ISSN (Online) : 2319 - 8753
ISSN (Print) : 2347 - 6710

International Journal of Innovative Research in Science, Engineering and Technology

Volume 3, Special Issue 3, March 2014

2014 International Conference on Innovations in Engineering and Technology (ICIET'14)
On 21st & 22nd March Organized by

K.L.N. College of Engineering, Madurai, Tamil Nadu, India

Distributed Channel Sensing Schemes In Multiuser Software-Defined Radio Networks

R.Mahalakshmi, R.Vijayakarthika
Dept of ECE, M.Kumarasamy college of engineering, Karur, Tamilnadu,India

ABSTRACT—Cognitive radio networks(CRNs)is new paradigm that provides the capability to share or use the spectrum is an opportunistic manner. It ability to sense the unused spectrum at a specific time and location (spectrum hole).Cognitive Radio (CR) technology is a promising solution to enhance the spectrum utilization by enabling unlicensed users to exploit the licensed spectrum in an opportunistic manner. In this paper, sequential channel sensing problems for single and multiple secondary users (SUs) networks are powerfully modeled through finite state Markovian processes. The objective of this paper is to maximize the throughput for secondary user and reduced the number of handovers. A model for single user case is introduced and its performance is validated through analytical analysis. A modified p-persistent access (MPPA) protocol is proposed for multiple user. Since the method utilized experiences a high level of collision among the SUs, to mitigate the problem appropriately, p-persistent random access (PPRA) protocol is considered, which offers higher average throughput for SUs. The structure of the proposed scheme is discussed in detail, and its efficiencies are verified through a set of illustrative numerical result.

KEYWORDS- Wireless regional area network (WRAN),primary users(PUs),secondary users (SUs),Cognitive radio networks(CRNs),modified p-persistent protocol access (MPPA),p –persistent random access (PPRA).

I. INTRODUCTION

Demand of radio spectrum is increasing day by day due to increase in wireless networks and applications. Current radio spectrum is not efficient due to limited spectrum access in wireless networks [1]. Cognitive radio (CR) can improve spectrum efficiency through intelligent spectrum management technologies by allowing secondary users to temporarily access primary users unutilized licensed spectrum[2],[3],[4]. Generally speaking, there exists more than one channel to be sensed by a CR. To deal with this fact, sensing schemes are commonly divided into two categories [5], i.e., wideband sensing and narrowband sensing. Multiple channels are sensed simultaneously is called wideband sensing. On the other hand, when only one channel is sensed at a time, this sensing process is called narrowband. Lower power consumption, Easy implementation, and less computational complexity lead to great interest in narrowband sensing. The handover process, associated with narrowband sensing, is mainly categorized into reactive and proactive policies.

In general according to the target channel decision methods, spectrum handoff mechanisms can be categories into [6]: (1) proactive decision spectrum handoff: make the target channels for spectrum handoff ready before data transmission according to the long-term observation outcomes, and (2) reactive decision spectrum handoff: determine the target channel according to the results from on-demand wideband sensing. Compared to the reactive-decision spectrum handoff, the proactive-decision spectrum handoff may be able to reduce handoff delay because the time-consuming wideband sensing is not required [3]. A secondary user using a channel should sense for possible transmission initiations by primary users in the channel use by itself. If primary users start transmission, the secondary user should stop its transmission [7]. When false alarm and miss detection occurs in the spectrum sensing, the secondary user should find another unused channel and carry out handoff to it. The sensing schemes could be done using various methods which is studied from [5]. Minimizing the average number of handover through the concept of underlay transmission is investigated [8].

The main objective of this paper is minimizing the average number of handovers and increase the throughput for secondary users.

II. RELATED WORK

A. Modeling and Analysis for Spectrum Hhandoff in Cognitive Radio Network

Modeling and Analysis for Spectrum Handoffs in CRNs [7] have used an analytical framework to evaluate the latency performance of connection-based spectrum handoffs in CRNs. Here three key design feature used by 1) general service time distribution of the primary and secondary connections; 2) different operating channels in multiple handoffs; and 3) queuing delay due to channel contention from multiple secondary connections.

