Admission Control Based Network Optimization For Concurrent User Serving For CRN

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Abstract – Cognitive radio network is an emerging technology which ultimately aims at utilization of the available spectrum by all the licensed and unlicensed users in the network. The ultimate aim of the project is to improve the performance of a wireless cognitive radio network. Proper routing and resource allocation algorithms are used to improve the performance of the system. The main and important challenge in the cognitive radio network is the proper design of dynamic spectrum allocation algorithm which enables the secondary nodes or the cognitive nodes to use the available spectrum without interfering with primary nodes. The cognitive radio concept is well suited for a wireless mesh network (WMN) where a large volume of traffic is expected to be delivered more efficiently since it is able to utilize spectrum resources. Admission control algorithm and Frequency interference check along with routing and resource allocation will improve the performance of the system.

Keywords - Cognitive Radio, Wireless mesh network ,admission control algorithm, Frequency interference check.

I. INTRODUCTION

As wireless technologies tend to grow rapidly, spectrum allocation becomes a challenging task for the policy makers also referred as the primary users. So, some users acquire the license from the primary users. But majority of the spectrum will not be utilized, some part of the spectrum is been distributed for free usage and that free allocated spectrum is called unlicensed spectrum and the users using those spectrum are called unlicensed or secondary users. Federal Communication Commission's survey clearly shows that most of the licensed spectrum is not utilized. For example, when analog TV channels are been converted to digital , the analog Transmission spectrum becomes unutilized since they have shifted to a new spectrum for digital transmission. The concept of cognitive radio was proposed by Joseph Mitola who defines Cognitive Radio as a paradigm for wireless communication in which either a licensed or an unlicensed user communicates efficiently avoiding interference among them. Thus the spectrums are utilized by the use of Cognitive Radio. The most important challenge in Cognitive Radio is to share the available licensed spectrum to the cognitive users without interfering the primary users (Fig1.1)

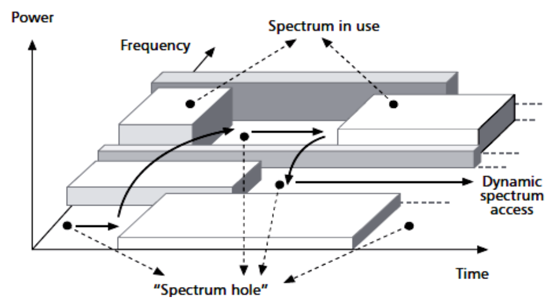

Fig 1 Illustration of spectrum holes

The main functions of cognitive radio include spectrum sensing, sharing, mobility and management. In order to avoid interference among the primary and the secondary users the spectrum must be sensed. Spectrum sharing is the major challenge in the cognitive radio networks. Spectrum sharing corresponds to the MAC. Spectrum mobility is where a cognitive or a secondary user exchanges its frequency of operation and there should be seamless communication needed in order to have a better spectrum utilization. Spectrum managements is where the best available spectrum must be captured to meet the users communication requirement and it is the duty of the cognitive nodes to decide on the best available spectrum band to meet the QOS requirements.

In general a cognitive radio network is a wireless mesh network and it is the one which relies on, opportunistic and dynamic spectrum access for its operational environment..In addition to this the cognitive radio network was also motivated by number of issues like Alleviating congestion in traditional WMNs, Increasing network coverage and Integration of heterogeneous wireless access networks.

Though the cognitive radio network gives the secondary nodes also called as cognitive nodes more flexibility and adaptability the communication process becomes more complex. This complexity arises due to the fact that the secondary users operate on different frequency channels on different time. So the secondary nodes which are communicating must decide on the available channel.

This paper aims on implementing the admission control algorithm and frequency interference check along with the routing and resource allocation in the cognitive radio networks.

The rest of this paper is organized as follows. In section II, a brief overview of the existing routing and spectrum allocation methods have been discussed. In section III the proposed method which uses admission control algorithm and frequency interference check has been discussed in detail. And explains how the proposed scheme is more beneficiary than the existing models .Section IV consists of the simulation results and the results have been compared with the existing model. Section V concludes the paper.

