EFFICIENT RESOURCE ALLOCATION METHOD FOR COGNITIVE RADIO MULTI USER NETWORKS

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Abstract: *In recent years, effective utilization of spectrum is prime issue in communication resource allocation. Most of the cases inefficient spectrum utilization takes place due to this secondary users need vast of Bandwidth. To avoid this problem so many methods are proposed for cognitive radio multi user networks. All these methods concentrates on quality of service and transmission rate, though quality of service and transmission rate may be achieved but these methods not able to concentrate spectrum utilization. In order to overcome this a fuzzy based spectrum utilization method is proposing. This proposed method gives better approximation than existing one.*

1. INTRODUCTION

In recent years, demand for wireless communication services has grown far beyond earlier predictions. Furthermore, in order to satisfy future market demand for mobile and broadband services, we can envisage deployment of next generation mobile networks and services which will need rapid and more flexible access to radio spectrum. Due to policy of exclusive frequency assignment, radio spectrum has become congested and scarce resource. Nevertheless, related surveys have proved that most of the allocated spectrum is underutilized to deal with increasing conflict of spectrum congestion and spectrum underutilization, cognitive radio technique has been proposed as a flexible method which allows secondary users to utilize already licensed bands opportunistically. Opportunistic radio spectrum access has the possibility to improve spectrum utilization and in perspective allowing next generation mobile networks access to the attractive radio spectrum bands. The main challenge to opportunistic radio spectrum access lies in finding balance in conflicting goals of satisfying performance requirements for secondary user (SU) while minimizing interference to the active primary users (PU) and other secondary users. Secondary user should not degrade performance statistics of licensed primary users. In order to achieve these tasks, secondary user is required to recognize primary users, determine environment tasks, secondary user is required to recognize primary users, determine environment characteristics and quickly adapt its system parameters corresponding to the operating environment. Main abilities of cognitive radio (CR) with opportunistic radio spectrum access capabilities are spectrum sensing, dynamic frequency selection and adaptive transmit power control.

In this paper we propose alternative spectrum allocating strategy which enables cognitive secondary user to achieve its required transmission rate and quality, then minimizing interference to the primary users and other concurrent secondary users. Spectrum sensing data and regulatory requirements defines maximum acceptable SU transmit power.

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Depending on the quality of service, SU receiver sets required Signal to noise ratio. Comparison of measured and power control ratio and minimum required SU transmit power.

Proposed Method is implemented using fuzzy logic system (FLS) Fuzzy logic systems have been successfully applied in many fields such as automatic control system, data classification, decision process, expert systems and some computer vision. Advantage of Fuzzy logic is that it merge objective analytic and experience based subjective knowledge. FLS formalize control algorithms which can tolerate imprecision and uncertainty of input data like spectrum sensing data and SINR measurements in this case. Additionally, proposed strategy can be implemented with low cost and easy to implement Fuzzy logic Controllers.

As fuzzy logic system is used to model systems and situations, taking into consideration uncertainty and ambiguity, it can be an efficient tool to be utilized in problems for which knowledge of all factors is insufficient to obtain.

II. COGNITIVE RADIO: AN INTELLIGENT WIRELESS COMMUNICATION SYSTEM

Based on software-defined radio Technology, Cognitive radios are the products of a multidisciplinary effort involving experts in wireless networks, digital communications, system engineering, artificial intelligence and other fields. As a result of these activities, it is hoped that these systems can simultaneously respect the rights of the incumbent license holders while providing greater flexibility and access to spectrum. Given the demand for more bandwidth and the total amount of underutilized spectrum, Dynamic Spectrum Access networks employ cognitive radio networks are a solution that can revolutionize the telecommunications industry, and significantly changing the way

we use spectrum resources, and other design wireless systems and services.

When will cognitive radio happen:

Full Cognitive Radios does not exist at the moment and they are not likely to emerge until 2030, when fully flexible software Defined Radio technologies and the intelligence required to exploit them cognitively can be practically implemented.

The main obstacle to realizing a Full Cognitive Radio is the challenge of making a truly cognitive device, or a machine with the ability to intelligently make decisions based on its own situational awareness. Cognitive science is in its infancy. At this stage it is impossible to tell when machine cognition will he realized: it could be 50 years, 100 years of perhaps not at all. We expect basic intelligent

III.FUZZY LOGIC SYSTEM

The design of cognitive radio is very challenging due to complexity, modularity, information imprecision and interpretability issues. Fuzzy logic system is chosen for the decision making because it is very much suited for non-linear, imprecision and multi valued problems as it is capable of making. The purpose of fuzzy logic is to realize sophisticated control systems considering that many times real problems cannot be efficiently expressed by means of mathematical models. So fuzzy set theory models the vagueness that exists in real world problems.

Fuzzy Logic is a departure from classical two-valued sets and logic, that uses "soft" linguistic (e.g. large, hot, tall) system variables and a continuous range of truth values in the interval [0,1], rather than strict binary (True or False) decisions and assignments. Formally, fuzzy logic is a structured, model-free estimator that approximates a reconfigurable CR prototypes to emerge within the next five years. Some devices available already have some elements of CR. E.g. WRANs, WLAN, Military follower jammers.