In the proposed preemptive resume priority (PRP) M/G/1 queuing network model to characterize the spectrum usage behaviors with all the three design features. This model analyzed the extended data delivery time of the secondary connections with proactively designed target channel sequences under various traffic arrival rates and service time

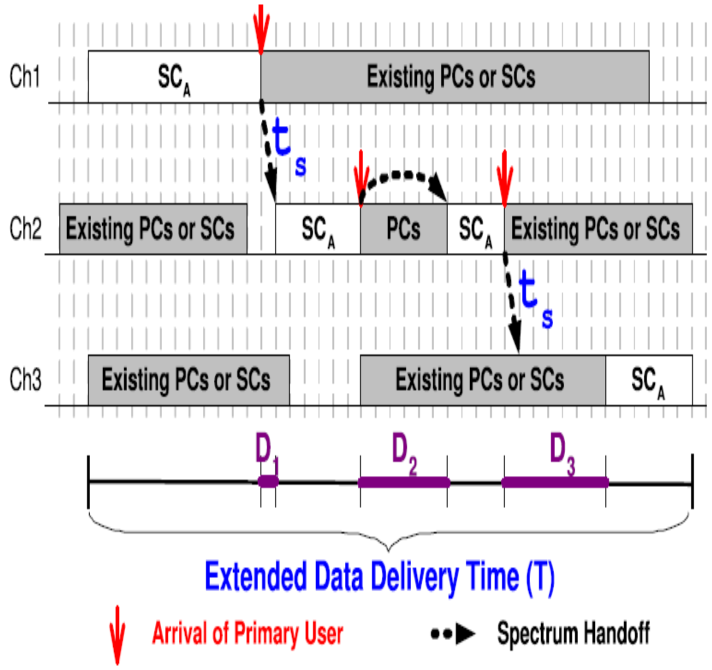

Fig. 1. An example of transmission process for the secondary connection SCA, where ts is the channel switching time, T is the extended data delivery time of SCA, and Di is the handoff delay of the ith interruption. The gray areas indicate that the channels are occupied by the existing primary connections (PCs) or the other secondary users' connections (SCs). Because SCA is interrupted three times in total, the overall data connection is divided into four segments.

distributions. These results are applied to evaluate the latency performance of the connection-based spectrum handoff based on the target channel sequences mentioned in the IEEE 802.22 wireless regional area networks standard. Then proposed traffic adaptive spectrum handoff, to reduce extends data delivery time. In this traffic-adaptive spectrum handoff to reduce the 35% of extend data delivery time comparing to the target channel selection method.

B. Cannel Sensing Order Setting in CRNs:a two user Case

Optimal selection of channel sensing order model for two user case[8] is introduced and its performance is validated through analytical analysis. This model extended to include brute-force search algorithm. Since the scheme utilized experiences a high level of computational complexity among the two user case, to mitigate the problem appropriately, greedy search algorithm and incremental algorithm is considered, its provide less computational complexity. It is exposed that, with a high probability, either suboptimal algorithm can reach an optimal point if a backoff mechanism is used for contention resolution. When adaptive modulation is adopted, it is observed that the traditional stopping rule does not lead to an optimal point in the two-user case. Additionally, we demonstrate that the adoption of adaptive modulation affects the optimal sensing-order setting of the two users, compared with the case without adaptive modulation.

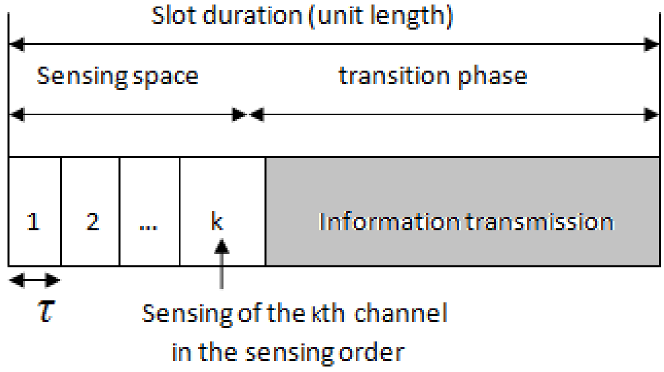

Fig.2. slot structure(when a secondary user stops after its *k*th sensing)

If the two users simultaneously decide to stop at the same channel, one of the following three contention level strategy will apply.1)FAIL_THEN_CONTINUE, 2)FAIL_THEN _QUIT, 3)COLLIDE. Maximal throughput of suboptimal algorithm is bounded by5%.This algorithms that have much less complexity and have comparable performance with that of brute-force search.

