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Context Aware Unlinking for Improving Quality of Service

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Abstract: The improvement in the Quality of Service for uplink in wireless communication system can be done in a better way by aware of the context it deals with. The prior measurement and statistics of the various context parameters will definitely help to control the system performance towards maximum efficiency. This paper proposed an algorithm to enhance the spectrum efficiency in uplink by controlling the operating power and by allocating the most suitable channel with the help of awareness of network context parameters. The effectiveness of the proposed system is ensured with software simulations. The results proved the improvement in the Quality of Service in uplink in terms of greater throughput, minimum delay and improved transmission gain.
Keywords: Uplink, Context aware, Quality of Service, Power control, Channel allocation

I. INTRODUCTION

Context aware computing is a pattern of mobile computing, where the mobile devices may identify and utilize the contextual data [1]. Dey has proposed the use of conceptual models and tools to encourage the improvements in context aware systems [2]. Long S et al have provided the variety of perspectives on how mobile terminals shall utilize the knowledge of context [3]. T. Yamabe et al presented a frame work for collecting and handling the contextual information [4]. B. E. Sanghir and N. Crespi formed a communication assistant which utilizes callee preferences and context to handle communications [5]. A. Ranganathan and Hui Lei proposed a Session Initiation Protocol based system which helps to enroute the communication of any device with respect to the preferences of the caller and callee and the context [6]. A web application prototype is formed by Y. Nakanishi et al, which allow the caller and callee to know about each other to support mobile communication [7]. A context aware system provided by S. Herborn et al can take care of the connectivity through horizontal hand over between to different networks [8]. A middle ware based prototype is developed by H. L. Truong et al that deals with the web services development on communication devices for collaborative purposes [9]. Context based techniques found by H. L. Truong et al handles variety of contextual information about users, services and activities [10].

II. CONTEXT AWARENESS

Always the knowledge of the present scenario helps for the quick actions on the improvement of the existing system. Assessing the system and then applying the essential alterations will improve the system performance in a constructive way. At device level, the context may be different with the battery state, CPU load and the device characteristics. The context on application may be real time, non-real time, video, web browsing, gaming and cloud based. In the point of user, the context should be the quality, user activity, user location and user's level of distraction. The contexts are motion, lighting cost and proximate devices in terms of environment. In the network, the context shall be congestion / load, air link and backhaul quality, available timely throughput and alternate network / spectrum availability. Using the knowledge of any such context shall help in the Quality of Service improvement in uplink.

III. QUALITY IMPROVEMENT

The techniques used for channel allocation and power control plays important role in minimizing the interference between the users and maximizing the performance of the users. The following challenges are faced by the wireless communication systems in controlling the power: Competitive users should be allocated with the unused available spectrum in a rational way, creation of a balance between the resources power, bandwidth and interference, self-organizing, autonomous operation of the network. There are several approaches to solve these problems. This paper concentrates on game theory and information theory for the solution.

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IV. SYSTEM MODEL

This paper proposed a distributed method for spectrum management that provides the best usage of the bandwidth and also maintains fairness among the contending users. To provide best uplinking Quality of Service to the users, it utilises the network parameters across the protocol stack. The cost of providing better Quality of Service in this method is minimized by selecting the best fitting channel. Here the term best fitting channel is the one, which closely match the desired Quality of Service of the serving user to the available channel quality of service. Each spectral band is capable of supporting the communication link with a certain Quality of Service.

Here we consider the desired Quality of Service and available Quality of Service as the parameters, which are pertinent to MAC layer functionality in frequency channel selection. Since this proposal is about selecting the best matching between desired and available Quality of Service, the evaluation depends on the average waiting time of all the users trying to make a call.

If the mobile terminals are allocated with spectrum in an arbitrary manner with first come first serve basis, the users will get the best Quality of Service channel available and it may fails to fulfil the user who has most specific requirements on Quality of Service. Before the channel allocations, the context of every connection has to be considered. This proposal of context aware uplinking is a non-greedy one, which allocates channel to the user based on their requirements, as the closest one.

