ISSN 2395-695X (Print)
ISSN 2395-695X (Online)
International Journal of Advanced Research in Biology Engineering Science and Technology (IJARBEST)
Vol. 2, Special Issue 10, March 2016

Efficient Method of Secondary Users Selection Using Dynamic Priority Scheduling

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ABSTRACT

A cognitive radio is the key technology that allows cognitive wireless terminals to dynamically access the available spectral opportunities.Cognitive radio spectrum is utilized by two types of CR Nodes, The Primary Users are Licensed Users allotted with a particular spectrum. The Secondary Users are Unlicensed Users and are regulated to use the spectrum when it is not used by the Primary Users. Secondary users need co-ordination in order to utilize channel effectively, but there are no existing standard regulations on how to co-ordinate the channel access among Secondary Users. In this project, we consider an Opportunistic Scheduling approach that co-ordinates channel access among Secondary Users along with Primary Users. This Opportunistic Scheduling by a Genetic Algorithm exploits the time varying nature of the network and couples the favorable channel conditions with other resource management functions. In the first phase of the project, we propose a channel access scheduling scheme that assigns priorities values to users based on their Maximum Tolerable Delay (MTD). Simulation is carried out in MATLAB and experimental results show that the throughput of the network is improved and delay is reduced by following this dynamic scheduling.

Index terms -Cognitive nodes, Maximum tolerable delay, and Cognitive radio networks.

INTRODUCTION

Cognitive radio is an intelligent wireless communication system that is aware of its surrounding environment (i.e., outside world), and uses the methodology of understanding by-building to learn from the environment and adapt its internal states to statistical variations in the incoming RF stimuli by making corresponding changes in certain operating parameters (e.g., transmit-power, carrier-frequency, and modulation strategy) in real-time, with two primary objectives in mind: highly reliable communication whenever and wherever needed; efficient utilization of the radio spectrum.

A cognitive radio terminal could also negotiate with other spectrum or network users to enable more efficient spectrum and network utilization. The negotiation procedure may be facilitated from the support of network infrastructure sides or just proceed in an Ad Hoc manner. Primary users wireless devices are the primary license-holders of the spectrum band of interest.

In general, they have priority access to the spectrum, and subject to certain Quality of Service (QoS) constraints which must be guaranteed.Secondary users may access the spectrum which is licensed to the primary users. They are thus secondary users of the wireless spectrum, and are often envisioned to be cognitive radios. For the rest of this chapter, we will assume the secondary users are cognitive radios (and the primary users are not) and will use the terms interchangeably.

LITERATURE SURVEY

Cognitive nodes [1] can arrive at an efficient and fair opportunistic channel access policy in scenarios where channels may be non-homogeneous in terms of primary user occupancy. For efficientopportunistic channel access, machine learning and repeated game theories have been proposed.

Opportunistic routing schemes[2] have their advantages if applied in cognitive radio networks (CRNs), since the reliability is better ensured. However, it is impractical and inefficient to directly use opportunistic routing protocols in CRNs, therefore multi-layer relay sets were proposed.

Opportunistic spectrum [3]access in cognitive radionetworks is regarded as solution to spectrum scarcity caused by the static allocation of the frequency spectrum. Unlicensed secondary users (SUs) access the spectrum opportunities which are licensed not licensed to them opportunistically without creating harmful interference to the licensed primary users (PUs). In typical wireless communications, to negotiate and establish a link between transmitter and receiver, common control channel is used. However, attackers can identify the common channel and jam it or overhear and misuse the information.

In a cognitive (secondary) multiple-access network [4]which is subject to interference power constraints imposed by a primary system, it is desirable to mitigate the interference on the primary and to harvest multiuser diversity gains in the secondary. To simultaneously achieve these goals, a two-step (hybrid) scheduling method is proposed that pre-selects a set of secondary users based on their interference on the primary, and from among them selects the user(s) that yield the highest secondary throughput.

Cognitive radio networks [5] have recently emerged as a promising technique to improve the utilization of the existing radio spectrum. The key enabler is the cognitive radio that can dynamically adjust its operating points over a wide range depending on spectrum availability. The main idea behind a cognitive network is for the unlicensed users to exploit the spatially and/or temporally under-utilized spectrum by transmitting opportunistically. How-ever, a basic requirement is to ensure that the existing licensed users are not adversely affected by such transmissions. Such interference with the licensed users may be unavoidable due to lack of precise channel state information. In this paper, we develop an opportunistic scheduling policy that maximizes the throughput utility of the secondary (or unlicensed) users subject to maximum collision constraints with the primary (or licensed) users in a cognitive radio network. Our scheme is shown to work in the presence of imperfect knowledge about primary user spectrum usage and provides tight reliability guarantees. The above network model considers access point-based networks with static (or locally mobile) licensed and fully mobile unlicensed users. In such networks, the licensed users may not schedule their transmissions, and thus, send at any time they desire. The unlicensed users must make an effort to opportunistically use the spectrum holes without interfering too much with the licensed users, and hence, need sophisticated scheduling mechanisms.

