Research on OFDM System Dynamic Allocation of Wireless Resources

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Abstract: OFDM (Orthogonal Frequency Division Multiplexing) system dynamic resource allocation can be utilized effectively limited system power and spectrum resources, improve system performance and those are widely studied. This article focuses on the resource allocation problem of a single-user, multi-user and multi-cell OFDM systems and reviews the existing research results, summarizes a hot research direction and lays the foundation for future research.

Introduction

OFDM is a special multi-carrier transmission scheme, will break down the high-speed serial data stream into several parallel sub data streams transmitted simultaneously effective against interference and radio channel frequency selective inter-symbol, it is considered to be the future of wireless communications The core technology .OFDM technology has been the European Digital Audio Broadcasting (DAB), the European Digital Video Broadcasting (DVB), IEE802.11 wireless LAN, IEE802.16 wireless MAN systems using .OFDM system can be flexibly choose suitable subcarriers for transmission, dynamic resource allocation, efficient use of limited spectrum resources system power and improve system performance. Subcarrier can be independently modulation and demodulation for resource allocation provides a finer granularity, which is OFDM dynamic resource allocation system has been extensively studied in recent years [1].

Dynamic resource allocation system early OFDM systems from discrete multi-tone modulation (DMT) system extending from the focus on single-user system power, dynamic allocation rates, maximize the rate of formation, power minimization and margin maximization problem categories literature is the study of classical literature such issues .OFDM system by different subcarriers distributed to different users, providing a new multi-user access methods, namely OFDMLA (Orthogonal Frequency Division Multiple Access). Multi-user OFDM systems using different user channel fading independence, the subcarrier channel conditions as much as possible and give a good user, in order to improve spectrum utilization, mining multiuser diversity. fairness between the blind pursuit of spectral efficiency caused by the user for , literature on dynamic allocation of resources to ensure that users of your stone characteristic under .OFDMA ensure orthogonality between users within the district, but if two adjacent cells to make spectrum reuse factor as close as possible and use the same spectrum resources, the cell edge interference would be serious. Therefore, the allocation of resources in a multi-cell OFDM system not only to complete the dynamic allocation within the district, but also the need for dynamic coordination of resources between the various cells [2].

In recent years, OFDM dynamic resource allocation system research focus from a previous theoretical studies to gradually shift the problems faced by the practical application, such as the study of in-band signaling overhead, noisy feedback channel, feedback impact on the system caused by the limited channel information, etc., etc. The objectives and related factors combined resource allocation at different levels considered together, the so-called "cross-layer resource allocation" is another new hotspot. Hotspot also includes resource allocation OFDM and other advanced technology combined system. OFDM and MIMO technologies are the allocation of resources to expand the freedom of airspace and take advantage of parallelism and frequency selective channel OFDM system channels in higher spectral efficiency. Cooperative communication and OFDM combination of India M dynamic resource allocation system to propose new perspectives and challenges, through collaboration between users, and load balance resources to further expand system capacity, improve system performance.

Resource Allocation in Multi-User System

Resource allocation for multi-user systems with different user channel fading independence, the subcarrier channel conditions as much as possible and give a good user, you can improve the spectrum efficiency and make full use of the multi-user diversity. Figure 1 shows a typical user downlink K assign a block diagram of 0 India M system, the base station side of resource allocation module to allocate resources based on the channel information of each user feedback, and through special signaling channel assignment information circular user, the solution according to the resource allocation information of the data is generally assumed that a subcarrier Up only points to a user, the article analyzes the multi-user system to maximize the rate of manpower issues, the application of mathematical knowledge of this rationality is given strict proof.

User Fairness. Important issue multi-user system Mining channel frequency-domain selectivity diversity and multi-user diversity, while fairness among users is cannot be ignored. For example, when the user is in a cell in a different location from the base station more recent users may monopolize all wireless resources, and relatively far away from the base station users cannot get service, make] S cannot be guaranteed. Common equity includes fairness and proportional fairness. Document 4 into account the user rate to meet the rate of max-min fairness requires maximization problem and power minimization problem [3].

The above algorithms, literature suggests that resource allocation algorithm based on maximizing the utility function. The main idea of the utility function is available resources (bandwidth, power, etc.) or performance (channel gain, data rate, delay, etc.) mapping to the corresponding utility value or cost value, a utility function for each user to determine the allocation of resources so that the utility function for all users and a maximum Particularly, when the utility function is logarithmic user rate. The algorithm is proportional fair scheduling algorithm under extended channel environment and when the utility function, and approaching infinity, the algorithm allows the user rate to meet the max-min fairness. Fairness to the loss of access to the general performance of the system is price, fair use of different criteria, reflecting the varying degrees of compromise between fairness and system performance.

Solution. Diversity and different optimization objectives multiuser OFDM system resource allocation problems generally can be modeled as optimization problems with constraints, the allocation of the multi-dimensional degree of freedom (subcarriers, speed, power, etc.) arising from the constraints of is the main reason for causing such problems complex. Most of these problems are considered NP-hard problem, resolve the more difficult to get the best, the best approach is to look for sub-optimal and optimal solutions.

