenna system (CAS) where all the antenna units are centrally collocated [5].

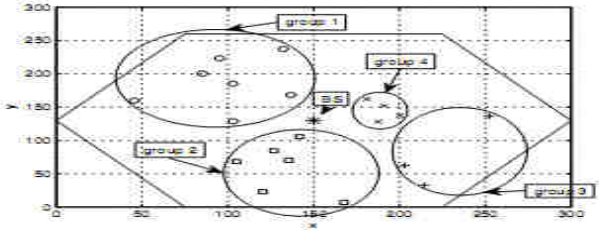

Fig .1 : Resource Allocation in Single Antenna Scenario [5]

In Chunk Based OFDMA Resource Allocation with Single Antenna Scenario, the allocation algorithm allocated chunks to users according to their average Signal to Noise Ratio within each chunk, where Bit Error Rate (BER) is make-sure within each chunk. Chunk based resource allocation is applied not only to the single antenna scenario but also to the multiple antennas [5].

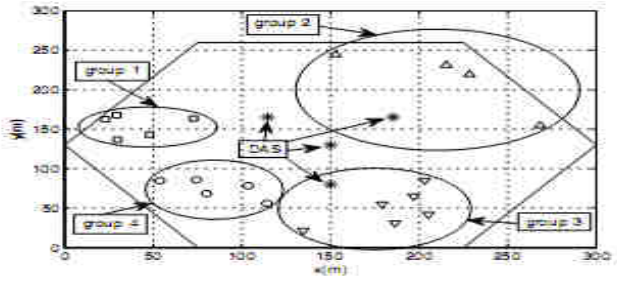

Fig. 2: Resource Allocation in Distributed Antenna System [6]

The resource allocation in chunk based OFDMA with single antenna scenario has low throughput. Total system throughput can be increased by placing BS's multiple antennas at different locations. Resource Allocation is performed centralized in Distributed Antenna System and

the available resources are used more efficiently. It is possible because of the different spreading environments across distributed antennas that to make better the wireless channels of users. Through a single transmission, data can be transmitted from each distributed antenna of the base station to multiple mobile users only in multicast systems [6]-[7].

Thus in OFDMA system, there are various approaches for resource allocation. In distributed antenna system one of the antenna placed at the center of the cell and other three antennas on the vertices of a triangle, having R/3m distance from the center. Resource allocation in single antenna scenario, the base station antenna is placed at the center of the cell. In Distributed Antenna System, total throughput of resource allocation will be more than resource allocation in single antenna scenario [5]-[7].

II. LITERATURE SURVEY

Stavros A. Kotsopoulos et al. [5], in this paper, the single antenna multicast OFDMA system is proposed by a resource allocation algorithm In this paper, each user and base station used a single antenna and allocation unit is a chunk. Chunk is a set of contiguous subcarriers. The purpose of this proposed algorithm is that to maximize the total throughput with respect to total available power and average bit error rate over a chunk. Disadvantage of this algorithm is that it is more complex.

Vasileios D. Papoutsis et al. [6], author designed a resource allocation algorithm for the MISO-OFDMA DAS downlink. In this paper, chunk is the resource allocation unit of multicast groups for reducing the complexity and considered average BER over each chunk. The base station consists of multiple antennas in a Distributed Antenna System (DAS). The purpose of this algorithm is to maximize the total throughput with respect to total available power and average bit error rate over a chunk. In this as number of chunks increases average throughput increases but complexity also increases.

Ioannis G. Fraimis et al. [7], in this paper, a resource allocation algorithm is proposed for the MISO-OFDMA DAS downlink in which resources are allocated on a per chunk basis. In this paper, the base station consists of multiple antennas in a Distributed Antenna System (DAS), whereas a single antenna is available to each user. The proposed algorithm has not fully optimize but this algorithm maximizes the total throughput with respect to total available power and it is proportional to data rate among users. The efficiency of this algorithm is affects by coherence Bandwidth of this algorithm.