V. CHANNEL ALLOCATION

Let B be the total spectrum available under observation for all the users. This frequency band is assumed to comprise *r* frequency sub-bands; represented by [f_1, f_2, ... f_r] (1) The occupancy or non-occupancy of these channels is represented by a +1 or -1respectively. For example [1 −1 .... 1] indicates channels $f_1$and f_r are occupied while $f_2$is free for usage. Associated with each channel is the Quality of Service (QoS) vector, which is dependent upon the physical nature of the sub-band. It is assumed that this QoS information is available by another learning based estimation technique. At any given time, *N* active users are searching for available spectrum with characteristics satisfying the service requirements of the user. These services belong to different classes such as; conversational class, interactive class, streaming class or background class.

The required QoS will vary based on the class and type of traffic and is represented by a QoS vector defined below,

$QoS_{req} =[PD_{req}\ PDV_{req} PLR_{req} TH_{req}]$ (2) Where PD is the packet delay, PDV the Packet Delay Variation or Jitter, PLR is the Packet Loss Ratio and TH represents the throughput.

Similarly, QoS available for each channel is given by

$QoS_{ava}=[PD_{ava}\ PDV_{ava}\ PLR_{ava}\ TH_{ava}]$ (3) The spectrum allocation algorithm seeks the best possible match between the users QoS requirements and the QoS available in the channel. To this end, a cost function has been defined as shown below. The spectrum allocation technique seeks to minimize equation for each user over L channels, where L is the number of suitable free channels (L<= K.) $\sigma_{ij}=(QoS_{req}\ i - QoS_{ava}\ j)Wi$ (4) Each QoS parameter may be weighted based on its criticality to the service desired. For example, packet delay is given more importance for voice communication than the packet error rate. The weight vector *Wi* is the vector of weights associated with each service class. The objective function of each user is given by

$U_i =1/\sigma_i^2$ (5) While the network cost function is given by

σ_i^2 (6) Each user seeks to maximize its utility function, which in turn ensures the minimization of Q.

The proposed algorithm for the channel allocation is based on the equation (4) and (5). If the number of users trying for connection is N and the number of available frequency band channel is K, then at the present scenario, it’s always N ≥ K. All the users who are trying to make a call are assigned with their own requirements of service. The mobile agent stores the required Quality of Service of each user requesting to make a call.

Then it scans and analyse the available Quality of Service of all the existing channels. Then it segregates the subgroup of channels, which are satisfied with the requirements of user. Channel allocation is done by calculating the Euclidean distance between the Quality of Service requirement of the user and the same available with the channel. The Quality of Service vector for every parameter is weighted according to the context of the call. The algorithm chooses the channel which has the closest Quality of Service vector as that of the call initiated in terms of the Euclidean distance. Satisfying this criterion will improve the utility of the user as defined by the equation (4). This improvement in turn enhances the network quality and also the spectrum efficiency.