II. REVIEW OF LONG-ESTABLISHED ROUTING AND SPECTRUM ALLOCATION METHODS

This section explains about the existing routing and spectrum allocation methods in cognitive radio networks

In [1] Joint routing and resource allocation method was used in this method routing is combined with the spectrum or resource allocation method to improve the performance of the system

In [2] the technologies involved in Cognitive Radio and an insight towards spectrum sensing in Cognitive Radio has been provided

In [3] the admission control algorithm of secondary users in CDMA based CRN has been used. An important consideration in this work is that this algorithm considers SIR of a secondary user to be above a threshold level or value and any interference at the primary user's receiver is below than a predefined interference value.

In paper [4] the achievable rates in cognitive radio networks has been discussed where the achievable region combines Gel'fand–Pinkser coding along with an achievable region construction for the interference channel In [5], the authors proposed a new scenario where a primary and a cognitive users wishes to communicate to different receivers.

In [6] routing and spectrum allocation was proposed considering route robustness condition. Some routes are considered form the robust route and spectrum is allocated along this route to guarantee a maximum throughput. A probabilistic path selection to estimate the available capacity on each and every channel has been discussed in [7] .

The various implementing issues in CRN for spectrum sensing has been dealt in [8].

In [9] a new approach of parallel spectrum sensing was proposed where several SUs are more desirably selected for performing the spectrum sensing, where during a sensing time or period, the selected SUs senses a different channel. So as a result of which, multiple channels can be sensed at the same time in one sensing period.

In [10] analysis of cooperative spectrum sensing and touched upon some of the existing challenges in the technique was considered . But randomization was not considered in their work which is the key concept in increasing the diversity.

III. PROPOSED SCHEME FOR CRN BASED ON ADMISSION CONTROL ALGORITHM AND FREQUENCY INTERFERENCE CHECK

In this section a detailed discussion of the spectrum allocation, the admission control algorithm and frequency interference check algorithm has been discussed in detail. Some important considerations have been made for the network model.

Network Model

i. 'n' number of unlicensed or cognitive users users.
ii. 'N' number of licensed or primary users.
iii. Group of 'n' unlicensed users will access 1/N of licensed users.
iv. Licensed user's idle time is the time slot for (n) group of cognitive users.

A. Spectrum Allocation

Cognitive radio networks are expected to play a significant role in terms of resource allocation. There is a set of M coordinated secondary users each trying to access one of N channels. Each SU should be told by an intelligent coordinator or be intelligent enough to choose the best spectrum band which will satisfy its QoS requirements.

Let B be the total bandwidth under observation by the SUs. This frequency band is assumed to comprise r frequency sub-bands; represented by

$$[\ f1\ f2\ ....\ f\ r\ ] \qquad (1)$$

The occupancy or non-occupancy of these channels is represented by a +1 or -1 respectively.. It is assumed that the QoS information is available by another learning based estimation technique. At any given time, N active SUs are searching for available spectrum (spectrum hole) with characteristics satisfying the service requirements of the user.. The required QoS will vary and is represented by a QoS vector defined below,

$$Qos_{req} = [PD_{req}\ \ PDV_{req}\ \ PLR_{req}\ \ TH_{req}] \qquad (2)$$

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

$$QOS_{ava} = [PD_{ava}\ \ PDV_{ava}\ \ PLR_{ava}\ \ TH]_{ava} \qquad (3)$$

The a cost function and the objective function of the secondary users is given as

$$\sigma_{ij} = (\,QOS_{req\,i} - Qos_{\,ava\,j}\,)W_i \qquad (4)$$

$$U_i = 1/\sigma_i^2 \qquad (5)$$

The algorithm for spectrum allocation is designed around equations (4) & (5). The number of users and the number of frequency channels available are N and K respectively, where N>=K. The service requirements of each user are assigned according to the application. An active user scans for all the available channels in the frequency band of interest. Of these channels, a subgroup of channels that satisfy the QoS requirements of the user are selected.

Spectrum allocation is done by computing the Euclidean distance between the users QoS vector and that of the channel. Each parameter of the QoS vector is weighted based on the application in hand. The algorithm chooses the channel that has the QoS vector closest to the application in terms of the Euclidean distance. Meeting this criterion would also maximize the utility for each user as defined by equation (4).Fig (2) shows the spectrum allocation mechanism

B. Admission Control Algorithm

As the demand for computational power increases, new designs for parallel computing are needed. The inherent part of the design is the topology of the interconnection network between processing units and the routing algorithm for the network. Desired are those networks which are less complex than the others.