C. Throughput and Collition Analysis of Multichannel Multistage Specctrum Sensing Algorithm

The author considered different multichannel multistage spectrum sensing algorithms for opportunistic spectrum access network [9]. On the ways to use to increase channel utilization in OSA communication is to use multistage sensing. The multistage sensing on network throughput and collision probability for a realistic network modal has been relatively unexplored. Here used SU and PU traffic model. The probabilities of arrival and departure of an SU frame are denoted by $P_{s,a}$ and $P_{s,d}$ respectively. The PU channel occupancy is time varying. That is, the probabilities of the start and end of a channel occupancy are denoted by $P_{s,a}$ and $P_{s,d,}$ respectively. In multistage sensing algorithm, Once connection is established, the sending SU node starts with the first stage of the multistage sensing algorithm on the first PU channel from a list of available PU channels.

In the multistage spectrum sensing algorithm, the SU transmission continues on the respective channel until the SU detects the PU presence in all the *S* stages of sensing until the last stage. The SUs may then switch to the next channel and restart the multistage spectrum sensing algorithm, depending on the radio architecture, as explained in the following sections.

1) Multichannel Sensing Using a Single Narrowband Radio
2) Multichannel Sensing Using Parallel Narrowband Radios

Multistage sensing provides more flexibility in optimizing the system's performance by varying the sensing time per stage and the number of sensing stages.This paper analyze the operation on multiple channels for nodes with single and parallel narrowband radios. The results also show that increasing the SU's buffer size results in an increase in throughput, and the increase is more significant for fast SU traffic.

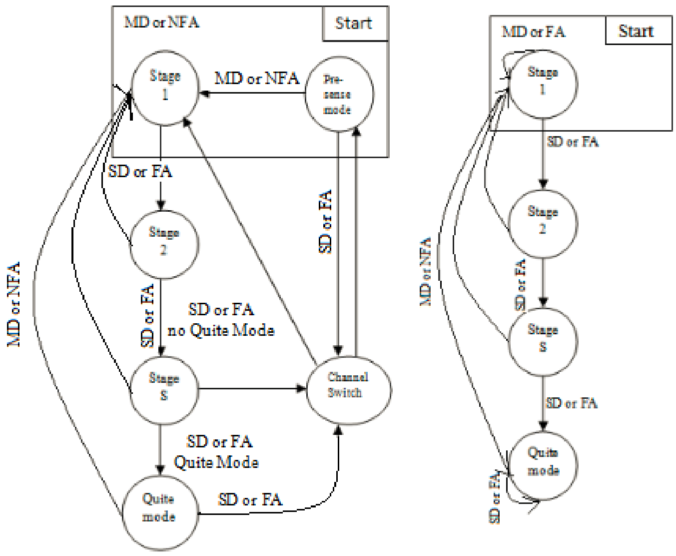

Fig. .3. Schematic representation of the considered multichannel multistage spectrum sensing algorithms. (a)Single narrowband radio case and (b) parallel narrowband radios case. MD: misdetection, SD: successful detection, FA: false alarm, NFA: no false alarm; dashed line: algorithms involving quiet mode; dotted line: algorithms involving presenting mode. Note that for brevity, we did not mark the transition to and from the idle stage if there are no frames to transmit.

Finally, in this paper comparing single and parallel narrowband radio systems, single narrowband radios result in a higher successful frame delivery rate, as opposed to parallel narrowband radios. However, this comes at the expense of the maximum achievable throughput, which scales with the number of available channels for parallel narrowband radios.

III. SCHEMATIC MODEL OF NETWORKS

D. System Model

We consider a time slotted CRN with N_s SUs, which attempt to opportunistically transmit on the channels committed to the N_p PUs. PUs starts their transmission using slot based system. SUs appropriately sense the each channel at the beginning of time slot, by the channels established as occupied or vacant [3]. SUs sense the channel only one spectrum at a time because it is used narrowband spectrum sensing. In this paper proposed a markovian chain analytical model, which enables us to model a fully distributed CRN, where the cannot cooperate with each other. Besides providing a systematic approach for the performance evolution, the model can be easily extended to the multiple SUs case by slightly modifying its nodes and routing probabilities. The extended model for multiple SUs model for modified p-persistent access (MPPA).The performance of MPPA model analyzed average number of handovers and average SUs throughput [5].