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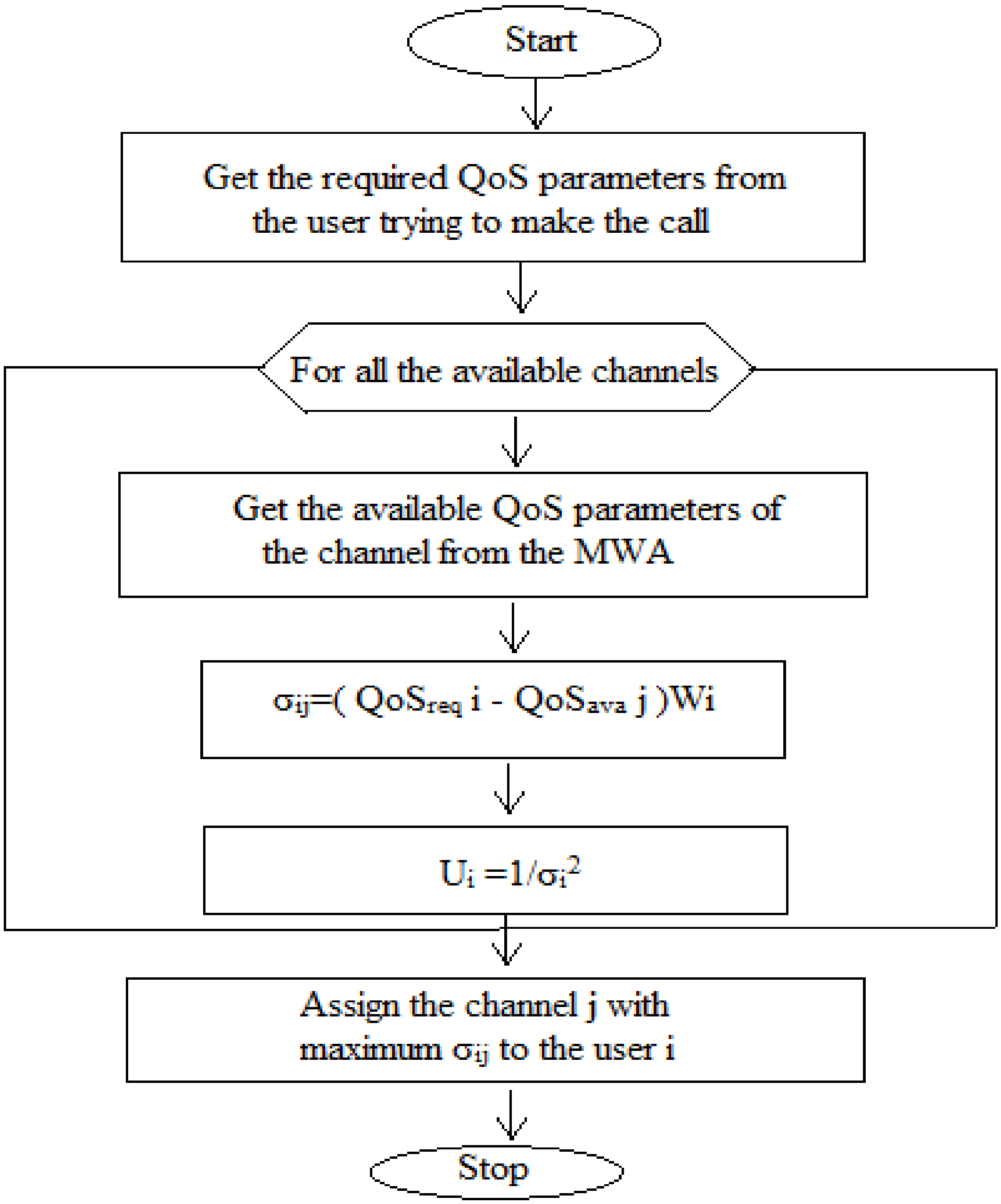

Fig 1. Flow Chart for the process of Channel Allocation

VI. POWER CONTROL

Here, a learning based estimation technique is used to optimize the power control and to enhance the energy efficiency. Each user act as an agent for power control, aims to adapt an optimal power allocation policy for its device. The Mobile Terminal follows a power setting algorithm to allocate optimal power for successful transmission with required Quality of Service. Based on the required and measured values of Signal to Noise Ratio and on the PH Report, the decision on transmission power control is taken by the Middle Ware Agent at the Base Station and is transmitted to the Mobile Terminal. With respect to the control decision taken by the Middle Ware Agent on transmission power, the path loss, high layer signalling and other factors, the power setting algorithm on the Mobile Terminal controls the power in optimal level for its own. In this way, the learning based power estimation technique is executed at the Mobile Terminals.