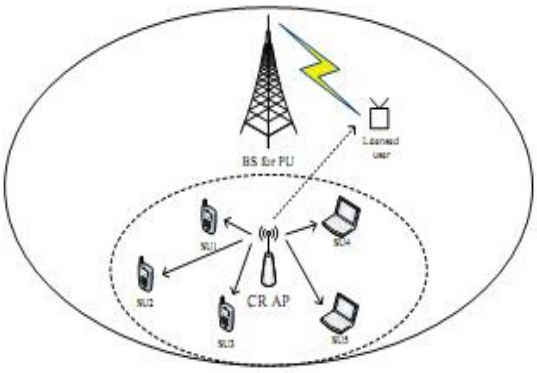

Fig.1. Cognitive Radio Architecture

Spectrum Pooling Concept:

A spectrum hole is a band of frequencies assigned to a primary user, but at a particular time and specific geographic location, the band is not being utilized by that use.

In the secondary usage scenario, the availability of the radio spectrum is dependent on the PU's usage statistics. So in order to transmit multimedia content, first we need to isolate a portion of the radio spectrum that is not in use by the primary users. We use the spectrum pooling concept which is the basis for virtual unlicensed spectrum [CORVUS], Since primary users use their bands intermittently, secondary users get the opportunity to exploit the temporarily available spectral resources to accomplish their own communication needs.

function through linguistic input/output associations. Fuzzy rule-based systems apply these methods to solve many types of "real-world" problems, especially where a system is difficult to model, is controlled by a human operator or expert, or where ambiguity or vagueness is common.

Membership functions

The membership function is a graphicalrepresentation of the magnitude of participation of each input. It associates a weighting with each of the inputs that are processed, define functional overlap between inputs, and ultimately determines an output response. The rules use the input membership values as weighting factors to determine their influence on the fuzzy output sets of the final output conclusion. If X is a collection of objects denoted generally by x, then a fuzzy set A in X is defined as a set of ordered pairs:

$A = \{(x, \mu A(x))\ x \in X\}$ Where μA is called the membership function (MF) for the fuzzy set A. The MF maps each element of X to a membership grade (membership value) between 0 and 1. Usually X is referred to as the universe of discourse, or simply the universe and it may consist of discrete (ordered or non ordered) objects or continuous space. To implement a decision making processes, fuzzy logic makes use of the so called Fuzzy Logic Controllers (FLCs). The essential part of the FLC is a set of linguistic control rules based on expert knowledge in the form:

IF (a set of conditions are satisfied) THEN (a set of consequences can be inferred)

Linguistic rules describing the control system consist of two part; an antecedent block (between the IF and THEN) and a consequent block (following THEN). Depending on the system, it may not be necessary to evaluate every possible input combination, since some may rarely or never occur. The inputs are combined logically using the AND operator to produce output response values for all expected inputs. The active conclusions are then combined into a logical sum for each membership function. A firing strength for each output membership function is

computed. All that remains is to combine these logical sums in a defuzzification process to produce the crisp output.

A general FLC consists of four modules: a fuzzy rule base, a fuzzy inference engine and a fuzzification /defuzzification module. AFLC operates by repeating a cycle of five steps implemented by these four modules. First, measurements are taken of all variables that represent relevant conditions of the controlled process. Next, these measurements are converted into appropriate fuzzy sets to From the Result, The decision making process is depends upon the distance between the primary and the secondary users. The less the distances, the more the probability of the decision.

V. CONCLUSION AND FUTURE WORK

The proposed method based on the fuzzy logic system to control the opportunistic spectrum access for secondary users in software defined radio networks. The Secondary users are selected based on some Antecedents [descriptors], which are spectrum utilization efficiency of the secondary user, Mobility, SNR, Free bandwidth available, Interference to the Primary Users, and Type of Service Required by the Secondary Users. This Scheme is based on Linguistic knowledge, so that an acceptable decision can be obtained. As a result, we represent the opportunistic spectrum access decision surface.

In Proposed approach, we obtained the advantage in terms of accuracy and low interference to the primary users, more over we can modify the membership functions of descriptors in accordance to requirements of the primary user network and the spectrum policy. Hence this approach is promising to be implemented practically in future Cognitive Radio networks. It is better if the secondary user express measurement uncertainties.

IV.SIMULATION RESULTS

We have modeled the system using Fuzzy logic toolbox in Mat lab 7.9. The descriptors are used as the inputs to the system and the opportunistic spectrum access decision possibility is the output of this system. The descriptive linguistic variables of velocity and the spectrum to be utilized by the secondary users are considered by three levels high, medium and low, and the distance is considered by three parameters near medium and far.

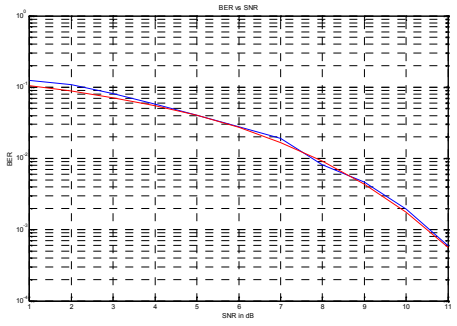

Fig.6.RuleEditor

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uses adaptive Fuzzy logic system, in this way scheme will become more accurate and quality of service[QoS] degradation can be mitigated, as it will govern the adaptive rules for priority purpose to use the spectrum opportunistically.

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