After a analyzed some drawbacks is there in MPPA method. PPRA method is overcome the MPPA problems. In this model SUs sequentially sense the each channels with same as well as various sensing orders, Hereby the CRN throughput increases through the reduction of the contention level among SUs.

Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

E. Modified p-PersistentAccessSchemes

In order to provide multiple access among the SUs, a modified version of the conventional p-persistent multiple access protocol is utilized in which each SU senses each channel with the probability p and skips the sensing process with the probability $(1 - p)$. The channel sensing probability, p, provides a degree of freedom to optimize the performance metrics, namely, the throughput of SUs.

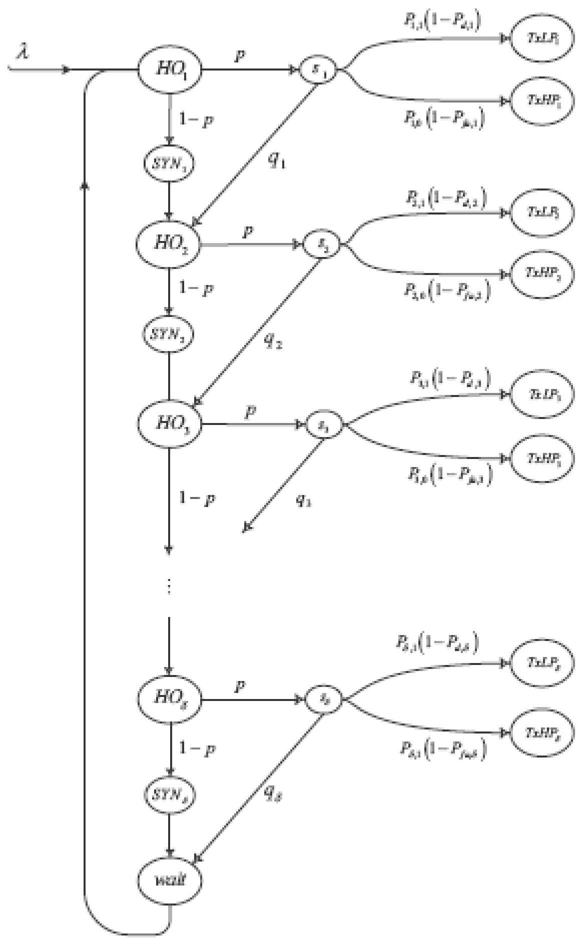

Figure 4. The Markov process of modified p-persistent access (MPPA) scheme for each secondary user's sensing- transmission process.

Figure. 4 illustrates the channel sensing-access policy of the proposed modified p-persistent access protocol (MPPA) used by each SU. Since at each stage i some requests may not be routed to the node Si, with the probability of $(1 - p)$, as discussed above, we add nodes *SYNi* in Fig. 2, in order to synchronize the requests. More specifically, the requests that enter standby mode (at node *SY Ni*) wait for τ time units (sensing period). Then, they are directed to the node *HOi*+1.

With the help of the synchronizer nodes, all requests will enter the *i*-th sensing node at the same time. As a result, the *i*-th channel will be busy at the beginning of the corresponding sensing interval if and only if the *i*-th PU is present. At first, all requests enter the node *HO*1. Then, they are routed to the first sensing node, *S*1, with the probability of *p*, or to the second handover node, *HO*2, after spending τ time units in the first synchronizer node *SYN*1, with the probability of $(1 - p)$. Based on the sensing results, packets in the node *S*1 are directed to the first transmitter node or the second handover node with the probabilities shown in Figure 4. The requests follow the same processes until a transmission opportunity is found or the handover limitation, discussed in (3), is reached. These requests must wait for the rest of the current time slot. Also note that the *i*-th stage of the MPPA protocol comprise of the nodes *HOi*, *SYNi*, *Si*, *TxLPi*, and *TxHPi*.

F. P-Persistent Random Access

We consider the p-persistent random access (PPRA) scheme, which equally distributes the load of the SUs within all channels, and hereby decreases the contention level and Raises the throughput of each SU.

