ISSN 2349-7815

International Journal of Recent Research in Electrical and Electronics Engineering (IJRREEE)
Vol. 2, Issue 2, pp: (36-40), Month: April 2015 - June 2015, Available at: www.paperpublications.org

Attaining Augmented Overhaul and Profit Maximization in Cognitive Wireless Interlock Networks

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Abstract: **With the increase in wireless communication, the necessary resources needed are getting scarcer. One of the resources is a spectrum. The electromagnetic spectrum is a natural resource that cannot be produced or destroyed. They should be used optimally. In older days, the spectrum is divided into portions and each portion is used by separate organizations. This is called static spectrum allocation. But, the organizations do not use the spectrum, fully both in case of time and in the case of bandwidth. The scarce resource spectrum is wasted. So, dynamic spectrum allocation is introduced. In this technique, the communication is done through the bandwidth which is free. So, wastage of bandwidth is reduced partially. In 2011, CWMN was introduced. *In this* type of network, there are two types of users. Primary licensed users, and secondary unlicensed users.**

Keywords: **Cognitive radio, channel allocation, routing, channel reuse, economic model, Markov decision process, wireless mesh network.**

1. INTRODUCTION

Primary users pay and buy a portion of bandwidth and use it. Secondary users use the bandwidth whenever the bandwidth of the primary users is idle. Thus, usability of the electromagnetic spectrum is increased. Base Station acts as the centralized control of the network. It makes the process of channel allocation and routing among the nodes.

In this proposed strategy, the channel allocation is based on the spectrum profitability which is the difference between the reward for serving the request and the physical cost. If the difference is positive, then the channel will be allocated else not. Also if the channel is allocated and when a primary user enters the channel, it again checks the capacity of the channel, capacity required by the primary user. If the spectrum overloads, connection with secondary users will be disconnected and transferred to alternate path if available. This will increase the spectrum usability and reduces the system overhead.

Ever increasing bandwidth demands from users of wire- less networks force the network designers to consider new network paradigms. The multi-hop wireless mesh net- works with cognitive ability have been identified as a valid network paradigm capable of providing significant increase of spectrum usage efficiency. In this environment, a channel of the primary user (channel owner) is used in an opportunistic manner by a secondary user (without access license) to establish its communication. Still the primary user, PU, has priority so the transmission of the secondary user, SU, should not interfere with the transmission of PU. These constraints combined with the time varying PU channels availability require new approaches for dynamic channel allocations, CAC and Routing and channel reuse in secondary networks. While in the literature there are some works that address particular issues, they do not provide a consistent framework that would cover all of these issues. In contrast we propose a novel homogeneous economic framework that integrates the mentioned issues and therefore simplifies the management and provides performance gains. In order to describe in more details the proposed framework and compare it with related works, we first present the considered system and the basic assumptions.

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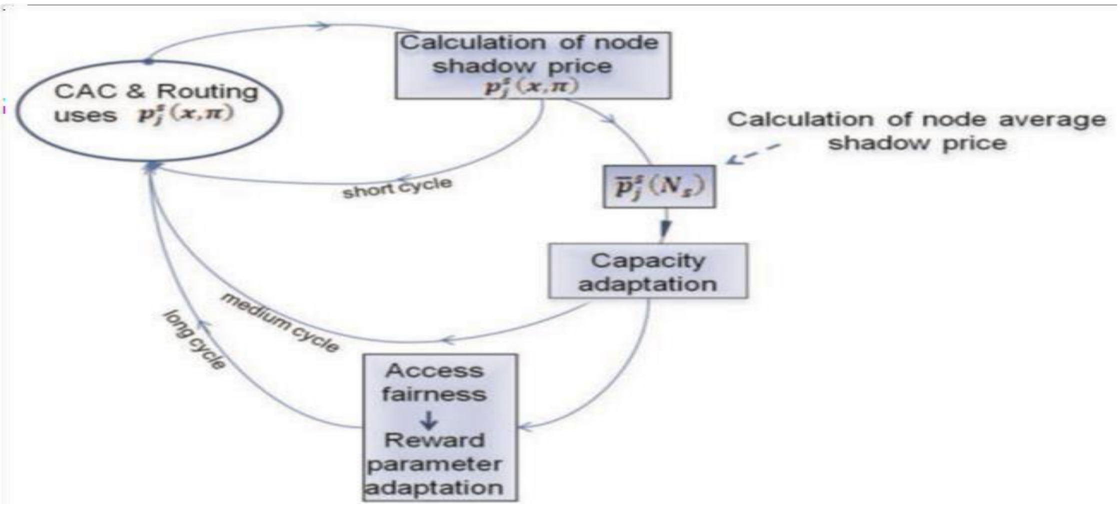
2. ECONOMIC FRAMEWORK