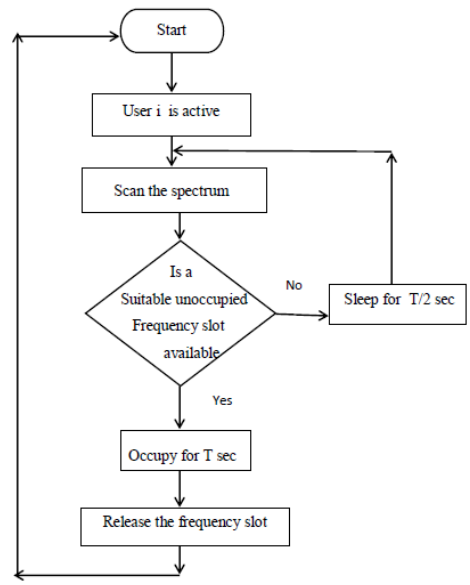

Fig 2 Spectrum allocation

Available network resources are measured by AC protocol. The proposed protocol is combined with DSR A route discovery is triggered at that time when a session requesting admission packet arrives at a source node Channel Idle time ratio is measured.

(i) Channel Idle time ratio

CITR is the minimum time required for the primary node to serve the secondary node. CITR is a very important parameter to be measured .

A Node 'N' requires a service from primary user and the primary node is not free. PU checks for the waiting time of the new request .If the waiting time of the new request is minimum to the execution time of the ongoing service The new request is forwarded to a new PU.If more than one primary users are within the range, the primary user which will have minimum frequency loss is chosen.

C. Frequency Interference Check

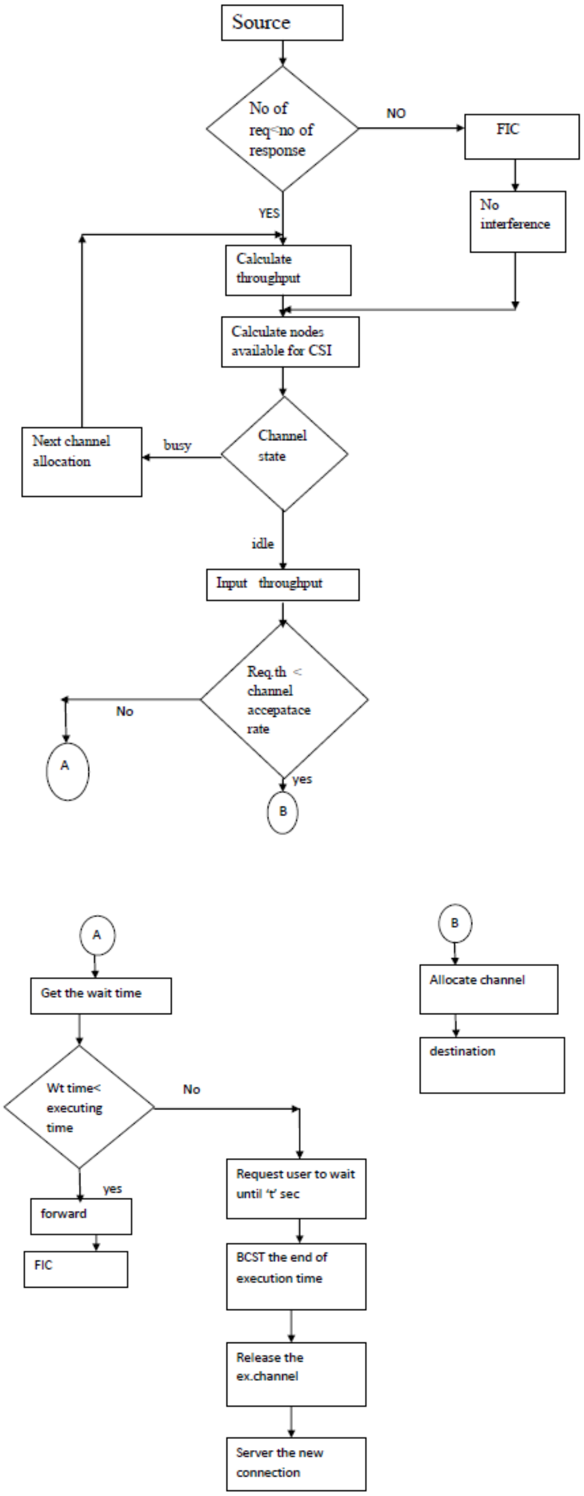

Fig 3 .CRN implementing Admission control algorithm and frequency interference check

A Frequency Interference Check (FIC) is an error-detecting code commonly used in digital networks and storage devices to detect accidental changes to raw frequency.