It is demonstrates the sensing-transmission stages of the proposed PPRA method. As it shows, at the *i*-th stages, a request is routed to the sensing nodes, *Si*,1, *Si*,2, . . . , *Si*,*Np*, corresponding to the channels 1, 2, . . .,*Np*, respectively, with the identical probabilities of *pNs* , after running a p-persistent protocol as described in the previous section. Then, the request will be directed to the corresponding transmission nodes, i.e., *TxLPi* or *TxHPi*, or the next handover node, i.e., *HOi*+1. Regardless of the exploited load balancing technique, other processes and parameters are the same as the MPPA scheme. In the Performance Analysis OF PPRA model, a channel, which is sensed busy by an SU, can be occupied either by the PU or the other SUs; because it may have been detected as a transmission opportunity by another SU at the previous stages. Therefore, in this model, the impact of other SUs' transmissions must be considered on the channels occupation probabilities.

IV. NUMERICAL METHODS

In this section, the performances of the proposed schemes are evaluated and compared by the analytical results and simulations considering the effects of different parameters introduced throughout the paper. The value of sampling frequency is adopted from [10], and the minimum allowable value of detection probability, *Pmin d* , the maximum admissible false alarm probability, *Pmax fa* , and the time slot duration, *T*, are chosen according to *IEEE 802.22* standard [11] and [12].

Figure 6. Shows the throughput measurement here a network has been created with 3 PUs and 47 SUs and the graph for number of packets transmitted per second (throughput) versus sensing probability. The proposed number of PUs 5 and 8 compare to the number of secondary users 1, 3, 5 is plotted. these simulation results shows that throughput achieved using average number of PUs5 and average number of SUs5 is better.

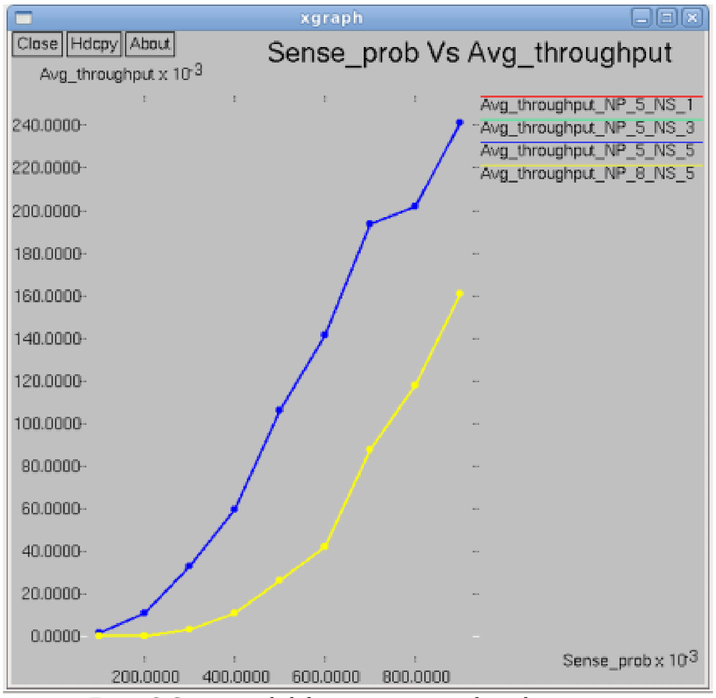

Figure 6. Sensing probability versus average throughput

From the figure 7. describes the average throughput of entire network.in this graph compare the average number of handover and average number of throughput and it is explain, when the number of handover redused that's the time increased throuput for CRNsnumer of handover in CRNs

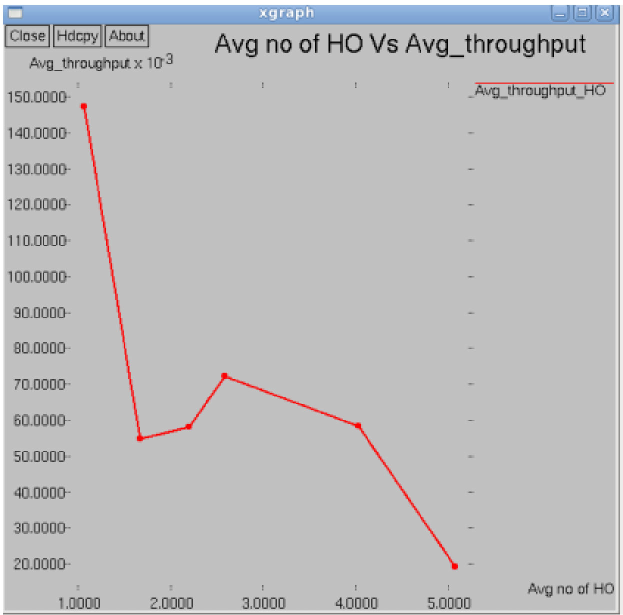

Figure 7.average number of throughput versus averarage

Number of handover

Figure. 8 further verifies our analysis and represents the plot of the maximum achievable throughput, corresponding to the optimum value of the spectrum sensing time, versus the number of PUs. Main points highlighted in Figure 5 are twofold. First, as the number of primary channels increases, the SU throughput increases as well, but in a saturating manner..