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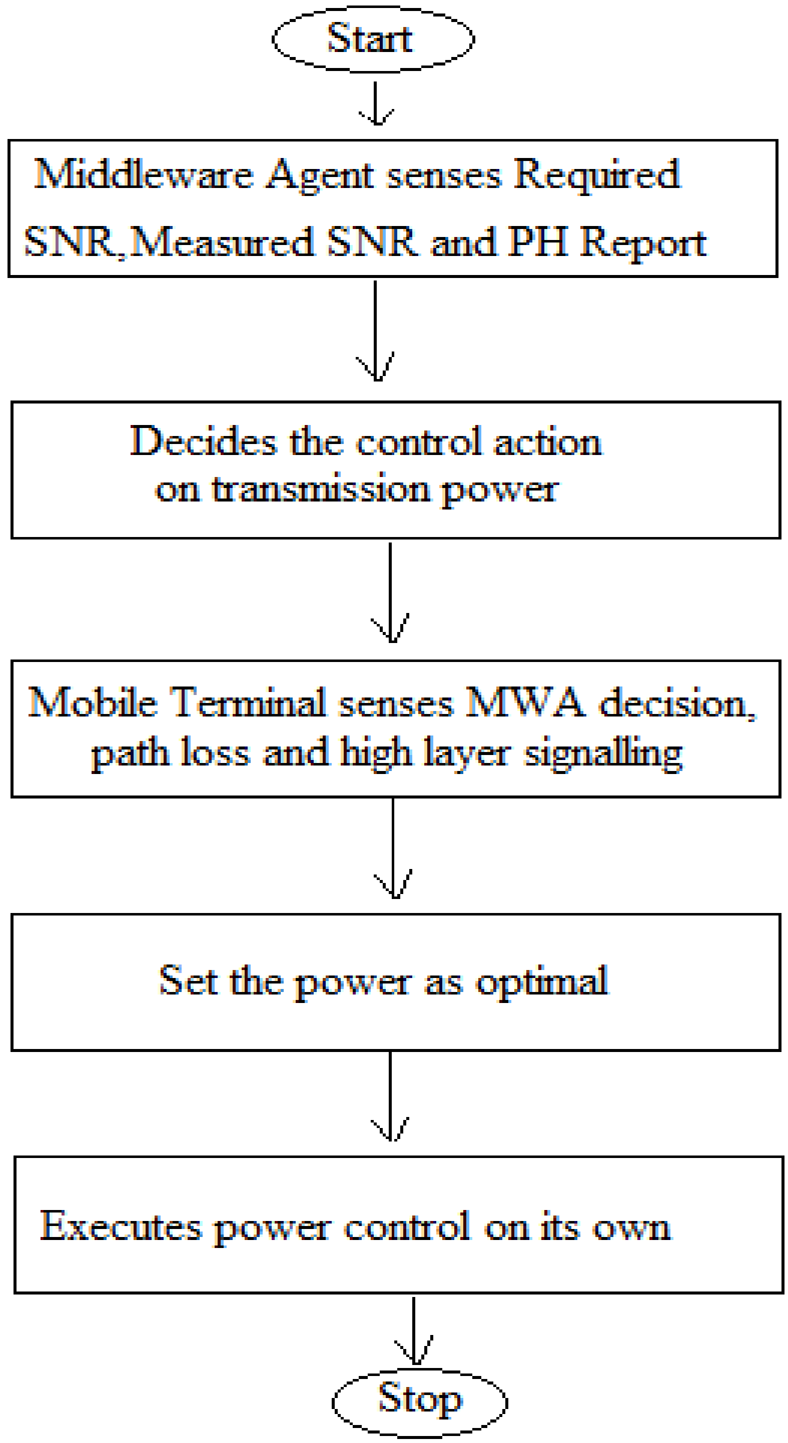

Fig 2. Flow Chart for the process of Power Control

VII. SIMULATION RESULTS

The performance characteristics is analysed here for the channel sensing and allocation along with the power control. The proposed algorithm ensures enhanced throughput and improved efficiency. The simulation is performed using Matlab software. The results are discussed below.