FICs are so called because the check (frequency verification) value is a redundancy (it expands the message without adding information) and the algorithm is based on cyclic frequencies.

Suppose the frequency of the exiting primary user and the new primary user are the same then frequency interference occur. In order to avoid frequency interference the frequency are checked and then the new request are forwarded to the node with does not have the same frequency.

Fig (3) shows the working operation of the admission control algorithm and frequency interference check algorithm in Cognitive radio networks.

In this section the detailed overview of the spectrum allocation, admission control algorithm and frequency interference check has been analyzed in detail. So the proposed method will provide a better performance in terms of reduction in delay and increase in through put values.

IV. SIMULATION RESULTS AND ANALYSIS

This section provides the simulation results of the proposed modela and it is compared The detailed simulated parameters of designed simulated environment are presented in the Table 1.

Table 1: Simulated Environment

S.No.	PARAMETERS	VALUE
1.	No. of Nodes	100
2.	Primary user	1
3.	Secondary user	dynamic
4	Frequency	2.47 Mhz
5	N/W area	1434*100
6	Routing protocol	DSR
7	Data rate	1.0MB
8	Antenna height	1.5 mts
9	BCST range	550 mts
10	Initial energy	20J
11	Tx power	60% of IE
12	Rx power	30% of IE
13	Time	30 ms

The performance evaluation of proposed method compared with the previous existing method by four performance metrics are delay, throughput, flow rate, transmission power

A. DELAY

The parameter delay is taken in to consideration because the main objective is to reduce the overall delay in the system. Delay is the sum of end-to-end packet transmission time, regeneration time (if any) and retransmission time for the packet. Delay varies as the number of packet varies. The graph is plotted for transmissions versus delay Fig (4). For each transmission, the number of packet is not constant. Therefore delay also varies. As the number of transmissions increase the delay increases but it is less in the model which implements ADM and FIC algorithm.

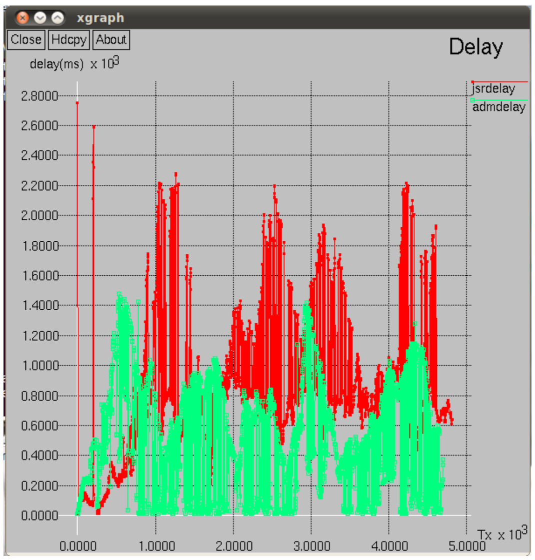

Fig 4 Transmission vs Delay

B. THROUGHPUT

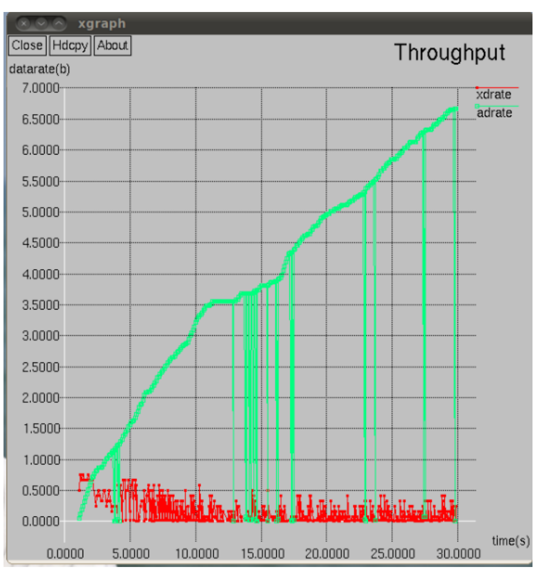

Fig 5 Time vs Datarate

Throughput or network throughput is the rate of successful message delivery over a communication channel.