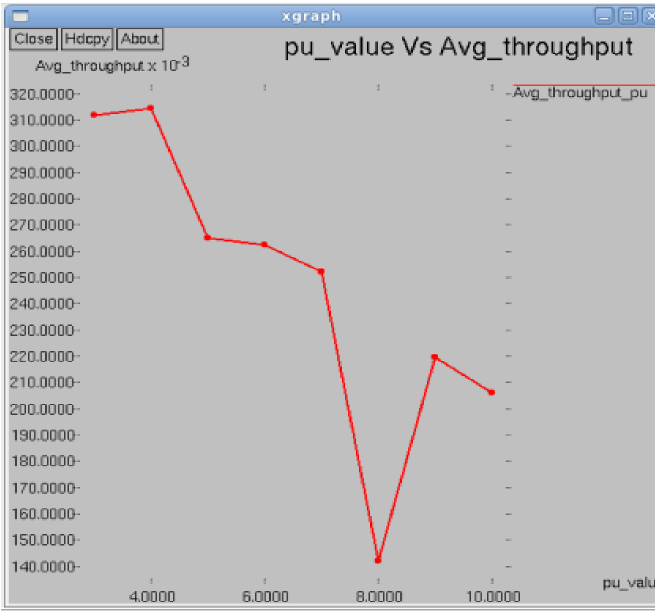

Figure 8. PUs value versus average throughput

Figure. 8 further verifies our analysis and represents the plot of the maximum achievable throughput, corresponding to the optimum value of the spectrum sensing time, versus the number of PUs.

Main points highlighted in Figure 5 are twofold. First, as the number of primary channels increases, the SU throughput increases as well, but in a saturating manner. This is due to the fact that, though the average number of obtained transmission opportunities increases by the number of primary channels, but the average time left for the transmission reduces.

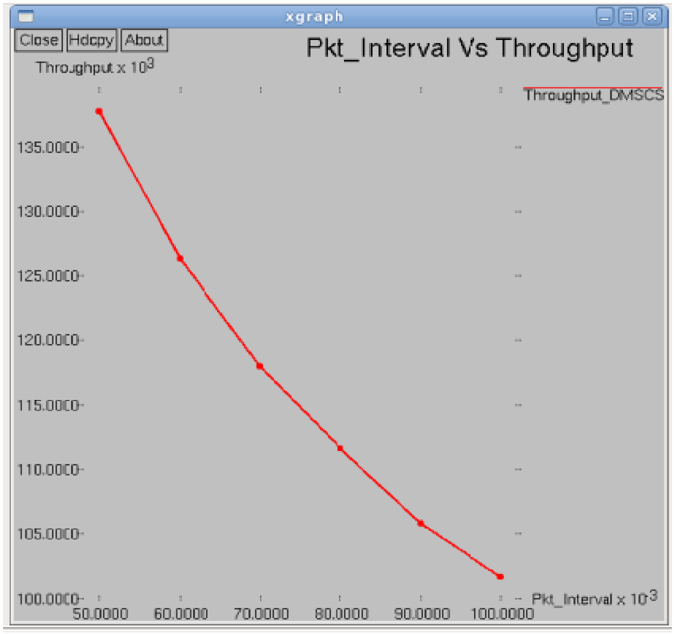

Figure 9. Packet interval versus Throughput

Second, this figure clearly demonstrates the importance and efficiency of having multiple handovers. Interestingly, the improvement in the SU's maximum throughput when using multiple handovers is about 44.5% compared to the case of *Np* = 1, with no handover capability, for the example considered.

The throughput DMSCS is demonstrated through figure 9. This shows the plot of the packet interval versus the throughput. Packet interval is reduced continuously so only throughput will be increase in this figure 9.