EXISTING SYSTEM

Secondary users can be selected based on their interference level to the primary user. Joint spectrum allocation can be used for spectrum sharing base on maximization of through put. In heterogeneous secondary user dynamic priority scheduling has been used to maximize the throughput by avoiding starvation of secondary user. Throughput satisfaction is obtained by allocating minimum required resources to primary user.CR is a spectrum sharing technology that allows unlicensed (secondary) users to operate in the licensed spectrum bands. It effectively improves the spectrum utilization in wireless communications.

PROPOSED SYSTEM

In order to co-ordinate among the channels priority based scheduling schemes is used based on maximum tolerable delay. The queuing method is based on single input single output. Maximize the packet transmission real time message scheduling before the dead line. The delay is based on space availability and if it is not applicable wait until for next slot. The guaranteed transmission is achieved by dynamic priority queue scheduling mechanism.

BACKGROUND AND RELATED WORK

Priority based scheduler has been proposed in [2],to solve co-existence problem between two different class of users in cognitive radio networks. Primary users get higher priority over secondary users focused on mitigating the interference between primary users and secondary user. To avoid interference to primary users, hybrid scheduling method is proposed in [3]. First they selects the secondary users based on their interference to primary users and then the users that maximize system throughput. In the paper [4], joint spectrum allocation and scheduling algorithm has been proposed that focuses on maximization of throughput and also tries to

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allocate spectrum fairly amongst cognitive users. Dynamic priority scheduling for heterogeneous secondary users has been proposed in [5] and tried to maximize the total throughput by avoiding starvation of secondary users. In scheduling model for cognitive radio is proposed. To reduce spectrum switches they have considered hybrid dynamic priority policy in which primary users use preemptive priority while secondary usersuse non-preemptive priority. Throughput satisfaction based scheduling is proposed in by allocating minimum required resources to secondary users to satisfied their need. They tried to maximize the number of secondary user that are satisfied in terms of throughput requirements.

DYNAMIC PRIORITY ASSIGNMENT

Let take n packets with maximum tolerable delay $d1$, $d2$, $d3$, $d4$....$dn$and the sizes are $s1$, $s2$, $s3$, $s4$......, sn. The initial priorities $p1$, $p2$, $p3$, $p4$.....$pn$of the packets would be respectively. Initially, we define priority of a packet $i$as $p0i$ and then increase the priority quadratically by the formula

P_{ti} = p0i + M.a + M2.a.$\sqrt{a}$….(1)

k is packet size, di is maximum tolerable delay and M is the "Waiting time"of the packet.

$\frac{1}{di} + M.a + M2.a.\sqrt{a} + M3.a2 + M4.a2.\sqrt{a}$….(2)

So, priority of packet $i$at time t is defined as:

P_{ti} =1/di+M.a+M2.a.$\sqrt{a}$….(3)

Let a packet $i$with maximum tolerable delay di with size si. So the priority of packet at time t is defined as:

P_{ti}=p0i+M.a+M2.a.$\sqrt{a}$…..(4)

Now we define priority change rate of packet $i$with waiting time M

D_{pi}/dM=a………(5)

D_{p1}/dM=a1 = 1/d21……..(6)

D_{p2}/dM= a2 = 1/d22……..(7)

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SYSTEM MODEL

In this paper, we model one primary user and multiple secondary users competing for the same channel with different maximum tolerable delay. Primary users have higher priority over secondary users. One important issue in cognitive radio is to model the primary users and secondary users traffic. To simulate the behavior of Cognitive Radio Networks we use exponential ON-OFF model for primary users activity[8]. ON state means primary user is using the channel while OFF state represents the time period when the channel is idle. The arrival time of each user is independent so Poisson arrival process is considered. Each primary user has two states: ON state and OFF state. Alternating ON/OFF model for primary user on channel *i*is regulated by birth-death process with death rate α and birth rate β. So, the length of ON and OFF period of primary users on channel *i*are modeled using exponential distribution with mean values of $1/\alpha$ and $1/\beta$ respectively.

P1 = P2 = (d2/d1)^2………(8)

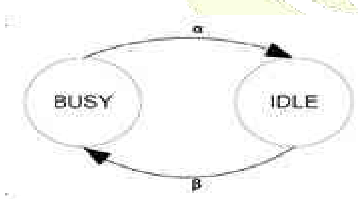

Fig.1Primary User Activity Model

PROBLEM FORMULATION

Let CR network contains N different priority queues *Q*1, *Q*2, *Q*3.......*QN* for secondary users. *QN* is the queue with the n-th highest priority and *Q*1 the least priority queue. When a secondary user has a message to transmit, it place into appropriate priority queue based on its maximum tolerabledelay and send a request to schedule to acquire the channel for transmission. We assign higher priority to the data packet with the shorter maximum tolerable delay and lower priority to higher maximum tolerable delay.