As it is clear form Fig (5) The graph is plotted for data rate and time. Due to more congestion and improper resource allocations, the existing work has only lesser data rates, whereas in case of an admission controlled process, the throughput increases steadily as time increases.

C. FLOW RATE

Flow rate is the rate at which packets are transferred between two nodes in a network.

When transmission increases, to avoid the network traffic or congestion, flow is increased. As shown in Fig (6) as flow rate increases, the number of data transferred per unit time also increases. The flow rate is maximum when the system is incorporating ADM in it.

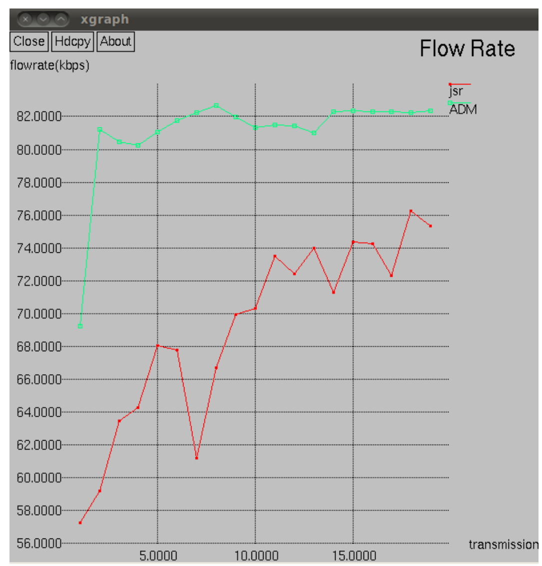

Fig 6 Transmission vs Flow rate

Flow rate is considered to the important parameter and it is very clear from the graph that when the number of tranmsission increases the flow rate aloso increses both in joint routing and the method which oncorporated ADM and FIC but the flow rate is high in the case of ADM because the primary user functions by knowing the execution time of each secondary users. Hence it is able to serve many secondary users in the network.

D. TRANSMISSION POWER

Transmission power is the amount of energy required to transmit the packets from the sender. From Fig (7) as the number of users increases, transmission power increases. Transmission power is variable according to the initial energy of the node. Compared to the Joint routing and resource allocation based operation, the amount of energy spent in admission control is less.

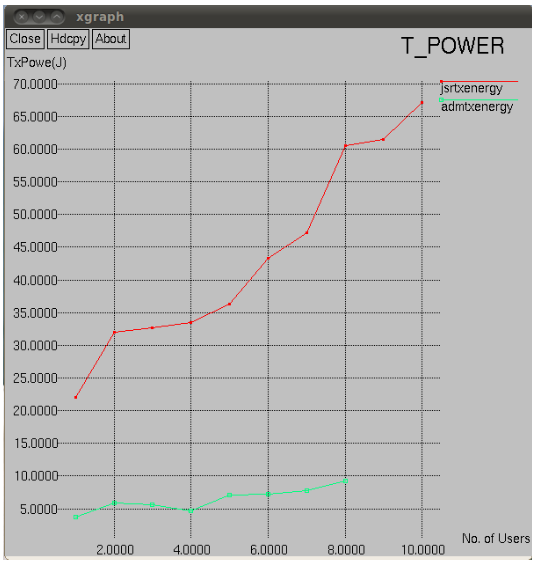

Fig 7 No of users vs Tx power

V. CONCLUSION

The admission control algorithm and FIC along with routing and spectrum allocation is provided for cognitive radio networks. Various performance analysis namely throughput and delay have been analyzed. The number of spectrum opportunities discovered is less in the existing scheme which leads to reduction in the throughput. Thus spectrum sensing and routing provides a better performance which has greater throughput, lesser delay in the cognitive radio network implementing Admission control algorithm and frequency interference check.

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