V. SIMULATION PARAMETER

Parameter	Description	Value
P_{max}	Minimum allowable detection probability	0.9
P_{max}	Maximum allowable false alarm probability	0.1
f_s	Receiver sampling frequency	6MHz
T	Time-slot duration	10 ms
T_{h0}	Required time for handover signal	0.01 ms
γ_s	Received SNR due to the SU signal	5Db
γ_p	Received SNR due to the PU signal	5Db

TABLE 1. Simulation Parameter

VI. CONCLUSION

In cognitive radio networks one objective is to achieve maximum spectrum efficiency. In this paper, we have demonstrated our research effort to achieve the efficient channel sensing schemes for SUs and reduced the number of handover in a multiple users in CRNs. Sensing is assumed in this paper. In reality, sensing error is inevitable. A channel sensing error is either a missed detection or false alarm. In this paper first, investigate the markovian process based structure of SUs in the CRNs. Then, MPPA method has been introduced and this method performance is evaluated the average SUs throughput and the average number of handovers. PPRA model mitigate the MPPA model and it has been proposed, which statistically distributes the SUs load among all channels. The schemes provides lower power consumption among SUs for accessing same channels and offers higher average throughput.

ACKNOWLEDGMENT

The authors would like to thank the assistant professor MR.R.Vadivelu, and the anonymous reviewers for their constructive comments and suggestions, which helped to improve the quality of this paper.

REFERENCES

[1] J. Jia, Q. Zhang, and X. S. Shen, "HC-MAC: a hardware- constrained cognitive MAC for efficient spectrum management," IEEE J. Sel. Areas Commun., vol. 26, no. 1, pp. 106–117, June 2008.

[2] S. Srinivasa and S. A. Jafar, "The throughput potential of cognitive radio: a theoretical perspective," IEEE Commun. Mag., pp. 73–79, May ,2007

[3] C.-W. Wang, L.-C. Wang, and F. Adachi, "Modeling and analysis for reactive-decision spectrum handoff in cognitive radio networks," 2010 IEEE Global Commun. Conf.

[4] ——, "Cognitive medium access: exploration, exploitation, and competition," IEEE Trans. Mobile Comput., vol. 10, no. 2, pp. 239–253, Feb.2011.

[5] Hossein, Shokri-Ghadikolaei, Student Member, IEEE, Fatemeh Sheikholeslami, "Distributed Multiuser Sequential Channel Sensing Schemes in Multichannel Cognitive Radio Networks" IEEE Trans.wireless commun.vol. 12, no. 5, may 2013

[6] D. J. Lee and M. S. Jang, "Optimal spectrum sensing time considering spectrum handoff due to false alarm in cognitive radio networks," IEEE Commun. Lett., vol. 13, no. 12, pp. 899–901, Dec. 2009.

[7] D. Lu, X. Huang, C. Liu, and J. Fan, "Adaptive power control based spectrum handover for cognitive radio networks," in Proc. 2010 IEEE Wireless Commun. Netw. Conf., pp. 1618–1622.

[8] R. Fan and H. Jiang, "Channel sensing-order setting in cognitive radio networks: a two-user case," *IEEE Trans. Veh. Technol.*, vol. 58, no. 9, pp. 4997–5008, Nov. 2009.

[9] W. Gabran, P. Pawelczak, and D. Cabric, "Throughput and collision analysis of multichannel multistage spectrum sensing algorithms," IEEE Trans. Veh. Technol., vol. 60, no. 7, pp. 3309–3329, Sept. 2011.

[10] Y. C. Liang, Y. Zeng, E. C. Y. Peh, and A. T. Hoang, "Sensingthroughput tradeoff for cognitive radio networks," IEEE Trans. Wireless Commun., vol. 7, no. 4, pp. 1326–1337, Apr. 2008.

[11] C. R. Stevenson, G. Chouinard, W. H. Z. Lei, and S. J. Shellhammer, "IEEE 802.22: the first cognitive radio wireless regional area network standard," *IEEE Commun. Mag.*, vol. 47, no. 1, pp. 130–138, Jan. 2009.

[12] Y. C. Tay, K. Jamieson, and H. Balakrishnan, "Collision-minimizing CSMA and its applications to wireless sensor networks," *IEEE Trans.Consum. Electron.*, vol. 22, no. 6, pp. 1048–1057, Aug. 2004.