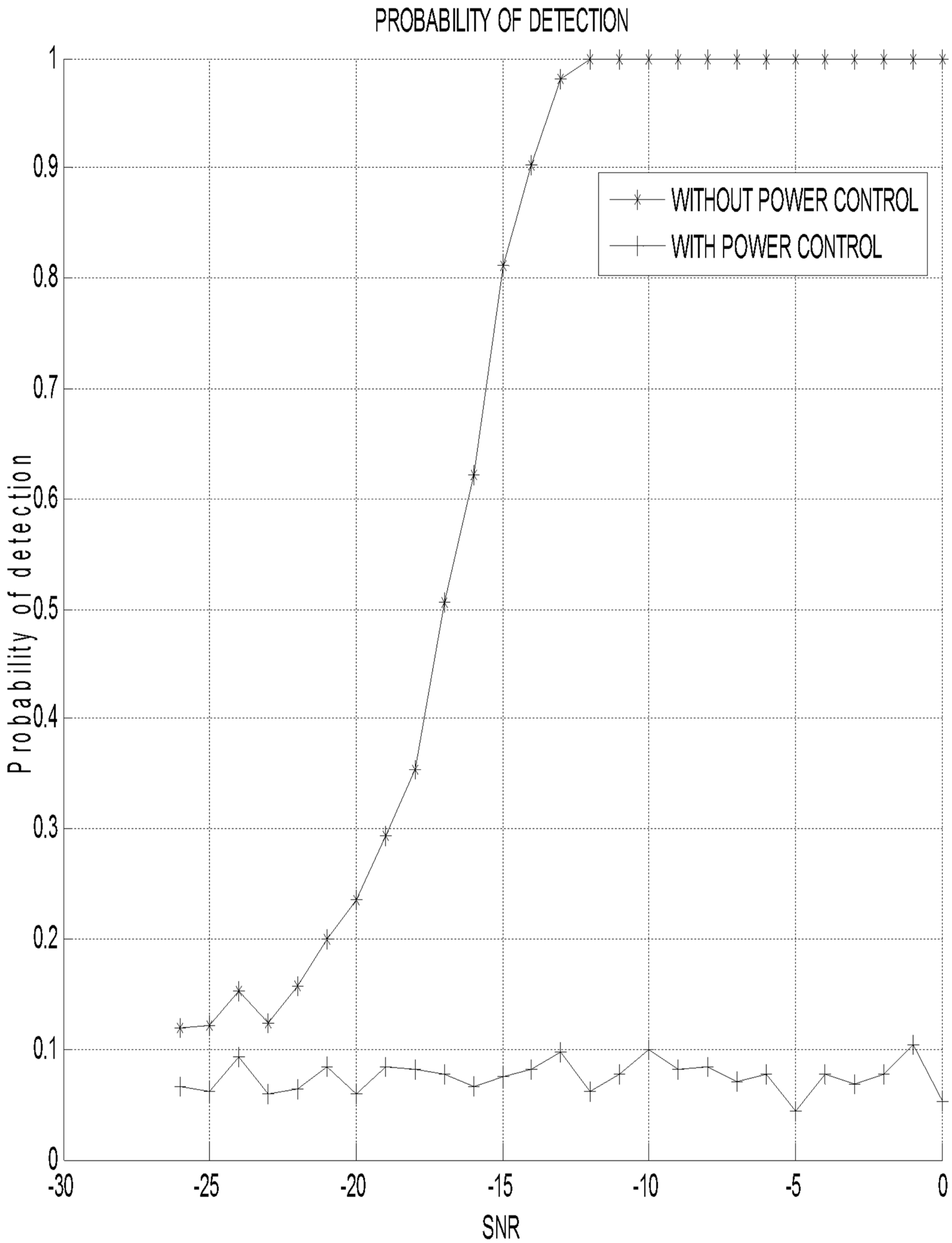

Fig 3. Probability of Detection

The probability of detection is the probability of success in allocating the suitable channel for the user for the uplinking by the base station. Without power control, while we allocate maximum power to the users, the interference increases with the power and is not possible to increase the number of successful users beyond a limit. With power control, it is possible to limit the power in required level and also to minimize the interference. So the number of successful users increases. Fig 3 shows the accuracy in probability of detection with power control than without power control.