The main idea is to reduce the degree of freedom in the allocation of resources, the original question is divided into several simple sub-problems, by solving the sub-problem, give a suboptimal solution to the original problem as Document 2, first assume that each consistent with the subcarrier modulation scheme, according to the requirements of each user rate calculated by the required number of sub-carriers, the second step is assigned a corresponding number of sub-carriers.

Due to the development of mature convex optimization theory, convex optimization problem has many good properties, such as the local optimum is a global optimum, the difference of the dual problem and the original problem solution is 0, KKT condition is the best solution and other necessary conditions are also sufficient, so the original problem into a convex optimization problem is relatively easy to solve, such as Document 1 by the integer variables relax restrictions are real numbers, then the introduction of a new variable, the original problem into a convex optimization problem using KKT condition problem optimal solution to the solution, to give solutions to meet the constraints of the original problem. Document 2 is how to use the issue of convexity, the original problem is divided into two levels of the main problems and secondary problems, the main problem Each Given a resource, once the problem can calculate the optimal allocation of resources in this, the main problem to adjust resource allocation based on the results of the next allocation. primary and secondary issues continue iteration, the optimal solution approximation problem.

Heuristic algorithms for specific problems people experience inspired rule out method, it may lack a solid theoretical foundation as Document 1 uses a genetic algorithm to solve the resource allocation problems can quickly get an effective solution [4].

Resource Allocation in Multi-Cell System.

Inter-cell interference is a problem inherent in cellular mobile communication systems, wireless communication systems hope future spectrum reuse factor as close to 1, which is a multi-cell system for resource allocation in the proposed new requirements. Users can use different cells the same subcarrier, but it will cause interference with other cell users, so the allocation of resources in a multi-cell OFDM system not only to complete the dynamic allocation within the district, but also need coordination between the cells dynamic resource for each user using all The pilot signal transmitted by the base station periodically performs channel estimation, reporting to the serving base station, passed by the serving base station to another base station, so that the base station can determine interference between base stations.

In a multi-cell environment, resource allocation generally has the following three ways:

Centralized. Centralized resource allocation by a central controller or coordinate the completion of each base station and transmitted to each base station through a backbone network, assign the result of all the base stations are transparent. As the literature centralized research subcarrier, bit, power joint distribution. Structure on each sub-carrier co-channel user set (Co-Channel user set), to deal with co-channel interference (co-channel linterference), by sending a parameter assignment, in base station power under limited circumstances, and maximize overall system throughput.

Semi-distributed resource allocation completed by the central controller and all the base stations, central control of resource allocation among regulate cell, each base station where the cell accomplish specific assignment, such as Document 3, the radio network controller (RNC) from the hierarchy level super frame decide which channel, the base station from the frame of the base station uses to decide which channel to which the user points.

Distributed no central controller, the allocation of resources by the respective base stations done individually as an application of the theory of literature studied each cell single-user multi-cell system of sub-carriers of non-cooperative game (noncooper-alive-game), bits power distribution. Each user is assigned on all the subcarriers by water power, the other user's signal as interference, without considering the allocation result of interference to other users.

In general, the best performance centralized resource allocation, the highest complexity of the system requirements are relatively high; semi-distributed second; distributed allocation algorithm is most simple, but also the worst performance is generally suboptimal.

Hot Direction

Previous studies based on many assumptions over recent years, people gradually concerns facing the practical application, such as literature analyzes the impact of the results allocated to notify the user needs band signaling overhead for dynamic resource allocation, noting that dynamic resource allocation not in any scenario better than the static resource allocation. Again, traditional resource allocation article assume that the base station can obtain the desired channel information, the actual system, the client channel estimation inaccuracies, and to reduce the amount of feedback introduction of limited feedback, feedback information processing delay, etc., will be informed of the exact extent that the base station channel information affected, thereby affecting the performance of resource allocation in the FDD downlink resource allocation system, users need feedback on all subcarriers channel information to the base station, in order to reduce the amount of feedback, literature suggests a bit limited feedback, and analyzes the impact on system performance. Documents analyze the performance loss when using delayed resource allocation channel information brought literature is analyzed in Mimo/OFDM system, the mean and covariance feedback and some other channel information, the Doppler effects algorithm performance by maximizing the rate issue.

Cross-layer resource allocation is another research focus. Resource allocation at different levels have different optimization goals and related factors, such as physical layer mainly consider spectral efficiency, power consumption, error rate and other data link layer buffer consider queue length, data throughput, network layer routing considerations, packet loss rate, you need to consider the application layer characteristics of the business itself requirements. the traditional design of model independent layers in a mobile wireless environment due to the variability and wireless links resource-constrained mobile devices and inefficient. Accordingly, it is proposed cross-layer resource allocation, the resource allocation process and a layer can interact with any other layer information.

Conclusion

This article discusses the OFDM system dynamic resource allocation of single-user, multi-user and multi-cell. Based on the comprehensive and systematic summarize on existing research results, this paper notes the general solution and challenges, and discussed the hot research directions in the future are hope there is some guidance for the future study.

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