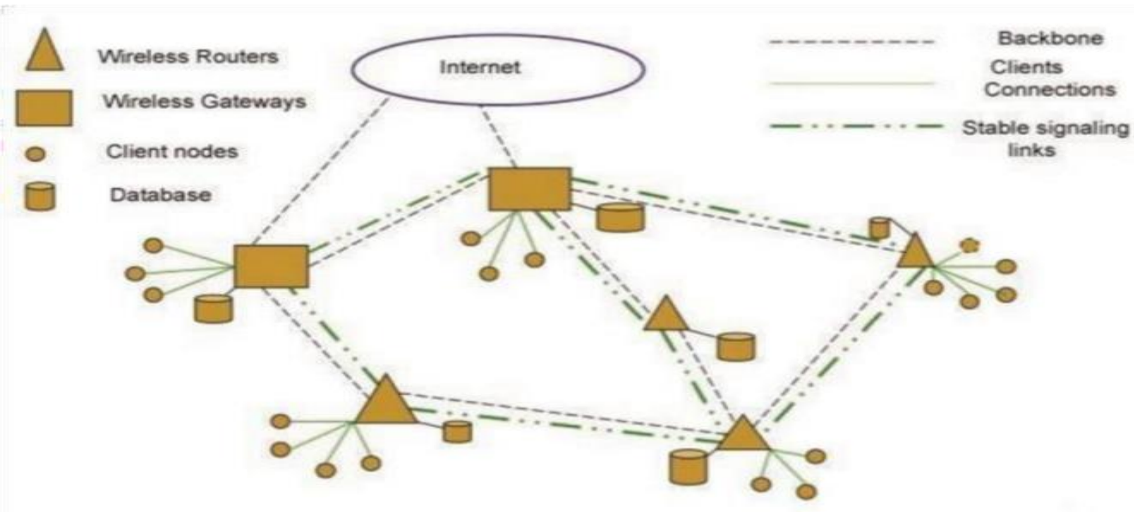
In this section we introduce a model for capacity adaptation and CAC and Routing that is based on an economic framework. First let us introduce the applied notation. Our cognitive wireless mesh network is defined by set of nodes $S = s_1,s_2,s_3,...,s|S||.|$ A secondary user connection of

Class j, $j = 1,2,..., J$, is characterized by its

Origin Destination (OD) pair, bandwidth requirement d_j, Poisson connection arrival process with rate λ_j , exponentially distributed connection service time with mean μ^{-1}_j, connection reward parameter r_j, and a set of alternative paths W_j. It is assumed that each admitted connection brings to the network a reward at the rate of $q_j = r_j \cdot \mu_j$ and therefore the reward parameter can be interpreted as average revenue from class j connection.



Implementation of the presented approach can be realized in several ways. The CAC and Routing algorithm could use a centralized server to calculate optimal routes but a decentralized (among the nodes) implementation seems to be better although it requires distribution of the metrics to all nodes so each node can calculate the optimal routes when needed. Such decentralized approach is analogous to OSPF routing algorithm implementation in autonomous Internet systems that is decentralized although it uses Dijkstra's algorithm that requires all network link states. Similarly, the adaptive capacity allocation can be implemented in centralized or decentralized way depending whether the network operator wants to have a centralized database in a



Server or a decentralized database with a complete image in each node. Each of these solutions has well known advantages and disadvantages related to reliability, signaling traffic, and database synchronization problems. In this paper we do not address these issues.