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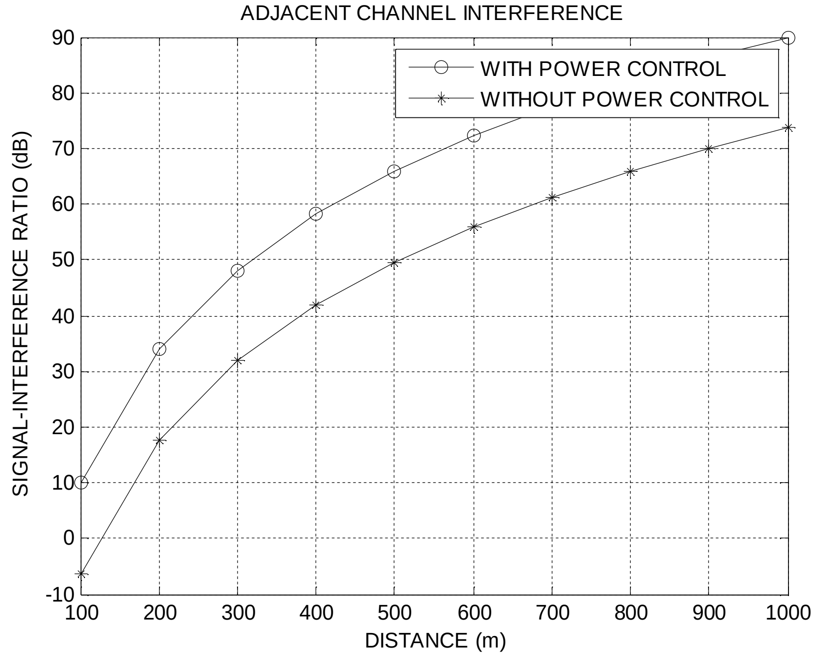

Fig 4. Adjacent Channel Interference

Fig 4 infer that the signal to interference ratio is optimal with the power control at the users whereas without power control the interference due to the new user is higher and it reduces the overall throughput of the system.

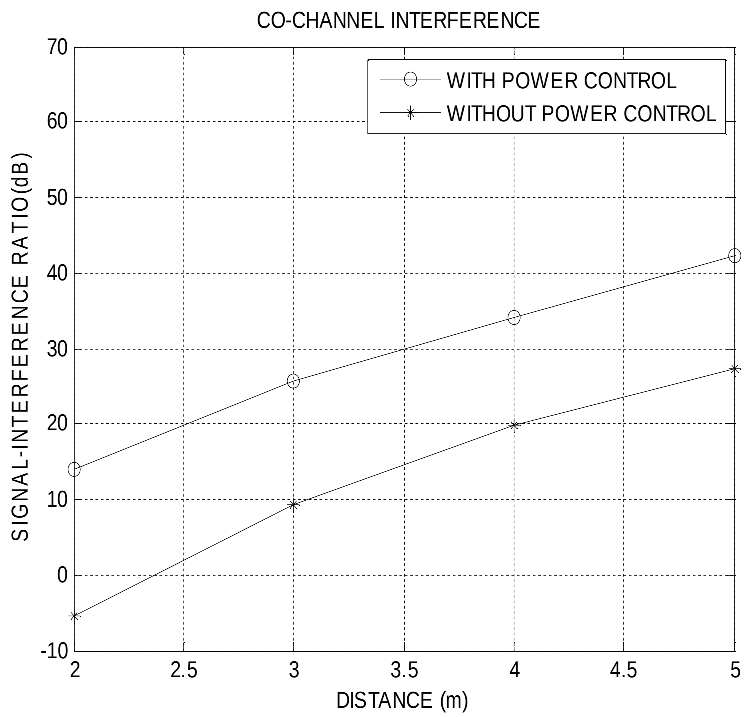

Fig 5. Co Channel Interference

Fig 5 infers that the co channel interference is lower with the optimal power control applied at the users, whereas without power control the interference from the new users is higher and thus it reduces the overall throughput.