Stavros A. Kotsopoulos et al. [8], in this paper a user selection and resource allocation algorithm is developed for multi-user downlink MISO-OFDMA that assimilates fairness by imposing proportional constraints among the data rates of users. In this paper base station uses many antennas and a single antenna is available to each user. This algorithm is based on Zero Forcing Beam Forming and Spatial Correlation which maximizes the sum of the users' data rates with respect to total available power and proportional fairness among users' data rates.

Na Gao et al. [9], in this paper, under different power control conditions, the author proposed the optimal chunk resource allocation algorithm. This allocation maximizes a general utility function of average users data rates for wireless OFDMA systems. This optimal scheme can be achieved by Lagrange dual-based gradient iterations with fast convergence and low computational complexity. In this scheme, if the value of utility parameter increases, fairness increases but total throughput decreases.

Peter W. C. Chan et al. [10], for multiplexing the signal of multiple users in every subcarrier, the author considered the multiuser MISO-OFDMA downlink system using Zero Forcing-SDMA. The aim of this scheme is to derive the resource allocation algorithm to maximize the sum capacity of the system by using power allocation, transmit and receive beam forming and user selection.

Huiling Zhu et al. [11], in this a chunk based resource allocation scheme by using joint chunk, power and bit allocation is designed. This scheme analyzed by maximizing the throughput under a total power constraint. The efficiency of this dynamic power allocation scheme is compared with the scheme of fixed power allocation. The average throughput decreases as the bandwidth ratio increases in both dynamic power allocation and fixed power allocation scheme.

Duy T. Ngo et al. [12], in this paper, the proposed schemes are efficient low complexity resource allocation for OFDMA based multicast wireless systems. In these schemes the total available bandwidth among multicast groups are able for flexibility and fairly distributed. These schemes can achieve a high system throughput.

Miaowen Wen et al. [13], in this paper, both Zero-Forcing(ZF) and OFDMA(Orthogonal frequency Division Multiple Access) interleaved SC-FDMA(Single-Carrier Frequency Division Multiple Access) systems are presented for bit error rate analysis. This scheme is used Nakagami-m frequency selective fading channels with arbitrary m. The performance of this scheme depends on the number of subcarriers for a specific user and channel order.

Changho Suh et al. [14], the authors considered the resource allocation problem using the assumption of multiple description coding (MDC) for multicast services over multicarrier systems. To reduce the complexity, the author proposed a two step suboptimum algorithm by separating subcarrier allocation and bit loading.

OFDMA is a multiple access scheme based on dividing an entire channel into many orthogonal narrow band subcarriers. OFDMA has the ability of delivering high speed data connections in a multipath environment. Literature shows that user selection and resource allocation plays important role in the performance of OFDMA. There are many algorithms for User Selection and Resource Allocation in OFDMA.

Chunk is a group of subcarriers. There are various approaches for selection of subcarriers and resource allocation in OFDMA. First approach is that the base Station uses many antennas whereas a single antenna is available to each user. Second approach is that the base station and each user equipped with a single antenna. Third approach is that the base station consists of multiple antennas in a Distributed Antenna System (DAS).

In the first approach whereas a single antenna is available to each user has large complexity. In second approach whereas each user equipped with a single antenna has less average throughput. Total system throughput can be increased by placing BS's multiple antennas at different locations, configure with the DAS.

Each and every algorithm and approach have its own advantages and disadvantages. So there is a trade-off between number of subcarriers per chunk, number of multicast groups, average throughput and average outage probability.

III. APPLICATIONS

OFDMA has been used in the mobility mode of IEEE802.16 WiMAX., is a working specification in 3GPP Long Term Evolution downlink. It is the candidate access method for the IEEE802.22 Wireless Regional Area Networks. Clearly that it is a recent advance in wireless communication technology which has led to significant innovations that enable OFDMA-based wireless access networks. It provides better Quality-of-Service (QoS) than ever with convenient and in expensive deployment and mobility.