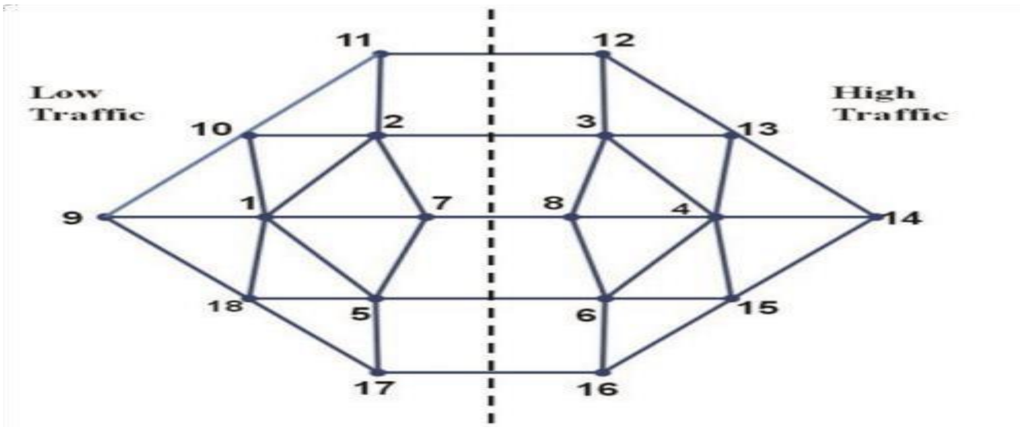
3. PROJECT USE IN DOMAIN

- With the increase in wireless communication, the necessary resources needed are getting scarcer. One of them is bandwidth.
- Due to static allocation of spectrum, bandwidth will be wasted at idle time. I.e., the spectrum is not used.
- So, dynamic spectrum allocation is introduced. But the efficiency of algorithms used for this dynamic spectrum allocation is not up to the mark.
- So, the operating cost of the system will get drastically increased.
- In this project, an economic framework for routing and channel allocation that will increase the profitability of the network is proposed.

4. SCOPE OF PROJECT

The electromagnetic spectrum is becoming scarcer due to the increase in usage of wireless networks. It is a natural resource it can be neither created nor destroyed. So, several techniques are proposed for the effective usage of the electromagnetic spectrum. One of the advanced technologies introduced is Cognitive Radio Network (CRN).

Cognitive (or smart) radio networks are an innovative approach to wireless engineering in which radios are designed with an unprecedented level of intelligence and agility. This advanced technology enables radio devices to use spectrum (i.e., radio frequencies) in entirely new and sophisticated ways. Cognitive radios have the ability to monitor, sense and detect the conditions of their operating environment, and dynamically reconfigure their own characteristics to best match those conditions.



The main scope of the project is to maximize the profitability of network using the combined framework of routing and channel allocation. The profit of a network is determined by the difference between the cost of serving a request and the revenue obtained from serving that request. In order to increase the profitability, the physical cost of the system to compute the route and to make decisions about the spectrum allocation should be reduced. In this paper an economic framework for reducing the complexity of routing and channel allocation is proposed.

5. FUTURE ENHANCEMENT

- The algorithm does not consider Byzantine attacks. But it can be controlled by integrating adaptive reputation based clustering in decision making.
- The usability of spectrum is not increased to hundred percent.
- Once the decision is made, other secondary users would not get channel though they have equal priority.
- To avoid this, scheduling can be done, but it will increase the overhead of the system.

- A simple scheduling algorithm that should not increase the overhead at the same time, it should not make the nodes to starve in the queue.

6. NUMERICAL RESULTS

We illustrate the performance of the proposed algorithms using a specific network scenario that was chosen to stress the adaptive algorithm and to allow easy understanding of traffic and performance changes. It has 18 nodes and its topology illustrated FIG. The principal network parameters are presented in Table II. There are 140 available cognitive channels which are initially distributed among the network nodes in such a way that 14 nodes obtain the capacity of 8 channels and the remaining 4 nodes obtain the capacity of 7 channels.

Each channel is subject to primary user arrival and we assume that each secondary user connection occupies one channel.

The PU channel occupation follows binomial distribution with the busy period probability of 0.2, and the mean service

7. CONCLUSION

We have proposed an economic framework that integrates CAC and Routing and channel allocation in cognitive wireless mesh networks. This integration is realized through the use of novel node shadow price concept that takes into account preemption of secondary users by primary users and is based on decomposed Markov decision process.

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