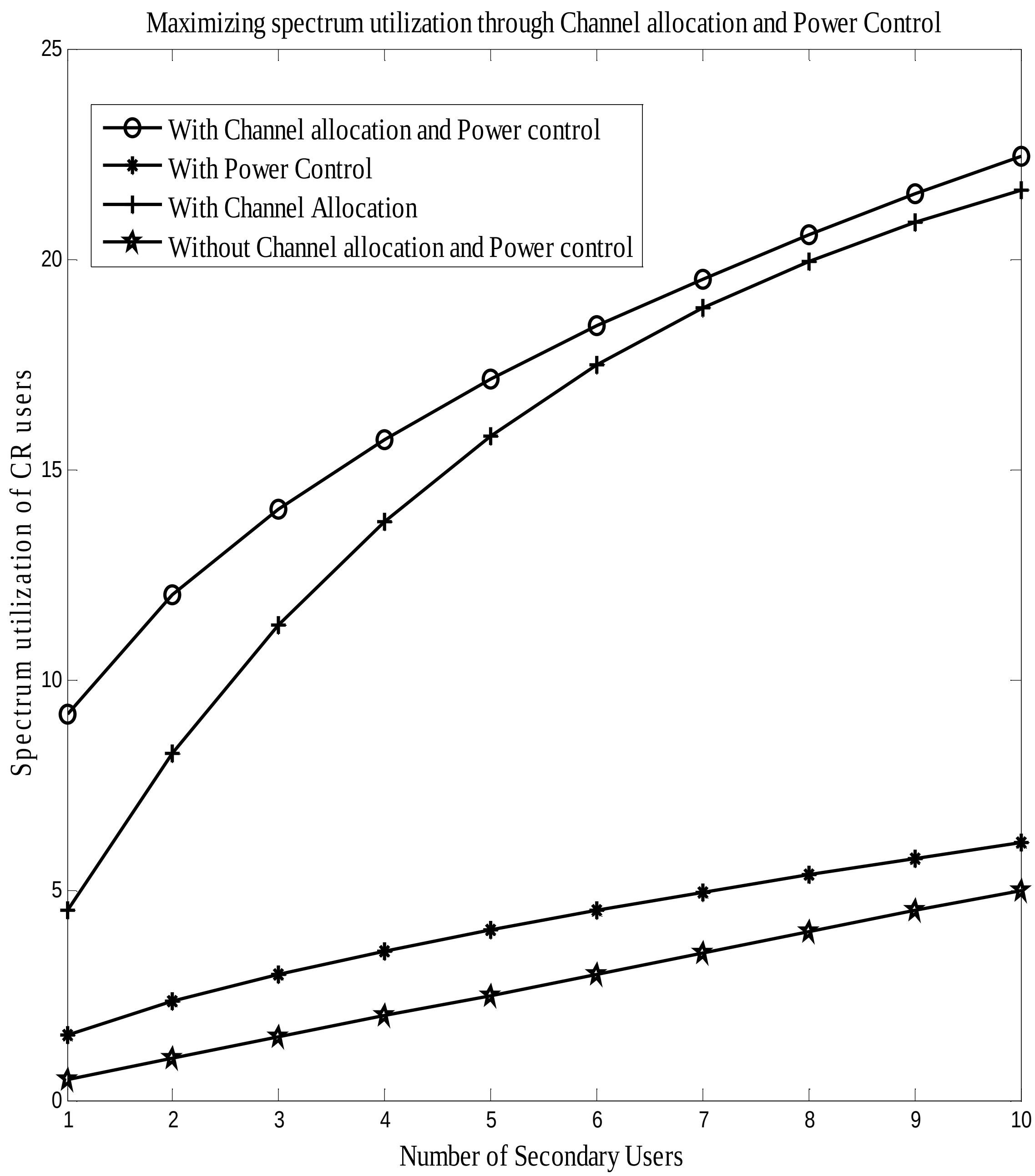

Fig6. Performance Comparison

Fig 6 compares the performance of the system with and without power control and channel allocation as aware of the context of network. It can be seen from the simulation result that maximum spectrum utilization is achieved when both the optimal power control and channel allocation are implemented in the system. s

VIII. CONCLUSION

The channel sensing method is proposed on the consideration of various network parameters. The analysis of the channel sensing

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and allocation method is done through simulation and the results show that the throughput of the system is enhanced. With the proposed method, the number of spectrum opportunities identified is more with less overhead and it improves the throughput. Various performance metrics like throughput and signal to interference ratio have been analysed. The proposed scheme provides a better performance which has greater throughput, lesser delay and higher transmission gain.

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