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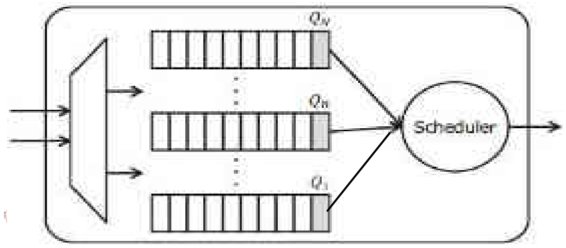


Fig 2. Multiple Priority Queues Scheduling Model

The proposed scheduling scheme aims to select data packet from N queues such that total number of transmitted packets (whose waiting time has not exceeded their maximum tolerable delay) is maximized while ensuring that their transmission duration does not exceed the transmitting time *Tt*.

PERFORMANCE EVALUATION

Unlike traditional radios, a cognitive radio may change its objectives as radio scenarios vary. Because of the dynamic pairing of objectives and contexts, it is imperative for cognitive radio network designers to have a firm understanding of the interrelationships among goals, performance metrics, utility functions, link/network performance, and operating environments. In this paper, we first overview various performance metrics at the node with diffusion based collaborative energy detection method. The enhancement work with double threshold is carried out and compared with the existing system to obtain a performance improvement.

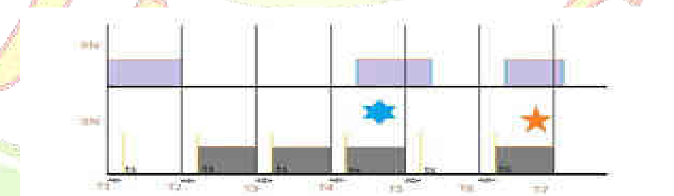
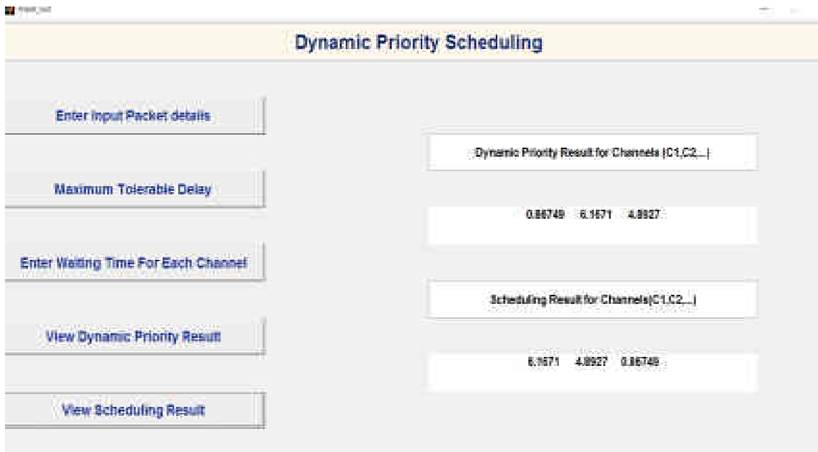


Fig 3. The Channel Access Scheduling Model for CR Users

RESULTS



OUTPUT TABLE

No of Channels	No of Packets	Waiting time	Dynamic Priority result
3	300	0.08 0.06 0.04	0.6732 0.6122 2.4409
4	400	0.01 0.05 0.09 0.07	1.7714 2.2212 2.5211 5.7864
5	500	1e-7 1e-8 0.04 0.09 0.03	0.64009 2.2862 3.5863 2.0252 0.6498

Table1. Output Analysis.

There are three secondary users like C1, C2, C3 each user will be allocated individual channels and transmitting different type of packets.Each channel will have separate waiting time (eg: 0.08, 0.06, 0.04)& priority will be set based on the maximum tolerable delay for each channel, as shown above. This is the dynamic priority scheduling proposed.

CONCLUSION

In this paper, we have studied a channel scheduling problem in cognitive radio networks. We proposed dynamic scheduling technique by considering primary users activity. From the above results, we concluded that in order to minimize the interference to licensed users and to maximize transmitted packet there should be trade-off between sensing time and transmitting time. We need to choose appropriate value of parameter *a* according to traffic quality of service requirements (multimedia, best-effort, interactive applications etc.) in order to avoid starvation of traffic and to reduce packet drops (due to expiration of maximum tolerable delay). We also found that the interference to primary user is not depend on priority system. We found the same number of collisions on different values of parameter a. we can increase throughput of CR system by tuning changing priority parameter.

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