IV. CONCLUSION

The importance of OFDMA system is high throughput and low outage probability. Many researchers have put their ideas & notions on resource allocation algorithm in chunk based OFDMA systems. Average *BER* over a chunk is taken into account and it could be said that there is a relation between average throughput and average outage probability. The appropriate parameterization depends on the needs of each system in total throughput, outage probability and complexity.

REFERENCES

[1] Ender Bolat, Thesis on "Study of OFDM Performance over AWGN Channels", Eastern Mediterranean University, Cyprus, 2003.

[2] Srikanth S., Kumaran V. Manikandan V. Murugesapandian, Tutorial Paper on "OFDMA", Anna University, Chennai, 2005.

[3] Victor C. M. Leung, Alister G. Burr, Lingyang Song, Yan Zhang, and Thomas Michael Bohnert "OFDMA Architectures, Protocols and Applications", Article ID 703083, 2009.

[4] Quang Duy La ,Boon Hee Soong, Yong Huat Chew, and Woon Hau Chin, "Orthogonal frequency division multiple access fundamentals and applications", International Standard Book Number: 978-1-4200-8824-3.

[5] [5] Vasileios D. Papoutsis, Stavros A. Kotsopoulos, "Chunk-Based Resource Allocation in Multicast OFDMA Systems with Average BER Constraint", IEEE Communication Letter, Vol.15, No.5, pp.551-553, 2011.

[6] Vasileios D. Papoutsis, Alexia P. Stamouli, "Chunk-Based Resource Allocation in Multicast MISO-OFDMA with Average BER Constraint", IEEE Communication Letter, Vol.17, No.2, pp.317-320, 2013.

[7] [7] V.D. Papoutsis, S.A. Kotsopoulos, "Chunk-Based Resource Allocation in Distributed MISO-OFDMA Systems with Fairness Guarantee", IEEE Communication Letter, Vol.15, No.4, pp. 377–379, 2011.

[8] V.D. Papoutsis, I.G. Fraimis, S.A. Kotsopoulos, "User selection and Resource Allocation Algorithm with Fairness in MISO-OFDMA", IEEE Communication Letter, Vol.14, No.5, pp.411–413, 2010.

[9] N. Gao, X.Wang, "Optimal subcarrier-chunk scheduling for wireless OFDMA systems", IEEE Transaction on Wireless Communication, Vol.10, No.7, pp. 2116–2123, 2011.

[10] Peter W. C. Chan, Roger S. Cheng, "Capacity Maximization for Zero-Forcing MIMO-OFDMA Downlink Systems with Multiuser Diversity", IEEE Transactions on Wireless Communication, Vol. 6, pp.1880-1889, 2007.

[11] H. Zhu, J. Wang, "Chunk-Based Resource Allocation in OFDMA Systems-Part II: Joint Chunk, Power and Bit Allocation", IEEE Transaction on Communication, Vol.60, No.2, pp.499–509, 2012.

[12] D.T. Ngo, C. Tellambura, H.H. Hguyen,"Efficient Resource Allocation for OFDMA Multicast Systems with Spectrum-Sharing Control", IEEE Transaction on Vehicular Technology, Vol.58, No.9, pp. 4878–4889, 2009.

[13] Miaowen Wen, Xiang Cheng, Xuefeng Yin, Liuqing

Yang, Bingli Jian, "A General Framework for BER Analysis of OFDMA and Zero-Forcing Interleaved SC-FDMA over Nakagami-m Fading Channels with Arbitrary m", IEEE Wireless Communications Letter, Vol.2, No.4, pp. 395-398, 2013.

[14] C. Suh, J. Mo, "Resource Allocation for Multicast Services in Multicarrier Wireless Communications", IEEE Transaction on Wireless Communication, Vol.7, No.1, pp.27–31, 2008.